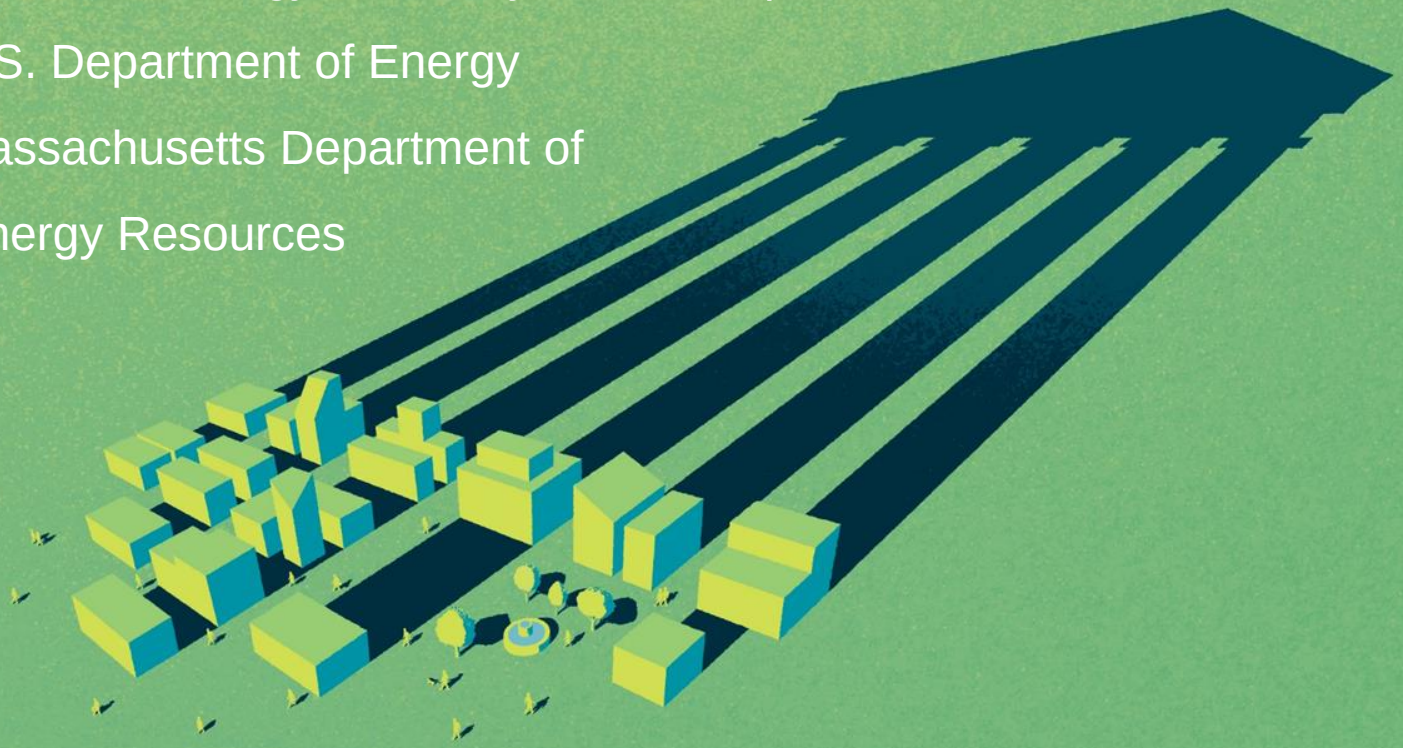
Commercial Asset Rating:
New Methods for Driving Investment

Kevin Rose | Northeast Energy Efficiency Partnerships

Andrew Burr | U.S. Department of Energy

Ian Finlayson | Massachusetts Department of Energy Resources



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MONUMENTAL GREEN

Course Description

Asset ratings assess the performance of a building's energy features irrespective of its operations and enable 'apples-to-apples' comparison between buildings.

New asset rating tools are being developed that allow building owners, investors, and service providers to quickly identify and understand energy efficiency investment opportunities at a much lower cost.

Learning Objectives

After this session, the attendee will understand the:

- benefits and constraints of ‘operational’ (such as Energy Star) and ‘asset’ commercial building energy ratings
- latest results and key findings from the MA Building Asset Rating and DOE Commercial Asset Score pilot projects
- status, opportunities, challenges, and future trajectories of state and federal building asset rating initiatives
- value of enhanced access to building energy performance information in encouraging real estate and financial markets to invest in energy efficiency improvements

Polling Question 1

- Who are you? Why are you here?
  - Already using or interested in asset rating
  - Want to learn what asset rating is
  - Use Portfolio Manager, and want to learn what else I can do.
  - Too many people in the session I actually want
  - Insomnia?

About NEEP

Mission

- Accelerate energy efficiency as an essential part of demand-side solutions that enable a sustainable regional energy system

Approach

- Overcome barriers and transform markets via collaboration, education, and expertise

Vision

- Region embraces next generation energy efficiency as a core strategy to meet energy needs in a carbon-constrained world

One of six regional energy efficiency organizations (REEOs) funded by the US Department of Energy (US DOE) to link regions to US DOE guidance, products and programs

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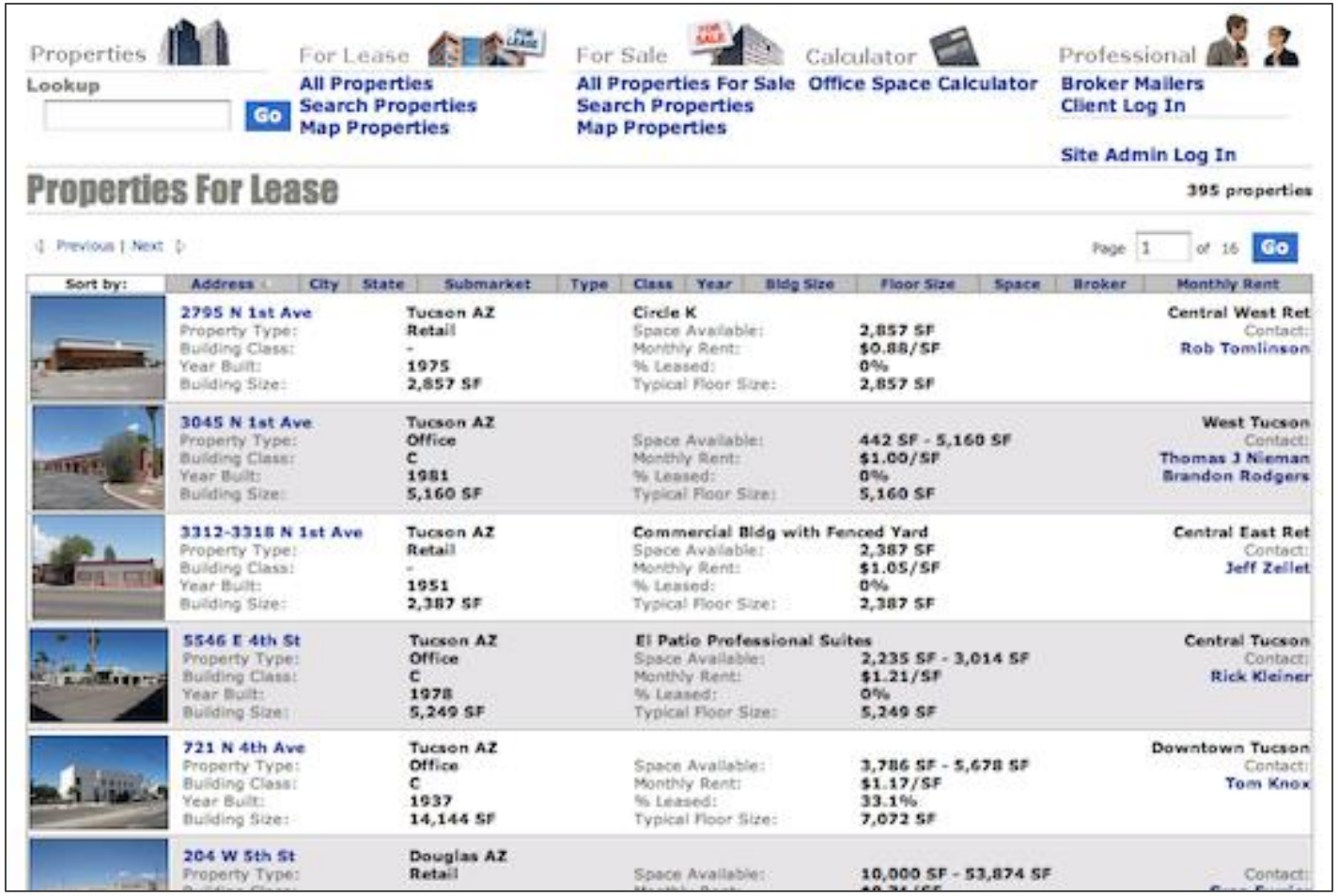
The Current State of Affairs



Properties
Lookup
Go
For Lease
All Properties
Search Properties
Map Properties
For Sale
All Properties For Sale
Search Properties
Map Properties
Calculator
Office Space Calculator
Professional
Broker Mailers
Client Log In
Site Admin Log In

Properties For Lease

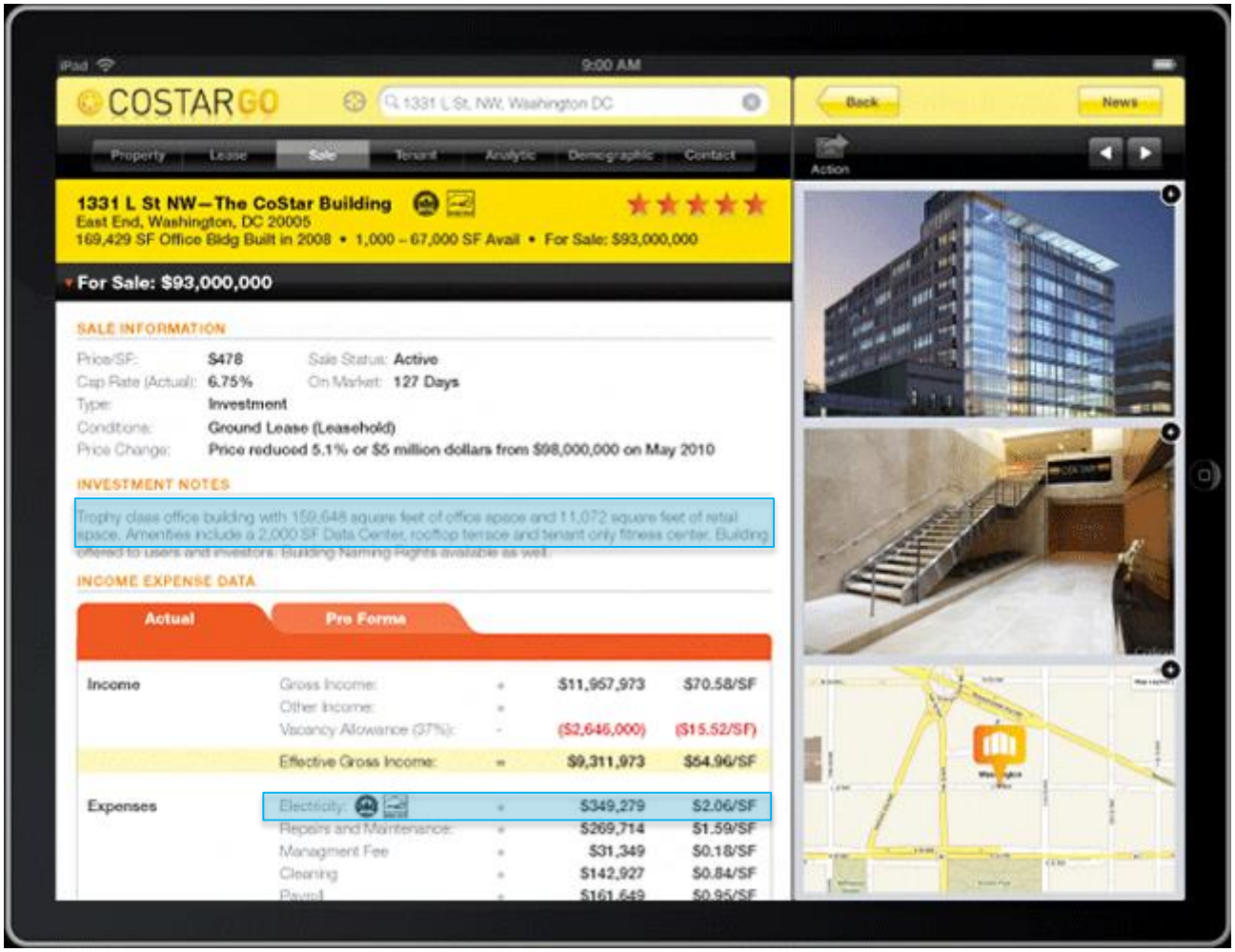
395 properties

Previous | Next

Page 1 of 16 Go

Sort by:	Address	City	State	Submarket	Type	Class	Year	Bldg Size	Floor Size	Space	Broker	Monthly Rent
	2795 N 1st Ave Property Type: Retail Building Class: - Year Built: 1975 Building Size: 2,857 SF			Tucson AZ		Circle K Space Available: 2,857 SF Monthly Rent: $0.88/SF % Leased: 0% Typical Floor Size: 2,857 SF						Central West Ret Contact: Rob Tomlinson
	3045 N 1st Ave Property Type: Office Building Class: C Year Built: 1981 Building Size: 5,160 SF			Tucson AZ		Space Available: 442 SF - 5,160 SF Monthly Rent: $1.00/SF % Leased: 0% Typical Floor Size: 5,160 SF						West Tucson Contact: Thomas J Nieman Brandon Rodgers
	3312-3318 N 1st Ave Property Type: Retail Building Class: - Year Built: 1951 Building Size: 2,387 SF			Tucson AZ		Commercial Bldg with Fenced Yard Space Available: 2,387 SF Monthly Rent: $1.05/SF % Leased: 0% Typical Floor Size: 2,387 SF						Central East Ret Contact: Jeff Zellet
	5546 E 4th St Property Type: Office Building Class: C Year Built: 1978 Building Size: 5,249 SF			Tucson AZ		El Patio Professional Suites Space Available: 2,235 SF - 3,014 SF Monthly Rent: $1.21/SF % Leased: 0% Typical Floor Size: 5,249 SF						Central Tucson Contact: Rick Kleiner
	721 N 4th Ave Property Type: Office Building Class: C Year Built: 1937 Building Size: 14,144 SF			Tucson AZ		Space Available: 3,786 SF - 5,678 SF Monthly Rent: $1.17/SF % Leased: 33.1% Typical Floor Size: 7,072 SF						Downtown Tucson Contact: Tom Knox
	204 W 5th St Property Type: Retail			Douglas AZ		Space Available: 10,000 SF - 53,874 SF						Contact:

The Even More Current State of Affairs



Barriers to EE Retrofits

Owners/Investors need efficiency information, but

- Cost of comprehensive audits too high
- Custom audits currently not scalable
- Utility data not sufficiently accessible

Operational Rating

Compare performance

- vs. its past
- vs. its peers

Tracking

- Energy
- Water

Benchmarking

Operational Rating

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Polling Question 2

- How effective are operational ratings / benchmarking in driving investment?
  - Very effective, or need more time to be
  - Not effective, we need more robust building level data
  - Helpful, but not sufficient
  - Not sure, need incentives / tax credits to justify $.

Asset Rating

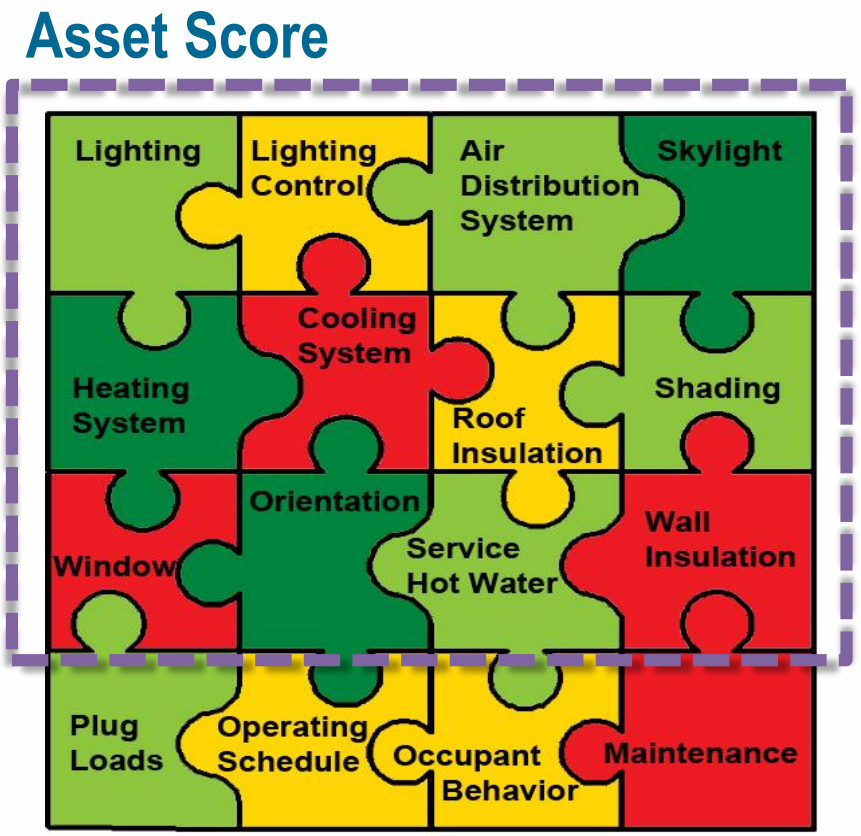
Analyzes energy features

- ~~Tenant driven loads~~

Energy modeling software

- Diagnostic tests

ASHRAE Level 2



Operational Versus Asset

USDA

LEARN MORE AT energystar.gov

ENERGY STAR® Scorecard

86

ENERGY STAR® Score

Sample Property

Primary Function: Office
Gross Floor Area (ft^2): 200,000
Built: 1980

For Year Ending: April 30, 2013
Date Generated: June 28, 2013

Property Address:
Sample Property
123 Main Street
Arlington, Virginia 22030

Nutrition Facts

COMMERCIAL BUILDING 4
ENERGY ASSET SCORE
BUILDING ASSETS

Retroficiency

Executive Summary

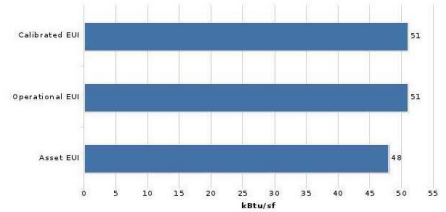
Overview

The following report summarizes the findings assembled based on an energy assessment conducted at 2 Oliver Street Boston, MA. Currently the 224,426 square foot office building consumes 3,243,034 kWh of electricity and 5,567 Therms of natural gas per year. The facility has an annual Energy Use Intensity (EUI) of 48 kBtu/square foot and an ENERGY STAR Score of 84 (Asset Model). Two notes on this report: 1. There continue to be questions about both the electrical and gas consumption that was reported for this building. The gas consumption is both very low and irregular. Gas data raises questions about the operation of the make-up air fan. 2. This building changed ownership immediately before the site visit and new staff were still becoming familiar with the specifics of the site.

Your Building Asset Rating (EUI) 48 Asset Rating

The chart below illustrates the annual EUI for this building in three related ways.

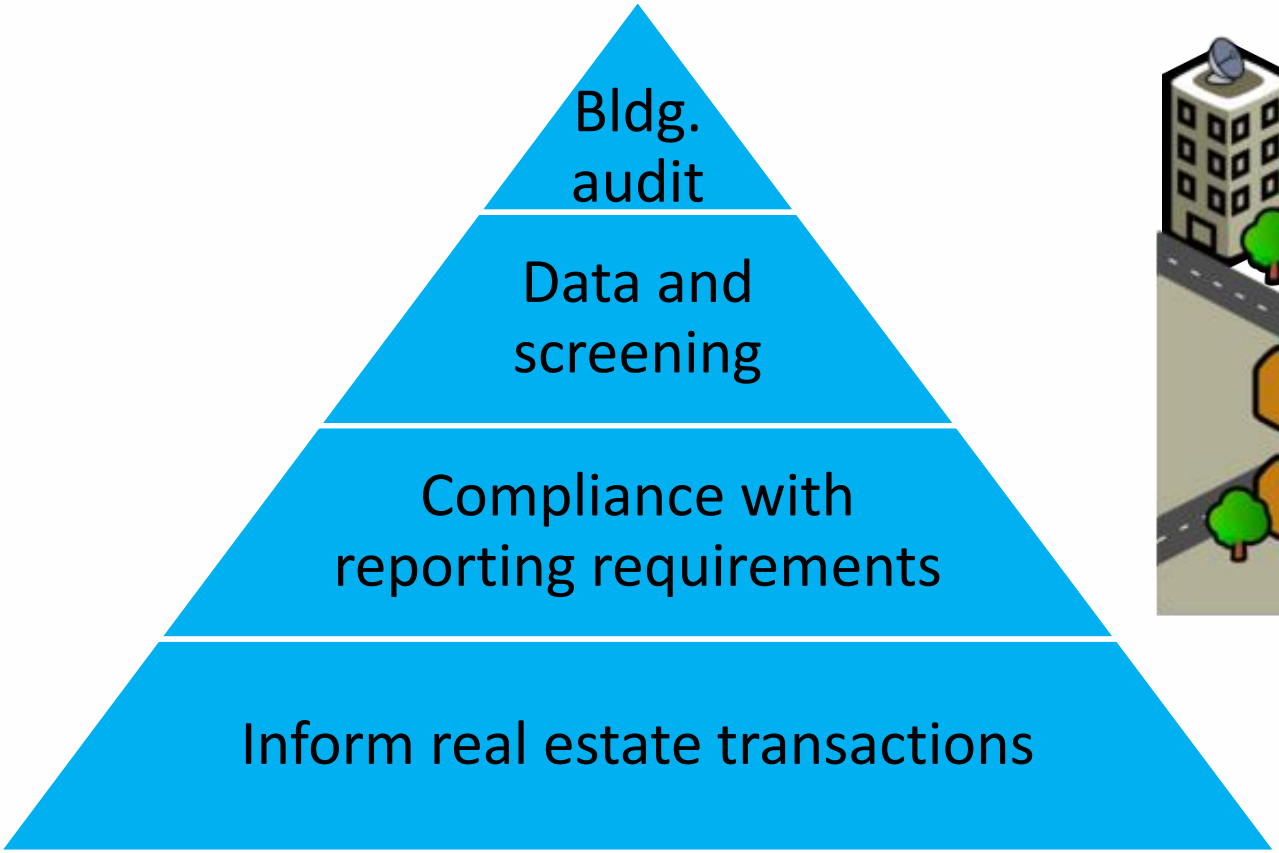
a) The calibrated EUI is modeled based on recent actual energy usage data.
b) The operational EUI is based on building usage adjusted for weather and is comparable to the building's ENERGY STAR Portfolio Manager EUI, which is shown for comparison on the next page.
c) The asset EUI adjusts the building energy model to reflect *typical* hours of use and *typical* office space tenants to allow for easy comparisons with other office buildings.



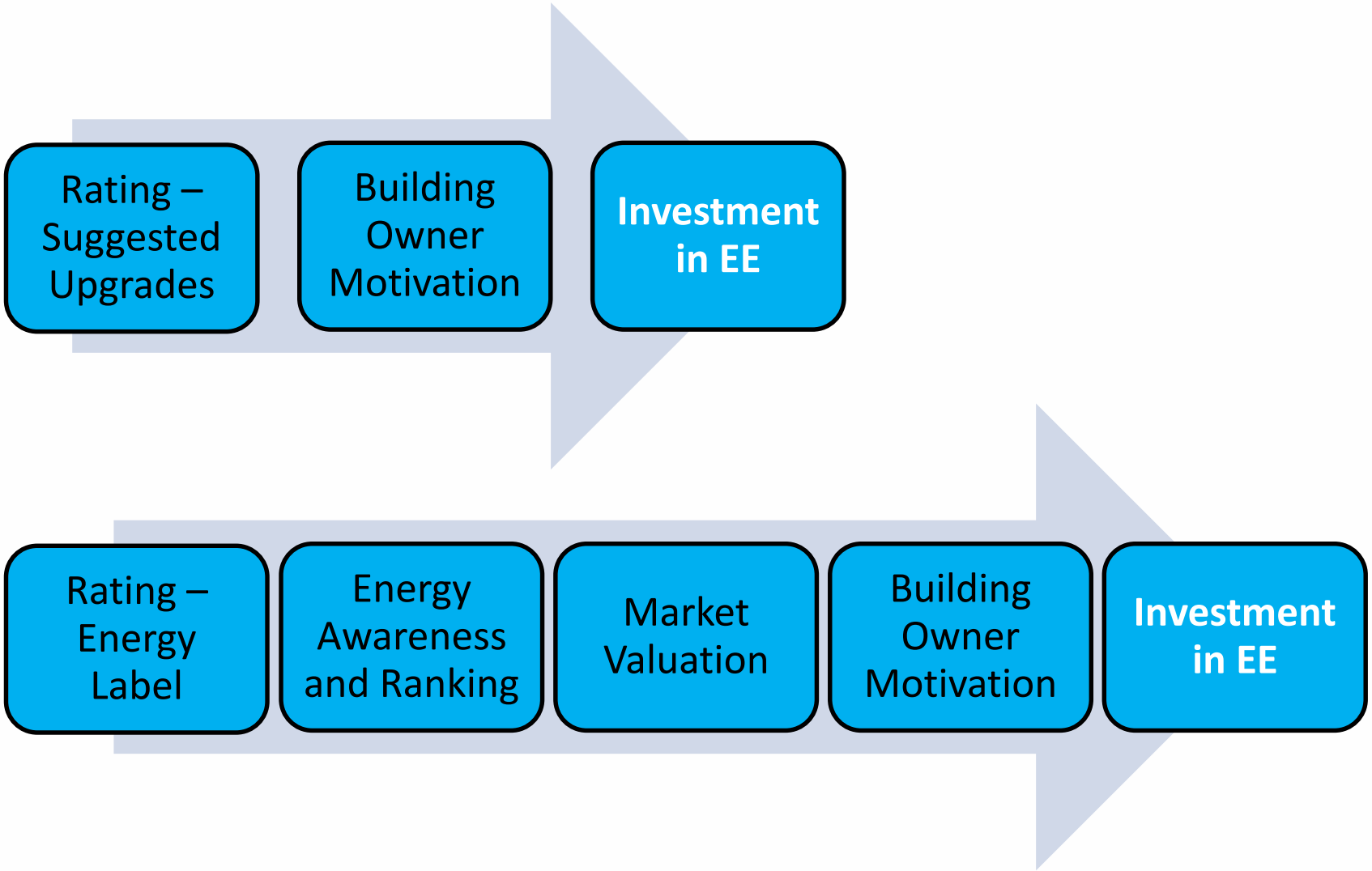
For this building, the Asset EUI is both low and close to the Calibrated value. This suggests that this facility is doing an adequate job of conserving energy. Regardless, expanding the building automation

ASHRAE Level 2 - Energy Survey and Analysis Page 1

Asset Rating: Applications



Asset Rating: Paths to Investment



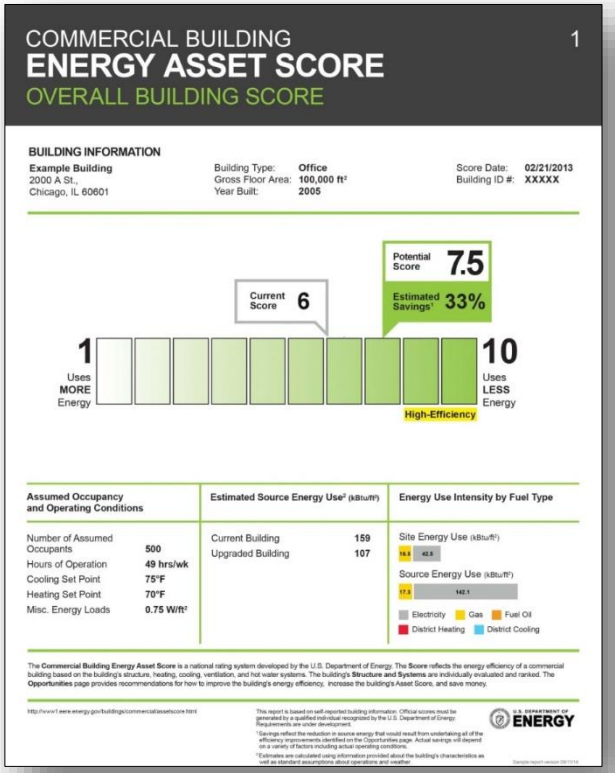
DOE Building Energy Asset Score

National, free software tool that diagnoses opportunities to improve EE

- Assesses the efficiency of structural, mechanical, and electrical building components
- Diagnostic tool, not an energy management tool

Demand is expanding

- Asset scores generated for more than 50 million square feet nationwide in more than 30 states


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 Savings¹ 33%
Current Score 6

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)
16.5 42.6

Source Energy Use (kBtu/ft²)
17.3 142.1

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.

http://www1.eere.energy.gov/buildings/commercialassetscore.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.

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Overview

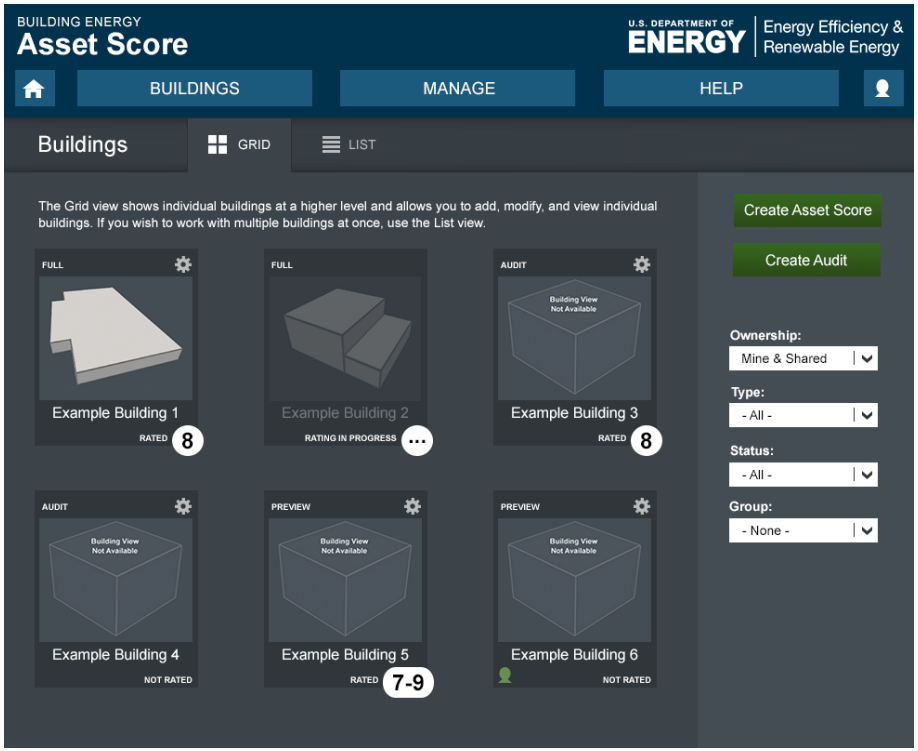
Asset Score runs a real-time, thermal dynamic energy simulation using EnergyPlus

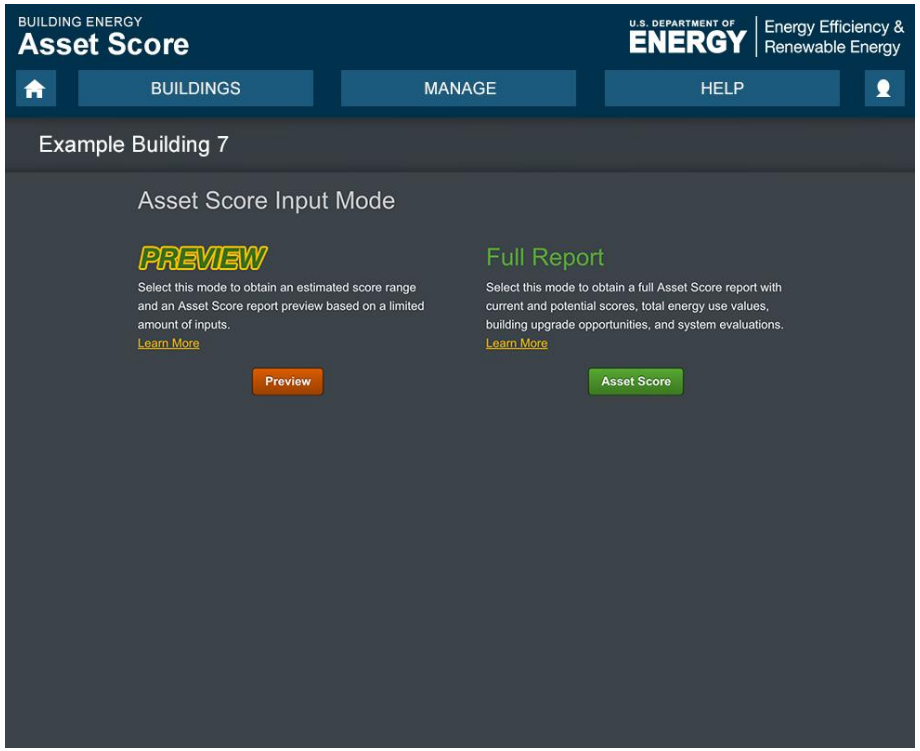
- Normalizes for building operations, occupancy, and tenant behavior
- Users enter building information through a web interface

Assesses new and existing buildings:

- Office, retail, warehouse, multifamily, educational, lodging
- Government facilities (police, library, city hall, etc.), parking garages, house of worship

Inside the Asset Score





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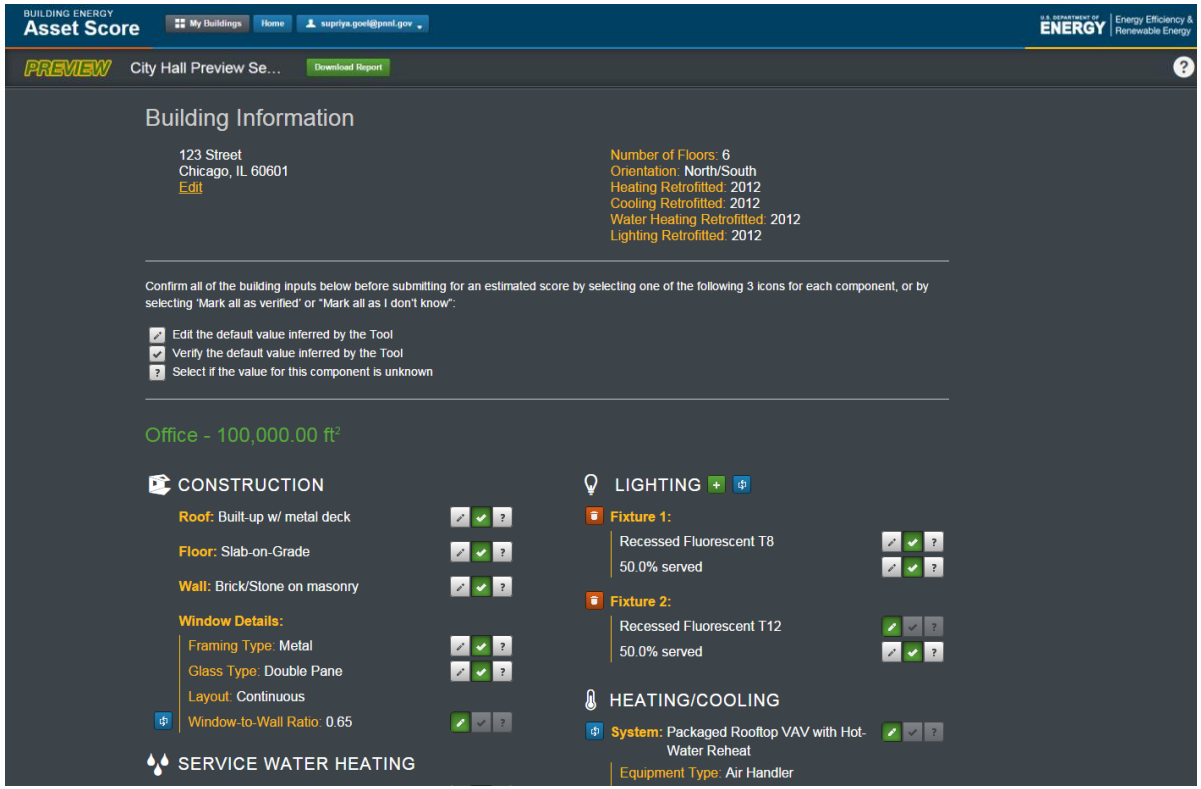
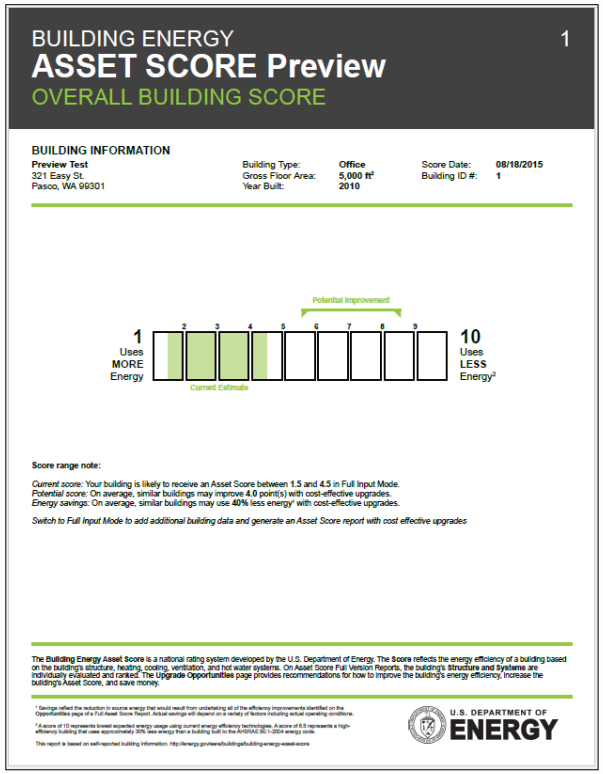
Asset Score Preview



Asset Score Preview



BUILDING ENERGY 1
ASSET SCORE Preview
OVERALL BUILDING SCORE

BUILDING INFORMATION

Preview Test
321 Easy St.
Pasco, WA 99301

Building Type: **Office**
Gross Floor Area: **5,000 ft²**
Year Built: **2010**

Score Date: **08/18/2015**
Building ID #: **1**

Potential Improvement

1 2 3 4 5 6 7 8 9 10

1 Uses MORE Energy

10 Uses LESS Energy[2]

Current Estimate

Score range note:

Current score: Your building is likely to receive an Asset Score between **1.5** and **4.5** in Full Input Mode.
Potential score: On average, similar buildings may improve **4.0** point(s) with cost-effective upgrades.
Energy savings: On average, similar buildings may use **40%** less energy[1] with cost-effective upgrades.

Switch to Full Input Mode to add additional building data and generate an Asset Score report with cost effective upgrades

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. On Asset Score Full Version Reports, 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 of a Full Asset Score Report. 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 0.5 represents a high-efficiency building that uses approximately 35% less energy than a building built to the ANSI/ASE 90.1-2004 energy code.

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

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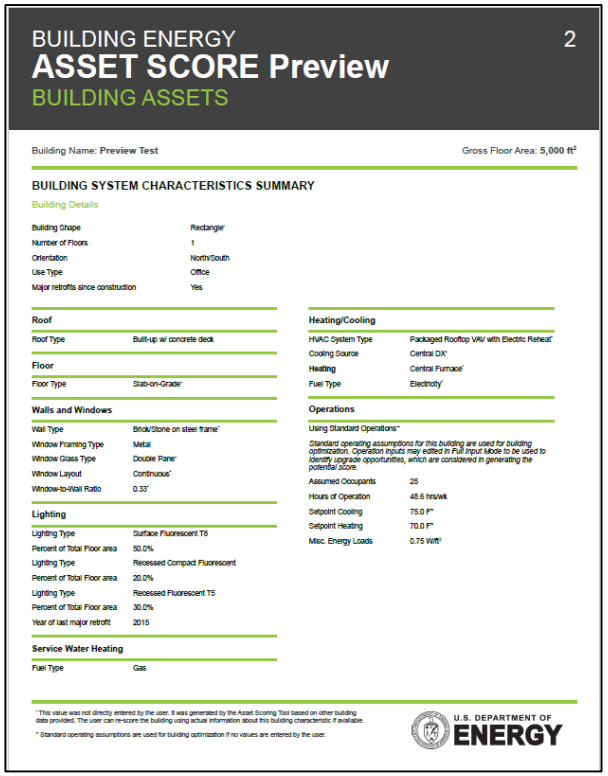


BUILDING ENERGY 2
ASSET SCORE Preview
BUILDING ASSETS

Building Name: **Preview Test**
Gross Floor Area: **5,000 ft²**

BUILDING SYSTEM CHARACTERISTICS SUMMARY

Building Details

Building Shape	Rectangle*
Number of Floors	1
Orientation	North/South
Use Type	Office
Major retrofits since construction	Yes

Roof

Roof Type	Built-up w/ concrete deck

Floor

Floor Type	Slab-on-Grade*

Walls and Windows

Wall Type	Brick/Stone on steel frame*
Window Framing Type	Metal
Window Glass Type	Double Pane*
Window Layout	Continuous*
Window-to-Wall Ratio	0.33*

Lighting

Lighting Type	Surface Fluorescent T8
Percent of Total Floor area	50.0%
Lighting Type	Recessed Compact Fluorescent
Percent of Total Floor area	20.0%
Lighting Type	Recessed Fluorescent T5
Percent of Total Floor area	30.0%
Year of last major retrofit	2015

Service Water Heating

Fuel Type	Gas

Heating/Cooling

HVAC System Type	Packaged Rooftop VAV with Electric Reheat*
Cooling Source	Central DX*
Heating	Central Furnace*
Fuel Type	Electricity*

Operations

Using Standard Operations**

Standard operating assumptions for this building are used for building optimization. Operation inputs may edited in Full Input Mode to be used to identify upgrade opportunities, which are considered in generating the potential score.

Assumed Occupants	25
Hours of Operation	48.6 hrs/wk
Setpoint Cooling	75.0 F°
Setpoint Heating	70.0 F°
Misc. Energy Loads	0.75 W/ft²

* 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 this building characteristic if available.

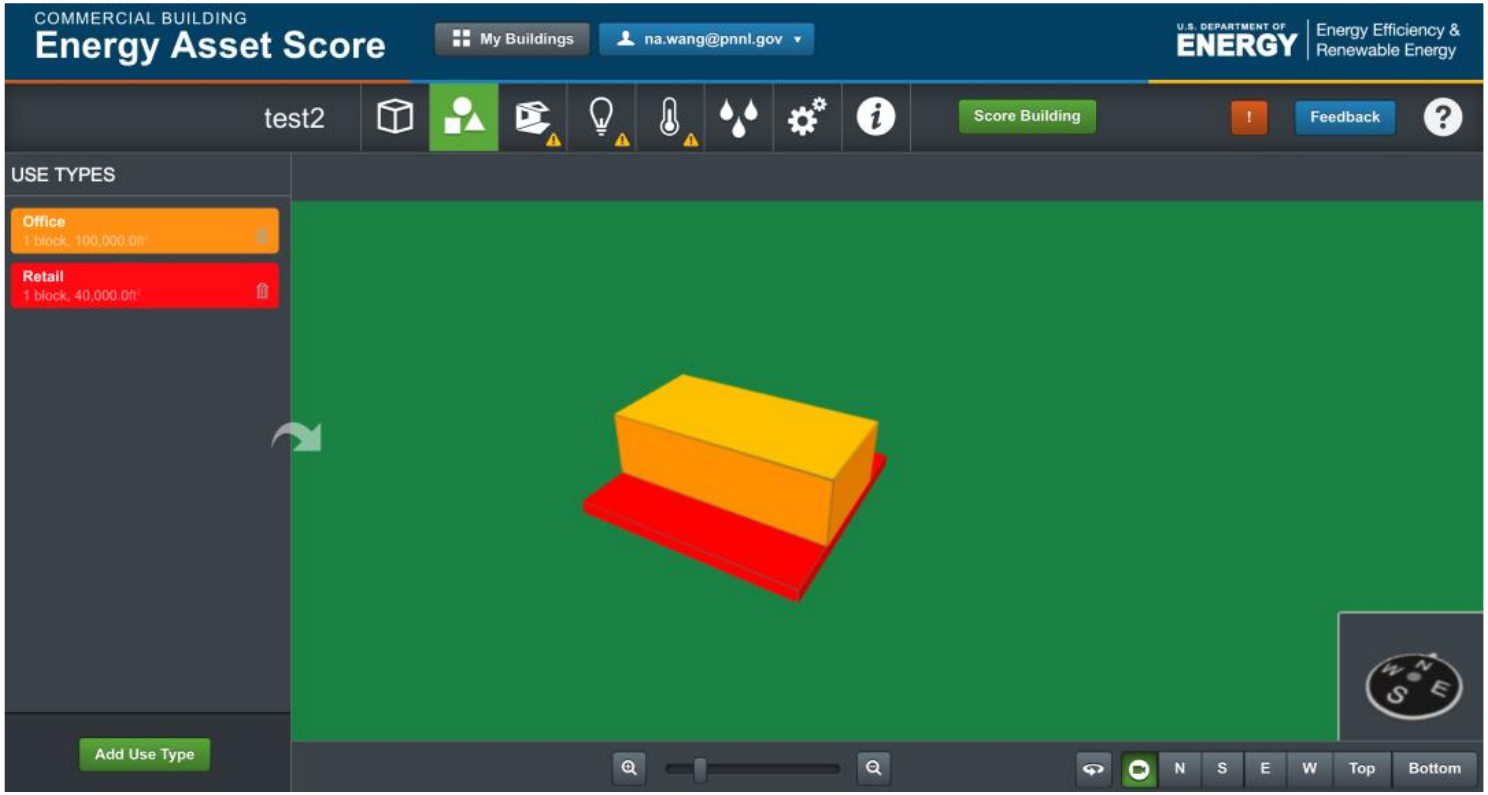
** Standard operating assumptions are used for building optimization if no values are entered by the user.

U.S. DEPARTMENT OF ENERGY

Asset Score Full Version

- 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 Full Version



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 Savings* 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 Use* (kBtu/ft²)

Current Building	159
Upgraded Building	107

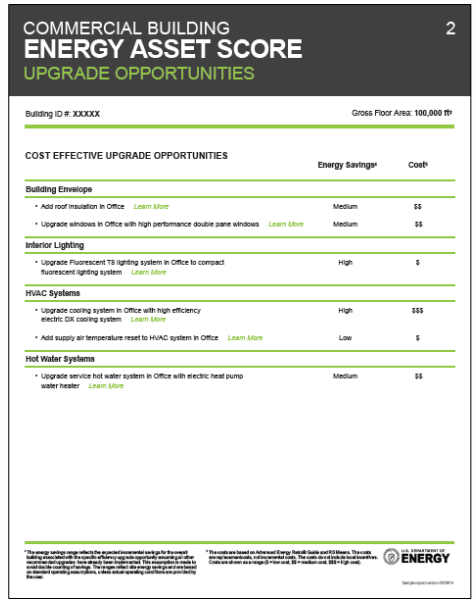
Energy Use Intensity by Fuel Type

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

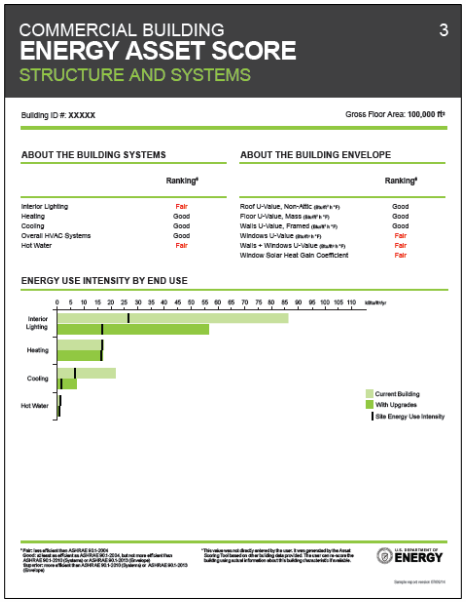
Building ID #: XXXXX
Gross Floor Area: 100,000 ft²

COST EFFECTIVE UPGRADE OPPORTUNITIES

	Energy Savings*	Cost*
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	$$$
• Add supply air temperature reset to HVAC system in Office *Learn More*	Low	$
Hot Water Systems		
• Upgrade service hot water system in Office with electric heat pump water heater *Learn More*	Medium	$$

* The energy savings range reflects the projected incremental savings for the overall building associated with implementing all of the measures in the upgrade. Some of the measures may have already been implemented. This assumption is made to avoid double counting of savings. The ranges reflect site energy savings and are based on standard operating assumptions, where actual operating conditions vary.

* The costs are based on Advanced Energy Retrofit Guide and RS Means. The costs are high level estimates, including material and labor. The costs do not include incentives. Costs are shown as a range (1=low 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

	Ranking*
Interior Lighting	Fair
Heating	Good
Cooling	Good
Overall HVAC Systems	Good
Hot Water	Fair

ABOUT THE BUILDING ENVELOPE

	Ranking*
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

* Rate is reflected from ASHRAE 901-2004 (Deemed) as revised and modified as ASHRAE/IESNA 90.2-2004, but not more efficient than ASHRAE 90.1-2010 (Deemed) or ASHRAE 90.1-2013 (Developed Stage from) more efficient than the ASHRAE 90.1-2010 (Deemed) or ASHRAE 90.1-2013 (Developed)

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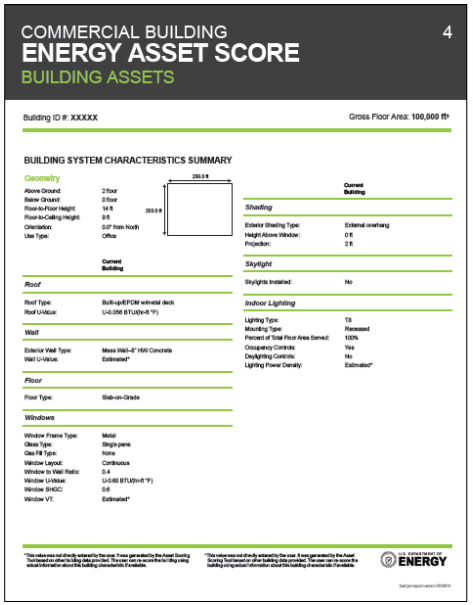
COMMERCIAL BUILDING
ENERGY ASSET SCORE
BUILDING ASSETS
4

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

BUILDING SYSTEM CHARACTERISTICS SUMMARY

Geometry

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

	Current Building
Roof	
Roof Type:	Built-up/EPDM w/metal deck
Roof U-Value:	U-0.056 BTU/(h·ft²·°F)
Wall	
Exterior Wall Type:	Mass Wall–8" HW Concrete
Wall U-Value:	Estimated*
Floor	
Floor Type:	Slab-on-Grade
Windows	
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-0.69 BTU/(h·ft²·°F)
Window SHGC:	0.6
Window VT:	Estimated*

	Current Building
Shading	
Exterior Shading Type:	External overhang
Height Above Window:	0 ft
Projection:	2 ft
Skylight	
Skylights Installed:	No
Indoor Lighting	
Lighting Type:	T8
Mounting Type:	Recessed
Percent of Total Floor Area Served:	100%
Occupancy Controls:	Yes
Daylighting Controls:	No
Lighting Power Density:	Estimated*

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GREENBUILD INTERNATIONAL CONFERENCE AND EXPO

MONUMENTAL GREEN

Asset Score Report

COMMERCIAL BUILDING 1
ENERGY ASSET SCORE
OVERALL BUILDING SCORE

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)
Hours of Operation	49 hrs/wk	Upgraded Building	107	Source Energy Use (kBtu/ft²)
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			

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U.S. DEPARTMENT OF ENERGY

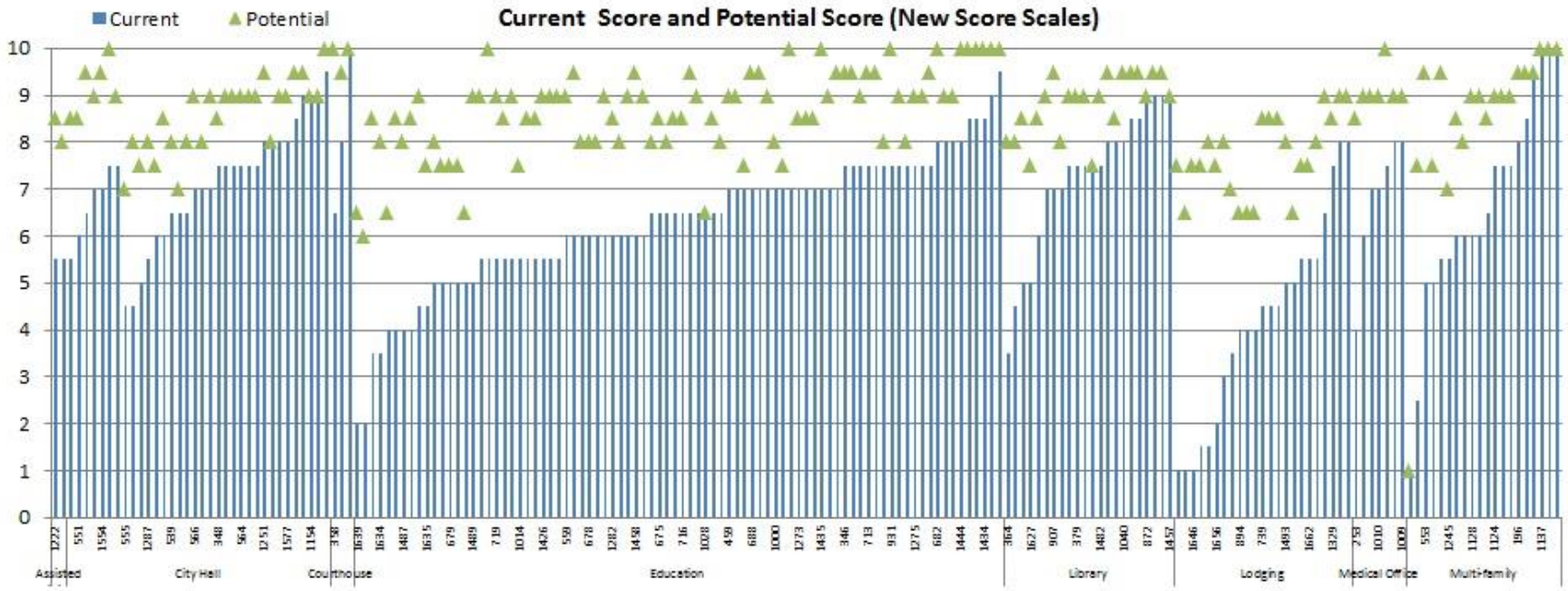
COST EFFECTIVE UPGRADE OPPORTUNITIES

	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	$$$
• Add supply air temperature reset to HVAC system in Office *Learn More*	Low	$
Hot Water Systems		
• Upgrade service hot water system in Office with electric heat pump water heater *Learn More*	Medium	$$

Analysis


Current
Potential
Current Score and Potential Score (New Score Scales)
10
9
8
7
6
5
4
3
2
1
0
Office

Analysis


Current
Potential
Current Score and Potential Score (New Score Scales)
10
9
8
7
6
5
4
3
2
1
0
Assisted
City Hall
Courthouse
Education
Library
Lodging
Medical Office
Multi-family

Asset Score Applications

Pre-audits

- Property owners and operators can determine where audits make sense

Business development

- Energy services companies and engineers can communicate improvement opportunities to property owners

Iterative design

- Architects can easily predict energy impact of design decisions

Due diligence

- Buyers and renters can understand EE indicators that affect energy costs

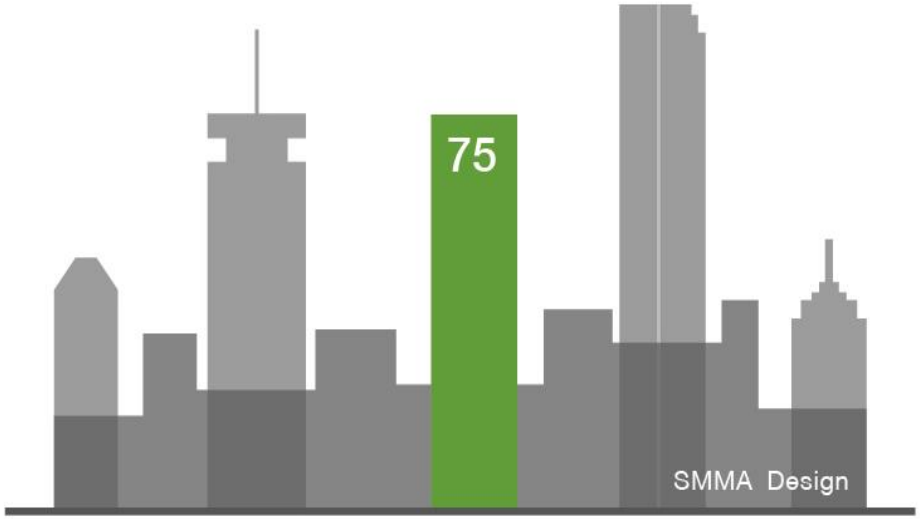
Polling Question 3

- Do you think a ‘per capita’ EUI would be substantially different from the current energy use per sq. ft metric?
  - Yes. Lower occupancy will correlate with lower energy use.
  - No. Occupancy is a fundamentally different variable than floor area.
  - I have no idea. Please illuminate me.
  - It depends. But I have a theory to explain why.

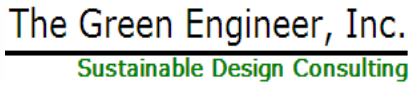
Raising the BAR

Preliminary findings of the 2012-2014

Massachusetts Building Asset Rating Pilot



Raising the BAR - Acknowledgements



BAR Goals

Goal 1

- Identify streamlined method for building energy audits

Goal 2

- Enable fair comparison between buildings

BAR Phases

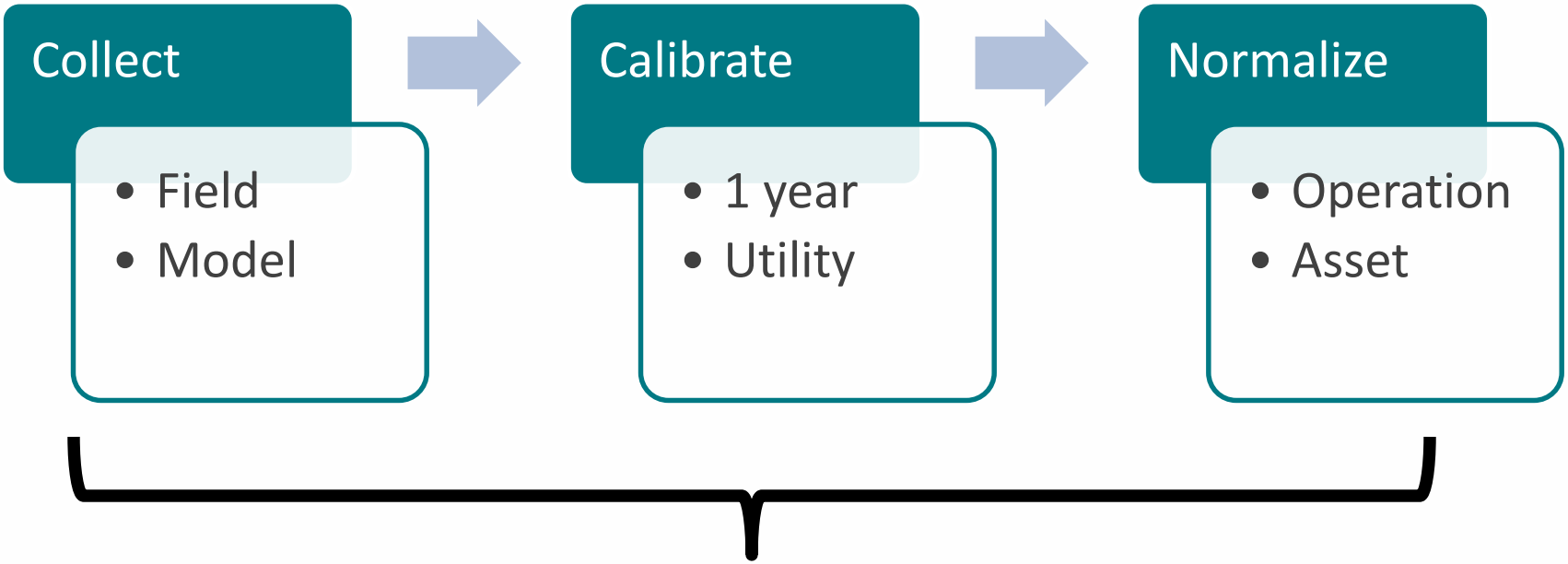
Phase 1: “Stress Test”

- 11 diverse buildings
- Compare traditional and innovative audits
- Key Findings
  - Protocols: Operation to Asset
  - Innovative Audit: compares well

Phase 2: Demonstration

- 32 diverse buildings
- Followed protocols
- Key findings presented herein

Process



Key Protocols:

-Measurement of square footage
-Inputs used to convert operational to asset
-Normalize for variance in occupancy and use

Utility Data Access – 3/50% rule

Goal: simple criteria to protect tenant confidentiality while mitigating data collection as a cost barrier.

Result: DOER & National Grid [1] developed a MOU for required tenant data release:

Three criteria

- Interval (15minute) electric meter data.
- More than 50% of the electric or gas load.
- Aggregate when 3 or more tenants in the building.

[1] Eversource (then NStar) provided data under the same 3/50% criteria without signing a formal MOU.

EUI Classes – Normalization Process

Input:
Consumption

Actual EUI
direct from utility billing data

Create:
Adjustable computer model

Calibrated EUI
recreated in computer model

Remove:
Vagaries of weather

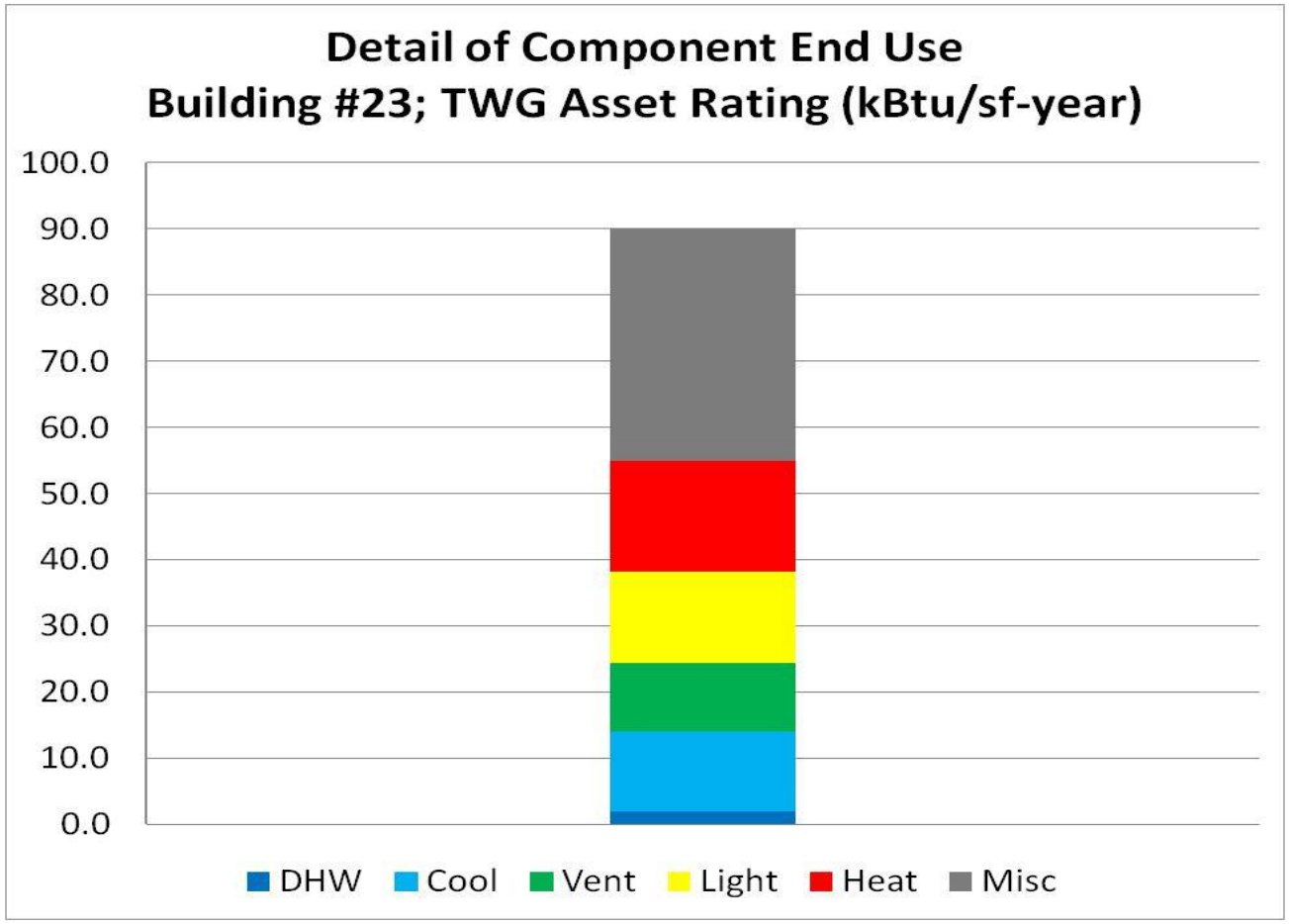
Actual EUI
Normalized for weather year

Actual EUI
Normalized for operations

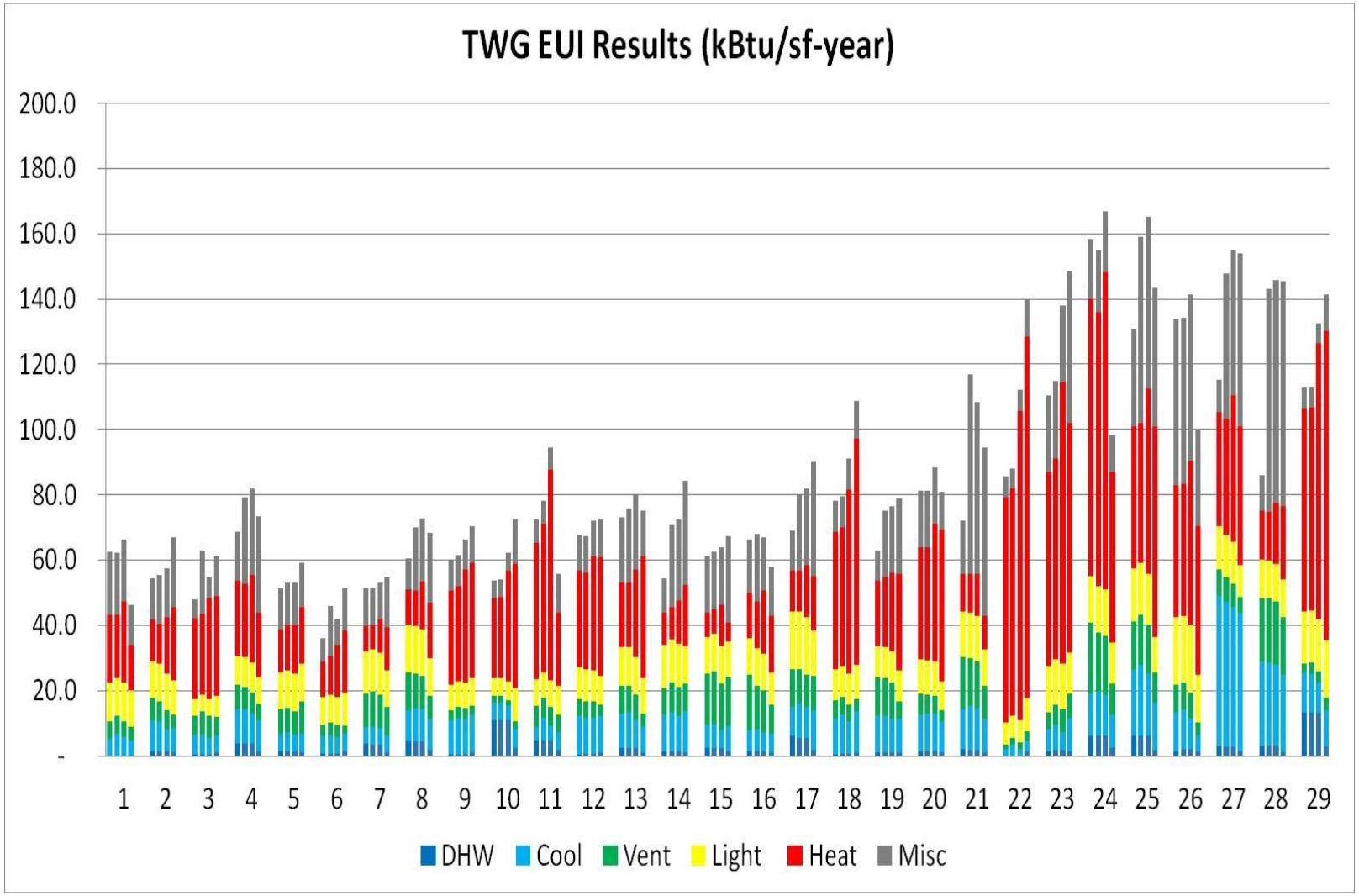
Remove:
Vagaries of users

Output: Normalized EUI

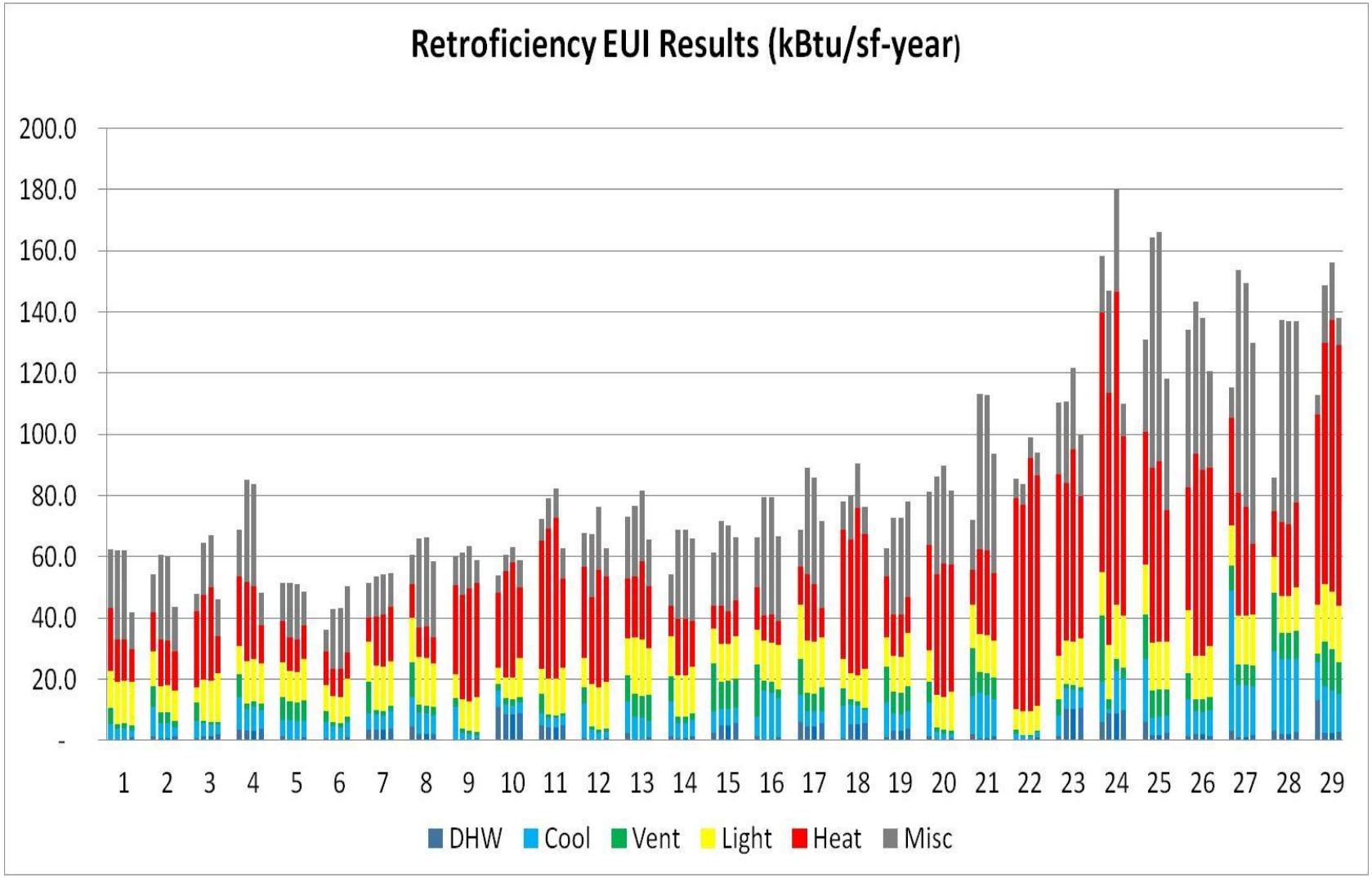
End Uses


Detail of Component End Use
Building #23; TWG Asset Rating (kBtu/sf-year)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
DHW
Cool
Vent
Light
Heat
Misc

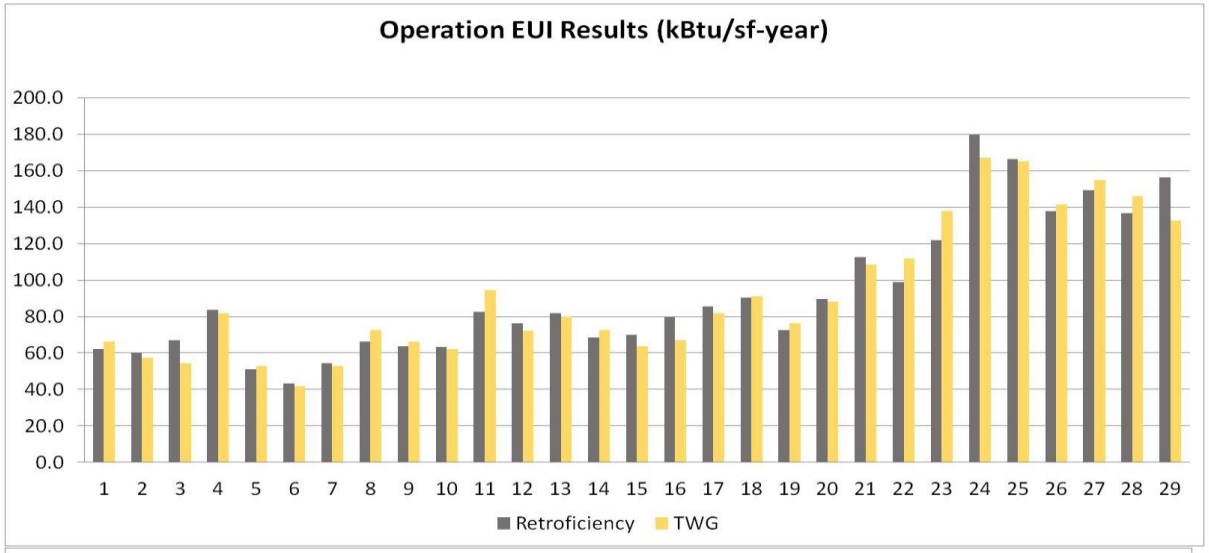
Results – The Weidt Group

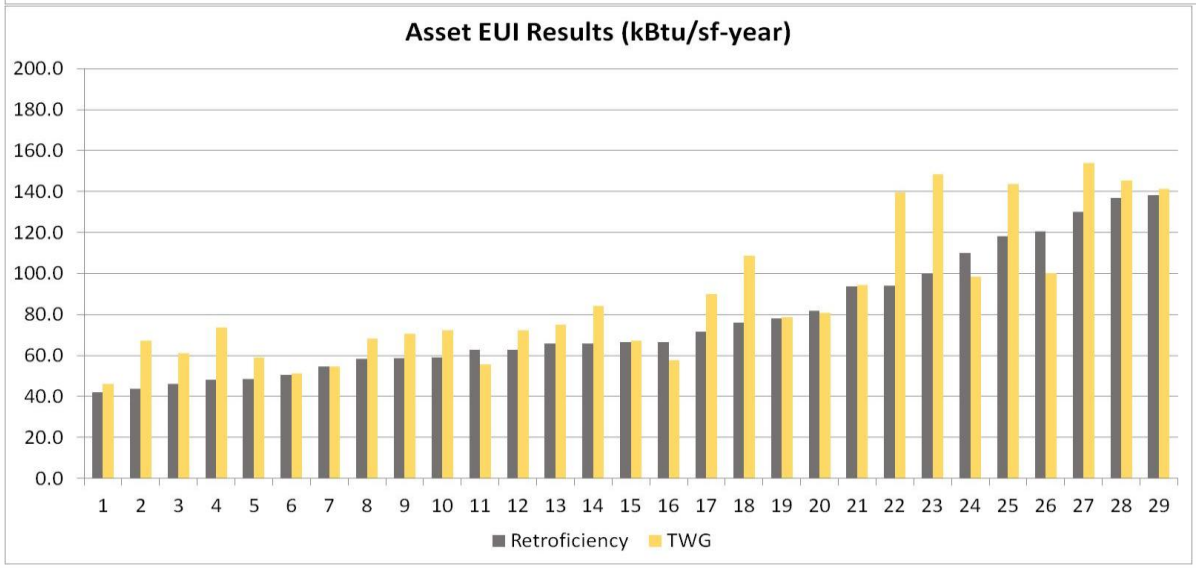


Results – Retroficiency

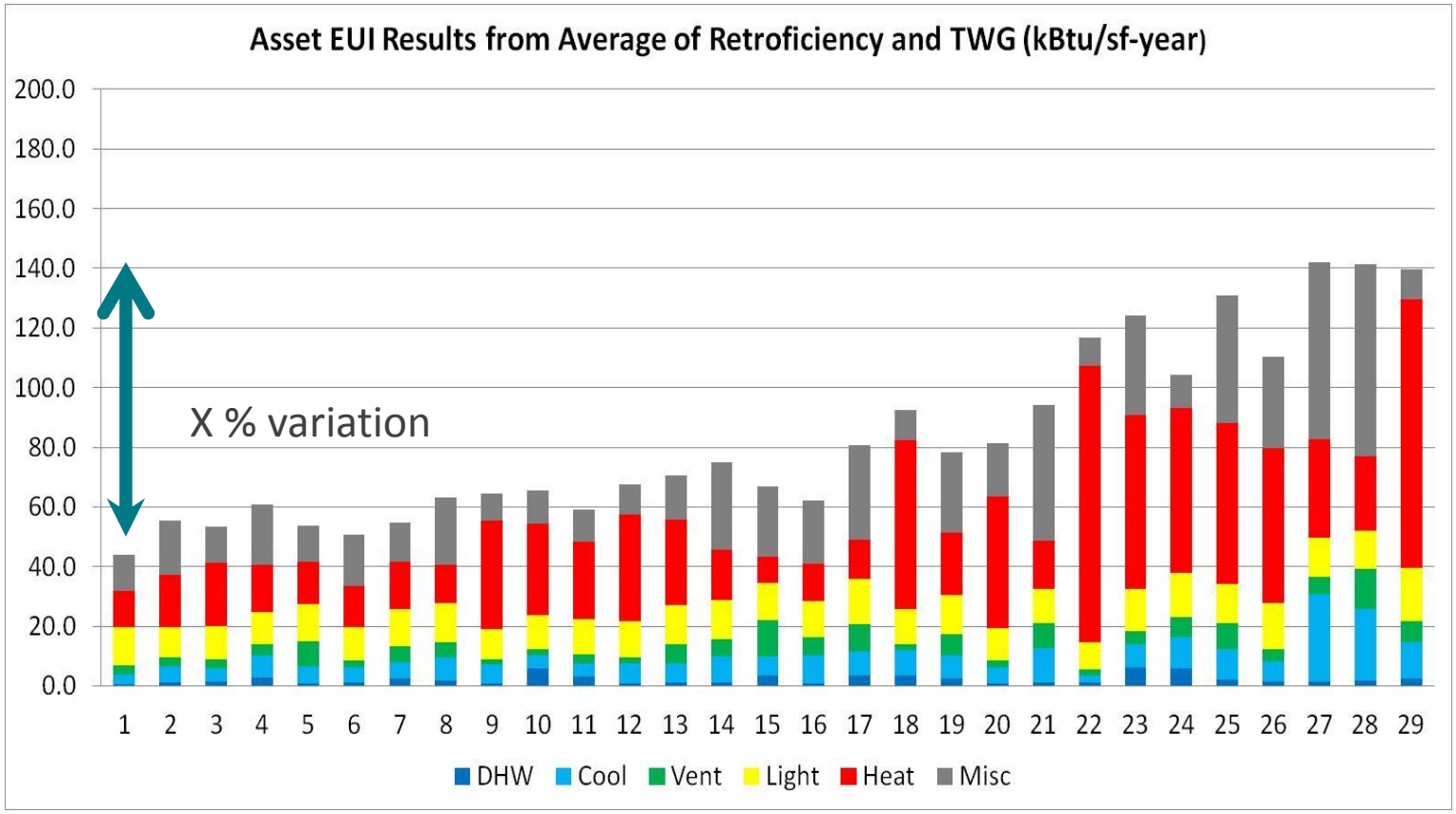


How did they compare?

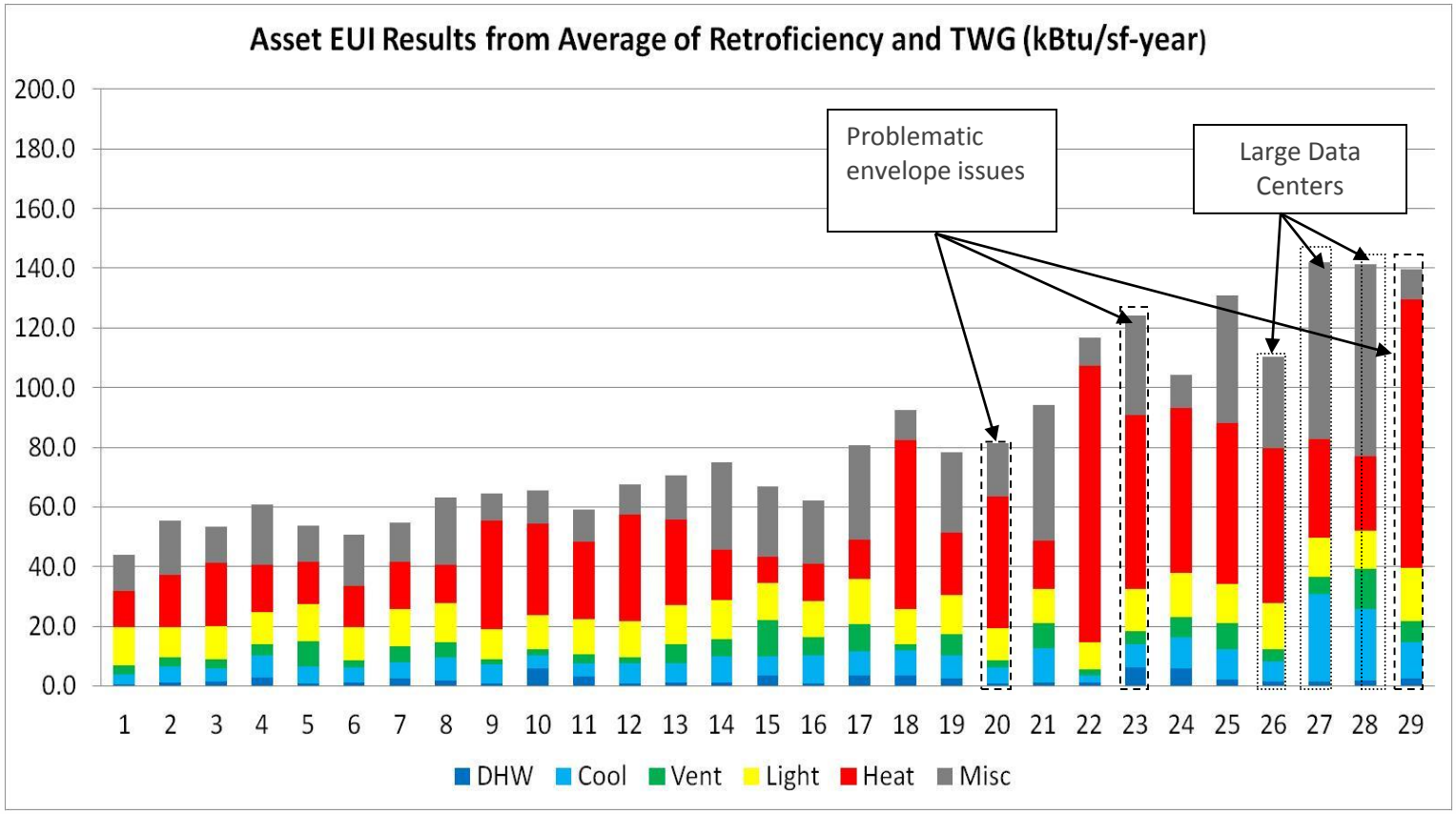




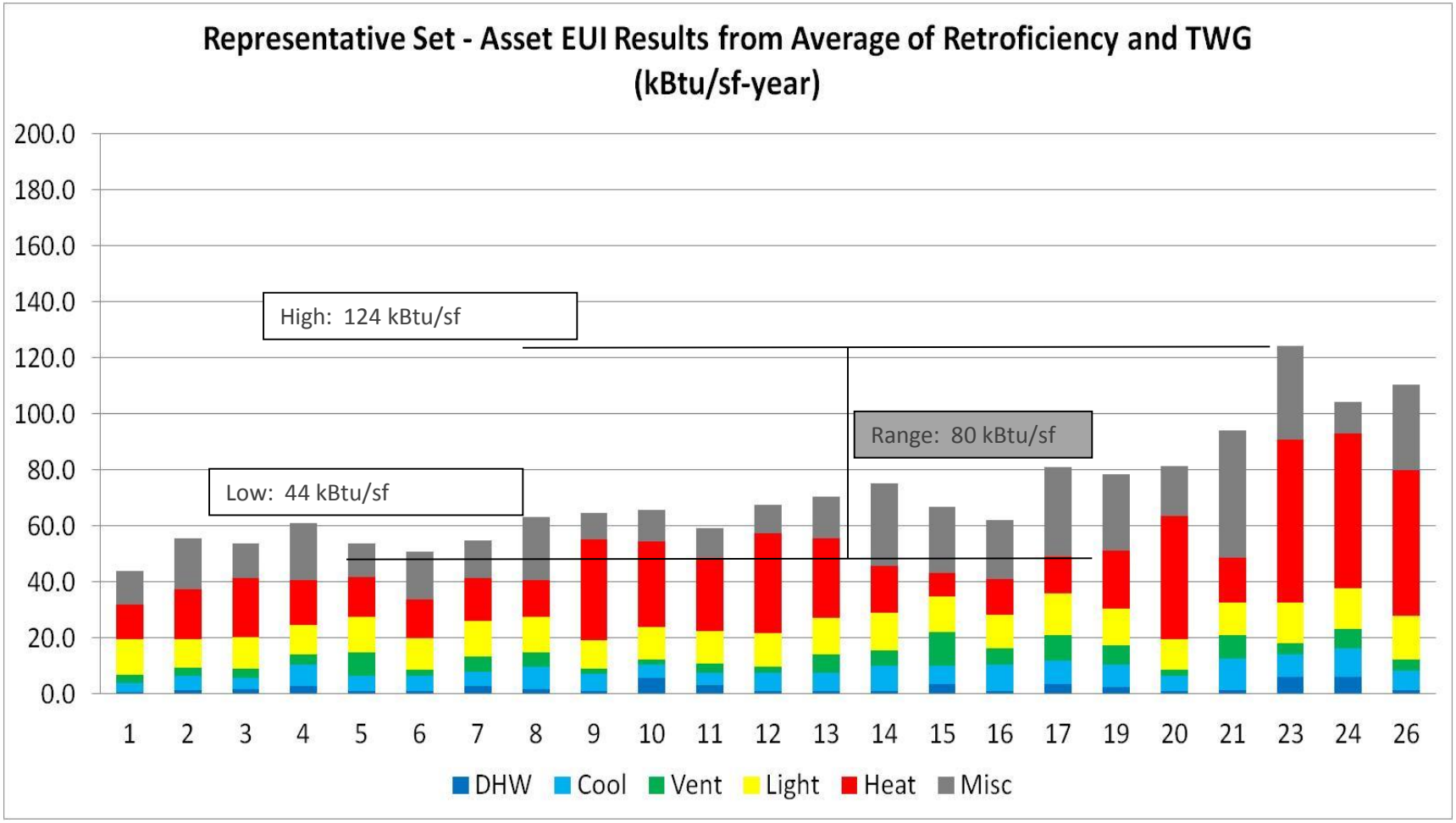
What can we learn from large variation



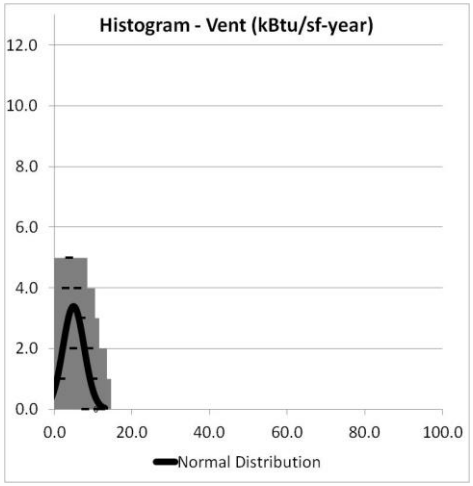
Referring to on site audits

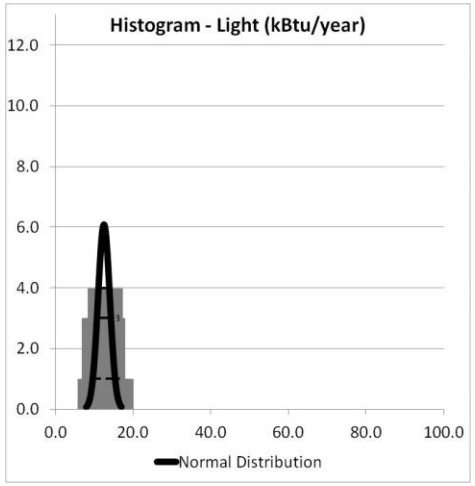


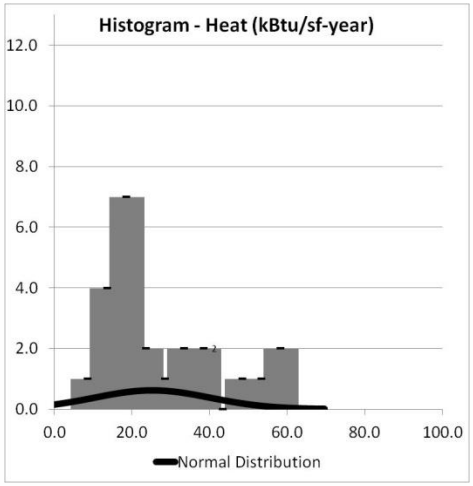
Still large variation remains

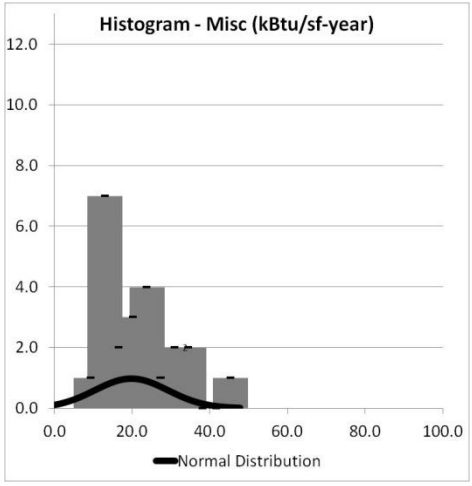


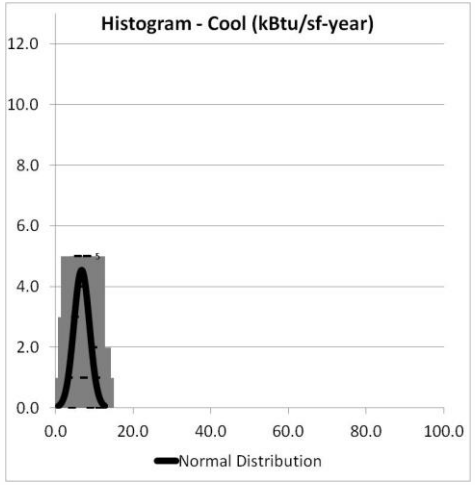
End uses reveal the variation

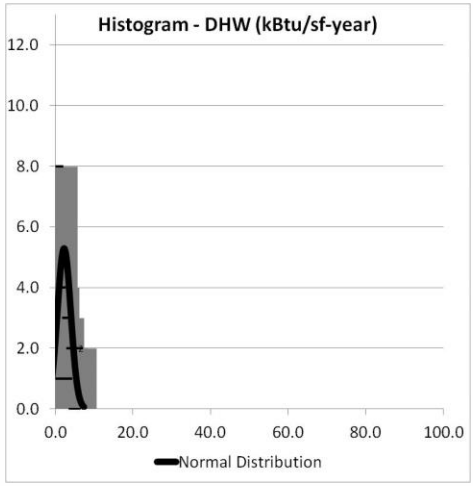




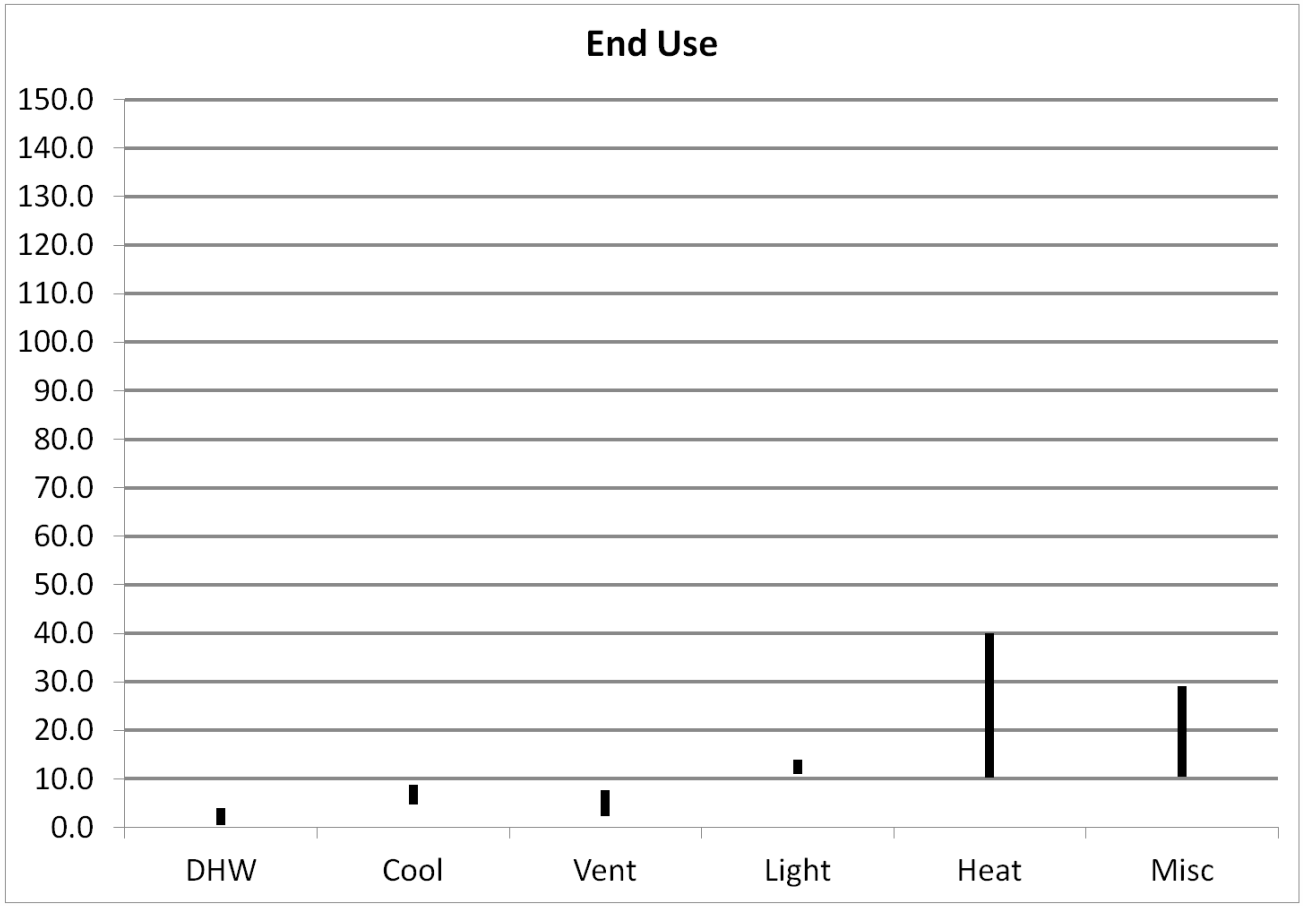


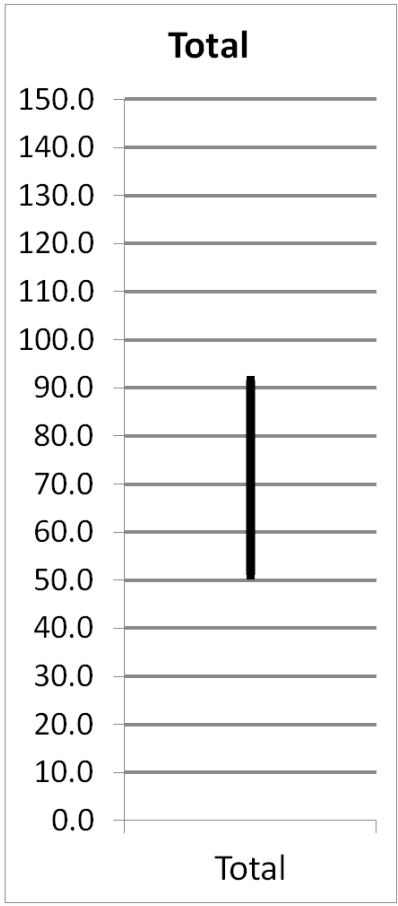




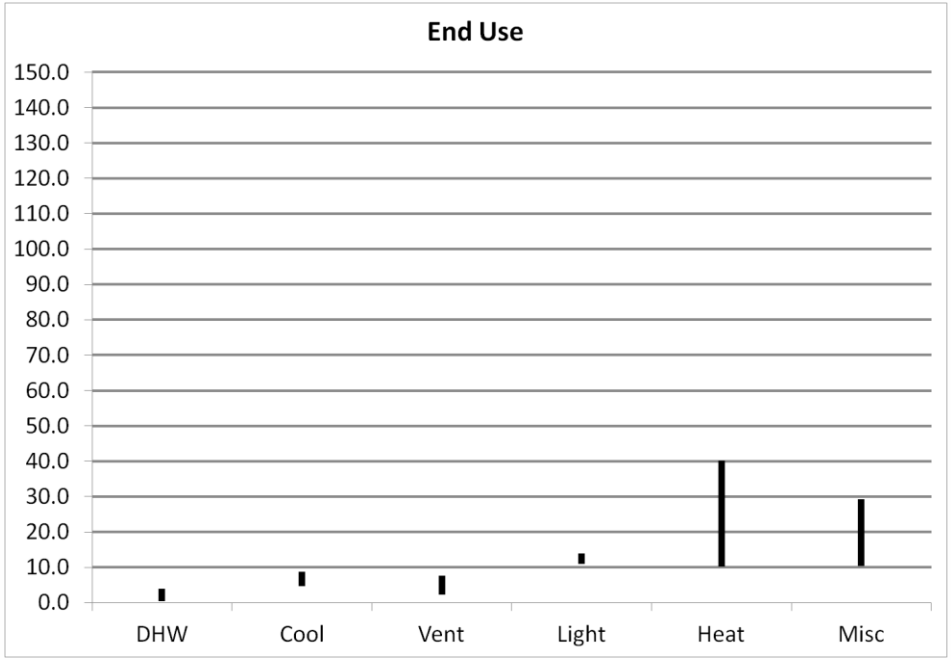


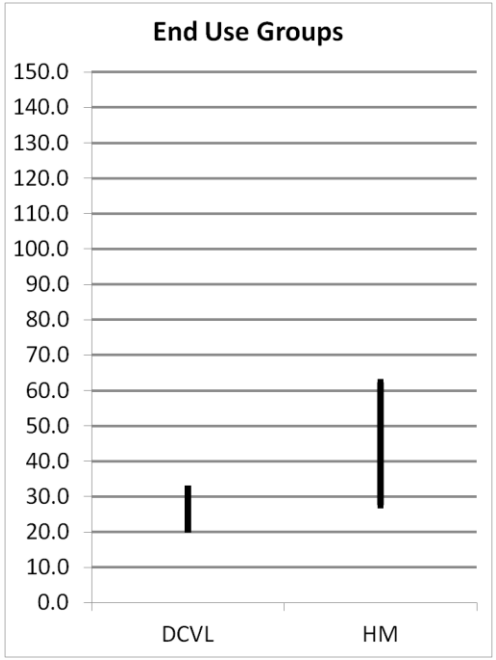
Projecting +/- 1 standard deviation

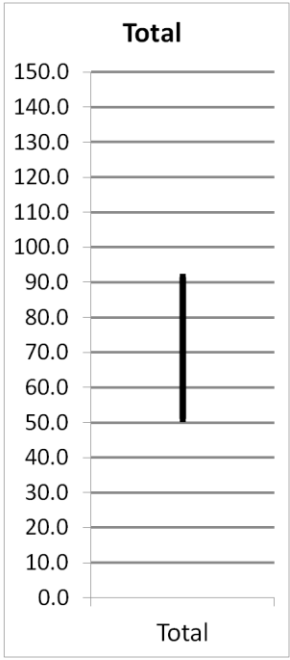


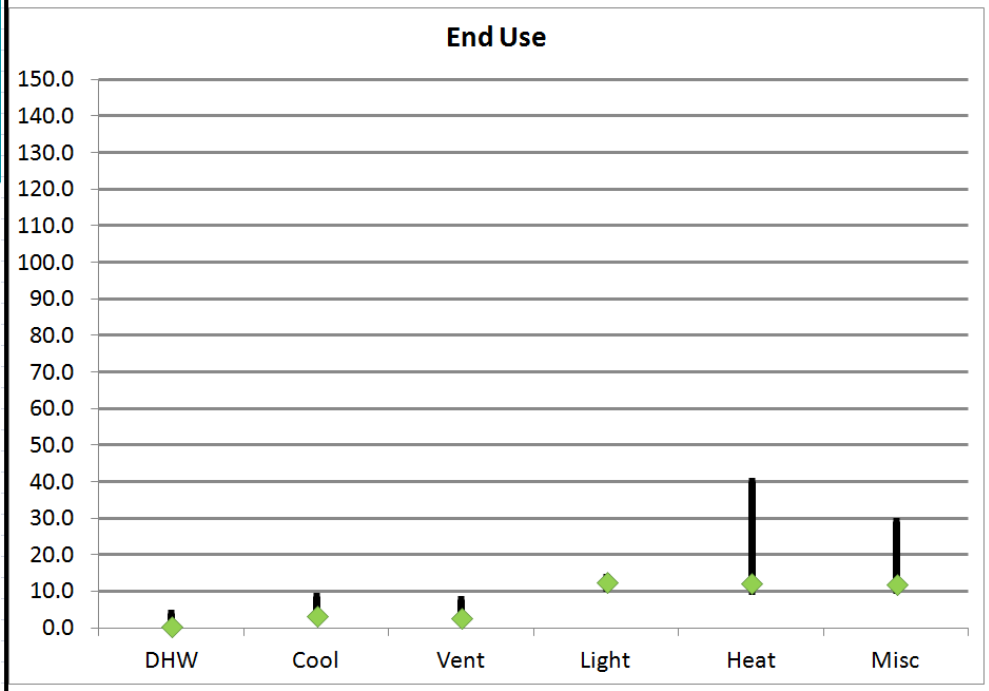


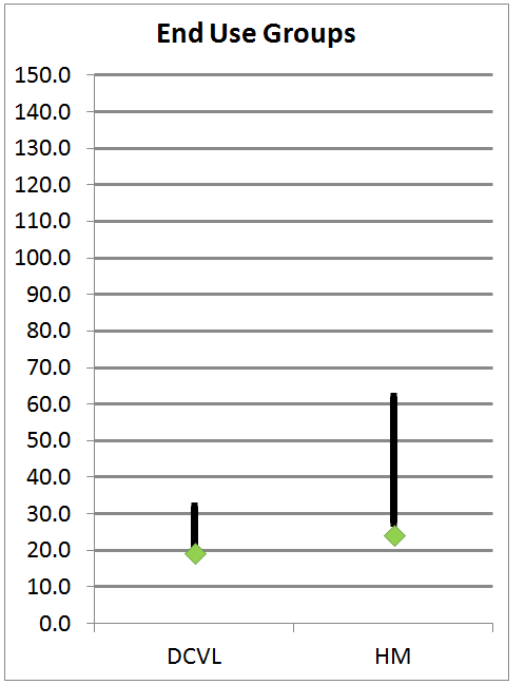
End Use Groupings can be Added

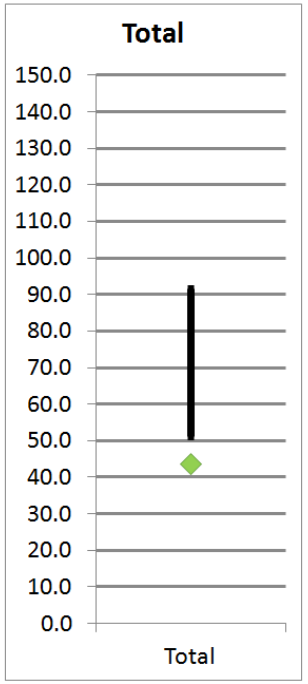


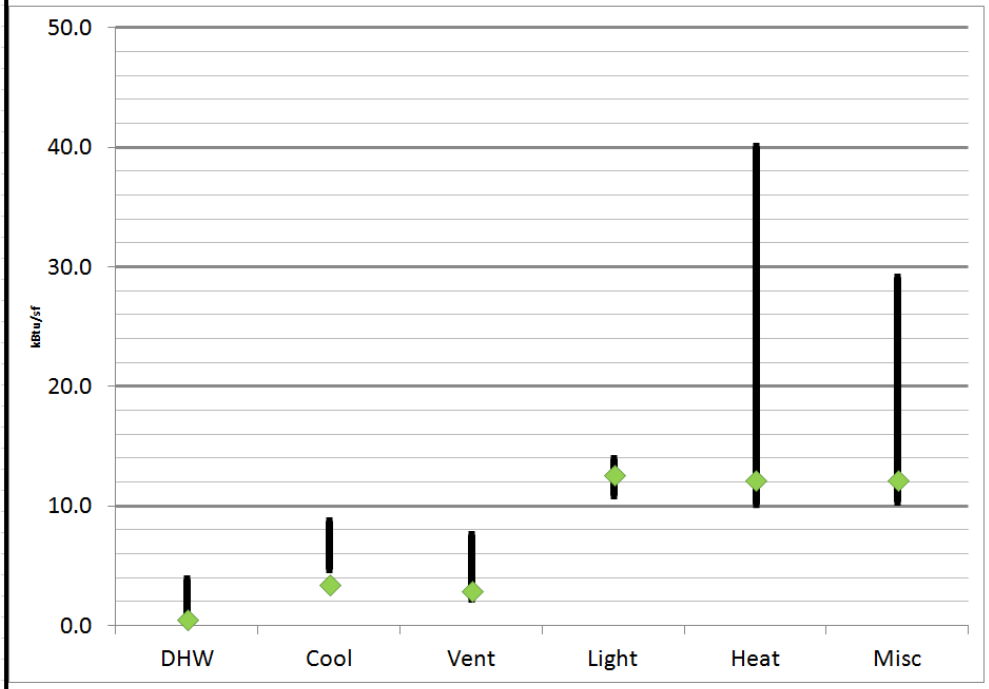












Building 1

Top of bar is one standard of deviation above average

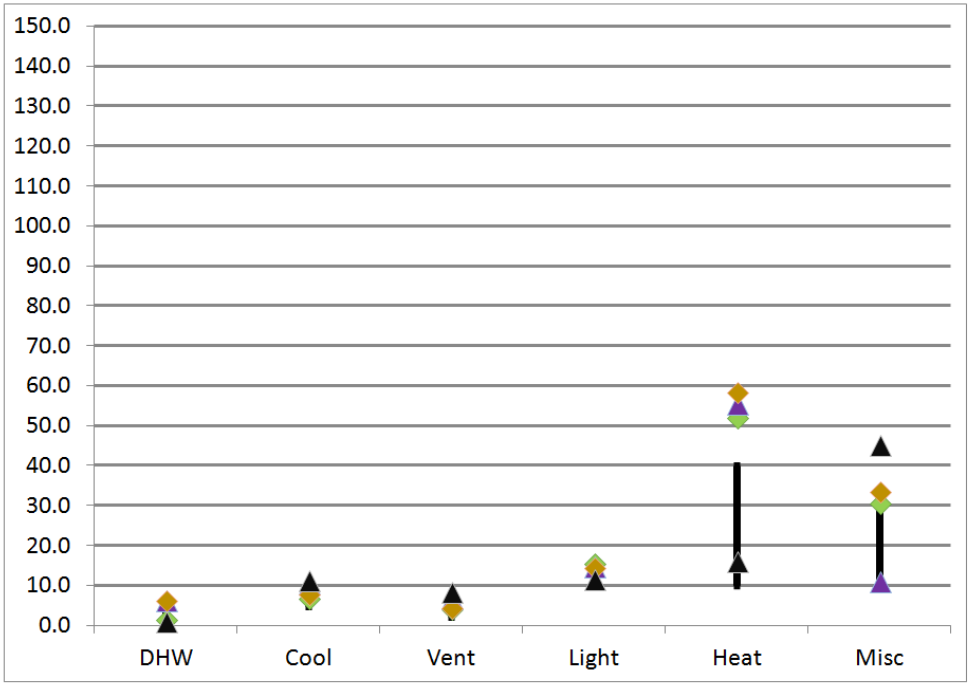
Middle of bar is set at average

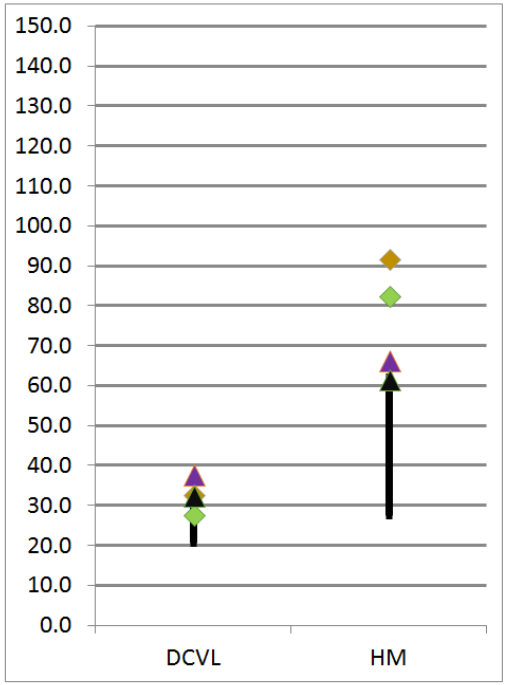
Bottom of bar is one standard of deviation below average

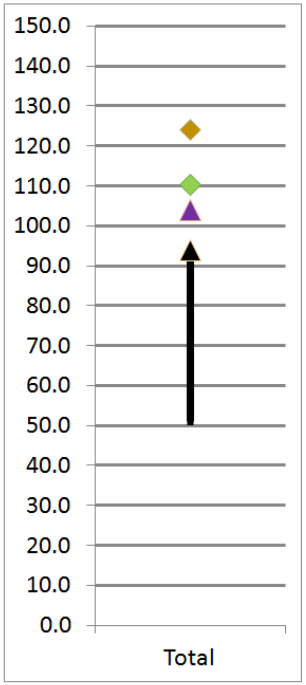
Symbol Legend

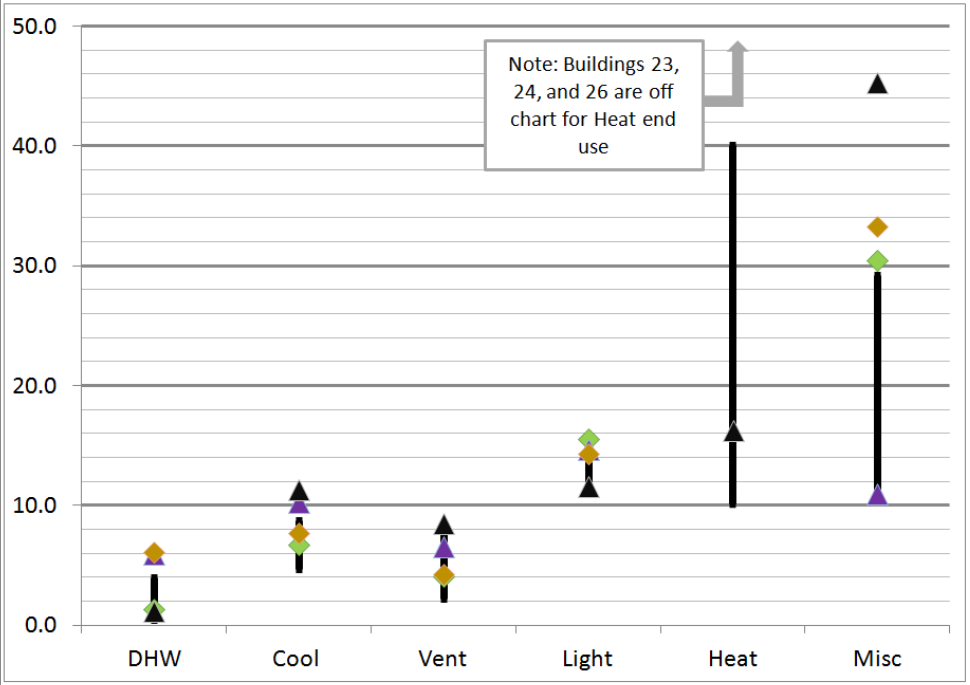
Bar Legend

End Use Map
(kBtu/sf-year)









Building 21

Building 23

Building 24

Building 26

Top of bar is one standard of deviation above average

Middle of bar is set at average

Bottom of bar is one standard of deviation below average

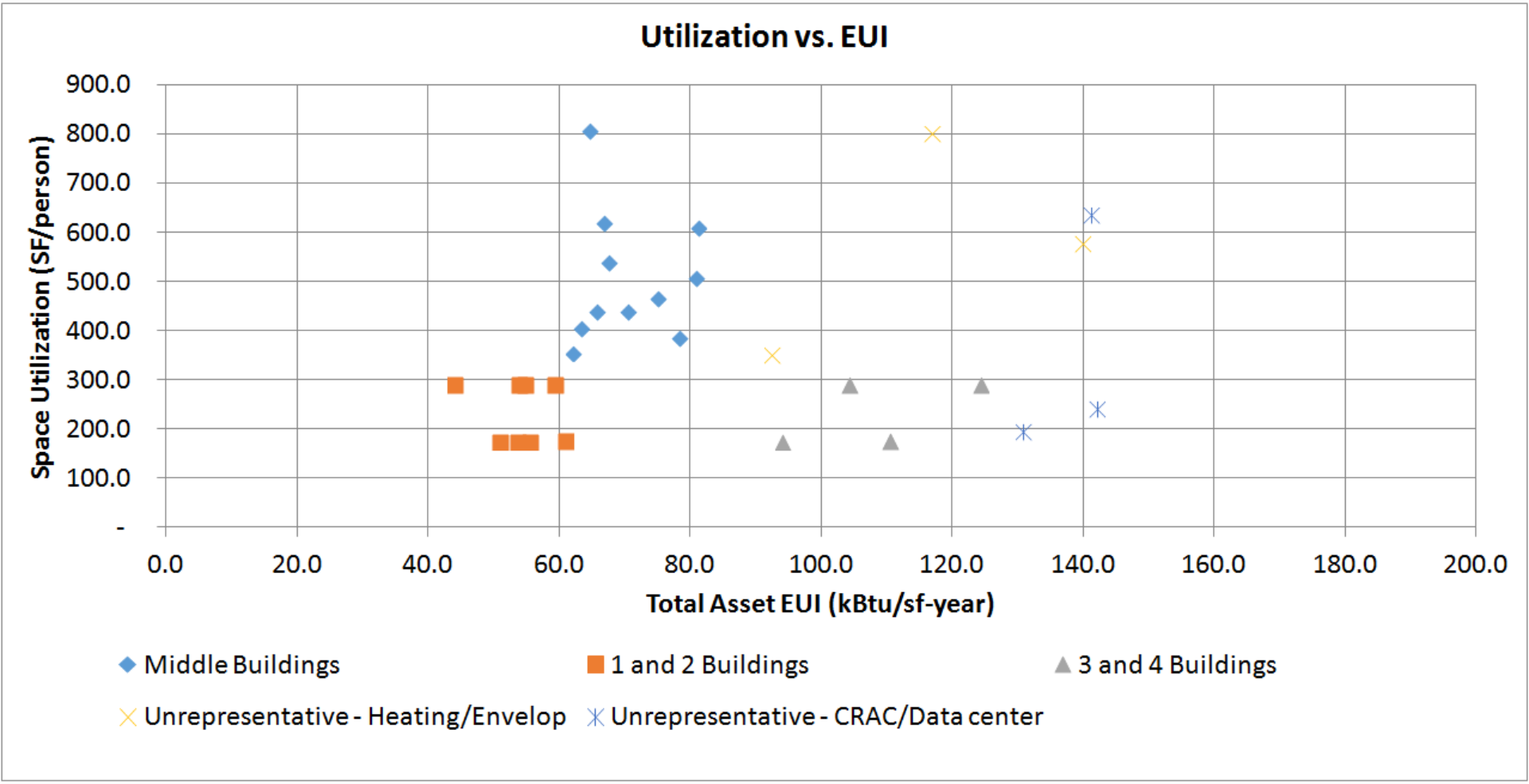
Symbol Legend

Bar Legend

End Use Map

(kBtu/sf-year)

Energy load vs Occupant load



MA Conclusions – Audits

Streamlined audits brought down costs while improving resolution

Protocols have come a long way

- Further refinements can be made
- Engineer doing on-site visit matters

Many buildings completed energy efficiency upgrades within a year of the audit

- Your third bullet
- Your fourth bullet

MA Conclusions – Building Data

End uses matter

- Heating and plug loads matter most

Models assume buildings work

- Some do, but many don't

Occupancy doesn't determine energy use

- HVAC + controls & envelope maybe do

Polling Question 4

- Do you anticipate incorporating building asset rating into your work?
  - Yes, I will start (or continue)
  - Maybe, now that I know about them
  - No, still not interested

Conclusions and Audience Questions

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