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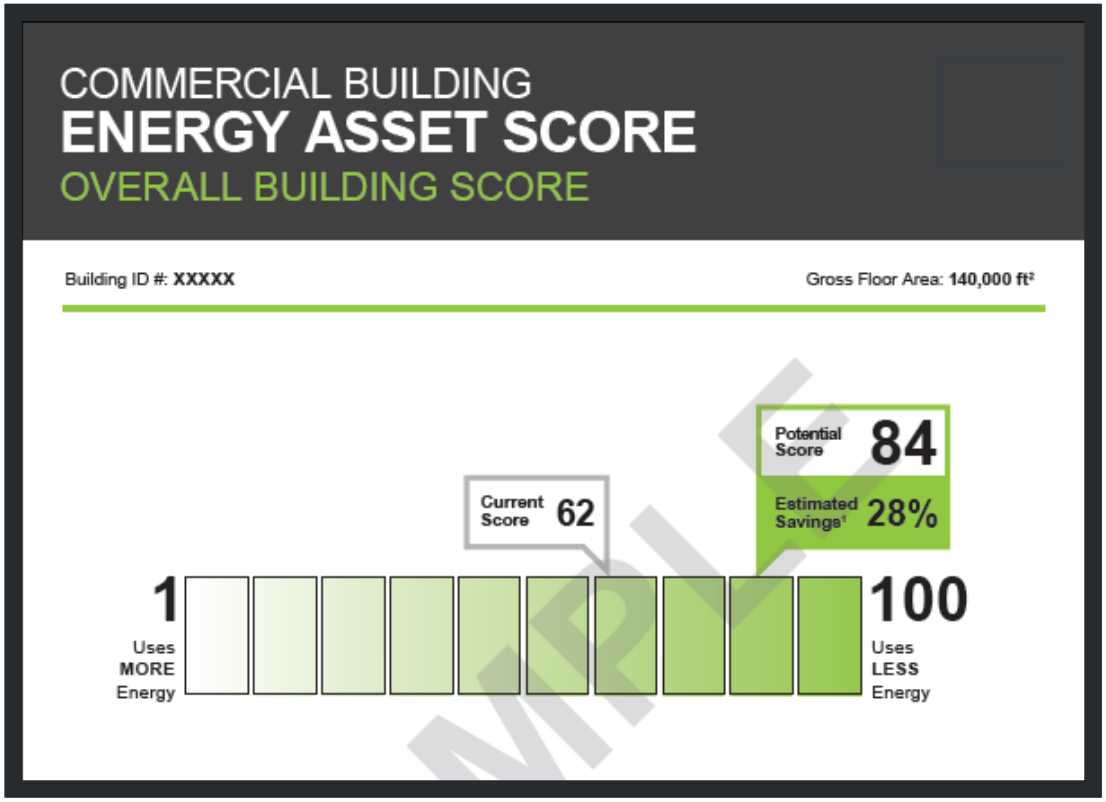

Commercial Building Energy Asset Score: Pilot Findings & Program Update

April 16, 2014

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Today's Agenda

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1) Asset Score Overview
2) Asset Score 2013 Pilot Summary
3) Pilot Participant Feedback
4) Next Steps

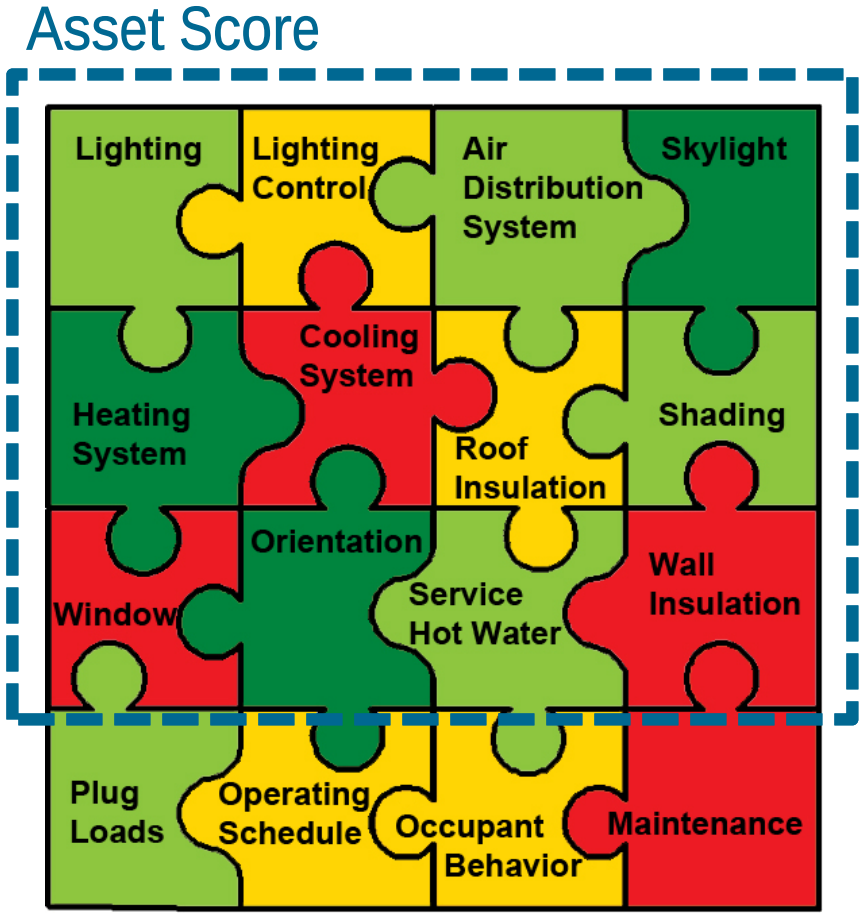
1) Asset Score Overview

Purpose

- **Develop national energy asset ratings to:**
  - Encourage investment in energy efficiency
  - Inform real estate transactions by allowing “apples to apples” comparisons
  - Reduce energy use in commercial and residential buildings.
- **Commercial Building Energy Asset Score (AS)**
  - Highlight a building’s as-built efficiency and its potential efficiency
  - Differentiate installed system efficiency from O&M issues and occupant behavior
  - Identify short-term and long-term capital investment needs

Commercial Building Energy Asset Score

- Asset Score reflects the as-built physical characteristics of a building and its overall energy efficiency, independent of occupancy and operational choices.
- The physical characteristics include
  - Building envelope (window, wall, roof)
  - HVAC system (heating, cooling, air distribution)
  - Lighting system (luminaire and lighting control systems)
  - Service hot water system
  - Other major energy-using equipment (e.g. commercial refrigerator, commercial kitchen appliances, etc.)



Building energy use is affected by many factors.

Relevance of Asset Score

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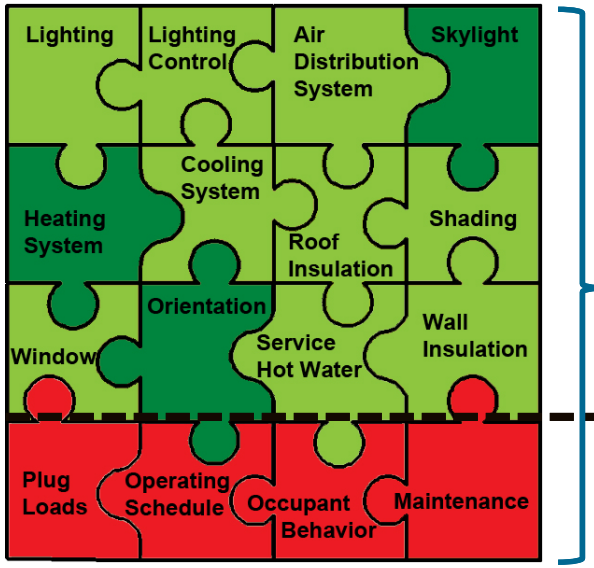
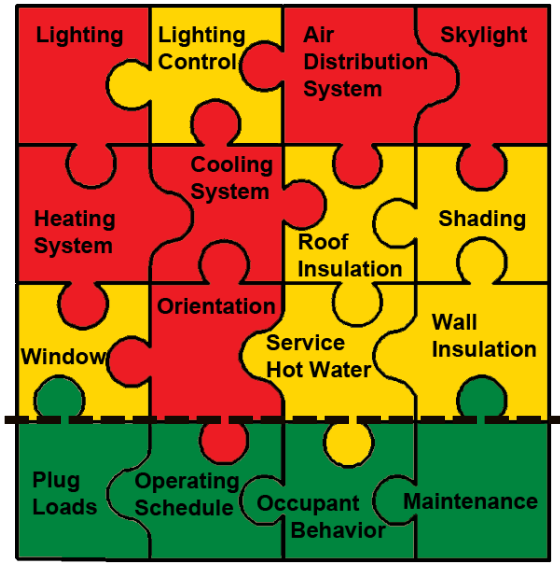
- Buildings #1 and #2 have similar ENERGY STAR scores, but widely divergent asset scores.
- Used together, an energy asset score and an energy benchmark can inform the decisions of a building owner, operator, buyer, or lessee.

Building #1: High Asset Score



Equivalent ENERGY STAR Portfolio Manager Score

Building #2: Low Asset Score



Energy Assets

O&M/ Occupant Behavior

- **Good energy assets**
- **Poor operation**
- **May be a candidate for low-cost operational improvements.**

- **Poor energy assets**
- **Good operation**
- **Low asset score may highlight need to replace outdated equipment or prepare for replacement costs in the near future.**

Why Use the Asset Score?

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- Consistent scoring method across U.S.
  - Flexibility to customize information to meet local needs
- Free, well-documented, non-proprietary software tool
  - Can be easily integrated with other tools thru APIs
  - Provides additional information beyond score (recommendations, EUI analysis)
  - Backed up by significant research
- Committed to continuous improvement
  - Ongoing analysis
- Easy to understand information
  - Can be tailored to variety of audiences (e.g., current owners/operators, buyers, appraisers, others)
- Benefits in the upcoming years
  - Infrastructure may be put into place for “validated” score
    - Training, testing of assessors, quality assurance requirements
  - Expanded level of customization in future iterations of the tool

Assess End Uses for Asset Score Report (Current Thinking)

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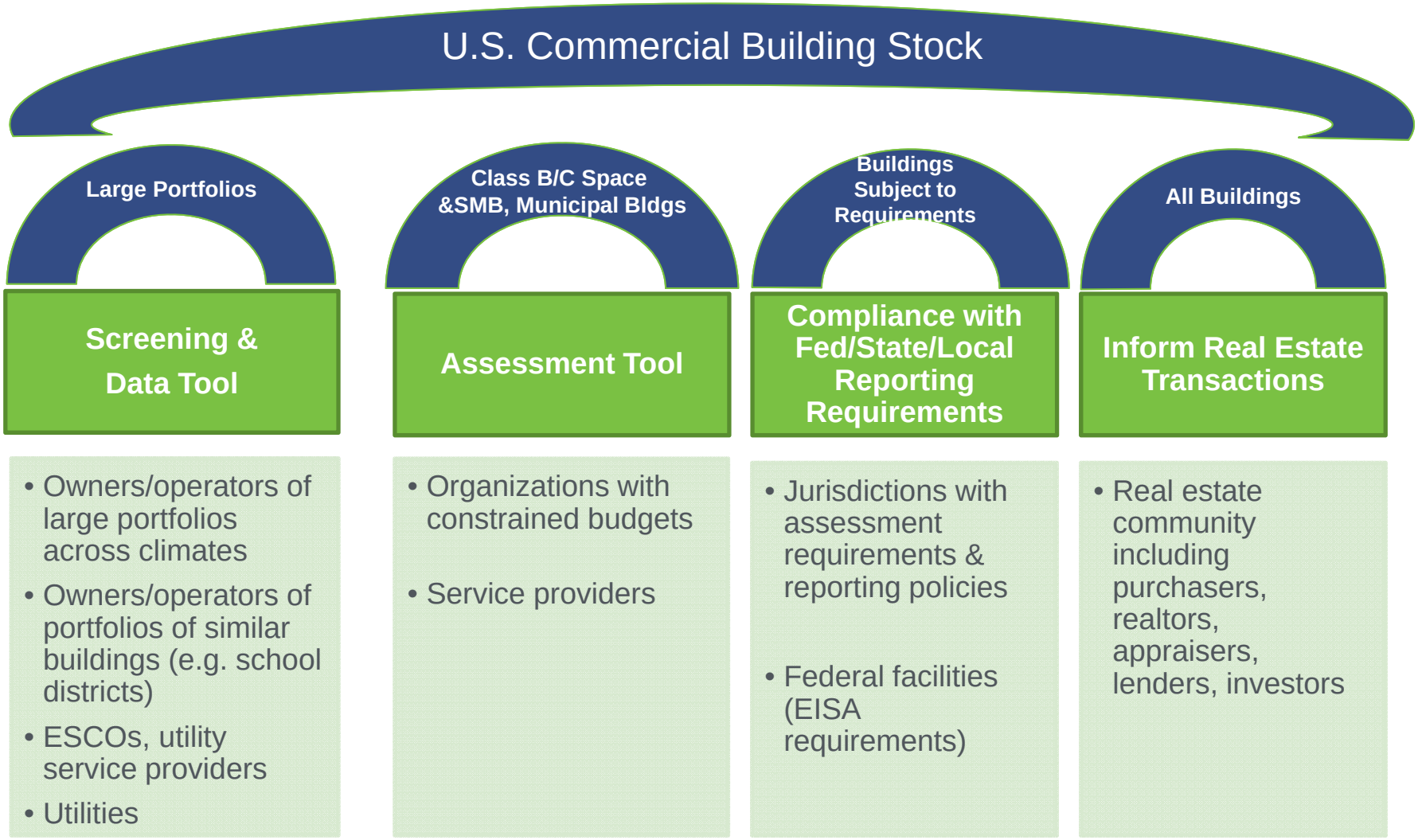

Asset Scoring Tool

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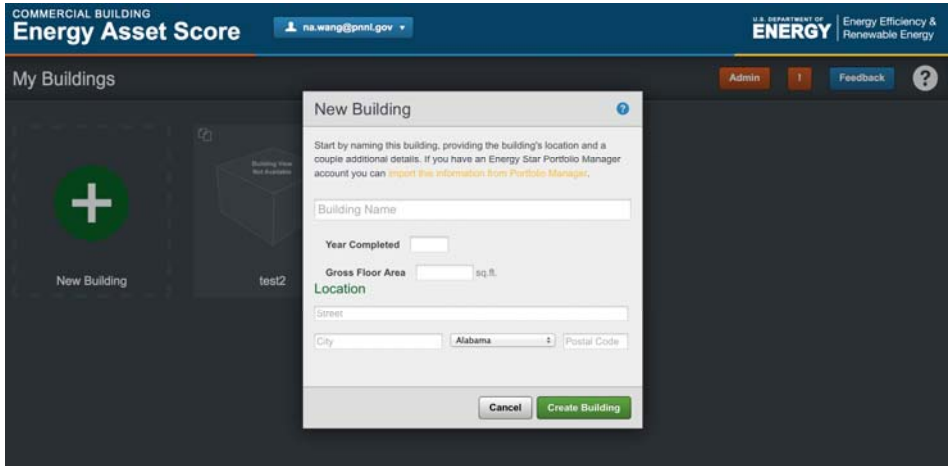
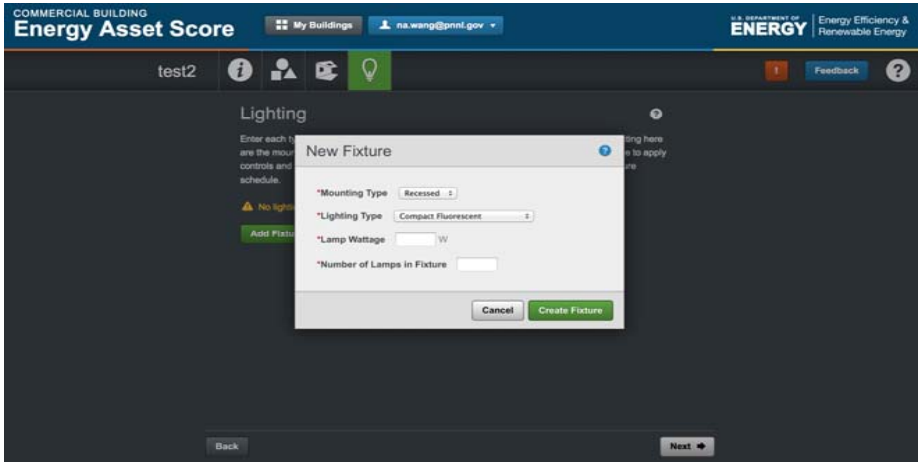
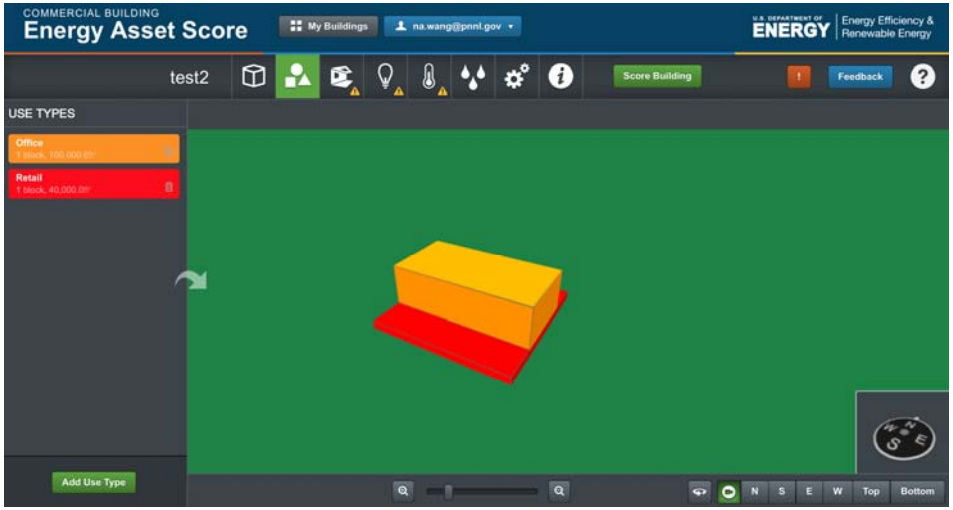


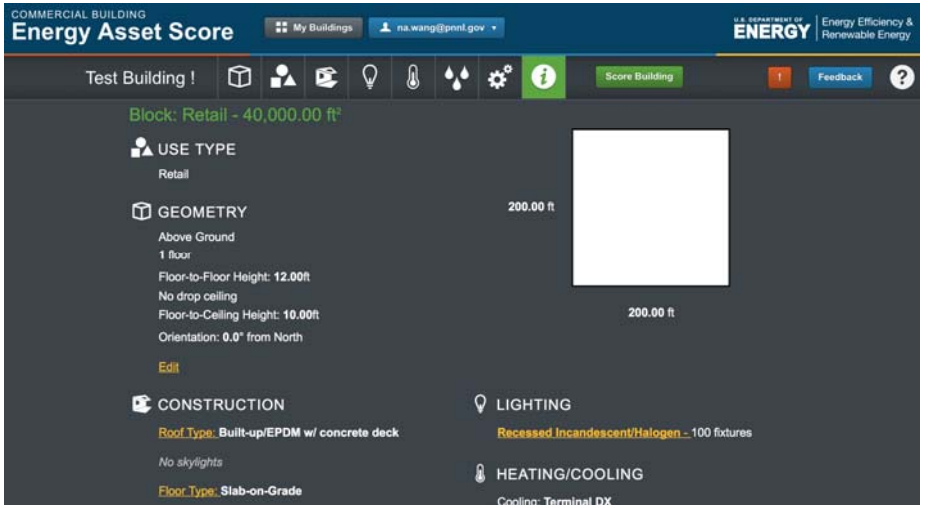
1. Create a new building and enter basic building information



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

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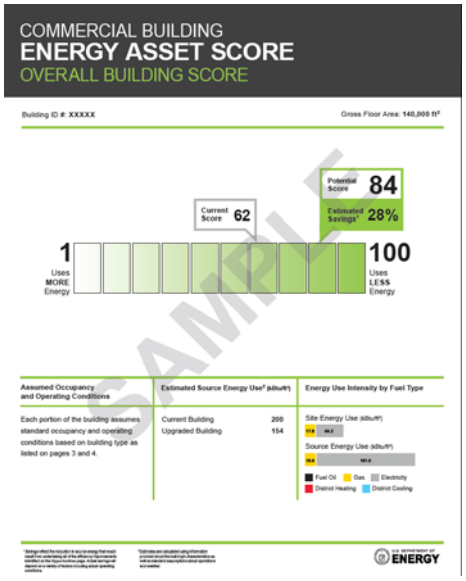
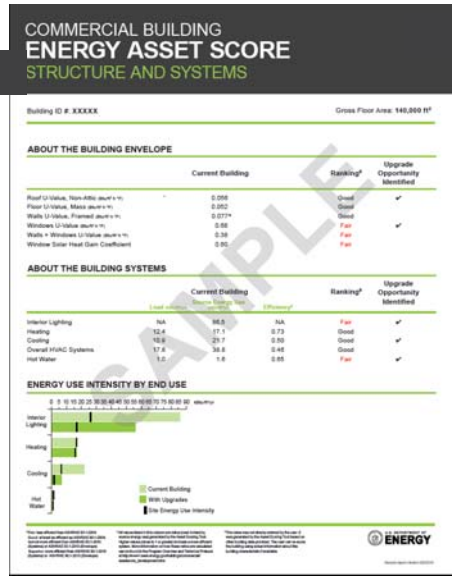
Four sections

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

Additional Guides Available

- Report Guide: Understanding Your Score
- Building Upgrade Guide: Next Steps for Improving Your Building





Asset Score

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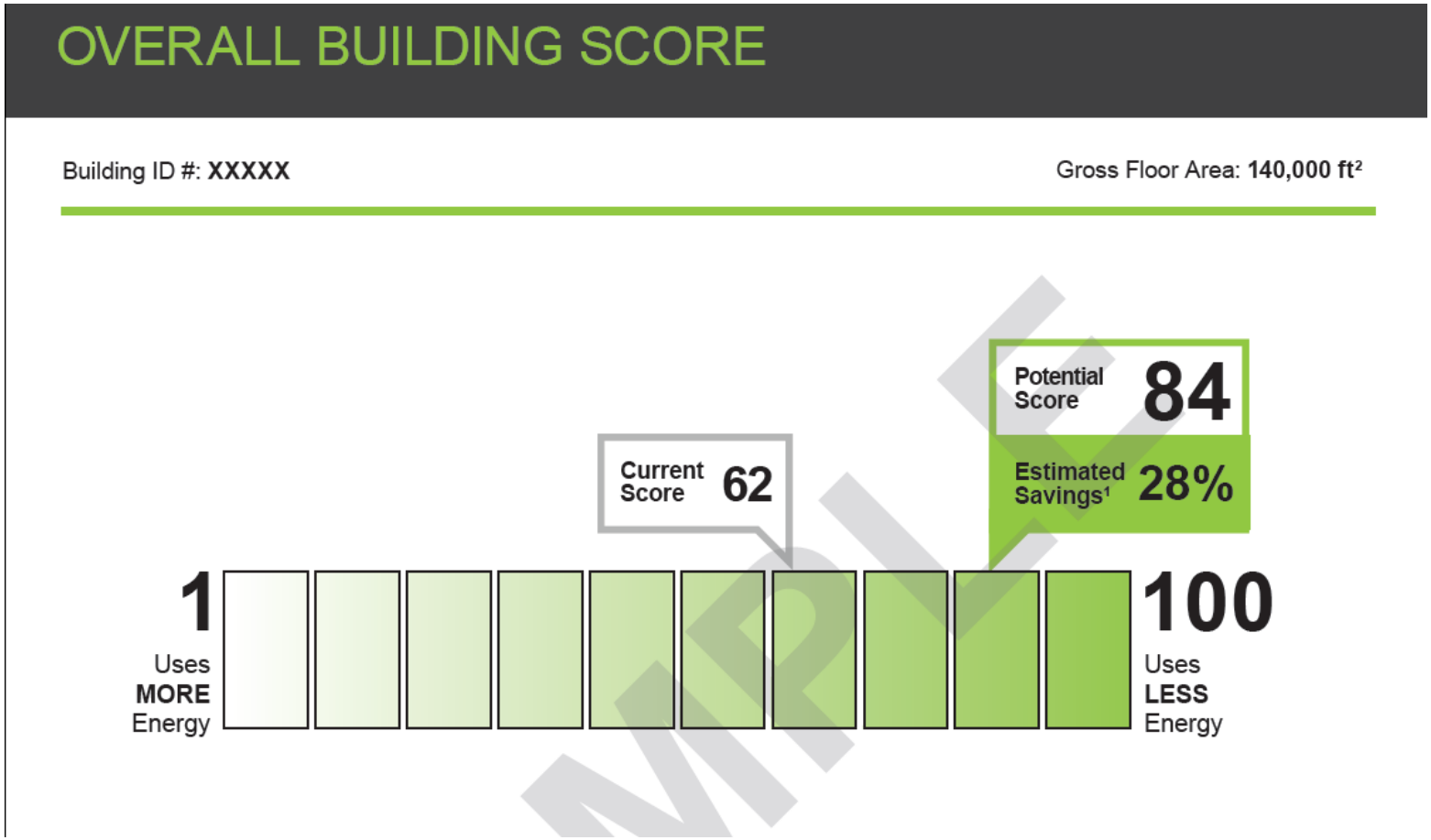
- Provides current score
- Provides potential score and estimated savings
- Weather normalized



Upgrade Opportunities

- Informs building owners of most cost-effective efficiency opportunities
- Applies life-cycle-cost analysis
- Estimates are given for potential energy savings and payback time
- Can help owners prioritize capital improvements across a portfolio of buildings

COST EFFECTIVE UPGRADE OPPORTUNITIES

	Energy Savings[7]	Simple Pay Back
Building Envelope		
• Add roof insulation in Office and Retail	5 - 10%	15 - 25 yrs
• Upgrade windows in Office with high performance double pane windows	5 - 10%	10 - 15 yrs
Interior Lighting		
• Upgrade incandescent lighting in Office and Retail to compact fluorescent lighting	10 - 15%	1.5 - 5 yrs
HVAC Systems		
• Upgrade cooling system in Office and Retail with high efficiency electric DX	10 -15%	5 - 10 yrs
Hot Water Systems		
• Upgrade service hot water system in Office and Retail with improved system efficiency	0 - 5%	< 1.5 yrs

System Evaluation

- Ranks building envelope, HVAC, lighting, and service hot water systems
- Indicates system performance and whether upgrades are recommended

ABOUT THE BUILDING ENVELOPE

	Current Building	Ranking[8]	Upgrade Opportunity Identified
Roof U-Value, Non-Attic (Btu/ft² h °F)	0.056	Good	✔
Floor U-Value, Mass (Btu/ft² h °F)	0.052	Good	
Walls U-Value, Framed (Btu/ft² h °F)	0.077*	Good	
Windows U-Value (Btu/ft² h °F)	0.68	Fair	✔
Walls + Windows U-Value (Btu/ft² h °F)	0.38	Fair	
Window Solar Heat Gain Coefficient	0.60	Fair	

ABOUT THE BUILDING SYSTEMS

	Current Building			Ranking[8]	Upgrade Opportunity Identified
	Load (kBtu/ft²/yr)	Source Energy Use (kBtu/ft²/yr)	Efficiency[9]		
Interior Lighting	NA	86.5	NA	Fair	✔
Heating	12.4	17.1	0.73	Good	
Cooling	10.9	21.7	0.50	Good	✔
Overall HVAC Systems	17.8	38.8	0.46	Good	
Hot Water	1.0	1.6	0.65	Fair	✔

End Use Energy Break-down

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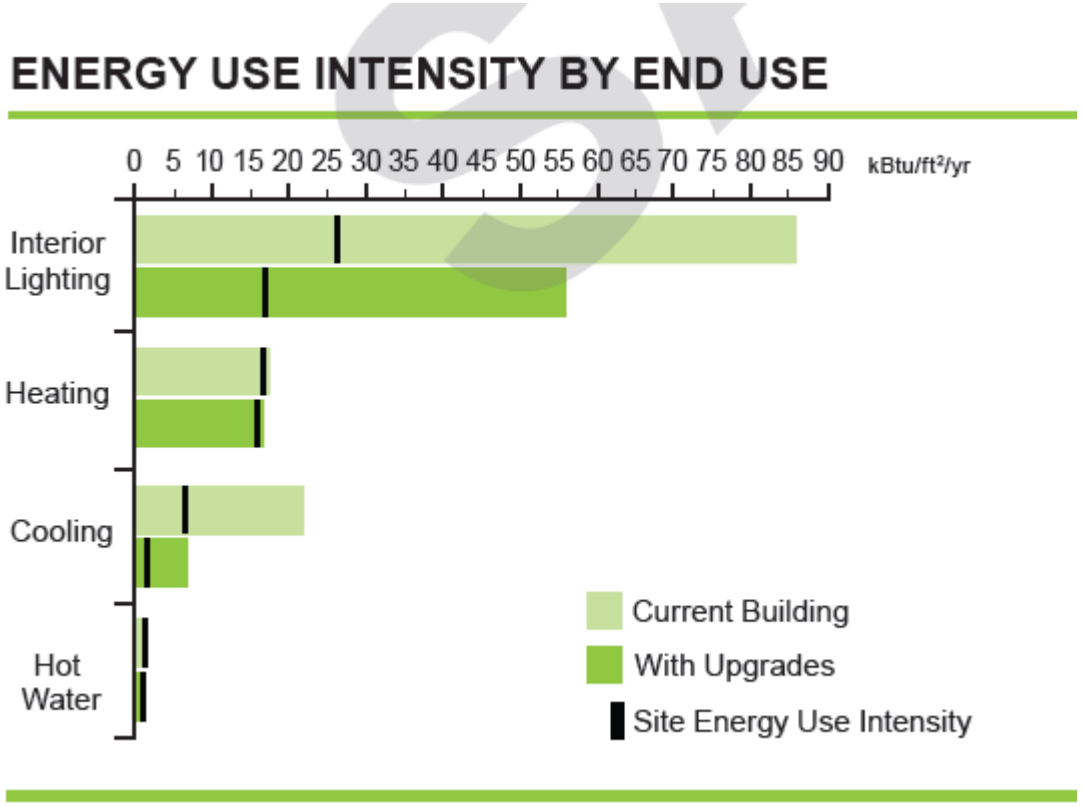
- Can help owners/operators
  - Plan for capital needs across a portfolio of buildings
  - Prioritize improvements within and among buildings



Building Assets

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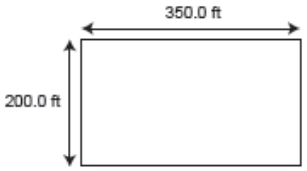
BUILDING SYSTEM CHARACTERISTICS SUMMARY

Geometry



Above Ground:	2 floor
Below Ground:	0 floor
Floor-to-Floor Height	
• Floor 1:	14 ft
• Floor 2:	10 ft
Drop Ceiling Installed:	No
Floor-to-Ceiling Height:	9 ft
Orientation:	0.0° from North

	Current Building
Roof	
Roof Type:	Built-up/EPDM w/metal deck
Roof U-Value:	U-0.056
Wall	
Exterior Wall Type:	Mass Wall–8" HW Concrete
Wall U-Value:	U-0.077*
Floor	
Ground Coupling:	Slab
Carpet Installed:	No

	Current Building
Windows	
Window Frame Type:	Metal
Glass Type:	Single pane
Gas Fill Type:	None
Operable Windows:	No
Window Layout:	Discrete
Window to Wall Ratio:	0.4
Window U-Value:	U-0.68
Window SHGC:	0.6
Window VT:	0.7*
Shading	
Exterior Shading Type:	External overhang
Height Above Window:	0 ft
Projection:	2 ft
Skylight	
Skylights Installed:	No
Indoor Lighting	
Lighting Type:	Incandescent
Mounting Type:	Recessed
Percent of Total Floor Area Served:	100%
Occupancy Controls:	Yes
Daylighting Controls:	No
Lighting Power Density:	2 W/ft²*

Additional documentation and guides available on-line for users.

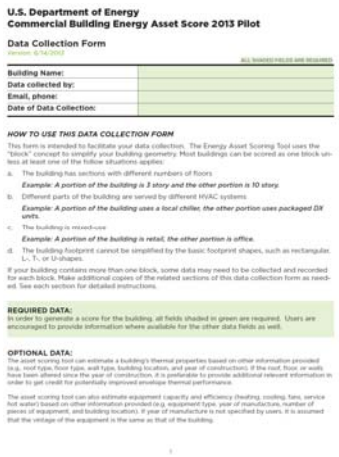
Supporting Documents For Users

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

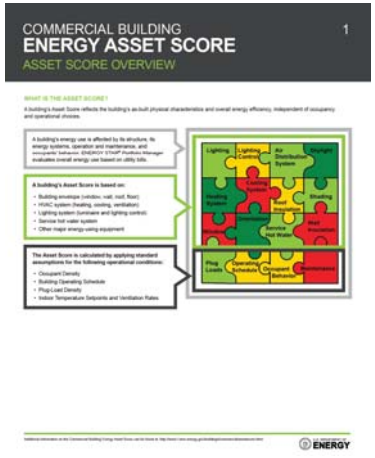
- Quick Start Guide
- Data Collection Form
- Priority Map
- Report Guide
- Building Upgrade Guide


U.S. Department of Energy
Commercial Building Energy Asset Score

Quick Start Guide


U.S. Department of Energy
Commercial Building Energy Asset Score 2013 Pilot

Data Collection Form


COMMERCIAL BUILDING
ENERGY ASSET SCORE
ASSET SCORE OVERVIEW


Commercial Building Energy Asset Score:
Building Upgrade Guide

GLOSSARY

2) Pilot Summary

Pilot Summary

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- 2012 and 2013 Pilots included over 200 buildings
  - Tested the technical value of the Asset Score
  - Collected feedback
- This presentation includes analysis of 191 buildings (completed by March 1, 2014).
  - 150 from 2013 pilot, 41 from 2012 pilot
  - 24 million square feet of commercial floor area
- AS Recommendations identified –
  - 278 billion Btu site energy savings
  - 838 billion Btu source energy savings
  - 8.4 million dollar cost savings*
  - $0.41/sq.ft. cost savings*

*assuming $0.01/kBtu source energy

Questions of Interest

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- **Does the recommendation engine work?**
  - Were buildings able to substantially improve scores with retrofits?
  - What EEMs were given to the pilot buildings? How many?

- **Are the scales reasonable? Why or why not?**
  - Do buildings fall across the entire (or majority of) scale?
  - Do buildings in different climate zones score equitably?
  - Can buildings move up on the scales?

- **Other lessons?**
  - How can tool testing be improved to reduce number of bugs/failures at time of official launch?

Building Use Type and Size

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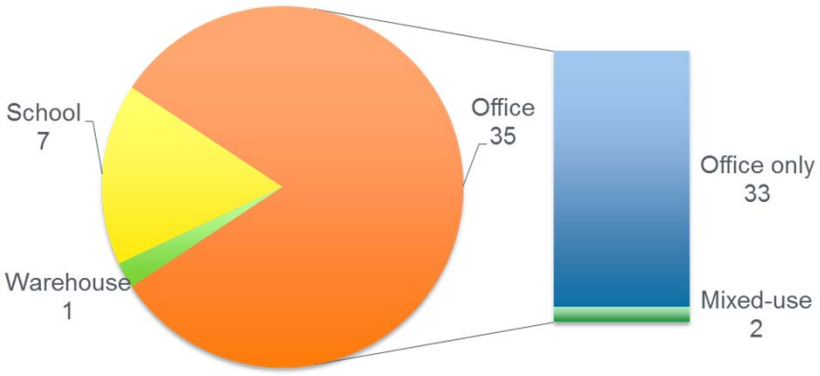
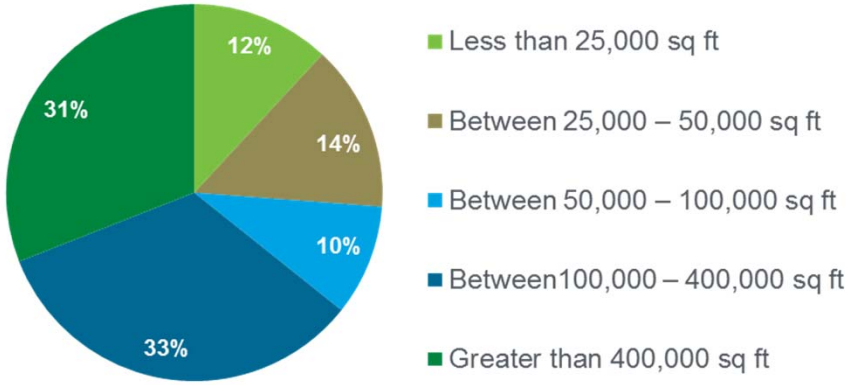
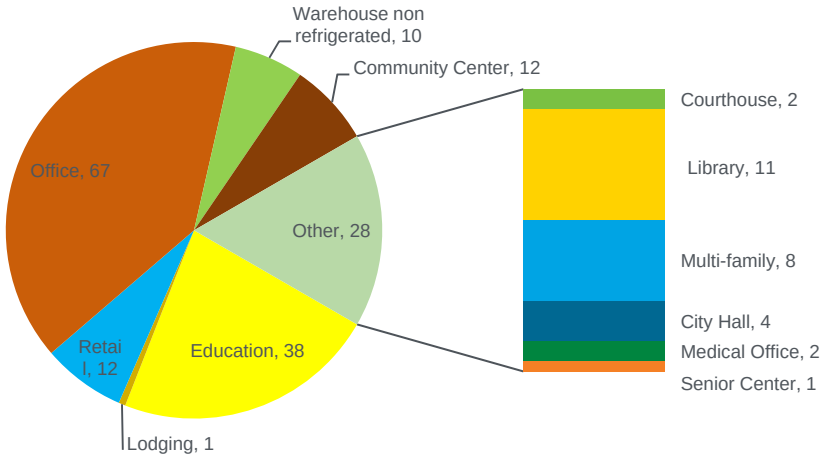
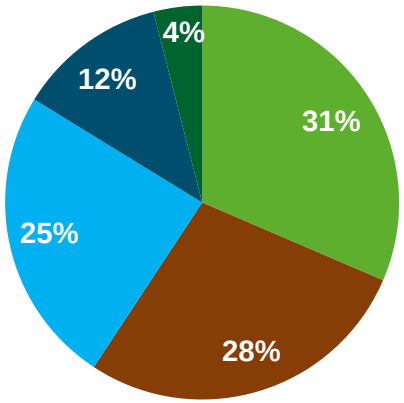
2012 Pilot

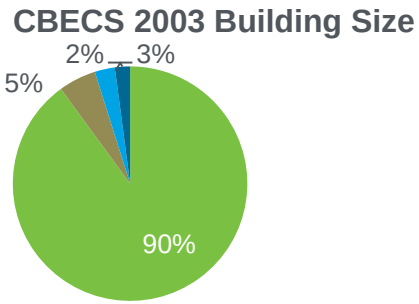




2013 Pilot







Climate Zone Locations

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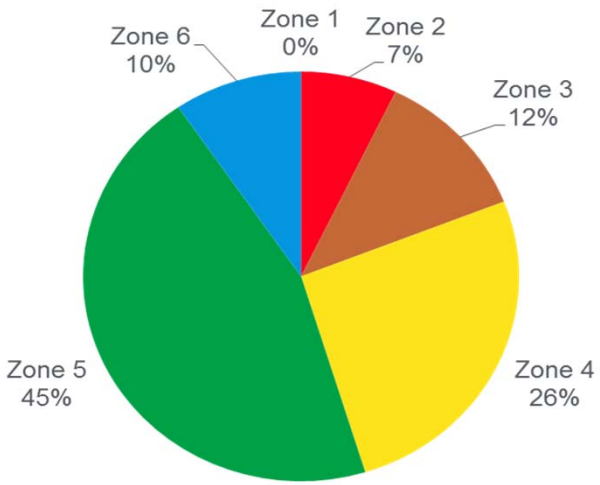
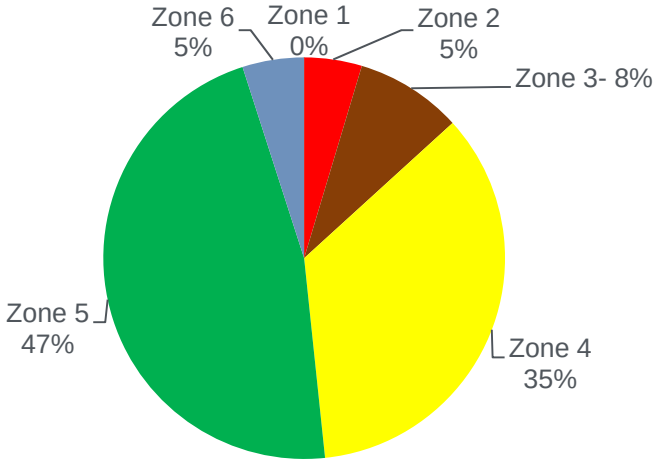
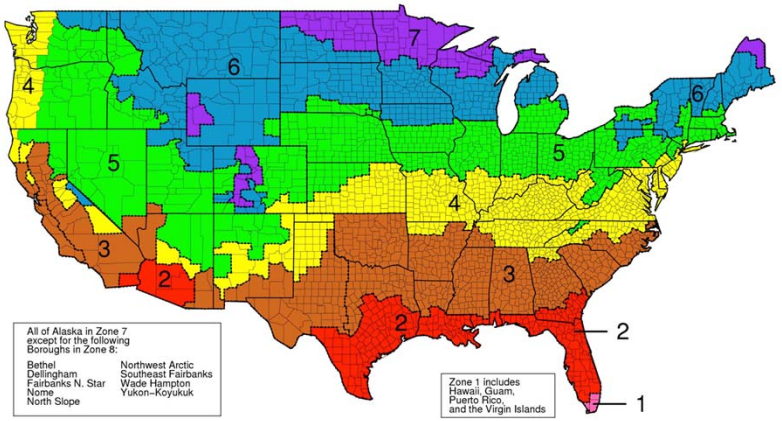
2012 Pilot



2013 Pilot





Building Vintage

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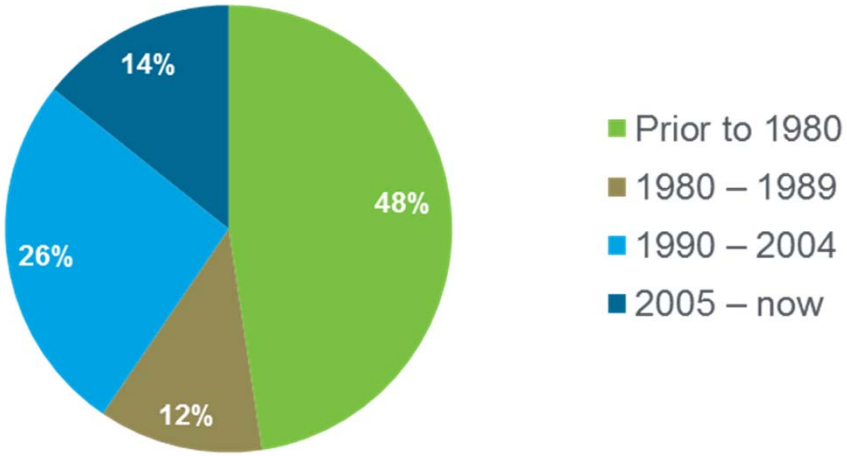
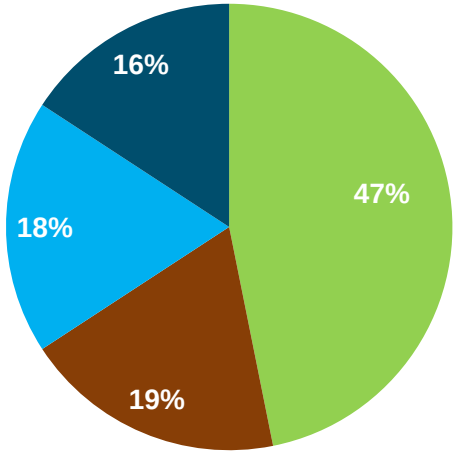
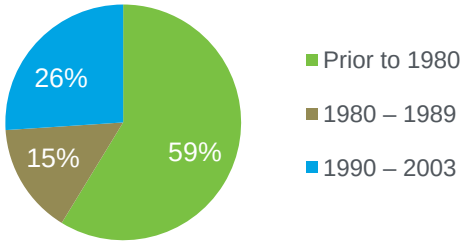
2012 Pilot



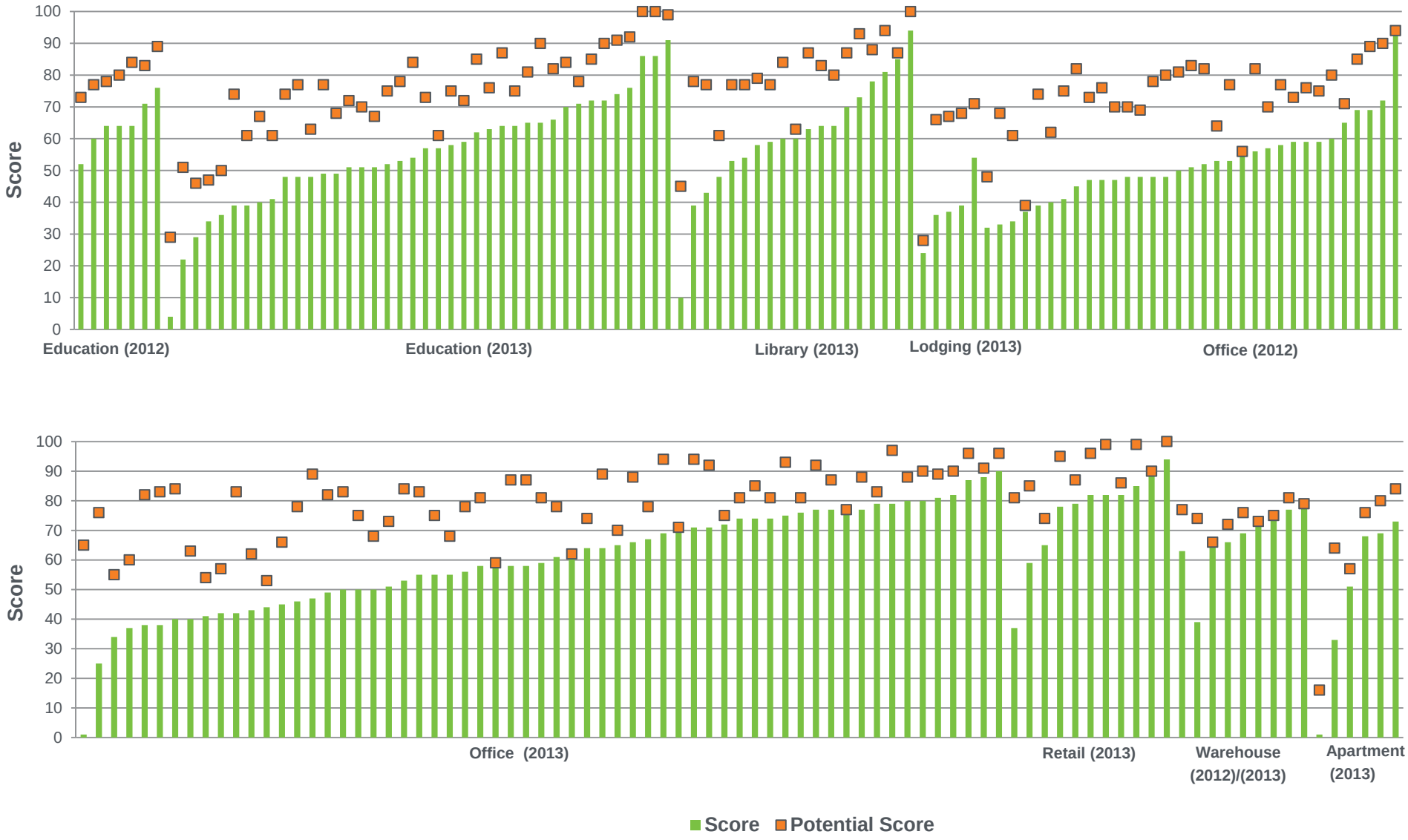
2013 Pilot



CBECS 2003 Building Vintage



Score Summary



Change in Score: Current vs. Potential

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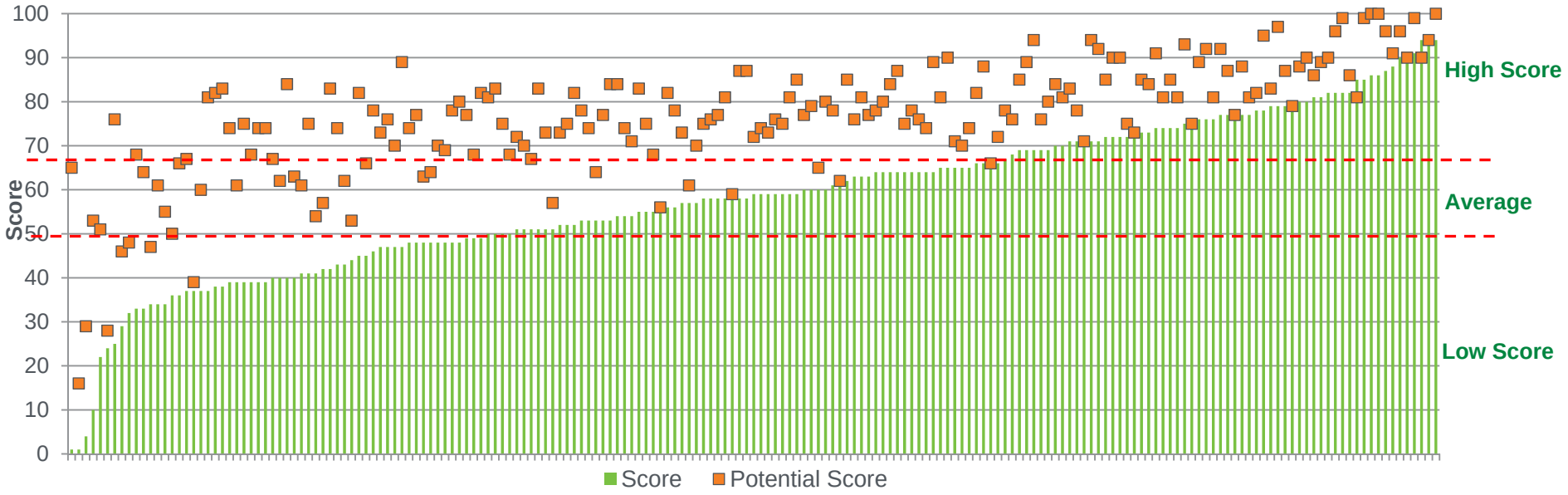

Building Rank by Score	Average Score	Average Potential	Average Change in Score	% Change
Low Score (bottom 1/3)	31.7	60.5	28.8	91%
Average Score (mid 1/3)	56.2	75.5	19.2	34%
High Score (top 1/3)	79.1	88.0	8.9	11%

- On average, lower scoring buildings have greatest potential for improving scores
- However, even those scoring in top third of scale can jump almost 10 points on average

Summary of Opportunities Recommended to Pilot Buildings

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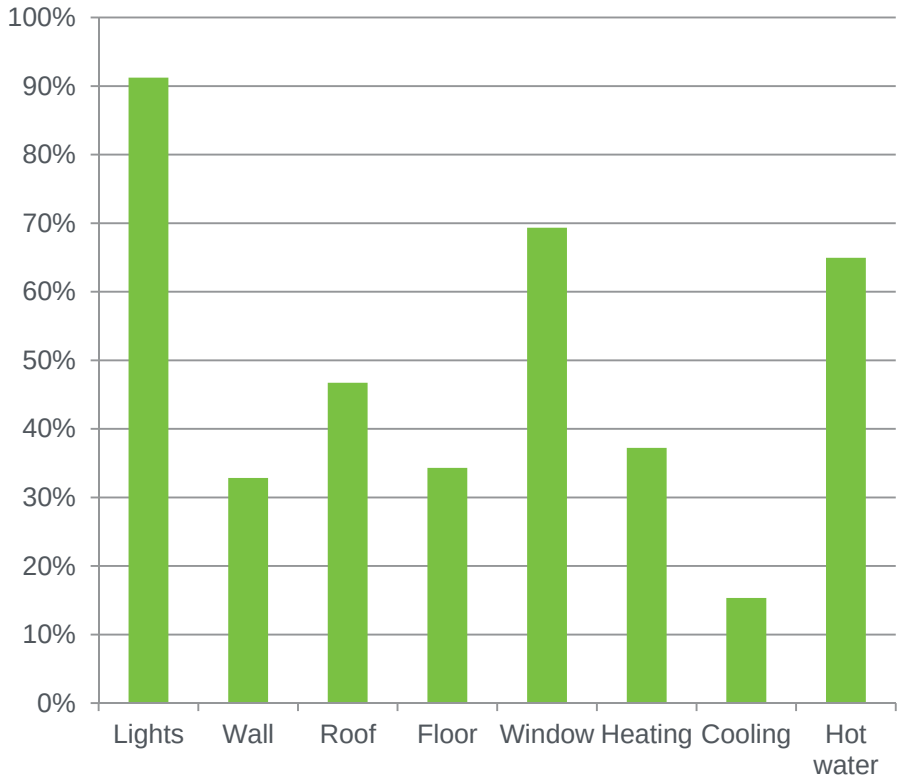
Percentage of pilot buildings that received a particular recommendation



TOP 3 Recommendations

- **Lighting retrofits** were recommended to more than 90% of buildings
  - Most common EEM in this category is upgrading to High Efficacy T8 Fluorescent Lighting followed by CFL.
- **Window upgrades** were recommended to about 70% of buildings.
  - 'Installing Commercial Style Vinyl Frame Triple Pane Argon/Super Low-e Windows' is the most common EEM.
- **Hot water related retrofits** were recommended to almost 65% of buildings
  - 'Wrapping Tank with Insulation' is part of most water heater related recommendations.

Building Ranking	Lights	Wall	Roof	Floor	Window	Heating	Cooling	Hot water
Low Score	35%	18%	16%	16%	30%	13%	9%	26%
Average Score	30%	10%	17%	12%	20%	13%	5%	23%
High Score	34%	8%	18%	10%	26%	15%	3%	22%

Pilot #2 Conclusions

- **Appropriate 100 Point Scales**
  - **Good distribution** across the scales, without clustering of scores (as seen in Pilot #1)
  - Lodging scale may be too stringent
- **Effective Whole Building Asset Rating System**
  - No single component is a good predictor of the overall energy efficiency of a building
- **Recommendation Engine is Sound**
  - Tool identifies cost effective recommendations
    - Enables a bottom tier building to improve its score by 65%, a mid-tier building by 31% and a top tier building by 12%
  - Identifies building sub-system with greatest potential for energy savings
- **User Interface, Messaging, and Testing Plan Need Improvement**
  - A number of bugs identified in Pilot #2 delayed production of Asset Score Reports
    - **Testing plan** has been **significantly improved** to reduce likelihood of widespread problems
  - Data requirements and meaning of Asset Score need to be further clarified
    - Greater inline assistance is being added and educational materials/outreach will be further refined

3) Pilot Participant Feedback

Post-rating Questionnaire

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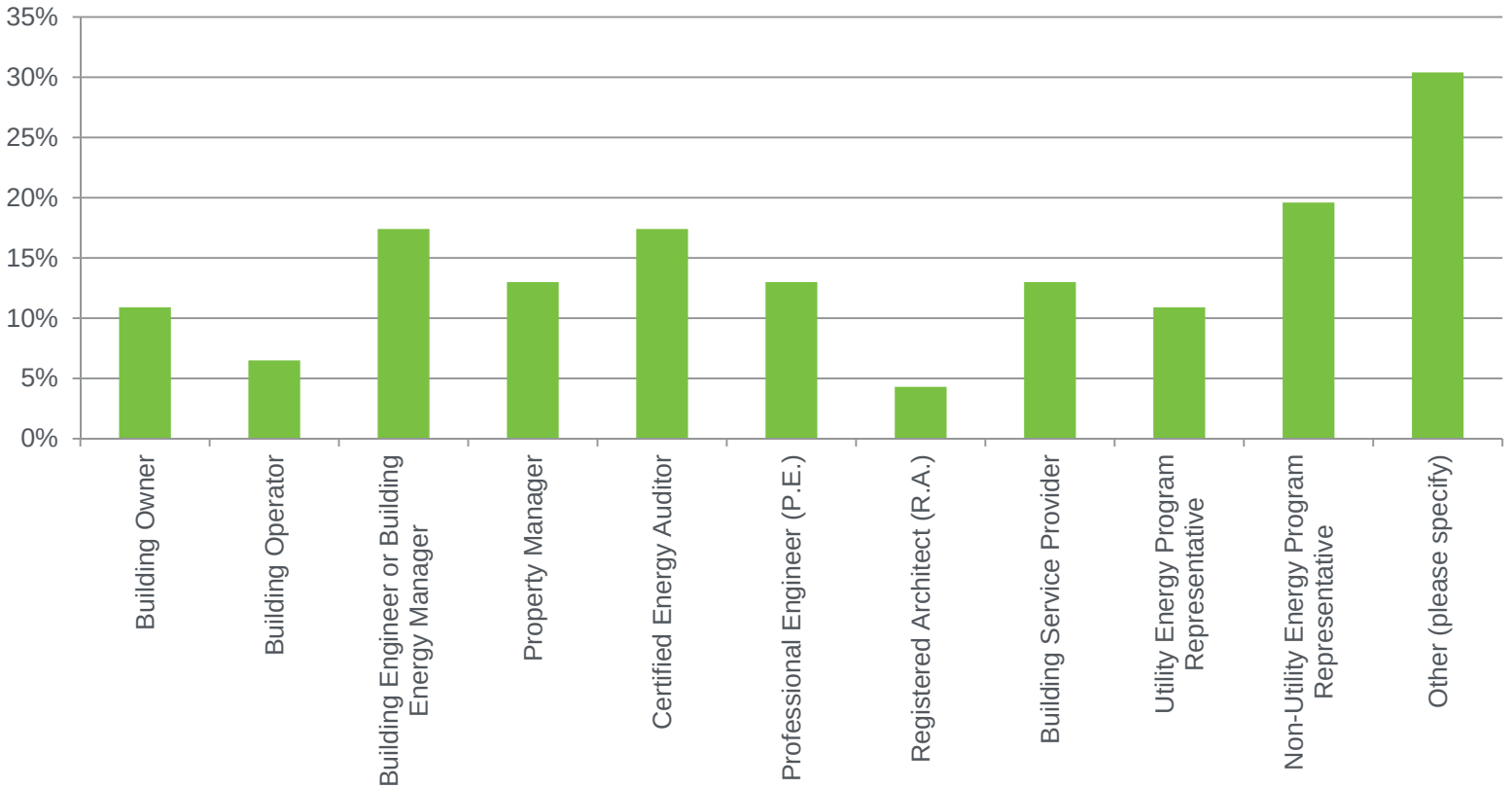
Which of the following best reflects your experience with commercial buildings? I am a…(select all that apply)



Post-rating Questionnaire

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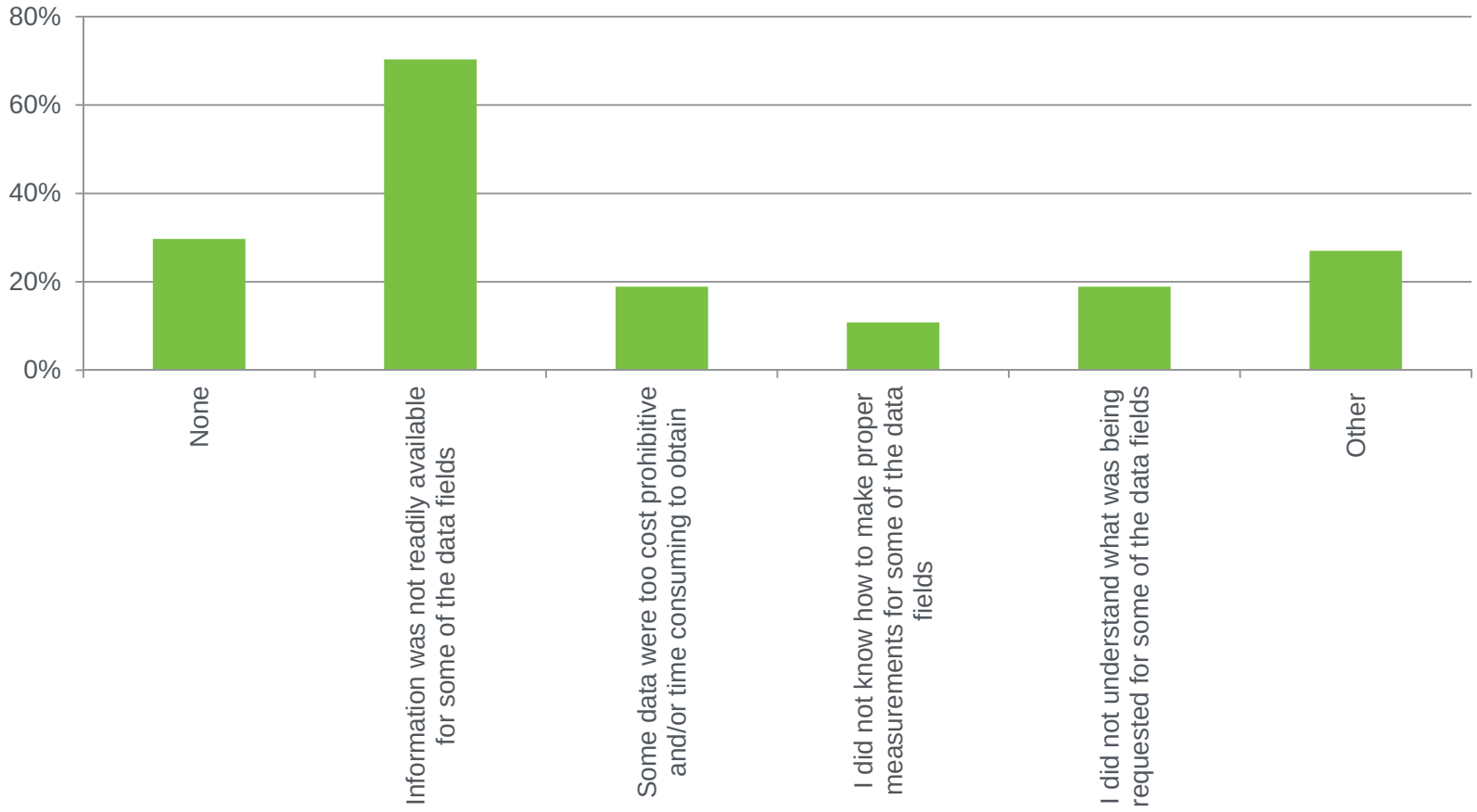
Did you encounter any problems gathering the Required Data?



Post-rating Questionnaire

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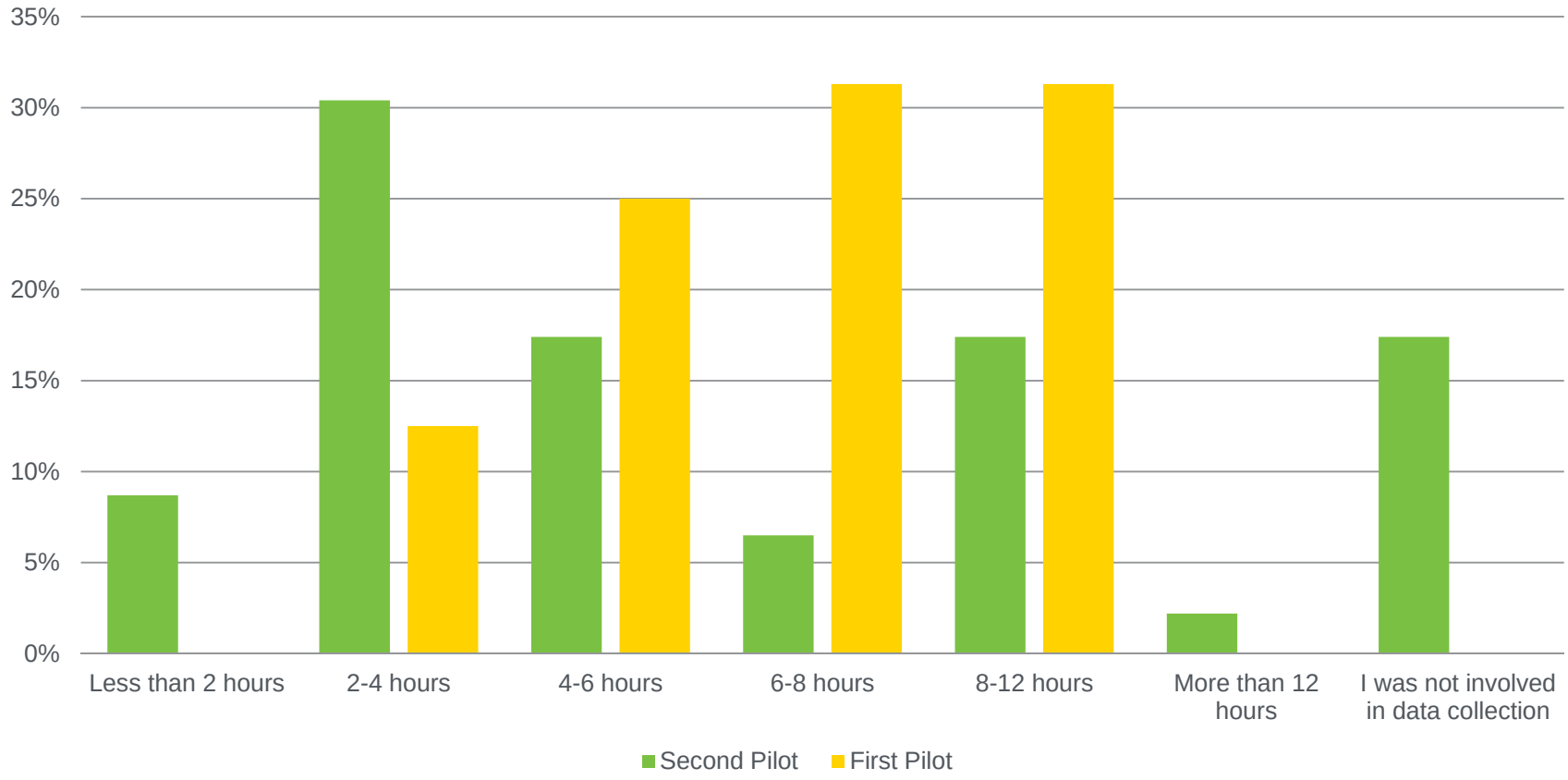
How long did it take to complete the data collection? (average per building)



Post-rating Questionnaire

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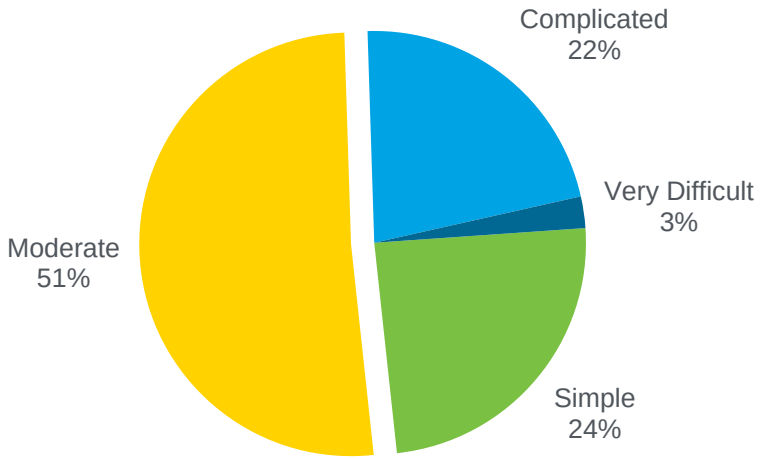
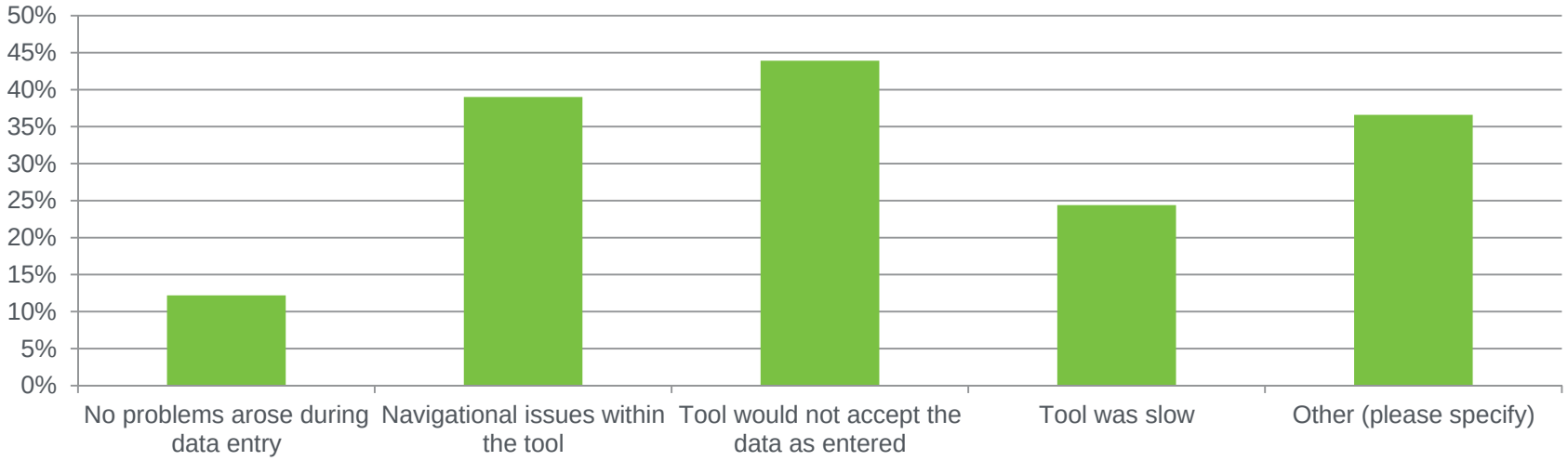
How would you rate the tool on overall ease of data input?



What problems arose during data entry?



Post-rating Questionnaire

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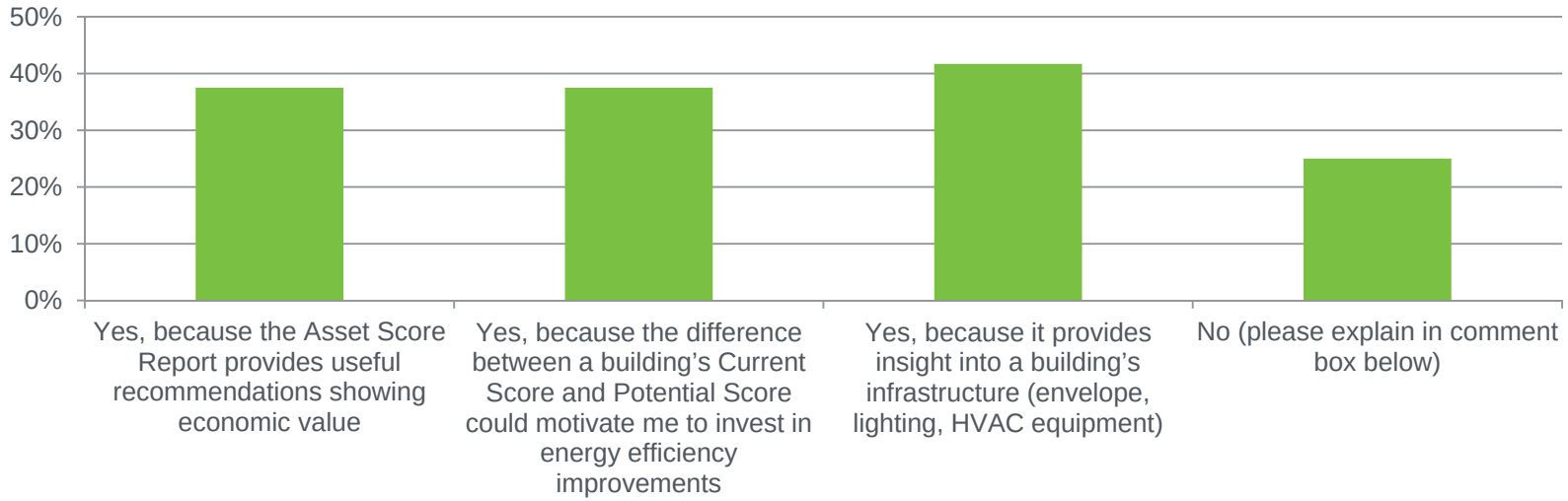
Do you think an Asset Score could inform your decision-making process, such as buying, leasing, retrofit, or other capital investment? (Choose all that apply.)



Interest in Future Use

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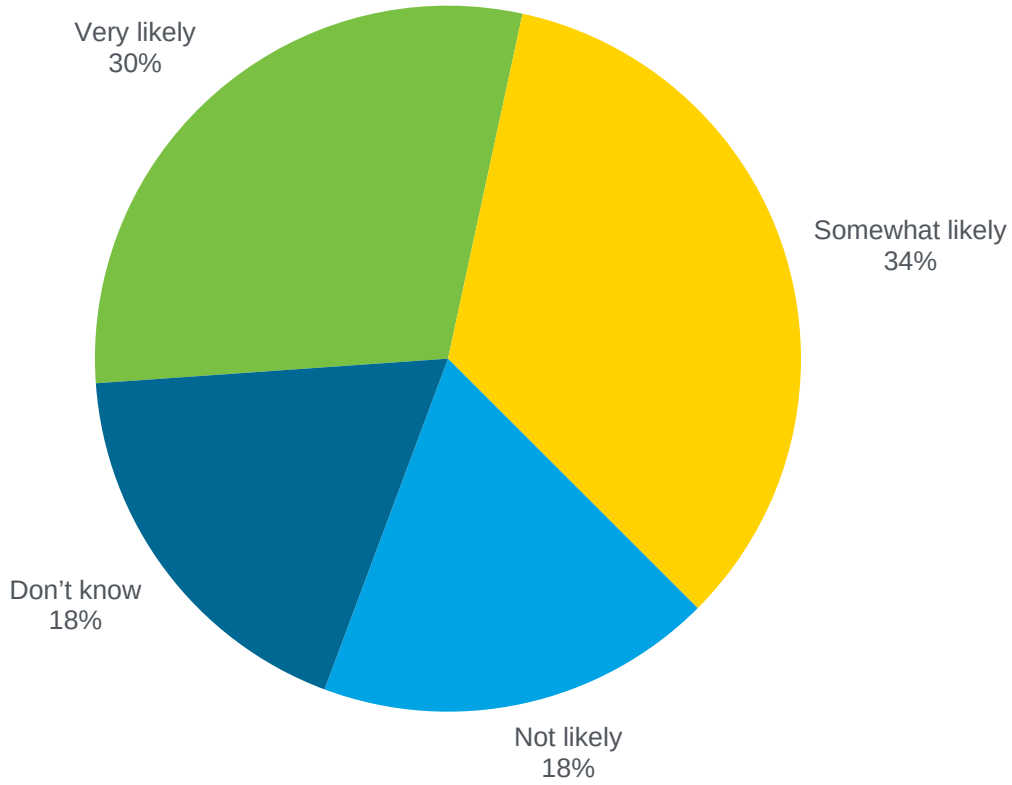
How likely would you be to use the Asset Scoring Tool when it is released publicly?



4) Next Steps

Further Refinement of Score & Report

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Evaluate specific use cases and obtain feedback on:

- Accuracy and usefulness of AS
- Opportunities to enhance value of the Score Report
- Value of Score Report vs. effort to collect and enter data
- Potential uses of Asset Score not yet considered

Additional Conference Call/Webinar

- More interactive opportunity to discuss various report options
- Tentatively planned for June/July 2014
  - If you're interested in participating, email us at **asset.score@ee.doe.gov**

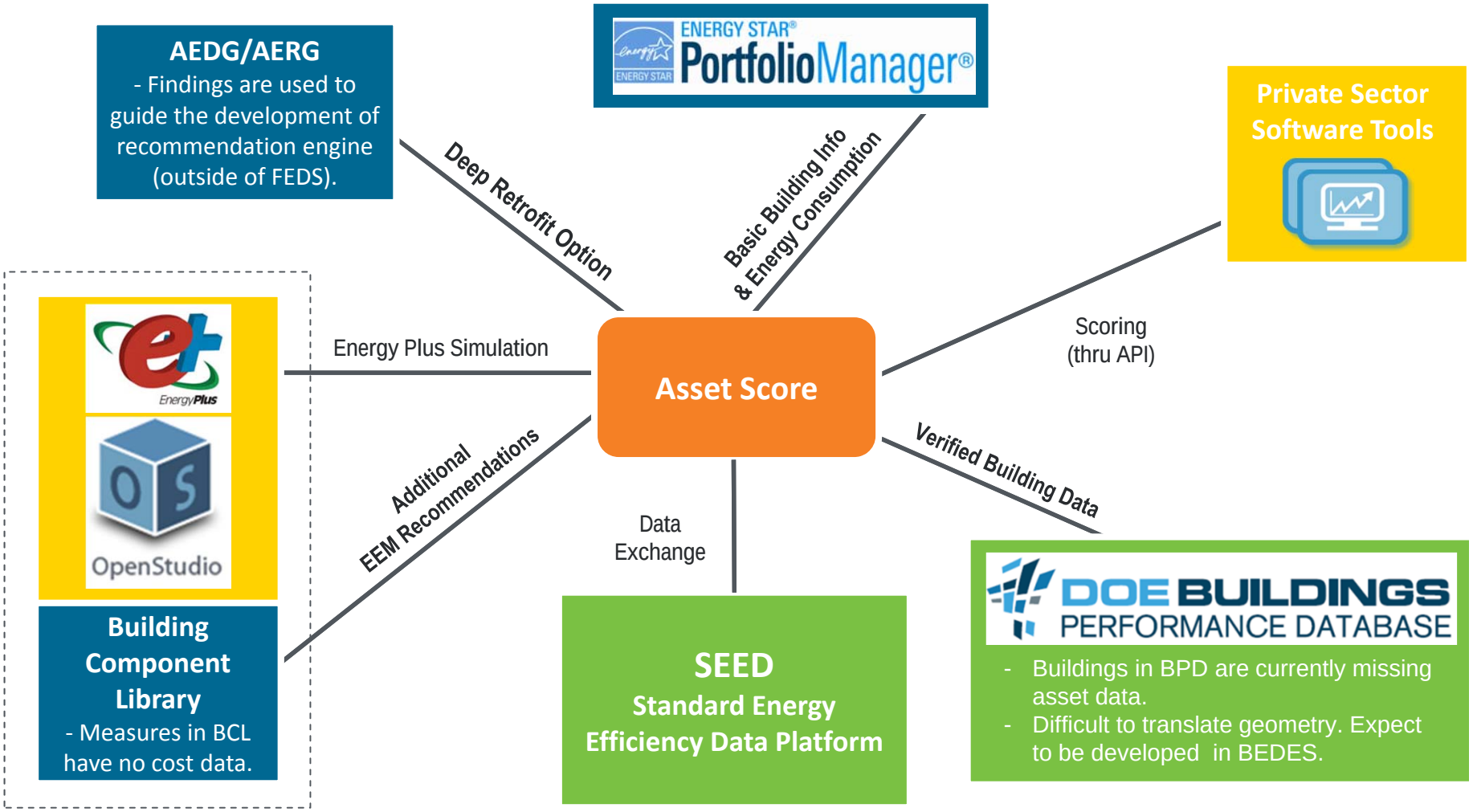
Technical Upgrades (through end of FY15)

- Update sensitivity analysis and EUI simulations to refine scales for 6 major use types (office, education, retail, warehouse, lodging, multi-family) + some variations (library, city hall, post office, etc.)
- Complete comprehensive test suites
  - A suite of tests to check all combinations of HVAC systems, as well as some alternative envelope and footprint combinations
- User experience improvements
  - Sharing of buildings between users
  - Spreadsheet download of multiple building data
  - Additional validation of all user inputs
  - More onscreen help
  - Suggested default values
- Ongoing API updates & support
- Link to Portfolio Manager, DOE's Standard Energy Efficiency Data (SEED) Platform & Buildings Performance Database (BPD)

Technical Upgrades (through end of FY15 - cont.)

- Enhance recommendations engine
  - Add recommendations for building sensors & controls
  - Investigate the “deep retrofit” option based on findings from use case analyses
- New features
  - Add unconditioned basement, elevators, parking garage
  - Add more use types with commercial refrigeration and kitchens
  - Add additional HVAC systems (baseboard heater, GSHP)
  - Integrate onsite renewables
- Develop infrastructure for validated AS including quality assurance protocols, training and testing of assessors
  - Provide “validated” score option with user authentication
  - Develop infrastructure for validated Asset Score
  - Quality assurance protocols
  - Assessor qualifications

Linking to Other Tools via APIs



Useful Links

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

- 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

Using the Tool

- Interested Users: You can sign up and use the tool as is today, however the Asset Score Report will change in the future release of the tool.
- Existing Users: You need to reset your password due to the "heartbleed" (security) issue.