Better Buildings®
U.S. DEPARTMENT OF ENERGY

DOE Asset Score: Coming to a Building Near You

U.S. DEPARTMENT OF ENERGY

PERFORMANCE SYSTEMS DEVELOPMENT

We Speak Building

Leveraging the Asset Score

By Greg Thomas

CEO, Performance Systems Development

PERFORMANCE SYSTEMS DEVELOPMENT

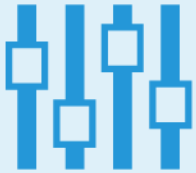
We Speak Building

Why an Asset Score?

Two Dimensions of Evaluating Building Performance

ENERGY STAR® Portfolio Manager® Score

The EPA Portfolio Manager Score informs overall **building performance**



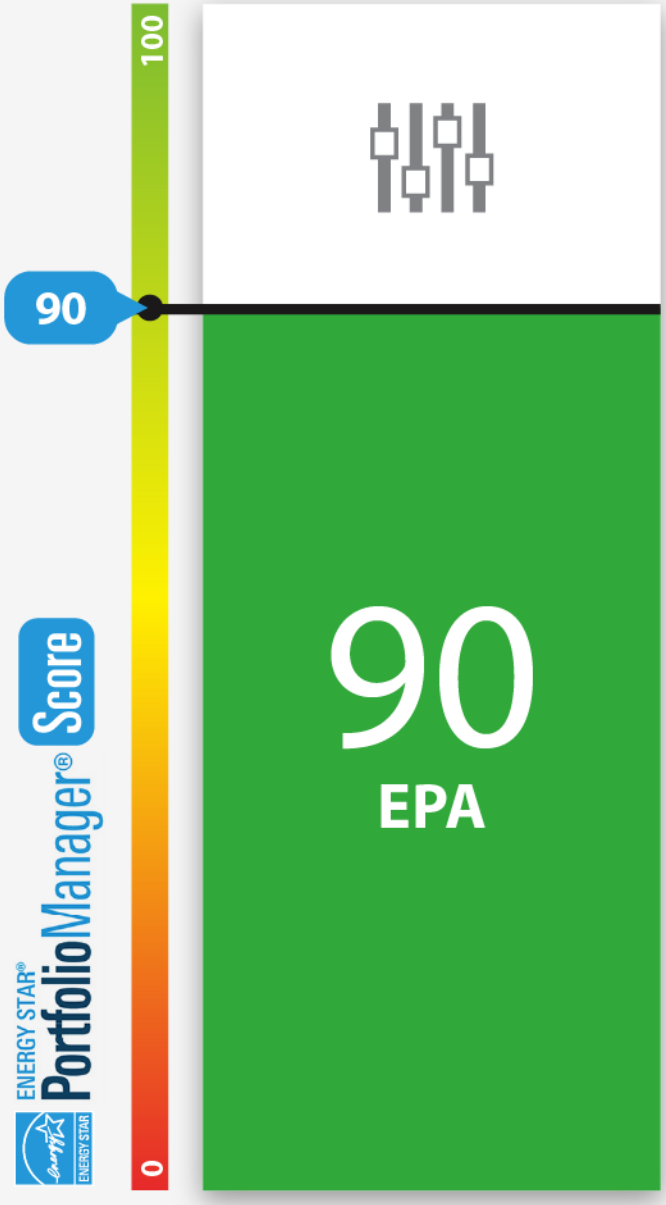
Does a building need a tune-up?

VS.

U.S. DEPARTMENT OF ENERGY Commercial Building Asset Score

DOE Asset Score informs whether a building will benefit from **capital investments**

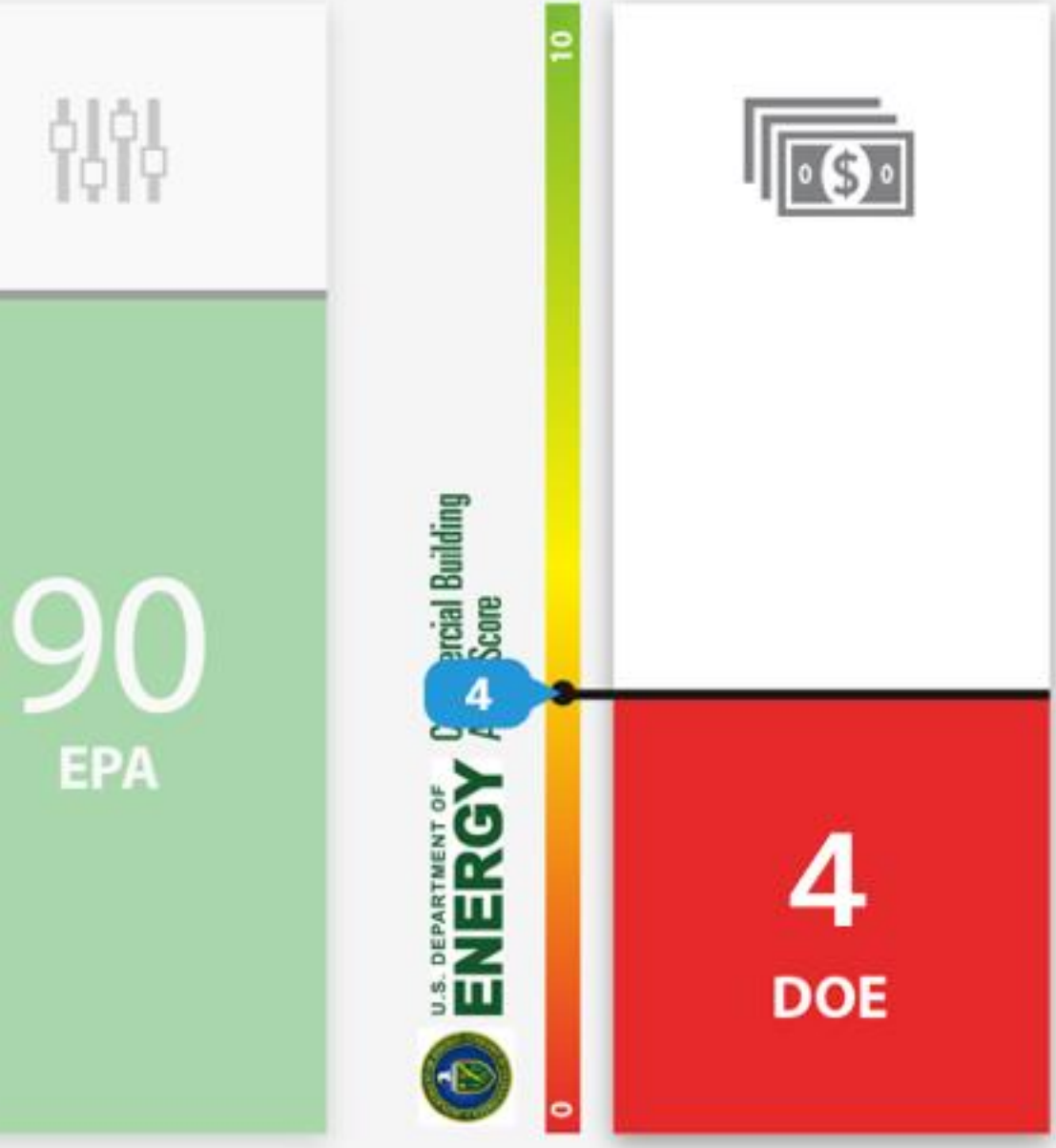
Does a building need new equipement?



ENERGY STAR® PortfolioManager® Score

The EPA PM quantifies **building performance** using actual energy bills, normalized to adjust for the economic use of the building.

The normalization process in in Portfolio Manager uses the analysis results of a nationwide survey of commercial buildings to factor out the influence of economic activity from the score. This means that a building open longer hours with higher occupancy can have the same or better score as a different building of the same use type (retail or school, for example) with open fewer hours and with less occupancy even though the first building has higher energy bills.



U.S. DEPARTMENT OF ENERGY Commercial Building Asset Score

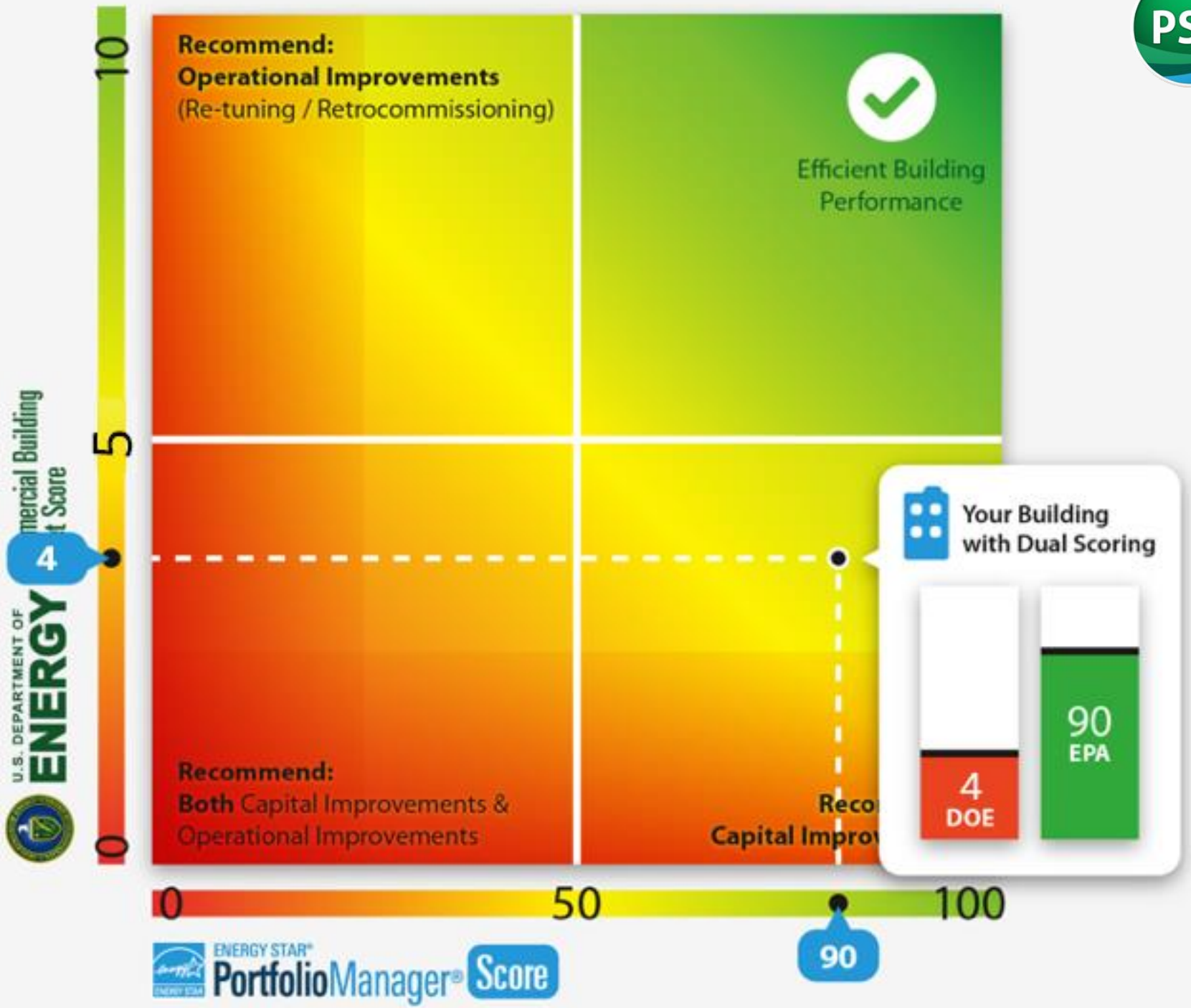
DOE Score tells you if you will benefit from improving the building with **capital investments**.

The DOE Asset Score does not use any energy bills, and instead collects information about the building characteristics like mechanical systems and envelope to calculate an expected energy use with standard occupancy. Data like the hours of use of the building do not matter.

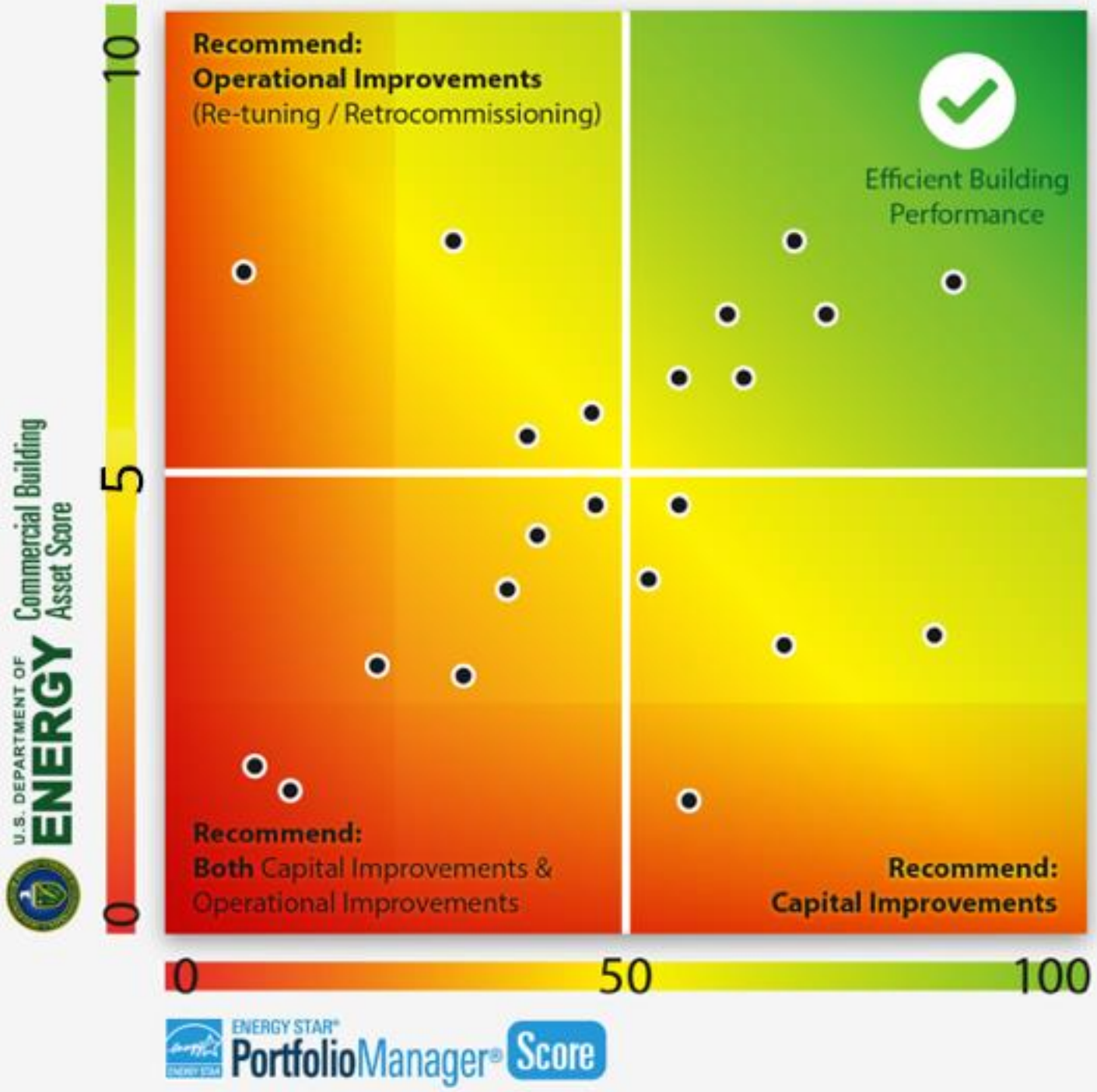
What happens when we combine the two types of scores?

Lets look at a portfolio of buildings that have both scores…

Creating a Scoring Matrix



Using the Scoring Matrix for Portfolio Assessment

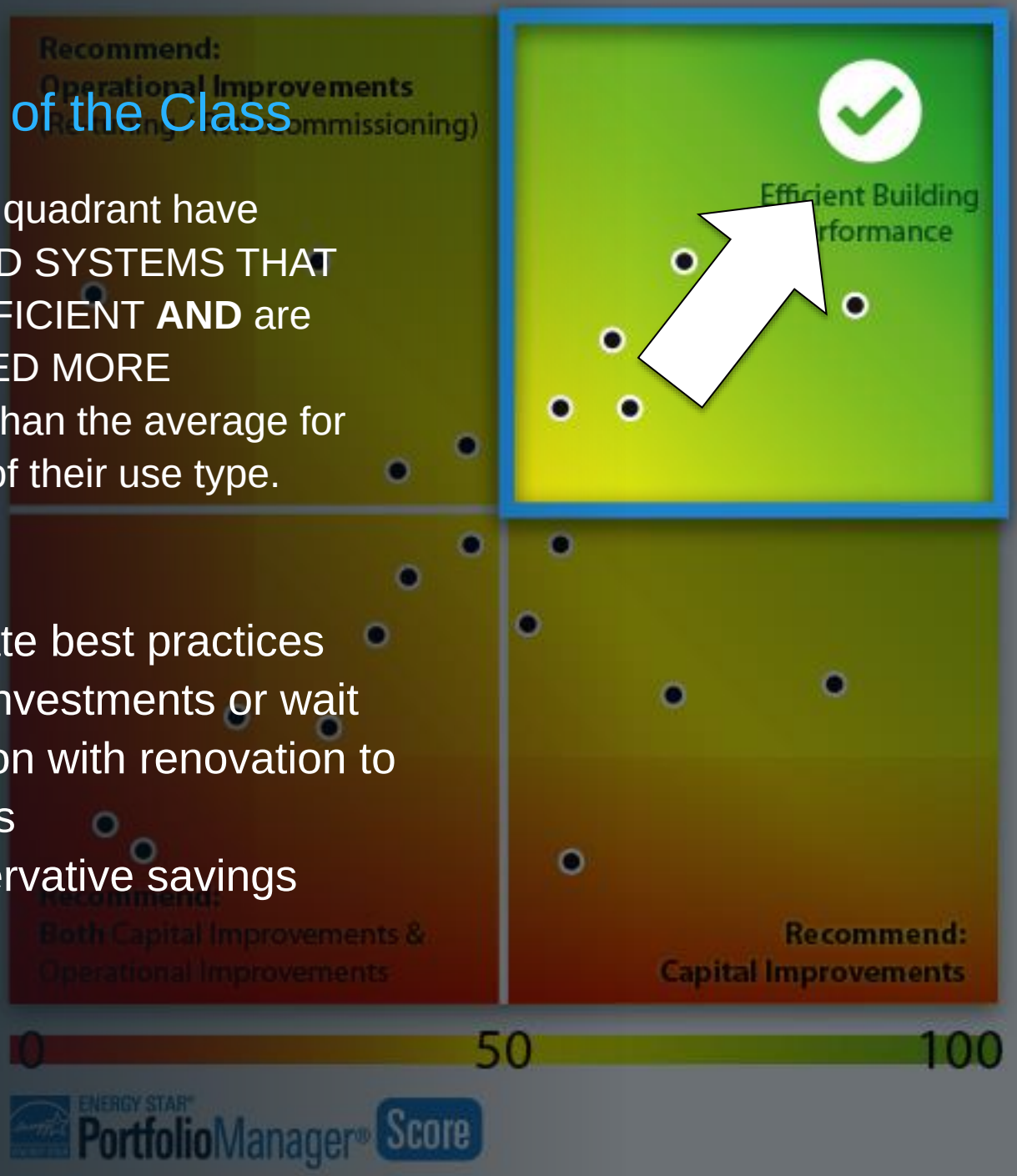


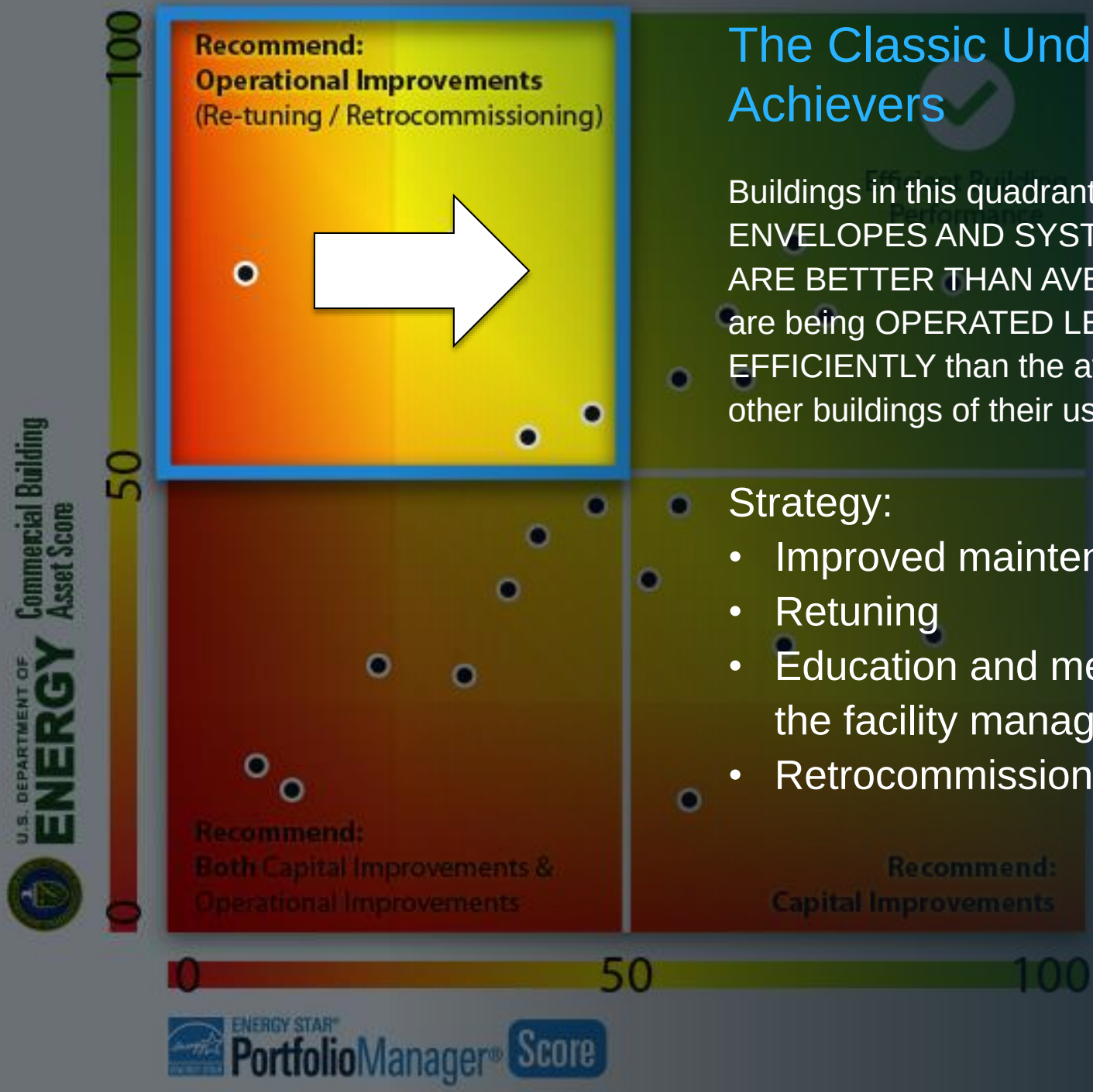
At the Head of the Class

Buildings in this quadrant have ENVELOPE AND SYSTEMS THAT ARE MORE EFFICIENT **AND** are being OPERATED MORE EFFICIENTLY than the average for other buildings of their use type.

Strategy:

- Communicate best practices
- Make light investments or wait for integration with renovation to reduce costs
- Make conservative savings predictions





The Classic Under Achievers

Buildings in this quadrant have ENVELOPES AND SYSTEMS THAT ARE BETTER THAN AVERAGE **BUT** are being OPERATED LESS EFFICIENTLY than the average of other buildings of their use type.

Strategy:

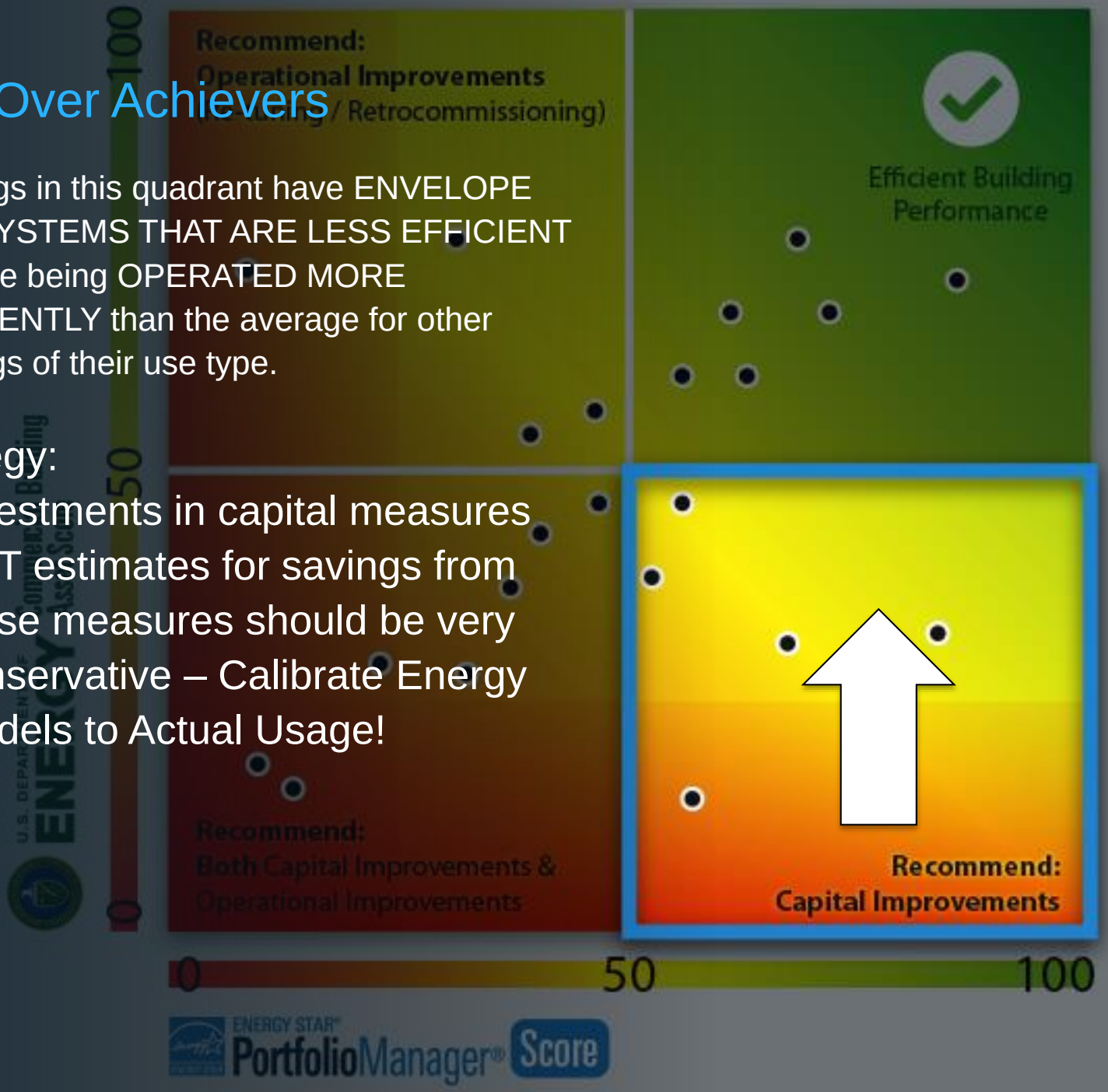
- Improved maintenance
- Retuning
- Education and mentoring of the facility manager
- Retrocommissioning

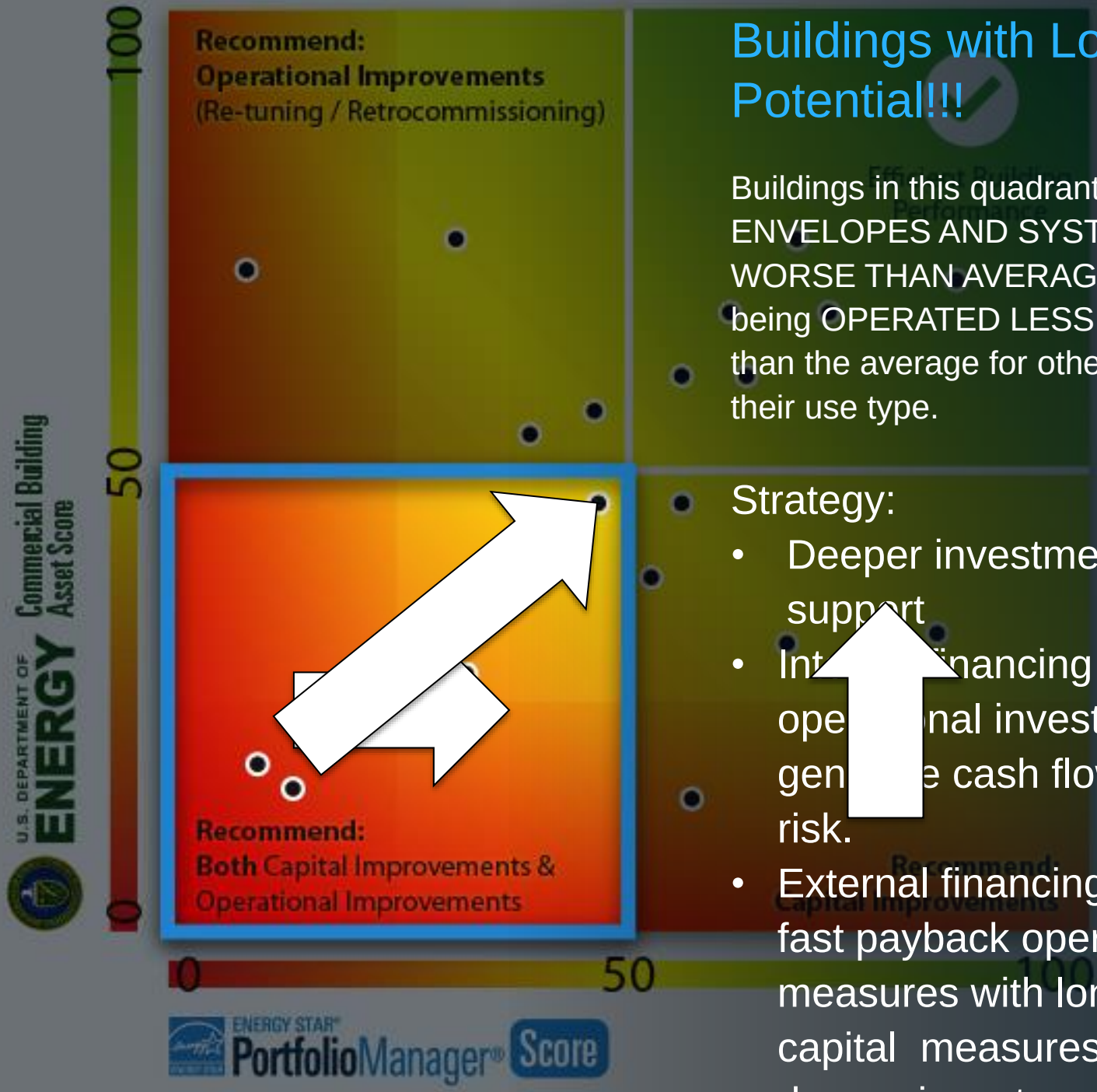
The Over Achievers

Buildings in this quadrant have ENVELOPE AND SYSTEMS THAT ARE LESS EFFICIENT **BUT** are being OPERATED MORE EFFICIENTLY than the average for other buildings of their use type.

Strategy:

- Investments in capital measures
- BUT estimates for savings from those measures should be very conservative – Calibrate Energy Models to Actual Usage!





Buildings with Lots of Potential!!!

Buildings in this quadrant have ENVELOPES AND SYSTEMS THAT ARE WORSE THAN AVERAGE **AND** are being OPERATED LESS EFFICIENTLY than the average for other buildings of their use type.

Strategy:

- Deeper investments and more support
- Int[illegible]nancing – Start with ope[illegible]nal investments to gen[illegible]e cash flow and reduce risk.
- External financing – Combine fast payback operational measures with long payback capital measures to support deeper investments

PERFORMANCE SYSTEMS DEVELOPMENT

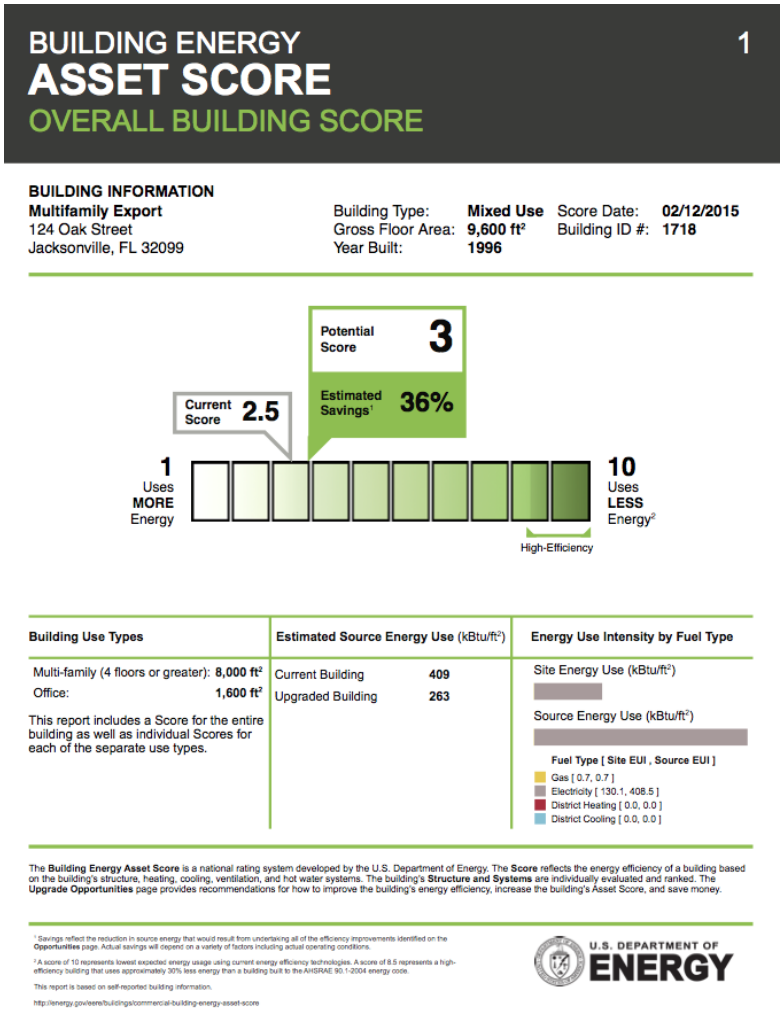
We Speak Building

Going Farther with the Asset Score

PERFORMANCE SYSTEMS DEVELOPMENT

What is Behind the Asset Score?

- Optimized reduced input energy simulation
- Built on OpenStudio platform
- Exports OSM model
  - Code compliance
  - Lite audits
- API available



BUILDING ENERGY
ASSET SCORE 1
OVERALL BUILDING SCORE

BUILDING INFORMATION
Multifamily Export
124 Oak Street
Jacksonville, FL 32099

Building Type: **Mixed Use**
Gross Floor Area: **9,600 ft²**
Year Built: **1996**
Score Date: **02/12/2015**
Building ID #: **1718**

Potential Score **3**
Estimated Savings[1] **36%**
Current Score **2.5**
1 Uses **MORE** Energy
10 Uses **LESS** Energy[2]
High-Efficiency

Building Use Types	Estimated Source Energy Use (kBtu/ft²)	Energy Use Intensity by Fuel Type
Multi-family (4 floors or greater): **8,000 ft²** Office: **1,600 ft²** This report includes a Score for the entire building as well as individual Scores for each of the separate use types.	Current Building **409** Upgraded Building **263**	Site Energy Use (kBtu/ft²) Source Energy Use (kBtu/ft²) **Fuel Type [Site EUI , Source EUI]** Gas [0.7, 0.7] Electricity [130.1, 408.5] 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/commercial-building-energy-asset-score

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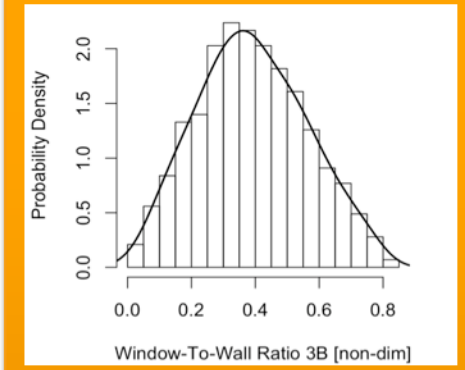
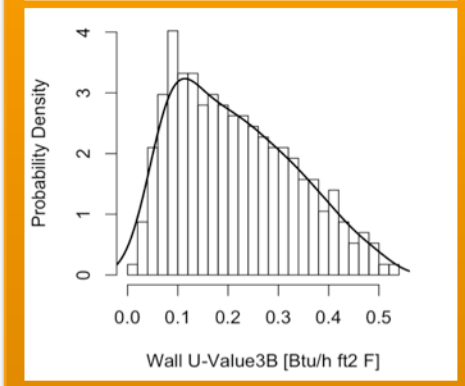
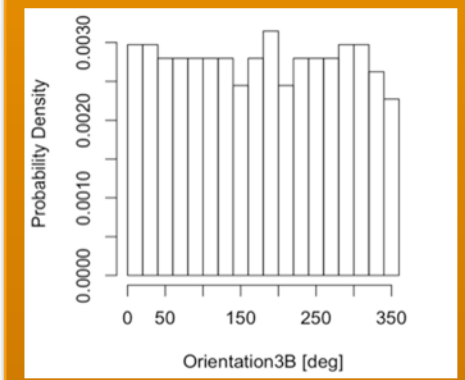
Analysis Supporting the Tool Development

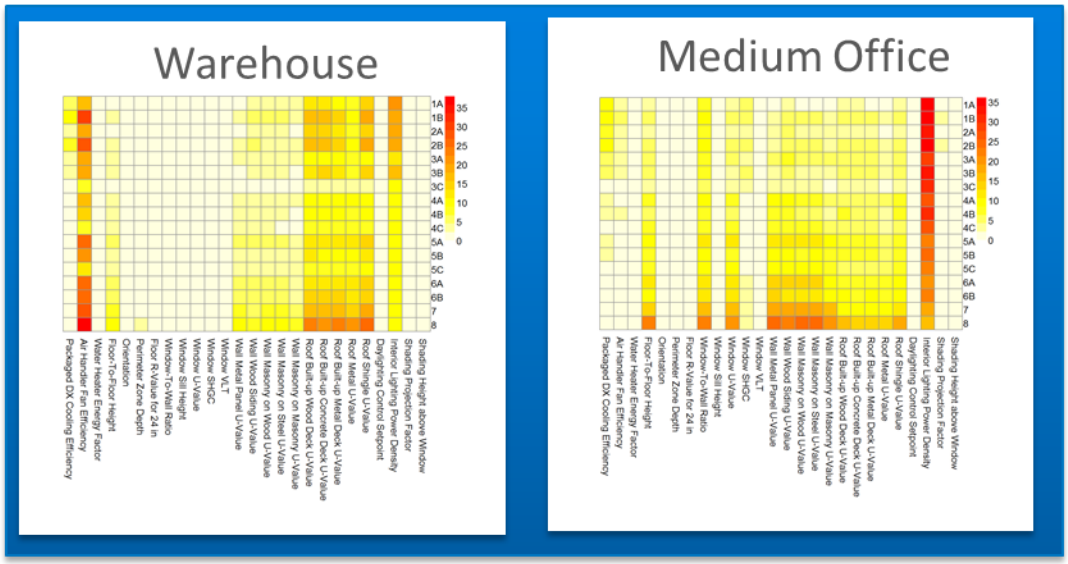
Input Parameters







Impact of each variable across all climate zones



Potential range of EUI combing all variables

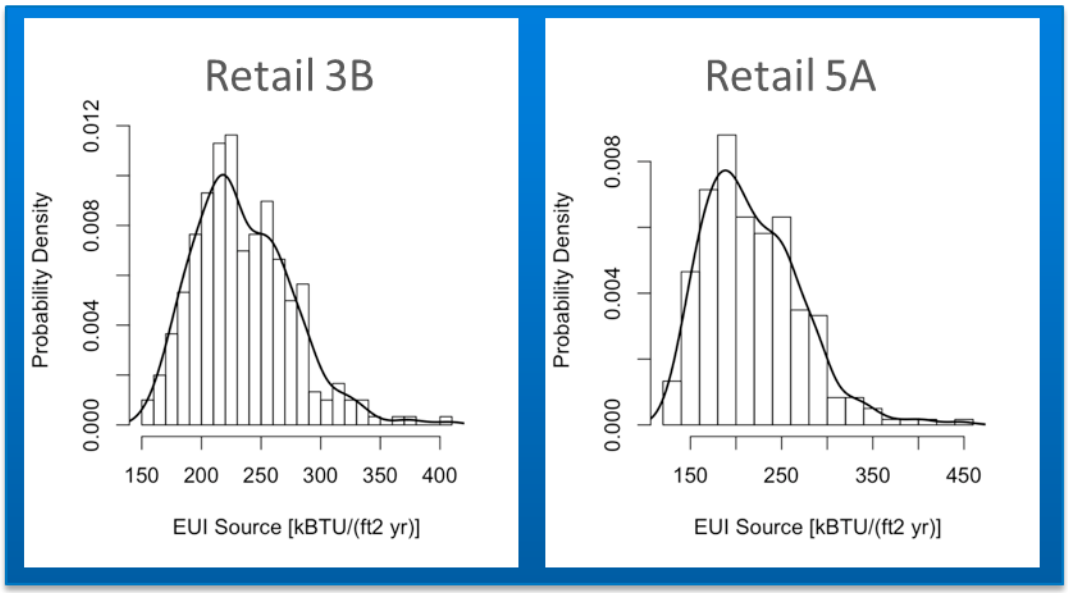
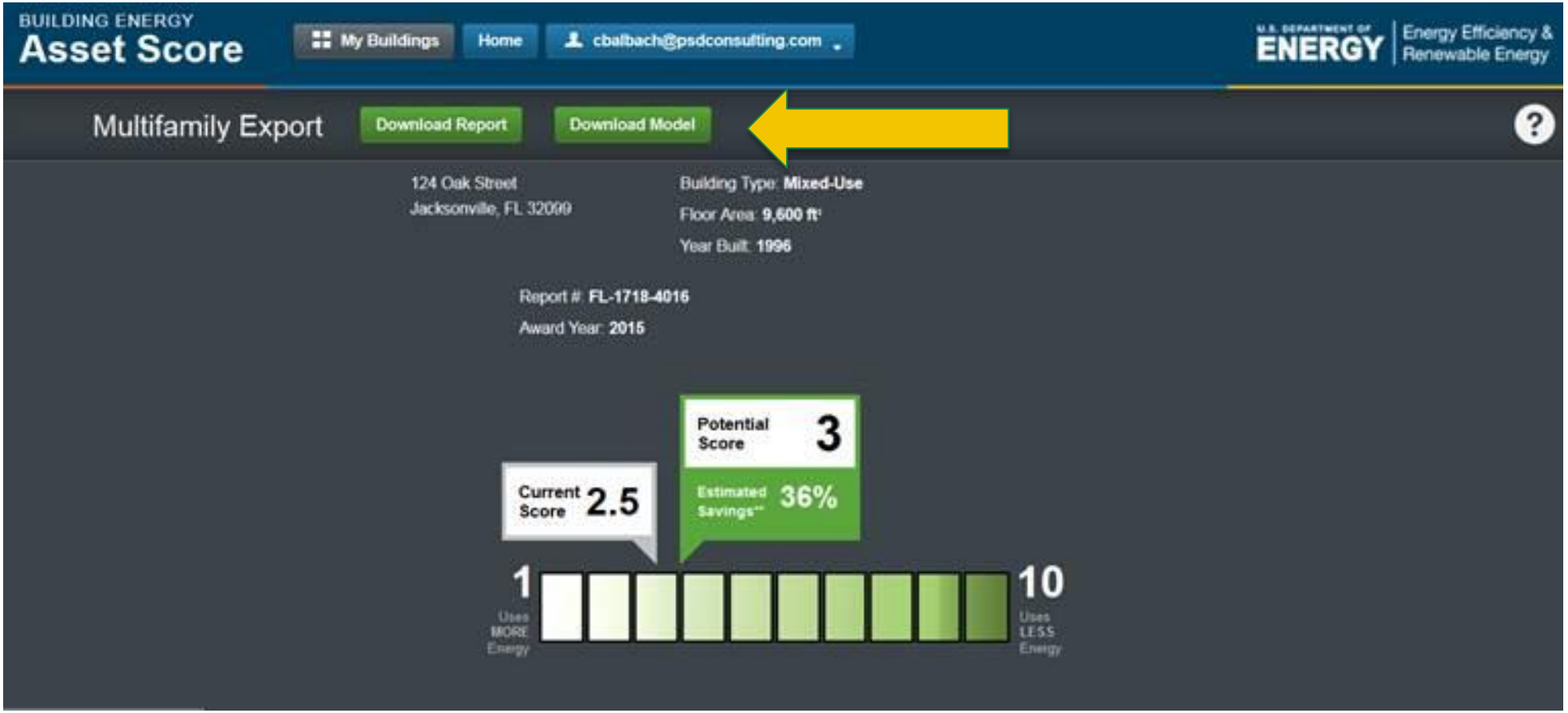


Image: NREL

PERFORMANCE SYSTEMS DEVELOPMENT

Exporting the OpenStudio Model Behind the Score



PERFORMANCE SYSTEMS DEVELOPMENT

What is DOE's OpenStudio?

OpenStudio is **BOTH**

- a Software Development Kit (SDK) for building energy modeling tools

and

- an Open Source Energy Modeling Application
- Developed by NREL

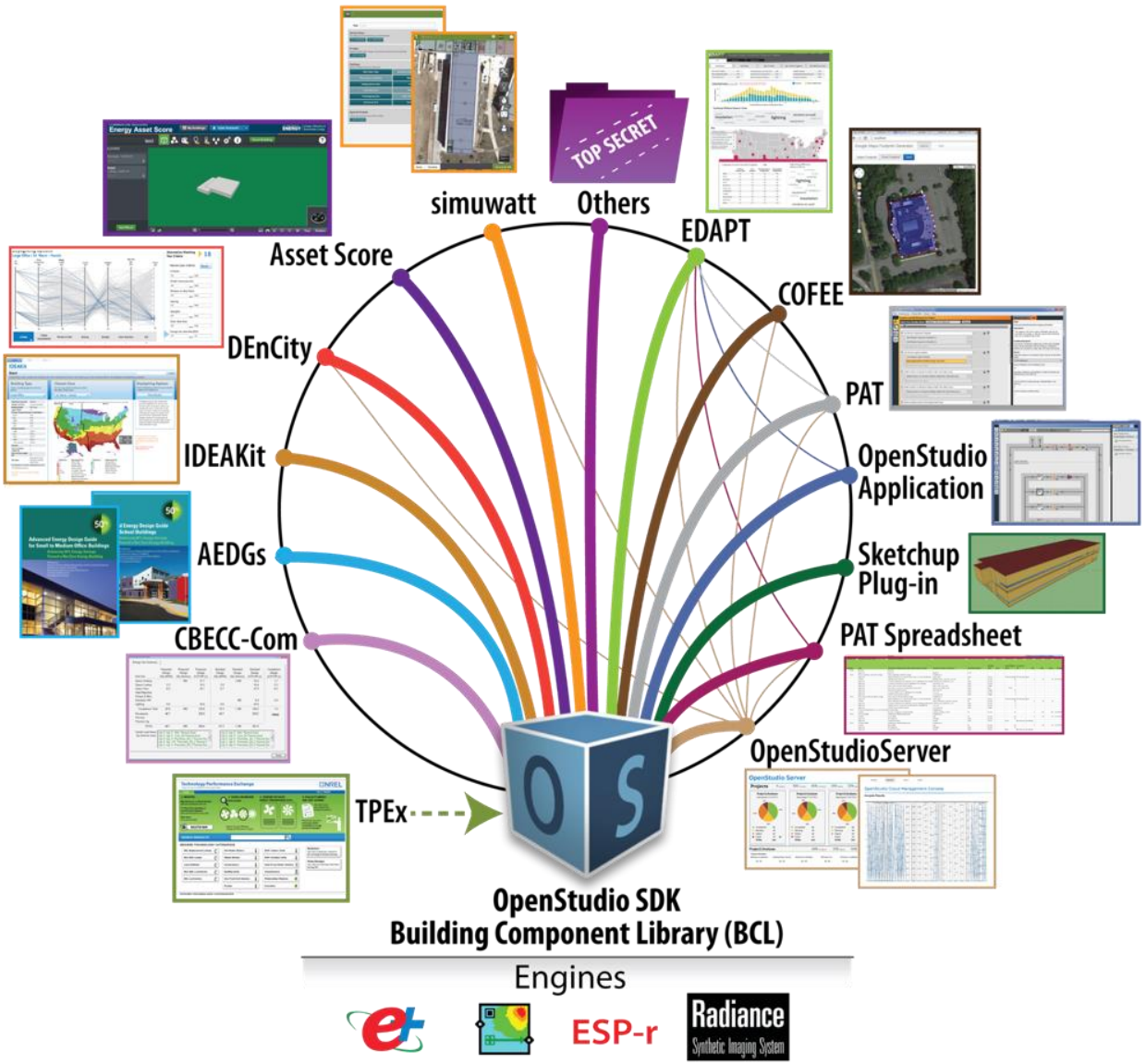


Image: NREL

PERFORMANCE SYSTEMS DEVELOPMENT

A Quick Intro to the OpenStudio Application

Define Resources

Workflow

Review Results

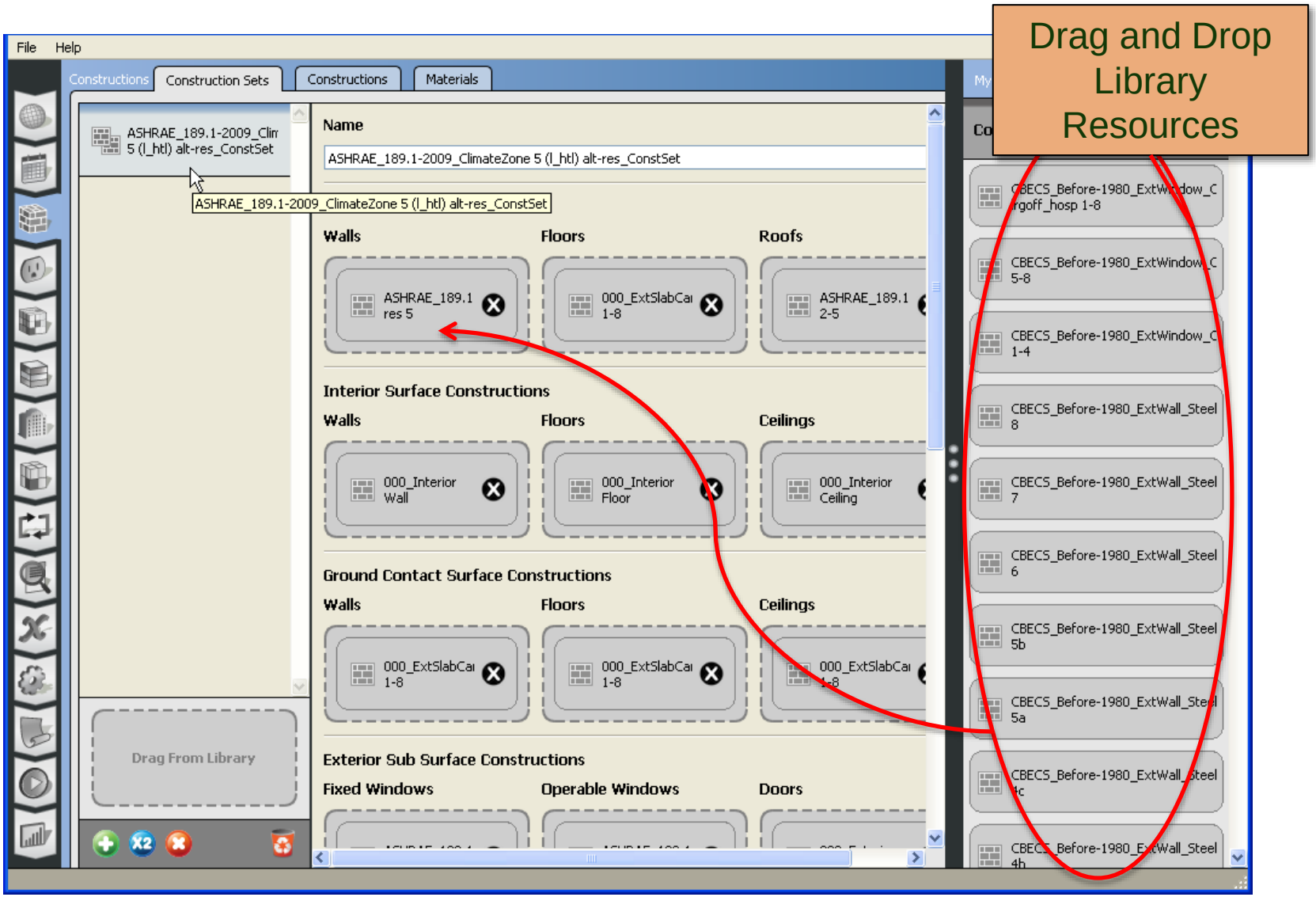


Image: NREL

PERFORMANCE SYSTEMS DEVELOPMENT

Templated HVAC Systems for Rapid Modeling

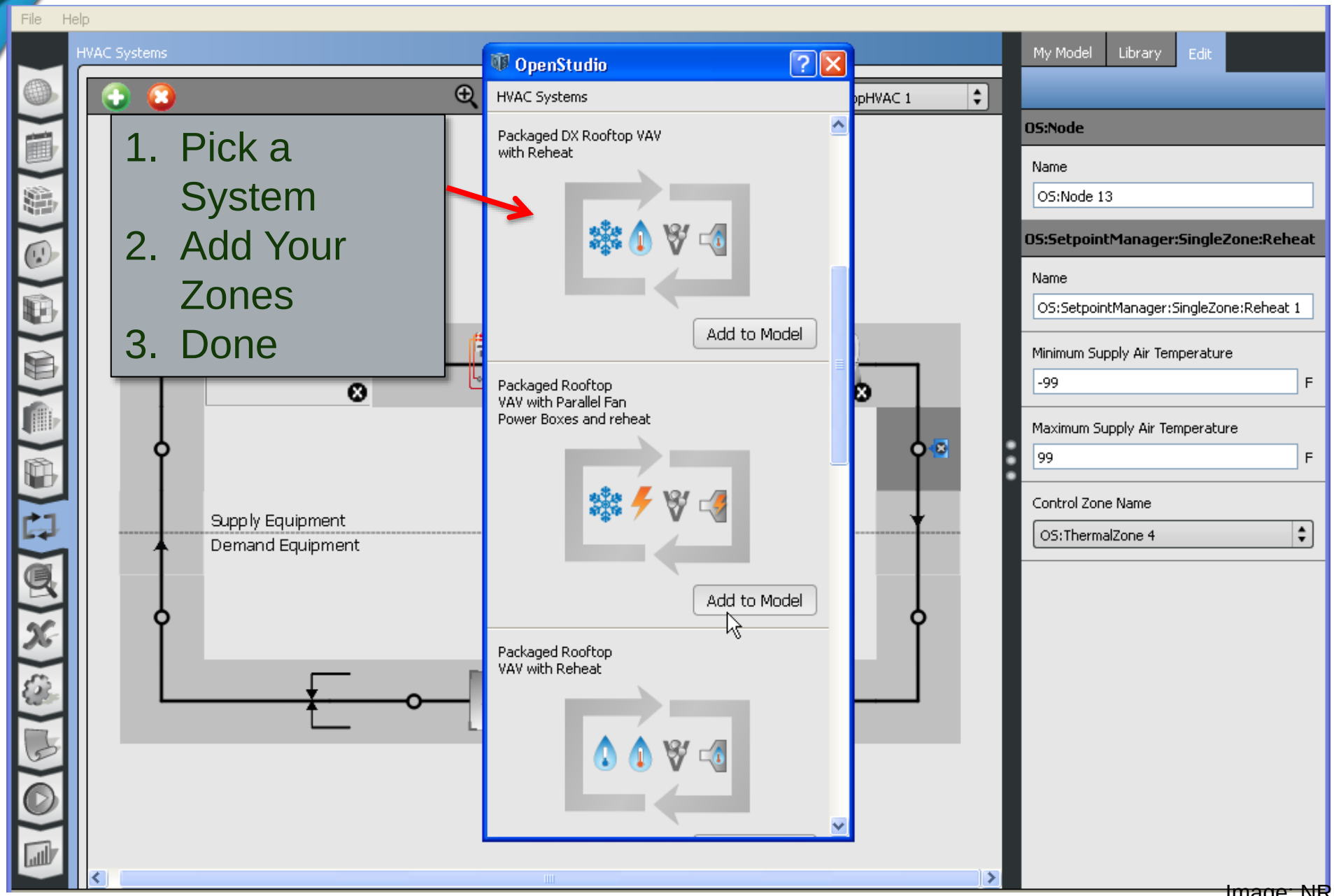


Image: NREL

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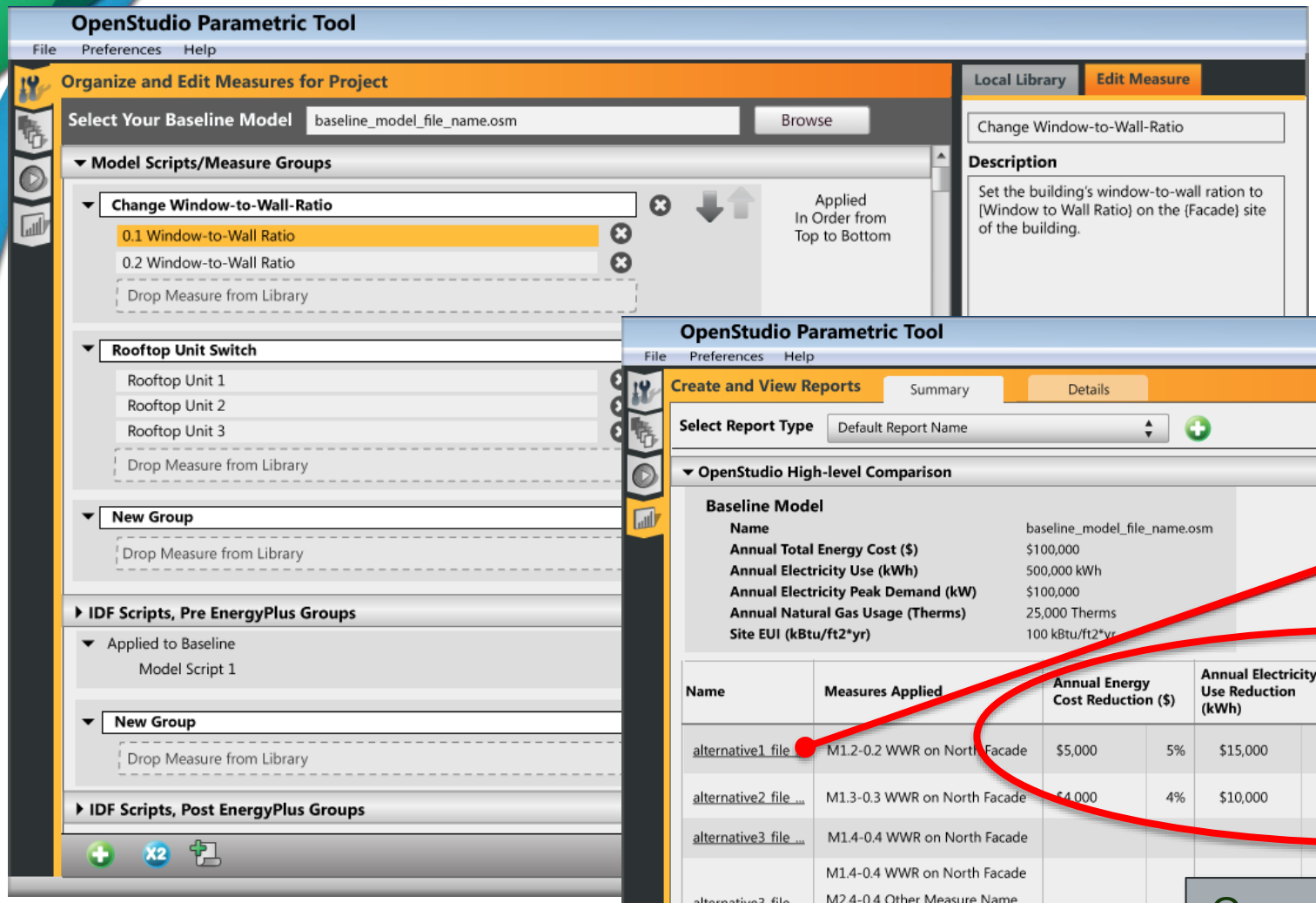
The OpenStudio Parametric Analysis Tool



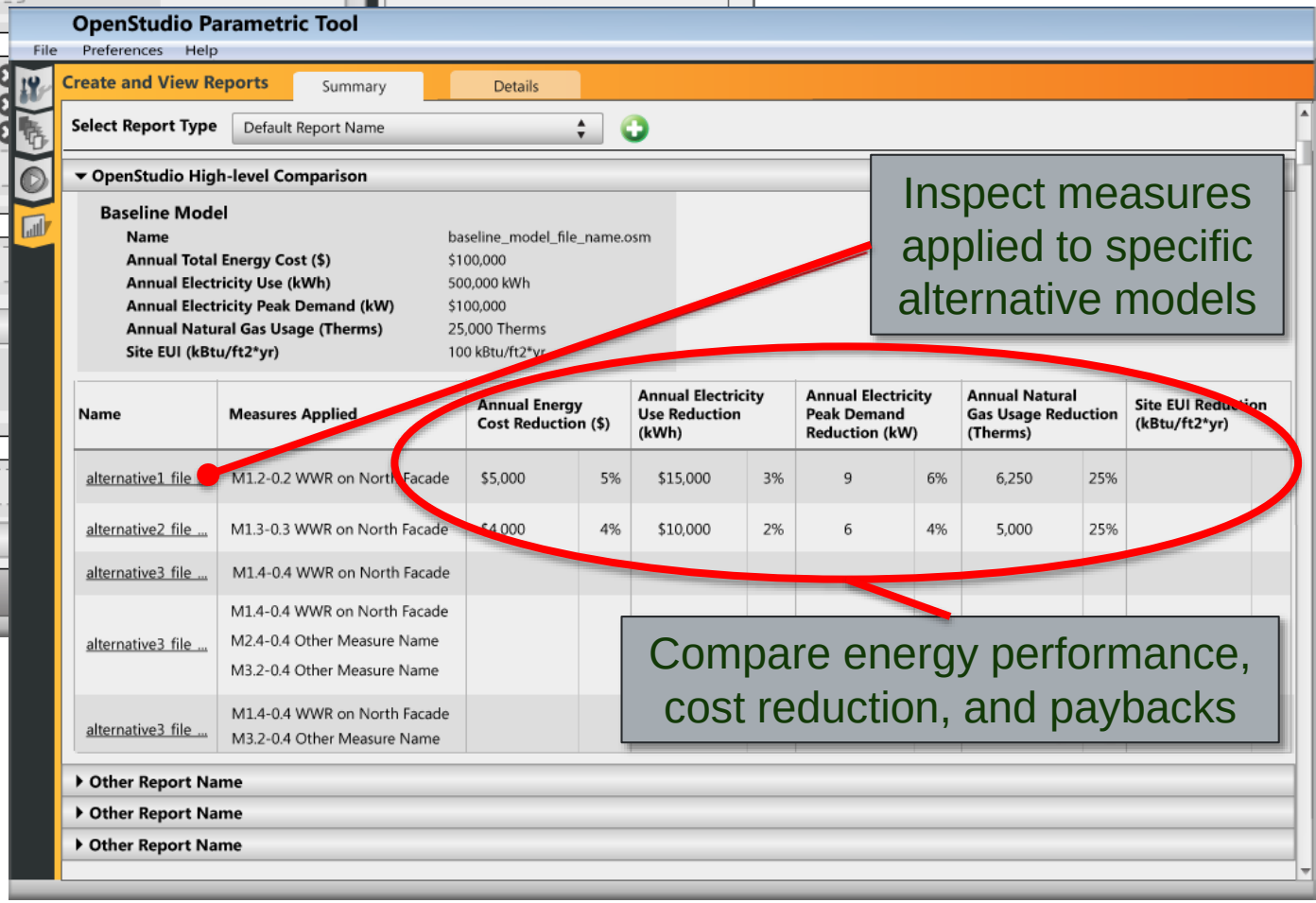


Image: NREL

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Fitting the Tool Set into a Whole Building Upgrade Process

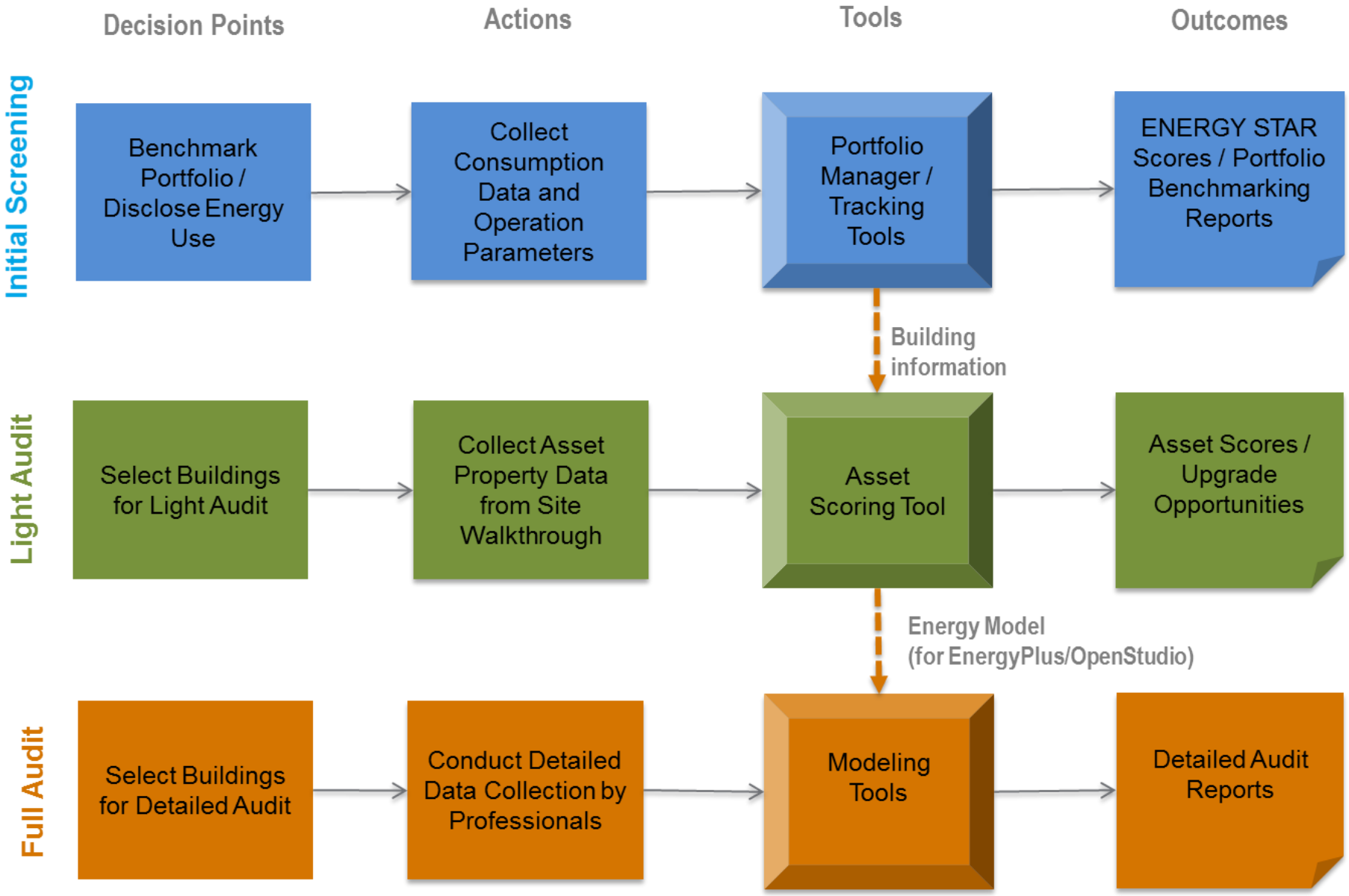
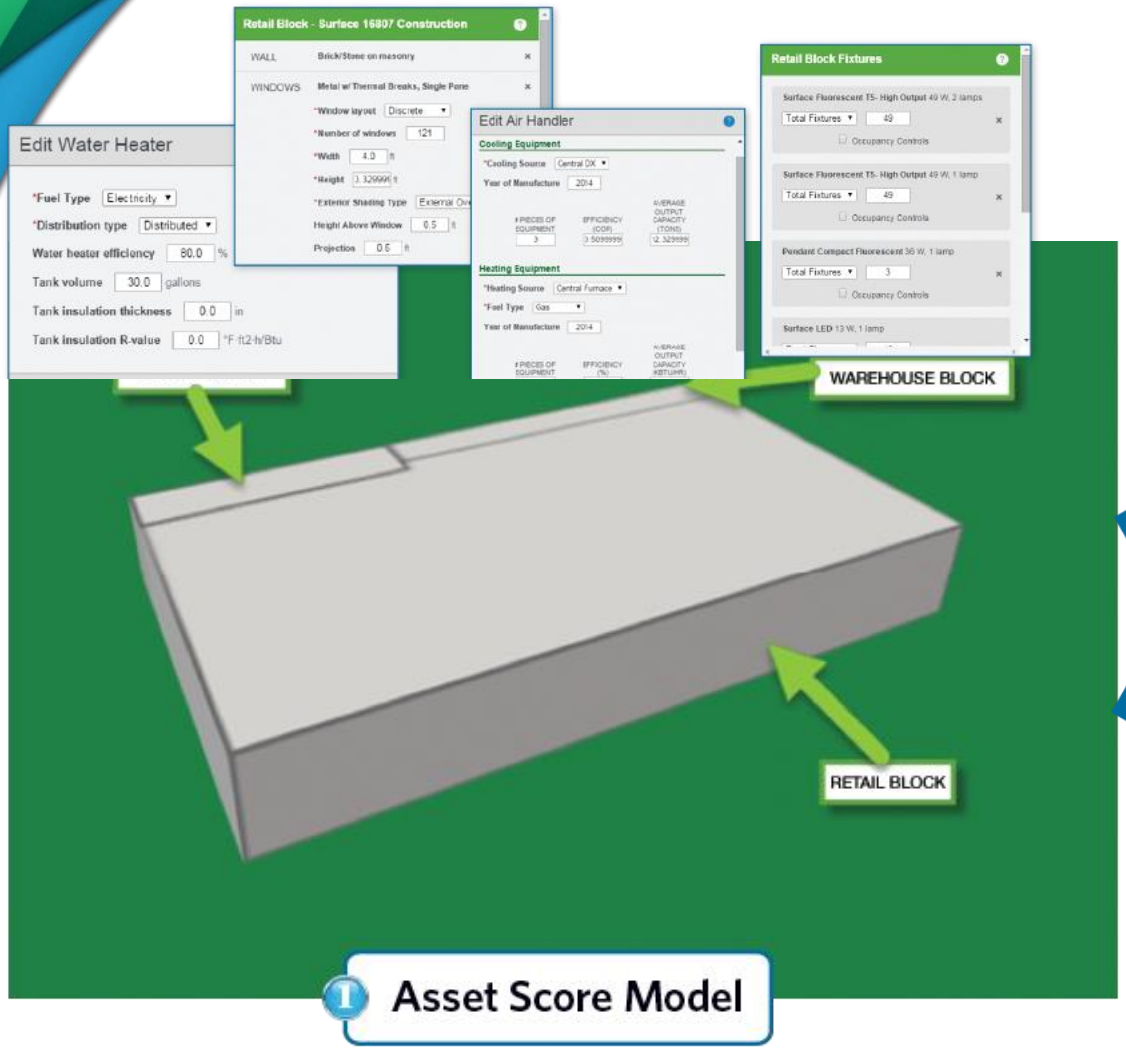
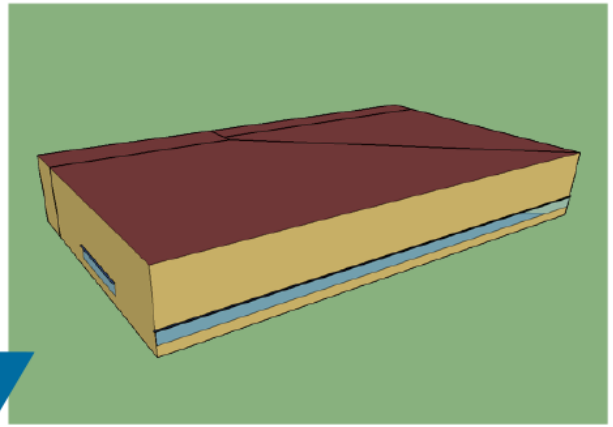


Image: Nora Wang PNNL

PERFORMANCE SYSTEMS DEVELOPMENT

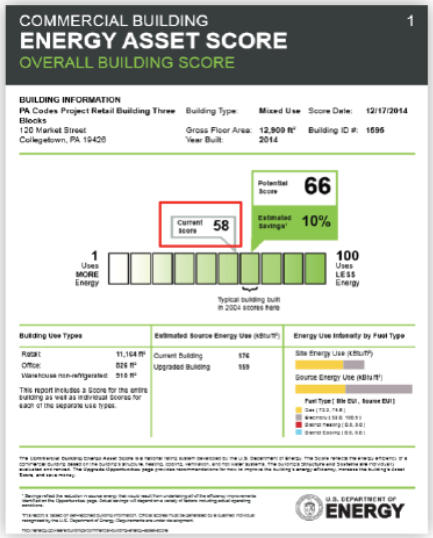
Using Asset Score Generated OpenStudio Models to Support Energy Code Compliance





OSM FILE

REPORT



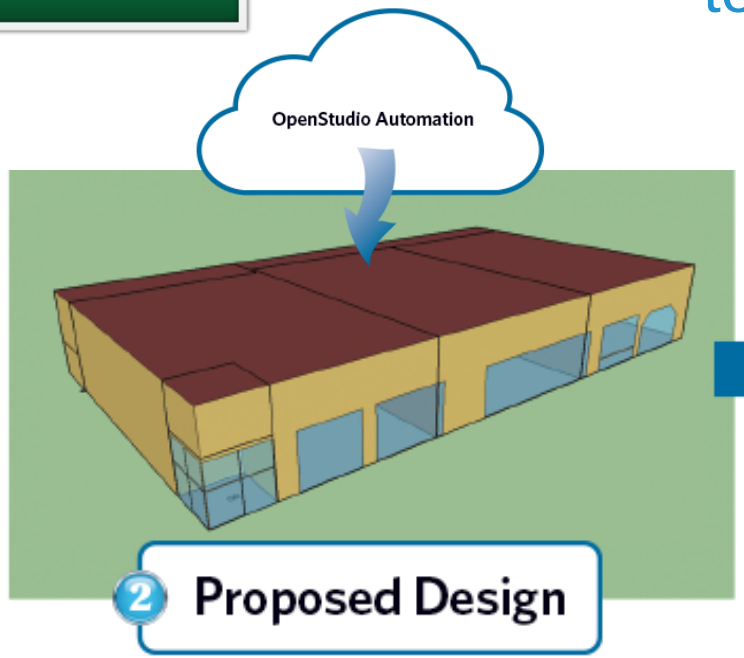
U.S. DEPARTMENT OF ENERGY

pennsylvania DEPARTMENT OF ENVIRONMENTAL PROTECTION

pennsylvania CONSTRUCTION CODES ACADEMY

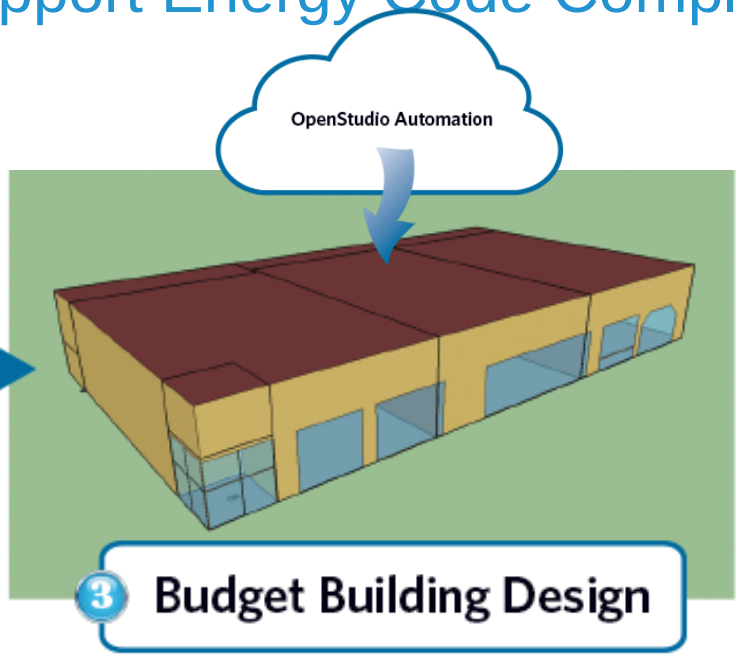
PERFORMANCE SYSTEMS DEVELOPMENT

Using Asset Score Generated OpenStudio Models to Support Energy Code Compliance



2 Proposed Design

- Create Proposed Model Envelope and Space Load Resources
- Refine Space Loads descriptions for specific OpenStudio Spaces
- Create Proposed Model HVAC Transformations
- Create Proposed Model Service Hot Water Transformations
- Debug Simulation
- Apply OpenStudio Tariff measure to determine Design Energy Cost results



3 Budget Building Design

- "Save As" a version of the Proposed Model to create a Budget Model
- Create Budget Model Envelope and Space Load Resource Transformations
- Create Budget Model HVAC Transformations
- Create Budget Model Service Hot Water Transformations
- Debug Simulation, check for thermal zone Unmet Hours
- Apply OpenStudio Tariff measure to determine Energy Cost Budget results

COMPLETED PROPOSED MODEL $ ≤ $ **COMPLETED BUDGET MODEL**

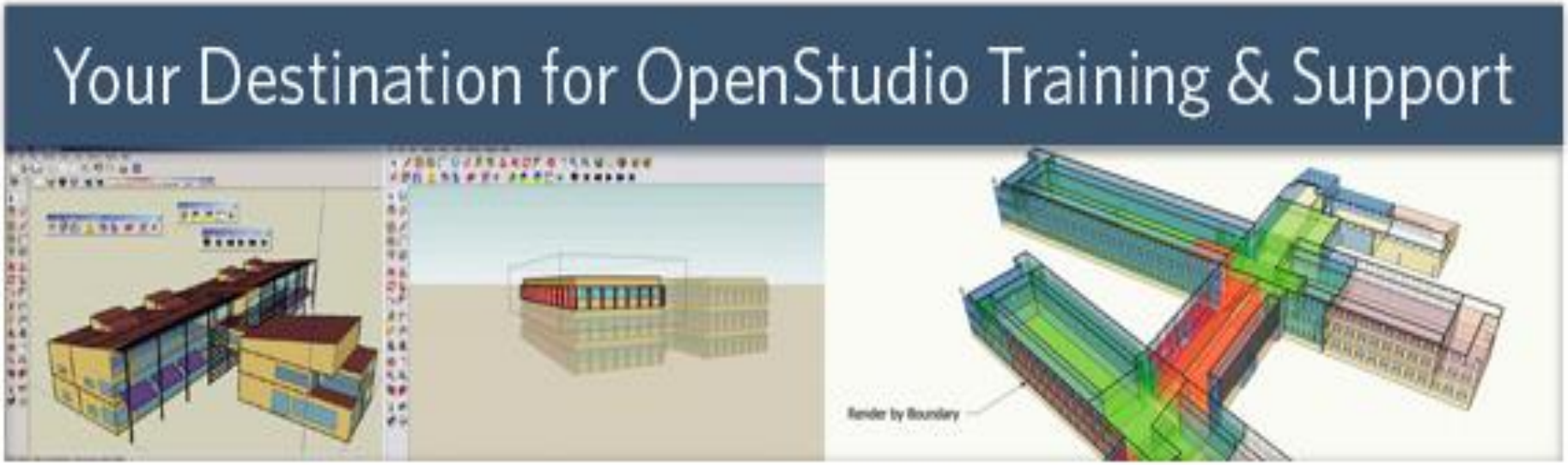
PERFORMANCE SYSTEMS DEVELOPMENT

Accessing OpenStudio Training

http://psdconsulting.com/openstudio-training/

www.OpenStudioTraining.com

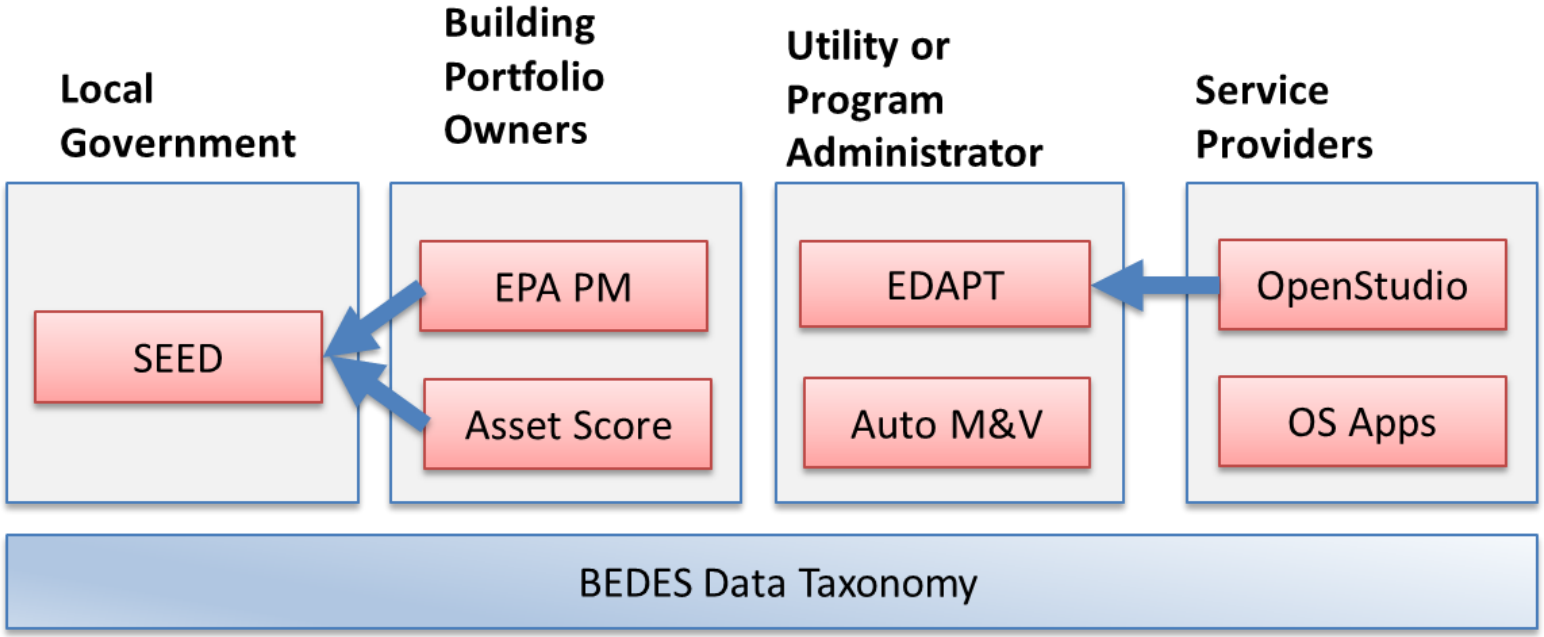
OpenStudio



PERFORMANCE SYSTEMS DEVELOPMENT

OpenEfficiency: Putting It All Together!

- Reduce transaction costs
  - Service provider and building owner
  - Program admin
  - Open source
- Improve data quality and usability
  - Data analysis
  - Incentive award
  - Evaluation risk reduction



PERFORMANCE SYSTEMS DEVELOPMENT

Contact Us

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Case Study: Utilization of the Department of Energy's Asset Score Tool

Presented by: Aaron Mehta, Director of Energy Information

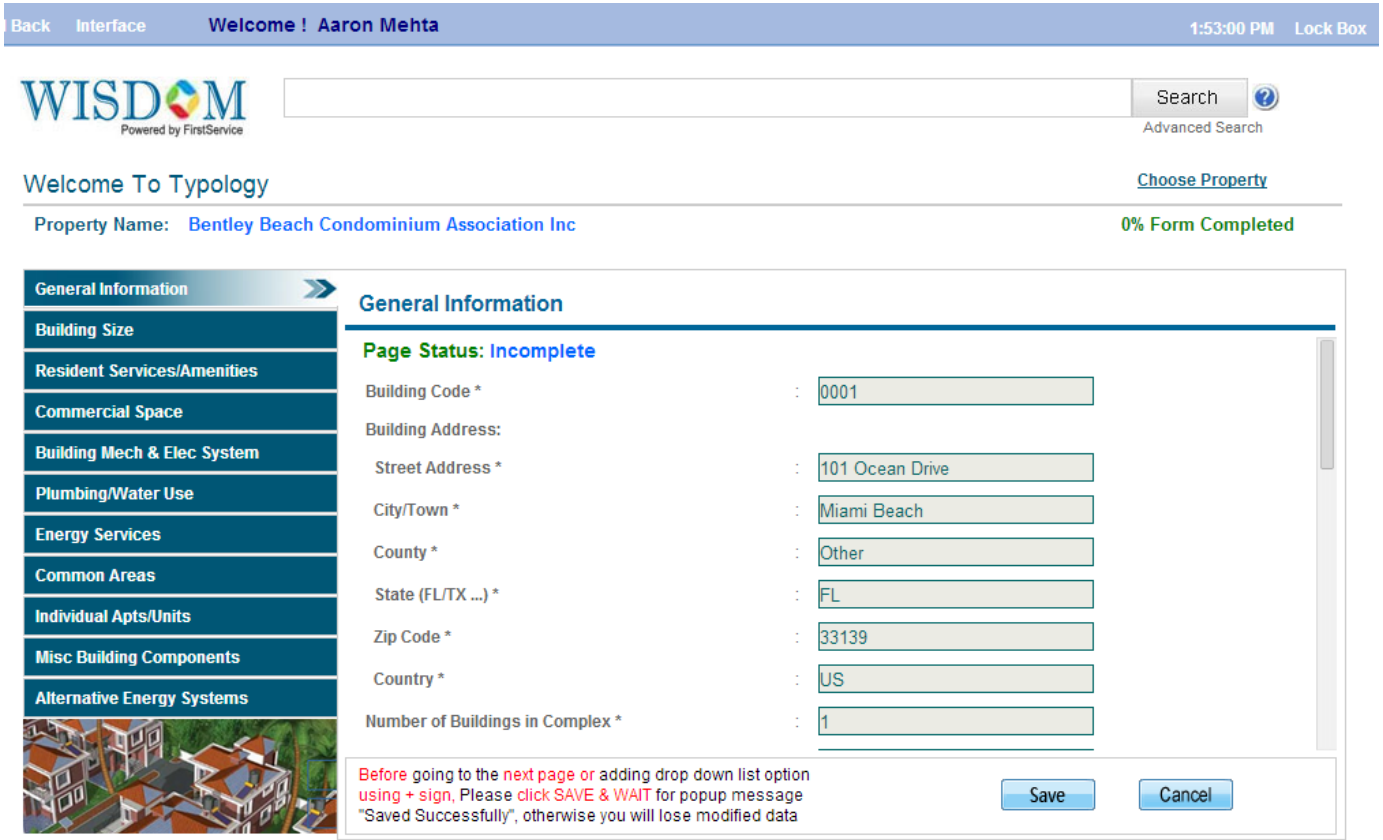
FS Energy Background

Energy Subsidiary of FirstService Residential

- Largest residential property management firm in North America
- 6,500 properties,1.5 million units
- $3-4 billion in managed energy spend / year

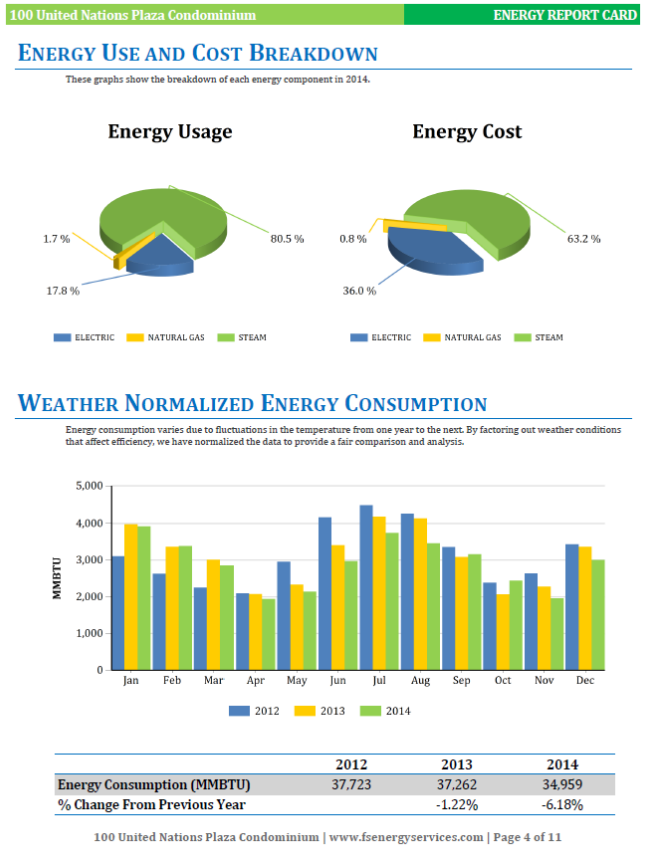
Benchmarking Strategy

- Monthly utility bill cost and consumption
- Building characteristics



Energy Report Cards

- Show historical energy cost and consumption information in charts
- Identify anomalies
- Identify trends and potential areas for improvement



100 United Nations Plaza Condominium | ENERGY REPORT CARD

Energy Use and Cost Breakdown

These graphs show the breakdown of each energy component in 2014.

Energy Usage

Energy Cost

Weather Normalized Energy Consumption

Energy consumption varies due to fluctuations in the temperature from one year to the next. By factoring out weather conditions that affect efficiency, we have normalized the data to provide a fair comparison and analysis.

	2012	2013	2014
Energy Consumption (MMBTU)	37,723	37,262	34,959
% Change From Previous Year		-1.22%	-6.18%

100 United Nations Plaza Condominium | www.fsenergyservices.com | Page 4 of 11

fs energy
Conserve. Save.

Limitations

- Piques stakeholder interest, but does not provide a tangible next step to take
- Identify buildings with relatively high Energy Use Intensity (EUI)
- Can identify the commodity or season where higher energy usage is taking place

Asset Score Utilization

- End-use analysis of energy consumption
- System-level evaluations
- Efficiency Improvement Opportunities – Cost/ROI

Operational Challenges Obtaining Data

- Gaining stakeholder engagement to collect pre-requisite information to utilize the tool
- High level of technical knowledge need to fill in certain sections
- Substitute services - in-person energy audit performed by an energy engineer

Tiered Approach

- Enter easy to obtain building and energy data from publicly available data sources
- Utilize existing on-site building engineers, supers, resident managers to fill in the next level of building characteristics
- Utilize engineers and architects who perform work at the sites to obtain the remaining information
- Share data with all stakeholders to drive value creation opportunities for the building and motivate everyone to continue obtaining data for other buildings

Contact Information

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DOE Building Energy Asset Score

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

Cody Taylor
May 28, 2015

Overview

National, free software tool for assessing the *physical and structural* energy efficiency of commercial and multifamily residential buildings

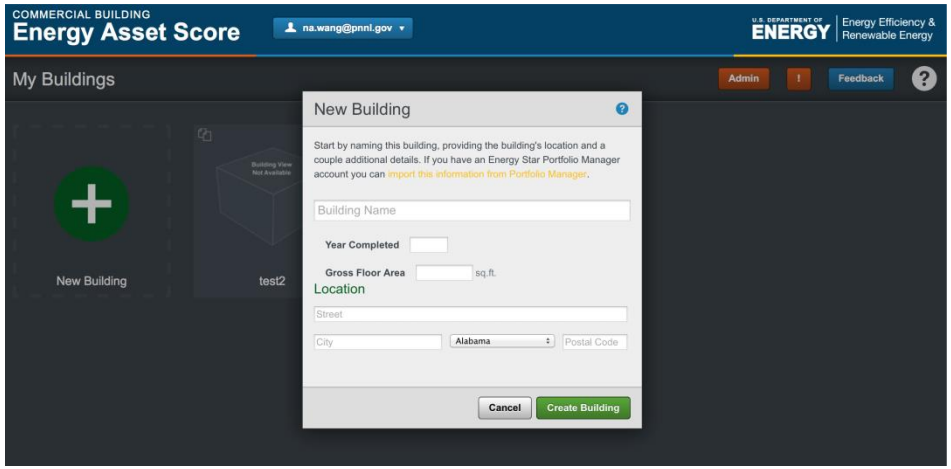
- Envelope (roof, walls, windows)
- Major systems and equipment (mechanical, electrical, service hot water)

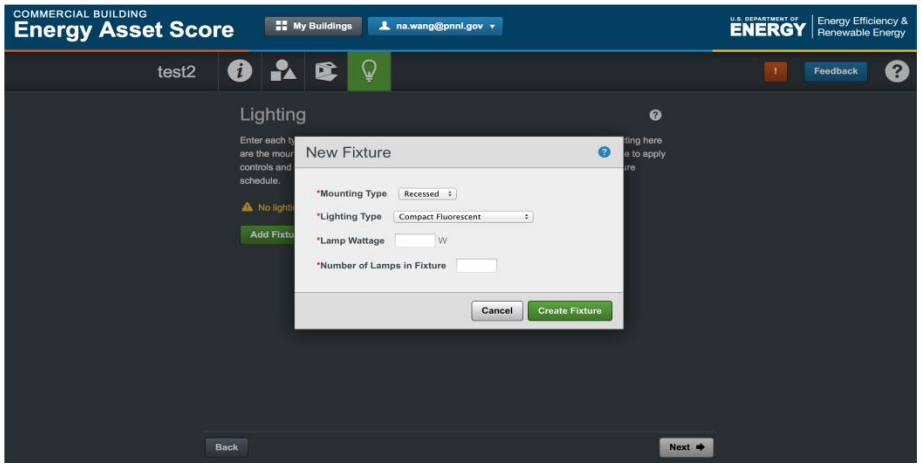
How it Works

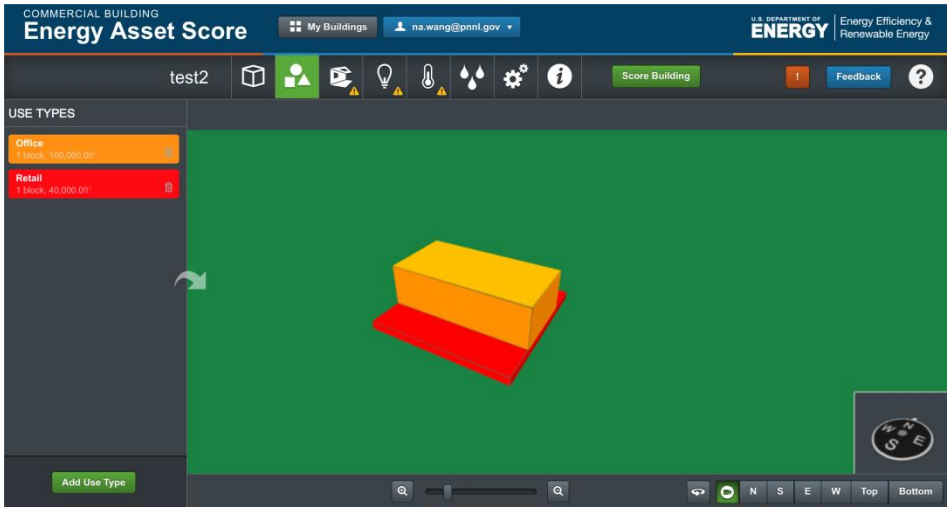
Asset Score runs an *energy simulation* using a powerful building energy modeling engine (EnergyPlus)

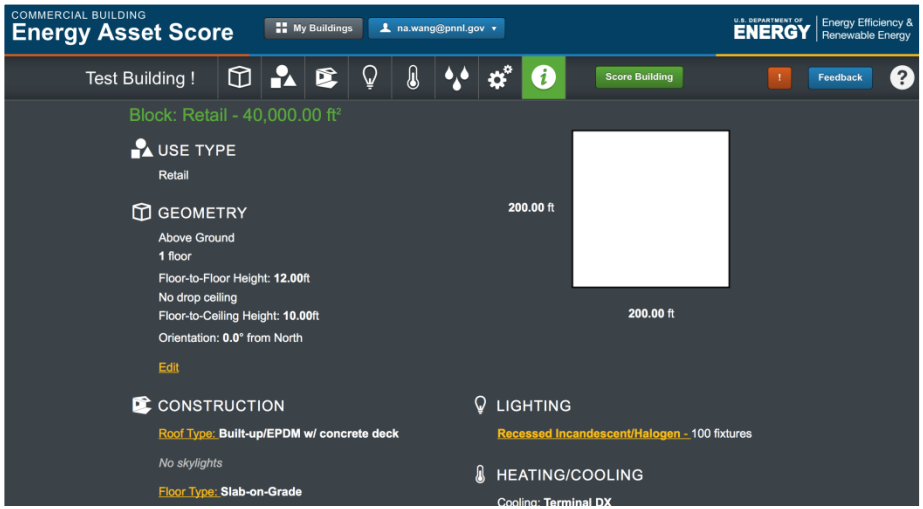
- The simulation normalizes for building operations, occupancy and tenant behavior
- Users (owner, operator, service, provider, etc.) enter building information through an web interface
  - General information: # of floors, footprint dimension, orientation, use type
  - Envelope components: Roof, exterior 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

How it Works









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

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 Score Report


COMMERCIAL BUILDING
ENERGY ASSET SCORE
OVERALL BUILDING SCORE
1

BUILDING INFORMATION

Example Building
2000 A St.,
Chicago, IL 60601

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

Score Date: 02/21/2013
Building ID #: XXXXX

Current Score 6
Potential Score 7.5
Estimated Savings¹ 33%
1 Uses MORE Energy
10 Uses LESS Energy
High-Efficiency

Assumed Occupancy and Operating Conditions

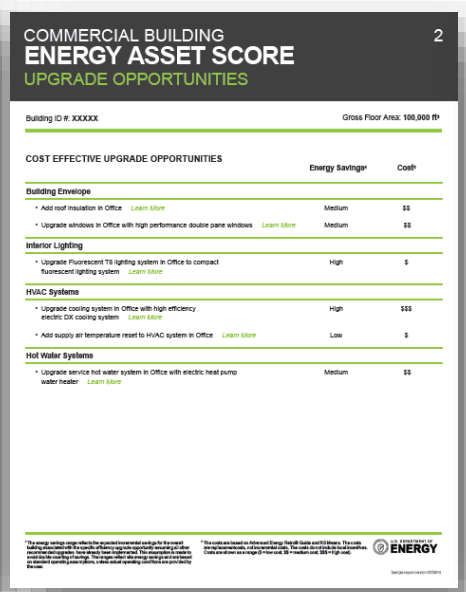
Number of Assumed Occupants	500
Hours of Operation	49 hrs/wk
Cooling Set Point	75°F
Heating Set Point	70°F
Misc. Energy Loads	0.75 W/ft²

Estimated Source Energy Use² (kBtu/ft²)

Current Building	159
Upgraded Building	107

Energy Use Intensity by Fuel Type
Site Energy Use (kBtu/ft²)
Source Energy Use (kBtu/ft²)
Electricity Gas Fuel Oil
District Heating District Cooling

The Commercial 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 commercial 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 Opportunities page provides recommendations for how to improve the building's energy efficiency, increase the building's Asset Score, and save money.


COMMERCIAL BUILDING
ENERGY ASSET SCORE
UPGRADE OPPORTUNITIES
2

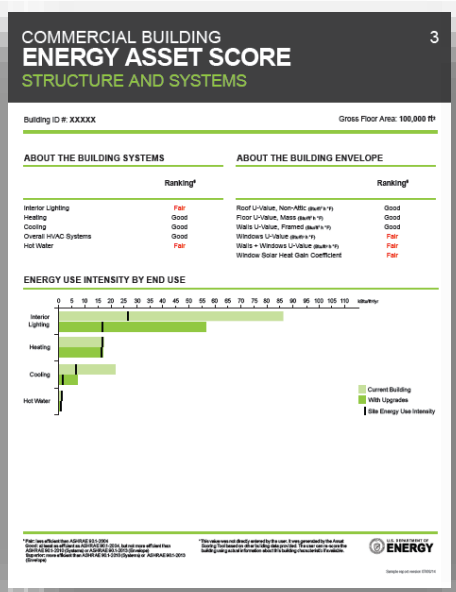
Building ID #: XXXXX
Gross Floor Area: 100,000 ft²

COST EFFECTIVE UPGRADE OPPORTUNITIES

	Energy Savings³	Cost⁴
Building Envelope		
• Add roof insulation in Office Learn More	Medium	$$
• Upgrade windows in Office with high performance double pane windows Learn More	Medium	$$
Interior Lighting		
• Upgrade Fluorescent T8 lighting system in Office to compact fluorescent lighting system Learn More	High	$
HVAC Systems		
• Upgrade cooling system in Office with high efficiency electric DX cooling system Learn More	High	$$$
• Add supply air temperature reset to HVAC system in Office Learn More	Low	$
Hot Water Systems		
• Upgrade service hot water system in Office with electric heat pump water heater Learn More	Medium	$$

³ The energy savings range reflects the expected incremental savings for the overall building energy use for the cost(s) of Balancing upgrade opportunity ensuring all other energy efficiency measures are in place. Savings may not be additive if more than one measure is implemented to avoid double counting of savings. The ranges reflect site energy savings (gas and site) based on standard operating assumptions, unless actual operating conditions are provided by the user.

⁴ The costs are based on Advanced Energy Retrofit Guide and RS Means. The costs are not incremental costs. The costs do not include local incentives. Costs are shown as a range (S = low cost, $$ = medium cost, $$$ = high cost).


COMMERCIAL BUILDING
ENERGY ASSET SCORE
STRUCTURE AND SYSTEMS
3

Building ID #: XXXXX
Gross Floor Area: 100,000 ft²

ABOUT THE BUILDING SYSTEMS

	Ranking⁵
Interior Lighting	Fair
Heating	Good
Cooling	Good
Overall HVAC Systems	Good
Hot Water	Fair

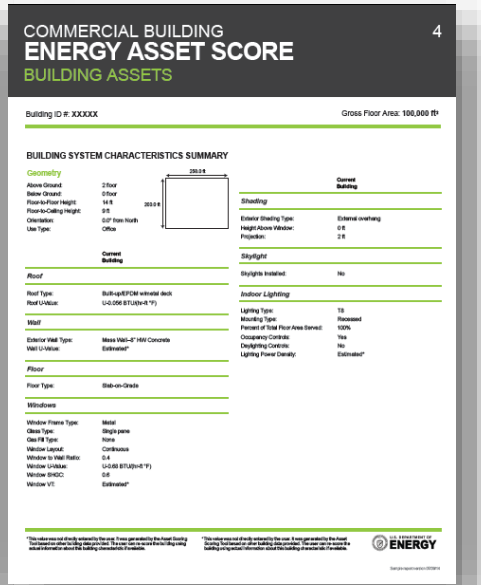
ABOUT THE BUILDING ENVELOPE

	Ranking⁵
Roof U-Value, Non-Attic (Btu/ft²·h·°F)	Good
Floor U-Value, Mass (Btu/ft²·h·°F)	Good
Walls U-Value, Framed (Btu/ft²·h·°F)	Good
Windows U-Value (Btu/ft²·h·°F)	Fair
Walls + Windows U-Value (Btu/ft²·h·°F)	Fair
Window Solar Heat Gain Coefficient	Fair

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

⁵ Fair: Less efficient than ASHRAE 90.1-2004
Good: At least as efficient as ASHRAE 90.1-2004, but not more efficient than ASHRAE 90.1-2010 (Systems) or ASHRAE 90.1-2010 (Envelope)
Best: Either more efficient than ASHRAE 90.1-2010 (Systems) or ASHRAE 90.1-2010 (Envelope)

⁶ This value was not directly entered by the user. It was generated by the Asset Scoring Tool based on other building data you input. The user can re-score the building using actual information about the building characteristics if available.


COMMERCIAL BUILDING
ENERGY ASSET SCORE
BUILDING ASSETS
4

Building ID #: XXXXX
Gross Floor Area: 100,000 ft²

BUILDING SYSTEM CHARACTERISTICS SUMMARY

Geometry

	Current Building
Above Ground:	2 floor
Below Ground:	0 floor
Floor-to-Floor Height:	14 ft
Floor-to-Ceiling Height:	9 ft
Orientation:	0.0° from North
Use Type:	Office

Roof

	Current Building
Roof Type:	Built-up/EPDM w/metal deck
Roof U-Value:	U-0.056 BTU/(h·ft²·°F)

Wall

	Current Building
Exterior Wall Type:	Mass Wall–4" HW Concrete
Wall U-Value:	Estimated*

Floor

	Current Building
Floor Type:	Slab-on-Grade

Windows

	Current Building
Window Frame Type:	Metal
Glass Type:	Single pane
Gas Fill Type:	None
Window Layout:	Continuous
Window to Wall Ratio:	0.4
Window U-Value:	U-0.65 BTU/(h·ft²·°F)
Window SHGC:	0.6
Window VT:	Estimated*

Shading

	Current Building
Exterior Shading Type:	External overhang
Height Above Window:	0 ft
Projection:	2 ft

Skylight

	Current Building
Skylights Installed:	No

Indoor Lighting

	Current Building
Lighting Type:	T8
Mounting Type:	Recessed
Percent of Total Floor Area Served:	100%
Occupancy Controls:	Yes
Daylighting Controls:	No
Lighting Power Density:	Estimated*

* This value was not directly entered by the user. It was generated by the Asset Scoring Tool based on other building data provided. The user can re-score the building using actual information about the building characteristics if available.

Asset Score Report

10-point scale based on predicted EUI

- Recently transitioned from 100-point scale
- Current and Potential Scores
- “10” represents lowest expected energy usage using current EE technologies
- Weather normalized
- Scale moves in half-point increments

COMMERCIAL BUILDING
ENERGY ASSET SCORE
OVERALL BUILDING SCORE

1

BUILDING INFORMATION

Example Building
2000 A St.,
Chicago, IL 60601

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

Score Date: **02/21/2013**
Building ID #: **XXXXX**

Potential Score **7.5**
Estimated Savings[1] **33%**
Current Score **6**

1 Uses **MORE** Energy — 10 Uses **LESS** Energy
High-Efficiency

Assumed Occupancy and Operating Conditions		Estimated Source Energy Use[2] (kBtu/ft²)		Energy Use Intensity by Fuel Type
Number of Assumed Occupants	500	Current Building	159	Site Energy Use (kBtu/ft²) 16.5 42.5
Hours of Operation	49 hrs/wk	Upgraded Building	107	Source Energy Use (kBtu/ft²) 17.3 142.1
Cooling Set Point	75°F			Electricity, Gas, Fuel Oil, District Heating, District Cooling
Heating Set Point	70°F			
Misc. Energy Loads	0.75 W/ft²			

The **Commercial 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 commercial 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 **Opportunities** page provides recommendations for how to improve the building's energy efficiency, increase the building's Asset Score, and save money.

http://www1.eere.energy.gov/buildings/commercial/assetscore.html

This report is based on self-reported building information. Official scores must be generated by a qualified individual recognized by the U.S. Department of Energy. Requirements are under development.

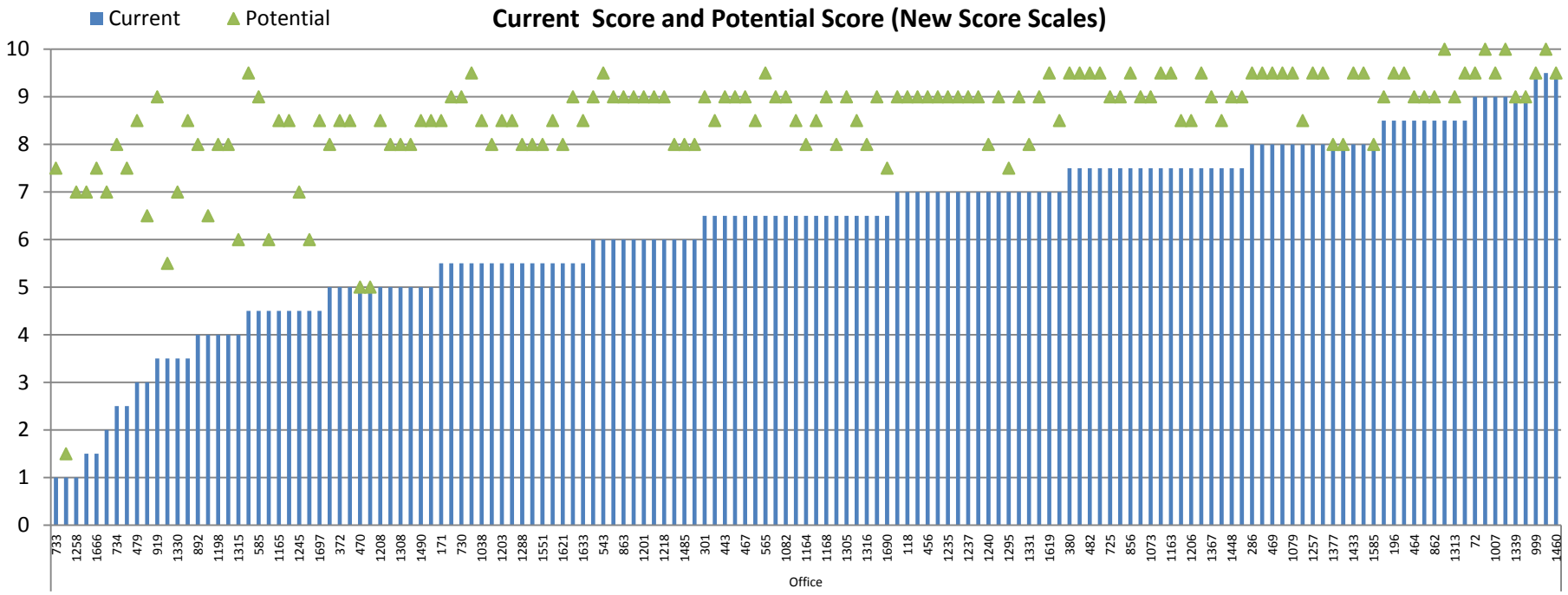
[1] Savings reflect the reduction in source energy that would result from undertaking all of the efficiency improvements identified on the Opportunities page. Actual savings will depend on a variety of factors including actual operating conditions.

[2] Estimates are calculated using information provided about the building's characteristics as well as standard assumptions about operations and weather.

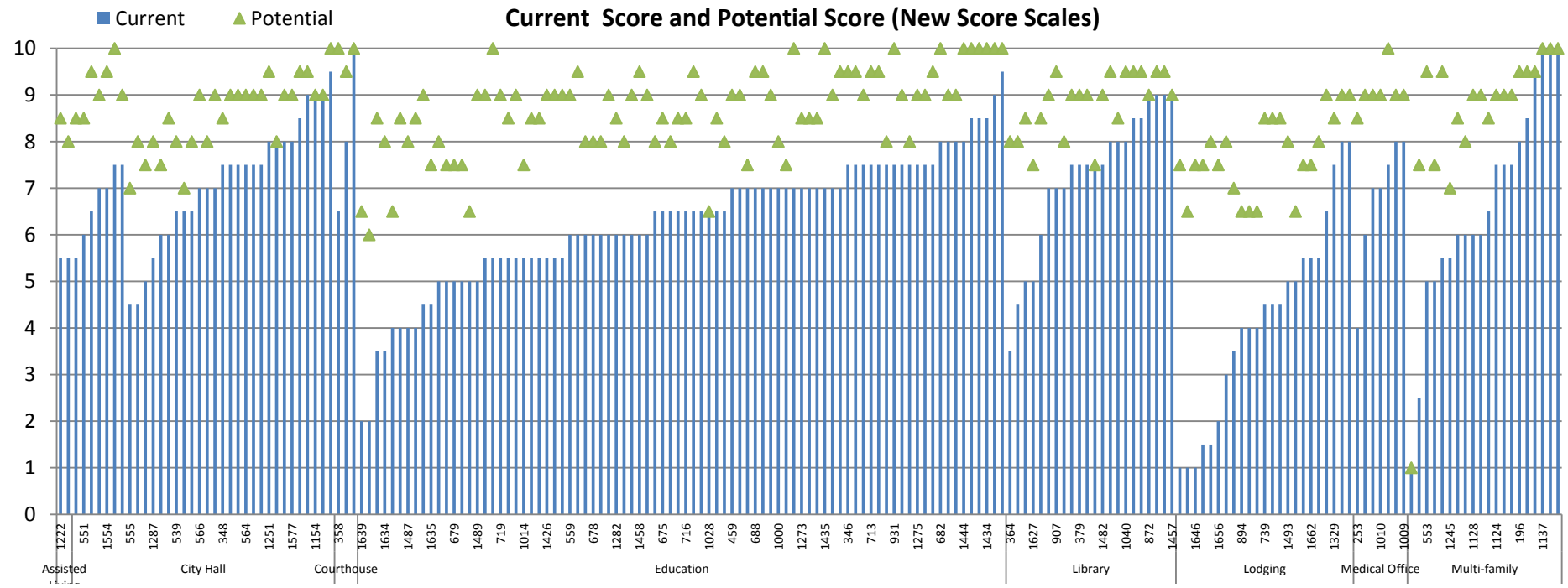
U.S. DEPARTMENT OF ENERGY

Sample report version 08/11/14

Score Distributions - Office



Score Distributions - Other



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

Asset Score Report

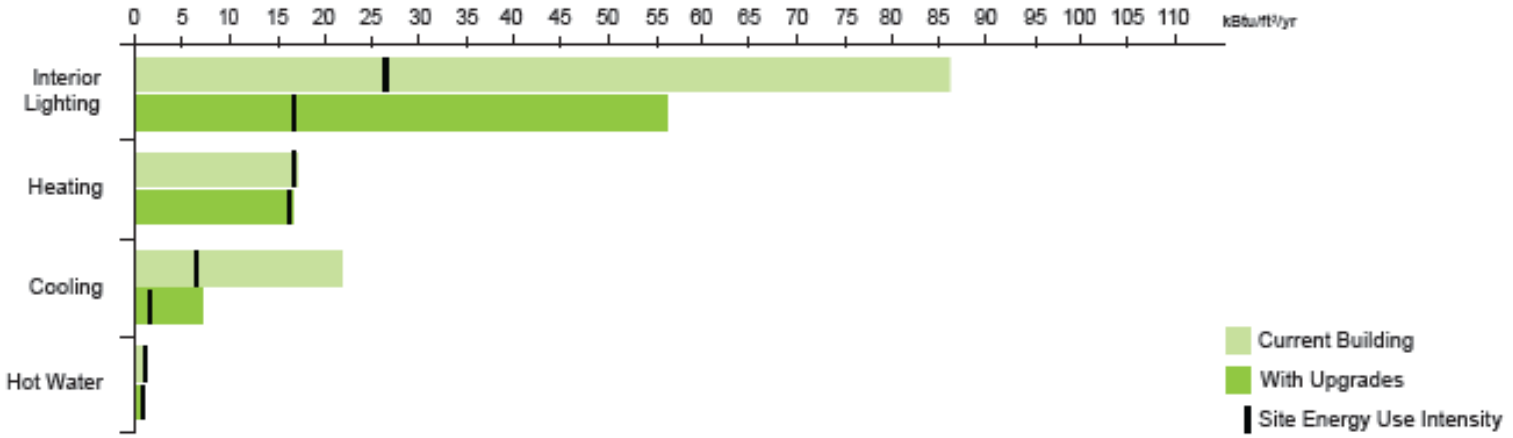
ABOUT THE BUILDING SYSTEMS

	Ranking[8]
Interior Lighting	Fair
Heating	Good
Cooling	Good
Overall HVAC Systems	Good
Hot Water	Fair

ABOUT THE BUILDING ENVELOPE

	Ranking[8]
Roof U-Value, Non-Attic (Btu/ft² h °F)	Good
Floor U-Value, Mass (Btu/ft² h °F)	Good
Walls U-Value, Framed (Btu/ft² h °F)	Good
Windows U-Value (Btu/ft² h °F)	Fair
Walls + Windows U-Value (Btu/ft² h °F)	Fair
Window Solar Heat Gain Coefficient	Fair

ENERGY USE INTENSITY BY END USE



Asset Score Report

COST EFFECTIVE UPGRADE OPPORTUNITIES

	Energy Savings[4]	Cost[5]
Building Envelope		
• Add roof insulation in Office *Learn More*	Medium	$$
• Upgrade windows in Office with high performance double pane windows *Learn More*	Medium	$$
Interior Lighting		
• Upgrade Fluorescent T8 lighting system in Office to compact fluorescent lighting system *Learn More*	High	$
HVAC Systems		
• Upgrade cooling system in Office with high efficiency electric DX cooling system *Learn More*	High	$$$
• Add supply air temperature reset to HVAC system in Office *Learn More*	Low	$
Hot Water Systems		
• Upgrade service hot water system in Office with electric heat pump water heater *Learn More*	Medium	$$

Value

Real estate owners and managers, designers, and government facilities managers can use the Asset Score to:

- Ensure the market recognizes EE capital investments
- Communicate the underlying energy efficiency of assets to tenants and investors
- Demonstrate national sustainability and CSR leadership
- Guide energy-related investment decisions and target improvement actions (beyond Portfolio Manager)
- For architects: Assess EE iteratively during design
- For governments: Provide transparency to taxpayers

Call for Users

DOE Office of Energy Efficiency and Renewable Energy will recognize stakeholders that use, or commit to use, the Asset Score by May 2015

- Planned media release in summer 2015 recognizing current and committed users
- Technical assistance from Pacific NW National Lab will be made available
- Commitment does not require disclosure of any kind

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