DOE Building Technologies Program

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

Commercial Buildings: Asset Scoring Efforts and Request for Information

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Energy efficiency in buildings: The valuation conundrum

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Key actors all have reasons to maximize energy performance…

- Owners/Investors: Property value, competitive advantage
- Operators: Reduced costs, increased NOI, fewer complaints
- Financiers, Insurers: Lower risk
- Tenants: Lower utility bills, improved comfort and productivity

….yet, market frequently still undervalues EE. Why?

- Difficult to get credible, comparable information at a low cost
  - No standard tools or methods exist to separately assess building infrastructure and energy systems
- Transaction costs (i.e., auditing, collecting data, evaluating information) are too high for many in the market
- Hard to assess complicated information at time of real estate transaction

DOE Goals

Reduce energy use in buildings

- Make it easy to get reliable information at a low cost
- Encourage greater investment in energy efficiency improvements
- Make the "value" of energy efficiency transparent to commercial building owners/operators, investors, real estate brokers, appraisers, lessees, etc.
- Provide free tools and information that private sector (e.g., software providers, energy professionals) can use and build on to accelerate the growth of the energy efficiency market

Federal tools can support buildings throughout their lifecycle

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- A suite of integrated tools can deliver useful and credible energy information to owners, investors, tenants, and operators throughout building lifecycle
  - Free and easy access to publicly developed tools can help decision makers use modeled and measured data as appropriate at particular decision points
  - Consistent data definitions can allow information to be carried throughout building lifecycle and used effectively by different tools, thereby reducing transaction costs
  - Integrated tools can also bring to bear market realities captured in large datasets
- Standard tools and protocols, rigorously tested and evaluated, can allow comparison of buildings' energy use, energy assets, and operations
  - Federal government can help ensure strong technical basis for outputs that can inform the market
  - Tools and outputs can be designed to serve the needs of different stakeholders

So …

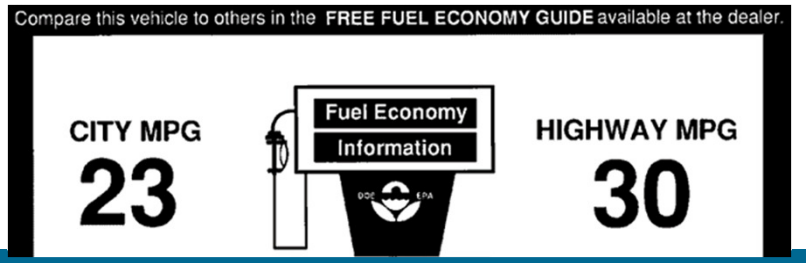
How does DOE's

Commercial Building Energy Asset Score

fit into this suite of tools?

Objectives

- Provide useful information through simplified scoring tool
- Highlight a building's as-built efficiency and its potential efficiency
- Differentiate installed system efficiency from O&M issues and occupant behavior
- Provide insight into the performance potential of individual energy systems
- Identify short-term and long-term capital investment opportunities
- Allow simplified and consistent assessment of buildings across the country
  - Takes operation out of the equation to allow "apples to apples" comparison -- like an MPG sticker for a building



Guiding Principles

- Information must be credible, reliable, and replicable
- Information must be transparent and easy to understand
- Collecting information and generating a score must be affordable
- Opportunities identified must be relevant and practical
- Program must include effective quality assurance
- Score must recognize building energy performance across the full range of building efficiency

Asset Score Provides Different Information from ENERGY STAR Portfolio Manager

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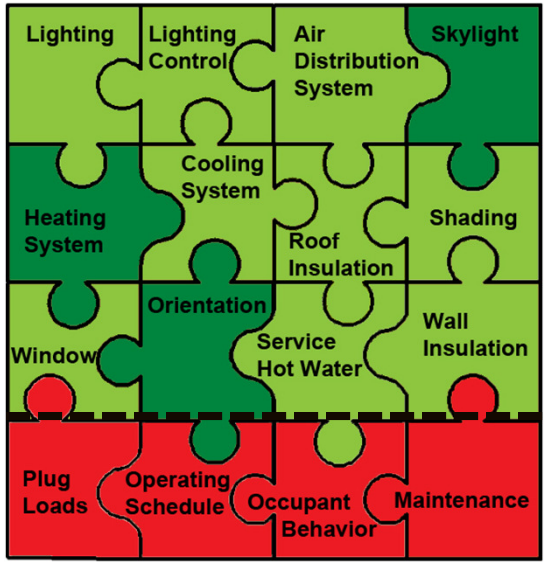
- Buildings #1 and #2 may have similar ENERGY STAR scores, but widely divergent asset scores.
- Used together, an energy asset score and an energy benchmark can inform the decisions of a building owner, operator, buyer, or lessee.

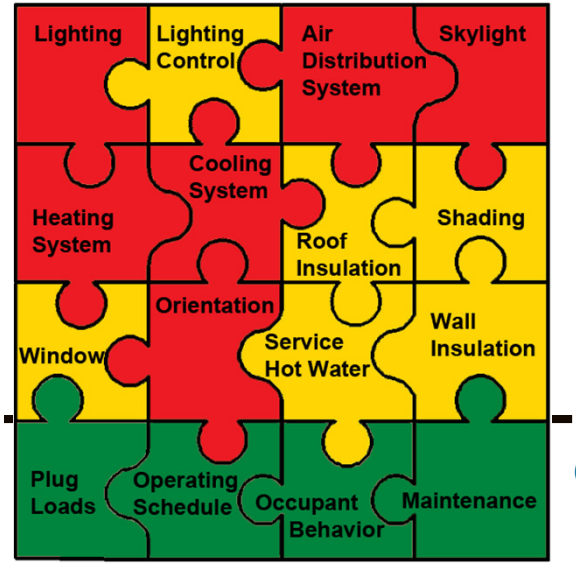
Building #1: High Asset Score



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

Equivalent ENERGY STAR Portfolio Manager Score

Building #2: Low Asset Score



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

Energy Assets

O&M/ Occupant Behavior

Asset Score Report: Four Sections

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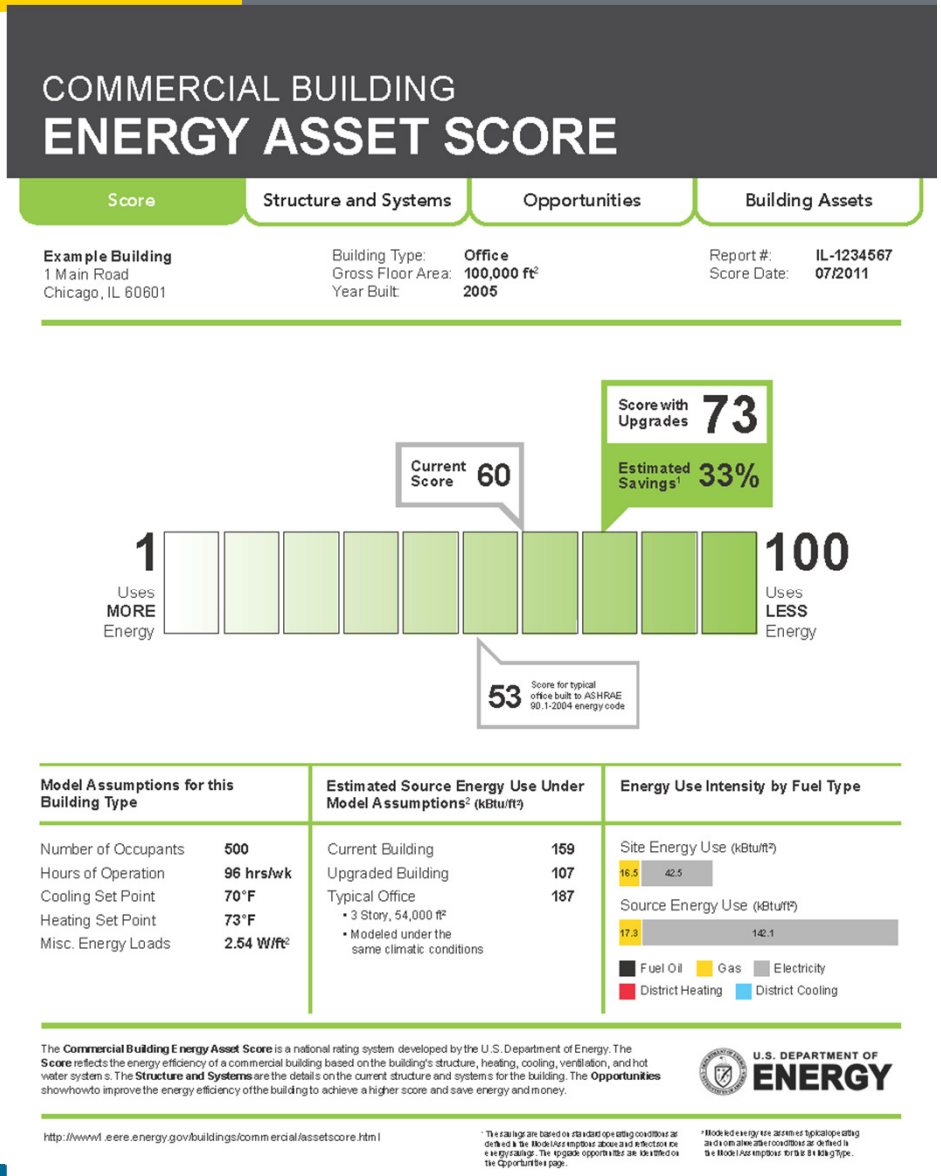
(1) Score

Highlights a building's as-built efficiency and its potential efficiency



COMMERCIAL BUILDING
ENERGY ASSET SCORE

Score | Structure and Systems | Opportunities | Building Assets

Example Building
1 Main Road
Chicago, IL 60601

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

Report #: **IL-1234567**
Score Date: **07/2011**

Score with Upgrades **73**
Estimated Savings[1] **33%**
Current Score **60**

1 Uses **MORE** Energy — 100 Uses **LESS** Energy

53 Score for typical office built to ASHRAE 90.1-2004 energy code

Model Assumptions for this Building Type		Estimated Source Energy Use Under Model Assumptions[2] (kBtu/ft²)		Energy Use Intensity by Fuel Type
Number of Occupants	500	Current Building	159	Site Energy Use (kBtu/ft²): 16.5, 42.5
Hours of Operation	96 hrs/wk	Upgraded Building	107	Source Energy Use (kBtu/ft²): 17.3, 142.1
Cooling Set Point	70°F	Typical Office	187	Fuel Oil, Gas, Electricity, District Heating, District Cooling
Heating Set Point	73°F	• 3 Story, 54,000 ft²		
Misc. Energy Loads	2.54 W/ft²	• Modeled under the same climatic conditions		

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 **Structure and Systems** are the details on the current structure and systems for the building. The **Opportunities** show how to improve the energy efficiency of the building to achieve a higher score and save energy and money.

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

[1] The savings are based on standard operating conditions as defined in the Model Assumptions above and reflect only energy savings. The upgrade opportunities are identified on the Opportunities page.

[2] Modeled energy use assumes typical operating and occupancy conditions as defined in the Model Assumptions for this Building Type.

Asset Score Report: Four Sections

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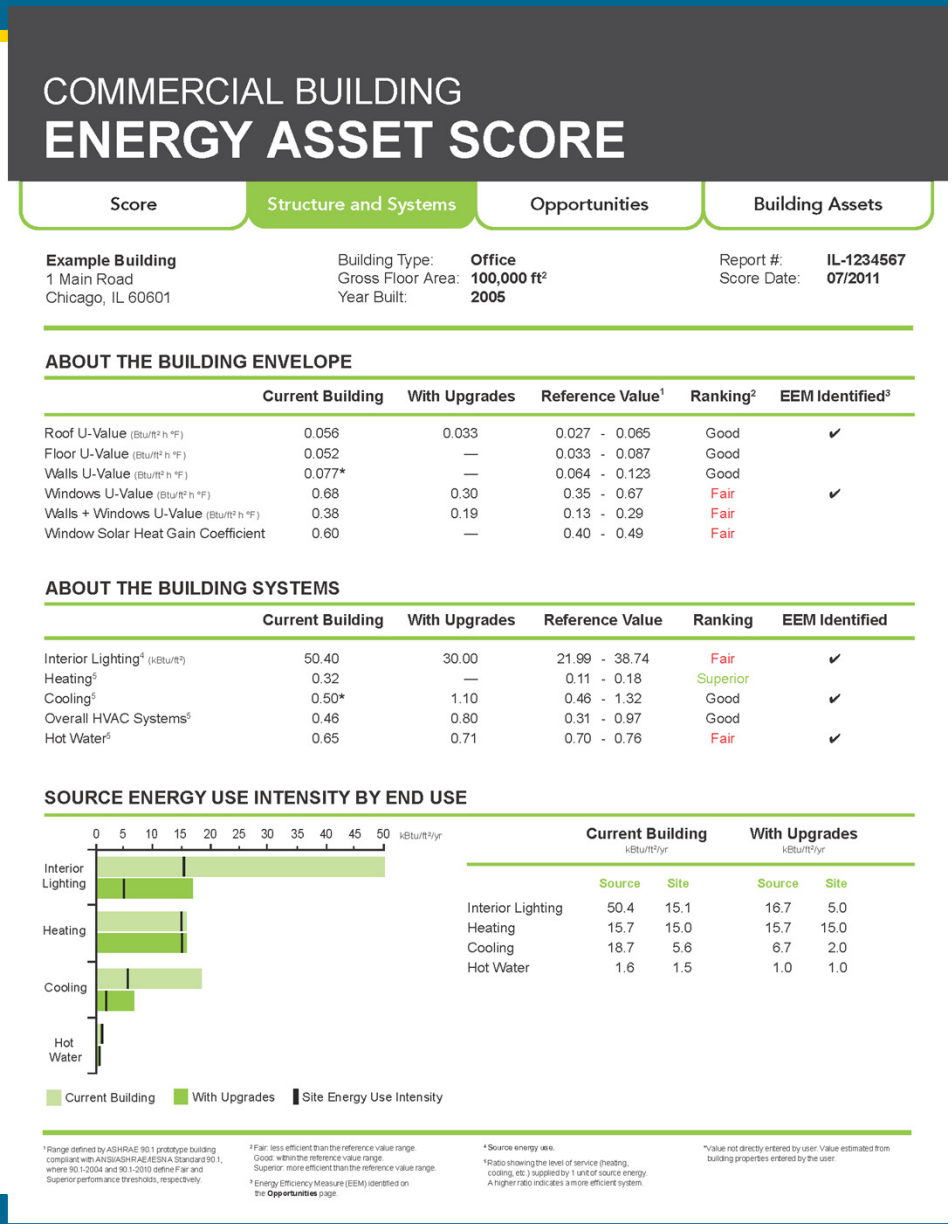
2) Structure and Systems:

Provides insight into the performance potential of individual energy systems



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ABOUT THE BUILDING ENVELOPE

	Current Building	With Upgrades	Reference Value[1]	Ranking[2]	EEM Identified[3]
Roof U-Value (Btu/ft² h °F)	0.056	0.033	0.027 - 0.065	Good	✔
Floor U-Value (Btu/ft² h °F)	0.052	—	0.033 - 0.087	Good	
Walls U-Value (Btu/ft² h °F)	0.077*	—	0.064 - 0.123	Good	
Windows U-Value (Btu/ft² h °F)	0.68	0.30	0.35 - 0.67	Fair	✔
Walls + Windows U-Value (Btu/ft² h °F)	0.38	0.19	0.13 - 0.29	Fair	
Window Solar Heat Gain Coefficient	0.60	—	0.40 - 0.49	Fair	

ABOUT THE BUILDING SYSTEMS

	Current Building	With Upgrades	Reference Value	Ranking	EEM Identified
Interior Lighting[4] (kBtu/ft²)	50.40	30.00	21.99 - 38.74	Fair	✔
Heating[5]	0.32	—	0.11 - 0.18	Superior	
Cooling[5]	0.50*	1.10	0.46 - 1.32	Good	✔
Overall HVAC Systems[5]	0.46	0.80	0.31 - 0.97	Good	
Hot Water[5]	0.65	0.71	0.70 - 0.76	Fair	✔

SOURCE ENERGY USE INTENSITY BY END USE

	Current Building kBtu/ft²/yr		With Upgrades kBtu/ft²/yr	
	Source	Site	Source	Site
Interior Lighting	50.4	15.1	16.7	5.0
Heating	15.7	15.0	15.7	15.0
Cooling	18.7	5.6	6.7	2.0
Hot Water	1.6	1.5	1.0	1.0

[1] Range defined by ASHRAE 90.1 prototype building compliant with ANSI/ASHRAE/IESNA Standard 90.1, where 90.1-2004 and 90.1-2010 define Fair and Superior performance thresholds, respectively.
[2] Fair: less efficient than the reference value range. Good: within the reference value range. Superior: more efficient than the reference value range.
[3] Energy Efficiency Measure (EEM) identified on the **Opportunities** page.
[4] Source energy use.
[5] Ratio showing the level of service (heating, cooling, etc.) supplied by 1 unit of source energy. A higher ratio indicates a more efficient system.
*Value not directly entered by user. Value estimated from building properties entered by the user.

Asset Score Report: Four Sections

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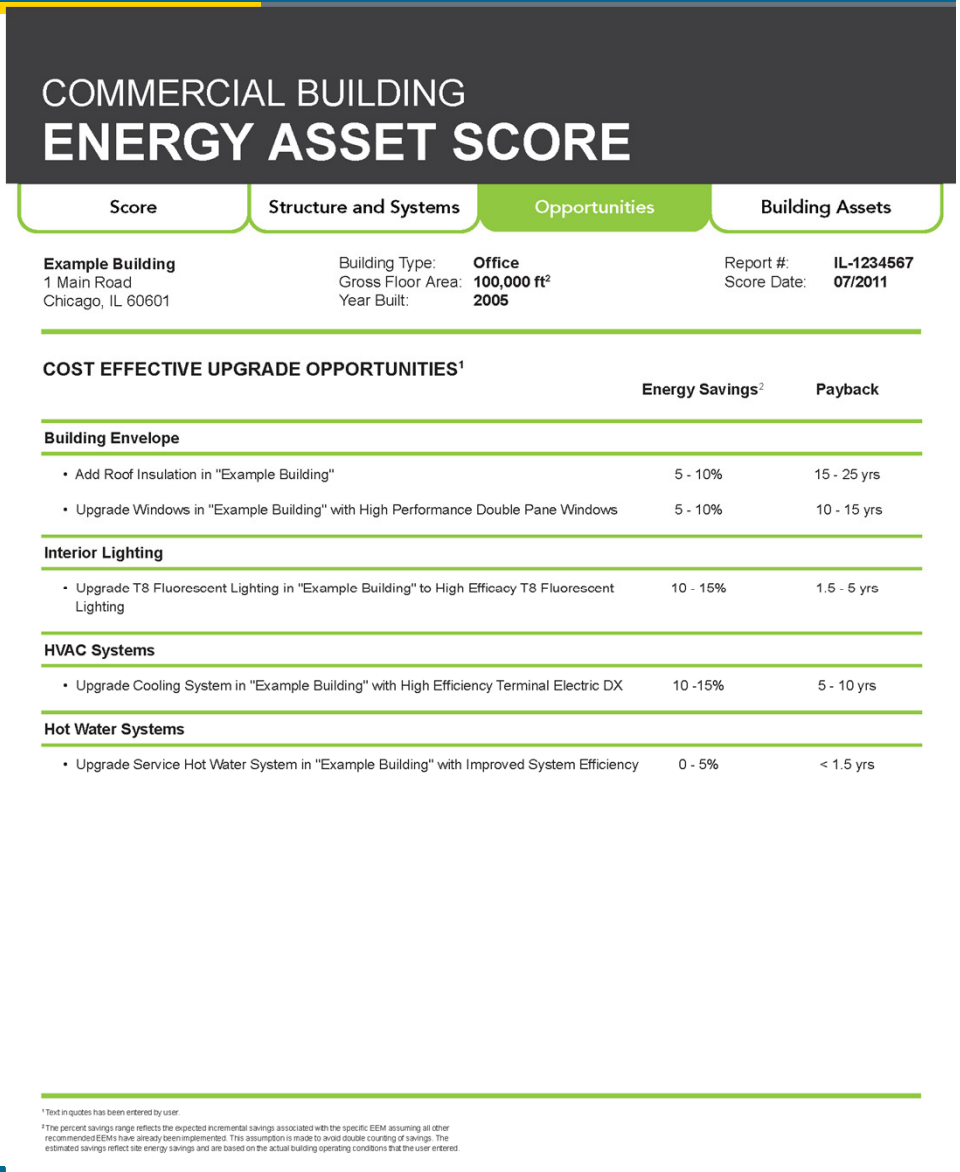
3) Opportunities:

Identifies short-term and long-term capital investment opportunities



COMMERCIAL BUILDING
ENERGY ASSET SCORE

Score | Structure and Systems | Opportunities | Building Assets

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COST EFFECTIVE UPGRADE OPPORTUNITIES[1]

	Energy Savings[2]	Payback
Building Envelope		
• Add Roof Insulation in "Example Building"	5 - 10%	15 - 25 yrs
• Upgrade Windows in "Example Building" with High Performance Double Pane Windows	5 - 10%	10 - 15 yrs
Interior Lighting		
• Upgrade T8 Fluorescent Lighting in "Example Building" to High Efficacy T8 Fluorescent Lighting	10 - 15%	1.5 - 5 yrs
HVAC Systems		
• Upgrade Cooling System in "Example Building" with High Efficiency Terminal Electric DX	10 -15%	5 - 10 yrs
Hot Water Systems		
• Upgrade Service Hot Water System in "Example Building" with Improved System Efficiency	0 - 5%	< 1.5 yrs

[1] Text in quotes has been entered by user.

[2] The percent savings range reflects the expected incremental savings associated with the specific EEM assuming all other recommended EEMs have already been implemented. This assumption is made to avoid double counting of savings. The estimated savings reflect site energy savings and are based on the actual building operating conditions that the user entered.

Asset Score Report: Four Sections

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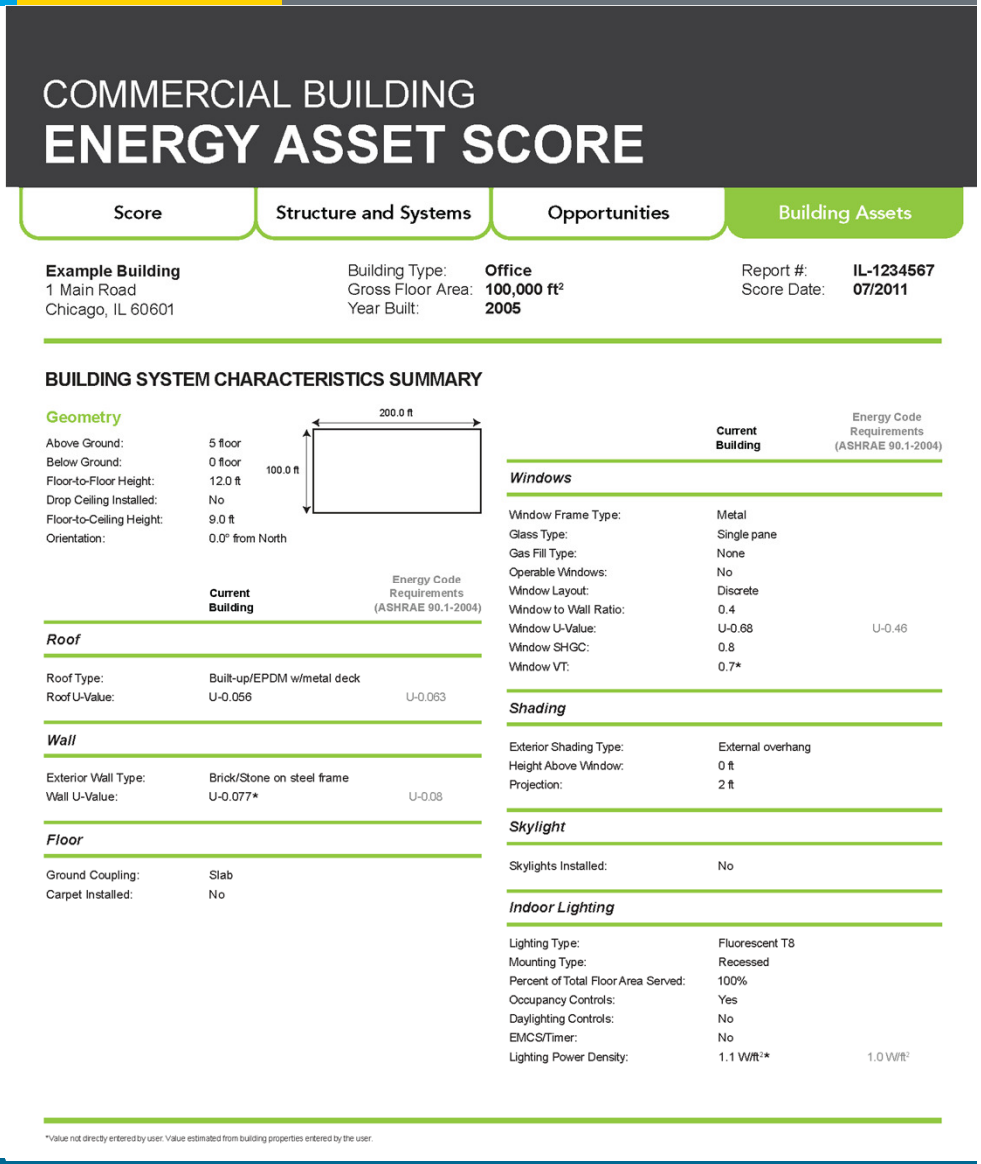
4) Building Assets:

Describes the inputs used to generate the score and report



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BUILDING SYSTEM CHARACTERISTICS SUMMARY

Geometry

Above Ground:	5 floor
Below Ground:	0 floor
Floor-to-Floor Height:	12.0 ft
Drop Ceiling Installed:	No
Floor-to-Ceiling Height:	9.0 ft
Orientation:	0.0° from North

200.0 ft
100.0 ft

	Current Building	Energy Code Requirements (ASHRAE 90.1-2004)
Roof		
Roof Type:	Built-up/EPDM w/metal deck	
Roof U-Value:	U-0.056	U-0.063
Wall		
Exterior Wall Type:	Brick/Stone on steel frame	
Wall U-Value:	U-0.077*	U-0.08
Floor		
Ground Coupling:	Slab	
Carpet Installed:	No	

	Current Building	Energy Code Requirements (ASHRAE 90.1-2004)
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	U-0.46
Window SHGC:	0.8	
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:	Fluorescent T8	
Mounting Type:	Recessed	
Percent of Total Floor Area Served:	100%	
Occupancy Controls:	Yes	
Daylighting Controls:	No	
EMCS/Timer:	No	
Lighting Power Density:	1.1 W/ft²*	1.0 W/ft²

*Value not directly entered by user. Value estimated from building properties entered by the user.

2012 Pilot Provided Useful Findings

- Data collection requirements are fairly reasonable
  - Looking for ways to reduce time requirements if possible (awaiting sensitivity analysis)
- ENERGY STAR Portfolio Manager and Asset Score can illustrate different building strengths and opportunities
  - One is not necessarily a predictor of the other
  - We'd like to better understand relationship between the two pieces of information and how to interpret the two together
- Overall asset score provides useful information
  - Reflects building's energy components as an integrated system
  - More than a sum of assessments of individual energy components
  - Seeking input on how to further improve value of information

Findings Led to Improvements… Further Testing Will Be Conducted in Pilot #2

- Enhancing scoring tool capabilities and asset score report
  - Improving ability to score complex buildings
  - Conducting sensitivity analysis to verify data requirements
  - Minimizing potential for erroneous inputs
- Reevaluating asset score scale
  - In first pilot, a score of "100" was pegged at net-zero
  - No buildings, even those that are very efficient, were able to score in top third of scale
  - EUI to Asset Score mapping tended to cluster scores together
- Improving usability of scoring tool
  - Usability testing underway
  - Clearer input definitions
  - Enhanced interface
- Improving energy efficiency measure recommendations
  - Comparing tool recommendations from those generated in more comprehensive audits
  - Assessing where gaps in recommendations may exist

DOE Pilot #2

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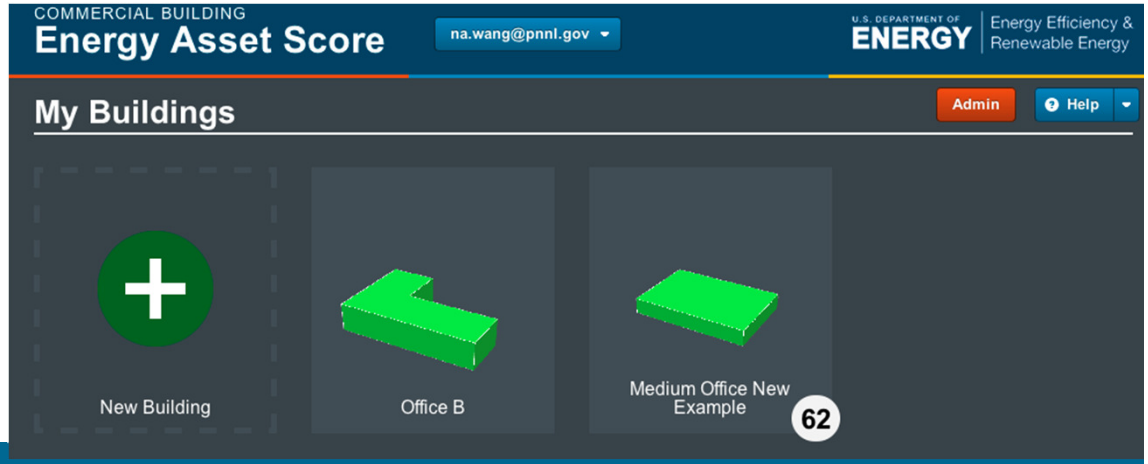
- New building types
  - Mixed use, lodging, libraries, multifamily, court houses, other
  - Will continue to test office, retail, schools, warehouses (focus of first pilot)
    - Buildings from Pilot #1 will be automatically rescored in Pilot #2
  - No buildings with refrigeration at this time
- Refined data collection process
  - Enhanced user interface with multiple blocks
  - Improved on-screen instructions and data collection form
  - Will allow multiple users to edit one building



Pilot #2: Primary Areas of Focus

- Simple vs. Advanced Score
  - What are the time requirements needed for the different levels of score?
  - How much do the time requirements vary depending on the type or complexity of building?
  - What is perceived as reasonable time needed to produce simple score? Advanced score?

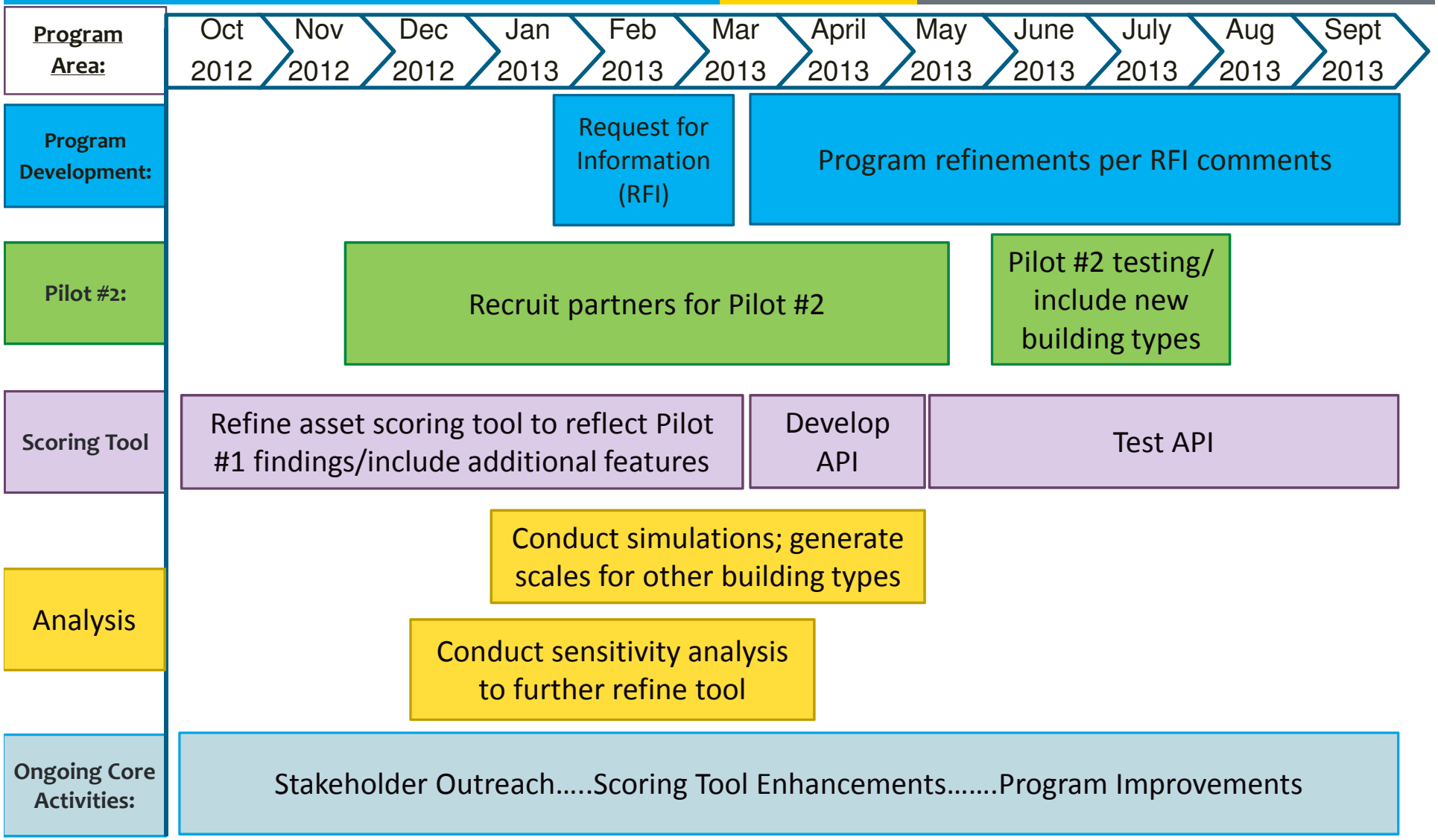
- Energy Efficiency Recommendations
  - How do the recommendations compare to those provided by other auditing options? (depends on availability of outside audit info)
  - Are recommendations in line with expectations? Are they useful?

- 100 Point Scale Values
  - How do different types of buildings score given new scales?

Request for Information (RFI)

- "Program Overview and Technical Protocol, Version 1.0" on web
  - Describes methodology, calculations, assumptions
  - Will be updated periodically to reflect changes to protocol
- Data collection and validation
  - Preliminary data classification
  - Requirements for simple score, advanced score
  - Requirements for assessor qualifications and quality assurance
- Score durability
  - DOE will notify scored buildings if periodic updates to the scoring methodology warrant rescoring.
  - If a building updates its systems or infrastructure, building should be rescored.
  - Should a building's score remain valid for at least 10 years?
- Asset Score Report
  - Information to be included in the energy asset score report

FY13 Timeline



We hope you will…

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- Participate in Commercial Building Energy Asset Score Pilot #2
  - Will likely run from late Spring thru July 2013
- Provide your feedback to the current Request for Information
  - Comments due March 11, 2013 to asset.score@ee.doe.gov
- Join our asset score stakeholder lists (residential, commercial)
  - Get notices of upcoming webinars, other information

We welcome your questions and comments.

asset.score@ee.doe.gov

Web Site:

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