Today’s Agenda

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

• 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
- 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- Low asset score may highlight need to replace outdated equipment or prepare for replacement costs in the near future.
Why Use the Asset Score?

- **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)

U.S. Commercial Building Stock

Large Portfolios

Screening & Data Tool

• Owners/operators of large portfolios across climates
• Owners/operators of portfolios of similar buildings (e.g. school districts)
• ESCOs, utility service providers
• Utilities

Class B/C Space & SMB, Municipal Bldgs

Assessment Tool

• Organizations with constrained budgets
• Service providers

Buildings Subject to Requirements

Compliance with Fed/State/Local Reporting Requirements

• Jurisdictions with assessment requirements & reporting policies
• Federal facilities (EISA requirements)

All Buildings

Inform Real Estate Transactions

• Real estate community including purchasers, realtors, appraisers, lenders, investors
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

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

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

OVERALL BUILDING SCORE

Building ID #: XXXXX

Gross Floor Area: 140,000 ft²

Current Score: 62

Potential Score: 84

Estimated Savings: 28%

1 Uses MORE Energy

100 Uses LESS Energy
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

<table>
<thead>
<tr>
<th>COST EFFECTIVE UPGRADE OPPORTUNITIES</th>
<th>Energy Savings</th>
<th>Simple Pay Back</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building Envelope</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Add roof insulation in Office and Retail</td>
<td>5 - 10%</td>
<td>15 - 25 yrs</td>
</tr>
<tr>
<td>- Upgrade windows in Office with high performance double pane windows</td>
<td>5 - 10%</td>
<td>10 - 15 yrs</td>
</tr>
<tr>
<td><strong>Interior Lighting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Upgrade incandescent lighting in Office and Retail to compact fluorescent lighting</td>
<td>10 - 15%</td>
<td>1.5 - 5 yrs</td>
</tr>
<tr>
<td><strong>HVAC Systems</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Upgrade cooling system in Office and Retail with high efficiency electric DX</td>
<td>10 -15%</td>
<td>5 - 10 yrs</td>
</tr>
<tr>
<td><strong>Hot Water Systems</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Upgrade service hot water system in Office and Retail with improved system efficiency</td>
<td>0 - 5%</td>
<td>&lt; 1.5 yrs</td>
</tr>
</tbody>
</table>
System Evaluation

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

### ABOUT THE BUILDING ENVELOPE

<table>
<thead>
<tr>
<th></th>
<th>Current Building</th>
<th>Ranking</th>
<th>Upgrade Opportunity Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof U-Value, Non-Attic</td>
<td>0.056</td>
<td>Good</td>
<td>✓</td>
</tr>
<tr>
<td>Floor U-Value, Mass</td>
<td>0.052</td>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>Walls U-Value, Framed</td>
<td>0.077*</td>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>Windows U-Value</td>
<td>0.68</td>
<td>Fair</td>
<td>✓</td>
</tr>
<tr>
<td>Walls + Windows U-Value</td>
<td>0.38</td>
<td>Fair</td>
<td></td>
</tr>
<tr>
<td>Window Solar Heat Gain Coefficient</td>
<td>0.60</td>
<td>Fair</td>
<td></td>
</tr>
</tbody>
</table>

### ABOUT THE BUILDING SYSTEMS

<table>
<thead>
<tr>
<th></th>
<th>Current Building</th>
<th>Ranking</th>
<th>Upgrade Opportunity Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior Lighting</td>
<td>NA</td>
<td>Fair</td>
<td>✓</td>
</tr>
<tr>
<td>Heating</td>
<td>12.4</td>
<td>Good</td>
<td>✓</td>
</tr>
<tr>
<td>Cooling</td>
<td>10.9</td>
<td>Good</td>
<td>✓</td>
</tr>
<tr>
<td>Overall HVAC Systems</td>
<td>17.8</td>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>Hot Water</td>
<td>1.0</td>
<td>Fair</td>
<td>✓</td>
</tr>
</tbody>
</table>

*Note: Values represent different units and may need to be converted for accurate comparison.*
End Use Energy Break-down

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

**ENERGY USE INTENSITY BY END USE**

- Interior Lighting
- Heating
- Cooling
- Hot Water

- Current Building
- With Upgrades
- Site Energy Use Intensity
# Building System Characteristics Summary

## Geometry

<table>
<thead>
<tr>
<th>Feature</th>
<th>Current Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above Ground</td>
<td>2 floor</td>
</tr>
<tr>
<td>Below Ground</td>
<td>0 floor</td>
</tr>
<tr>
<td>Floor-to-Floor Height</td>
<td></td>
</tr>
<tr>
<td>- Floor 1:</td>
<td>14 ft</td>
</tr>
<tr>
<td>- Floor 2:</td>
<td>10 ft</td>
</tr>
<tr>
<td>Drop Ceiling Installed</td>
<td>No</td>
</tr>
<tr>
<td>Floor-to-Ceiling Height</td>
<td>9 ft</td>
</tr>
<tr>
<td>Orientation</td>
<td>0.0° from North</td>
</tr>
</tbody>
</table>

## Windows

<table>
<thead>
<tr>
<th>Feature</th>
<th>Current Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Window Frame Type</td>
<td>Metal</td>
</tr>
<tr>
<td>Glass Type</td>
<td>Single pane</td>
</tr>
<tr>
<td>Gas Fill Type</td>
<td>None</td>
</tr>
<tr>
<td>Operable Windows</td>
<td>No</td>
</tr>
<tr>
<td>Window Layout</td>
<td>Discrete</td>
</tr>
<tr>
<td>Window to Wall Ratio</td>
<td>0.4</td>
</tr>
<tr>
<td>Window U-Value</td>
<td>U-0.88</td>
</tr>
<tr>
<td>Window SHGC</td>
<td>0.6</td>
</tr>
<tr>
<td>Window VT</td>
<td>0.7</td>
</tr>
</tbody>
</table>

## Roof

<table>
<thead>
<tr>
<th>Feature</th>
<th>Current Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof Type</td>
<td>Built-up/EPDM w/metal deck</td>
</tr>
<tr>
<td>Roof U-Value</td>
<td>U-0.056</td>
</tr>
</tbody>
</table>

## Wall

<table>
<thead>
<tr>
<th>Feature</th>
<th>Current Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior Wall Type</td>
<td>Mass Wall-5&quot; HW Concrete</td>
</tr>
<tr>
<td>Wall U-Value</td>
<td>U-0.077*</td>
</tr>
</tbody>
</table>

## Floor

<table>
<thead>
<tr>
<th>Feature</th>
<th>Current Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Coupling</td>
<td>Slab</td>
</tr>
<tr>
<td>Carpet Installed</td>
<td>No</td>
</tr>
</tbody>
</table>

## Shading

<table>
<thead>
<tr>
<th>Feature</th>
<th>Current Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior Shading Type</td>
<td>External overhang</td>
</tr>
<tr>
<td>Height Above Window</td>
<td>0 ft</td>
</tr>
<tr>
<td>Projection</td>
<td>2 ft</td>
</tr>
</tbody>
</table>

## Skylight

<table>
<thead>
<tr>
<th>Feature</th>
<th>Current Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skylights Installed</td>
<td>No</td>
</tr>
</tbody>
</table>

## Indoor Lighting

<table>
<thead>
<tr>
<th>Feature</th>
<th>Current Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting Type</td>
<td>Incandescent</td>
</tr>
<tr>
<td>Mounting Type</td>
<td>Recessed</td>
</tr>
<tr>
<td>Percent of Total Floor Area Served</td>
<td>100%</td>
</tr>
<tr>
<td>Occupancy Controls</td>
<td>Yes</td>
</tr>
<tr>
<td>Daylighting Controls</td>
<td>No</td>
</tr>
<tr>
<td>Lighting Power Density</td>
<td>2 W/ft²</td>
</tr>
</tbody>
</table>
Supporting Documents For Users

- Quick Start Guide
- Data Collection Form
- Priority Map
- Report Guide
- Building Upgrade Guide
2) Pilot Summary
Pilot Summary

• 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

- **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?
Climate Zone Locations

2012 Pilot

- Zone 5: 45%
- Zone 4: 26%
- Zone 3: 12%
- Zone 2: 7%
- Zone 1: 0%
- Zone 6: 10%

2013 Pilot

- Zone 5: 47%
- Zone 4: 35%
- Zone 3: 8%
- Zone 2: 5%
- Zone 1: 0%
- Zone 6: 5%

Map showing the climate zones of the United States with colors indicating the percentage of each zone.
Building Vintage

2012 Pilot

- Prior to 1980: 48%
- 1980 – 1989: 14%
- 1990 – 2004: 26%
- 2005 – now: 12%

2013 Pilot

- Prior to 1980: 47%
- 1980 – 1989: 16%
- 1990 – 2004: 18%
- 2005 – now: 19%

CBECS 2003 Building Vintage

- Prior to 1980: 59%
- 1980 – 1989: 26%
- 1990 – 2003: 15%
Score Summary

Score Summary for various building types over different years:
- Education (2012, 2013)
- Library (2013)
- Lodging (2013)
- Office (2012, 2013)
- Retail (2013)
- Warehouse (2012, 2013)
- Apartment (2013)

Graphs show the score and potential score for each type over the indicated years.
Change in Score: Current vs. Potential

- 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.

### Building Rank by Score

<table>
<thead>
<tr>
<th>Building Rank</th>
<th>Average Score</th>
<th>Average Potential</th>
<th>Average Change in Score</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Score (bottom 1/3)</td>
<td>31.7</td>
<td>60.5</td>
<td>28.8</td>
<td>91%</td>
</tr>
<tr>
<td>Average Score (mid 1/3)</td>
<td>56.2</td>
<td>75.5</td>
<td>19.2</td>
<td>34%</td>
</tr>
<tr>
<td>High Score (top 1/3)</td>
<td>79.1</td>
<td>88.0</td>
<td>8.9</td>
<td>11%</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Building Ranking</th>
<th>Lights</th>
<th>Wall</th>
<th>Roof</th>
<th>Floor</th>
<th>Window</th>
<th>Heating</th>
<th>Cooling</th>
<th>Hot water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Score</td>
<td>35%</td>
<td>18%</td>
<td>16%</td>
<td>16%</td>
<td>30%</td>
<td>13%</td>
<td>9%</td>
<td>26%</td>
</tr>
<tr>
<td>Average Score</td>
<td>30%</td>
<td>10%</td>
<td>17%</td>
<td>12%</td>
<td>20%</td>
<td>13%</td>
<td>5%</td>
<td>23%</td>
</tr>
<tr>
<td>High Score</td>
<td>34%</td>
<td>8%</td>
<td>18%</td>
<td>10%</td>
<td>26%</td>
<td>15%</td>
<td>3%</td>
<td>22%</td>
</tr>
</tbody>
</table>
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
Which of the following best reflects your experience with commercial buildings?
I am a...(select all that apply)

- Building Owner
- Building Operator
- Building Engineer or Building Energy Manager
- Property Manager
- Certified Energy Auditor
- Professional Engineer (P.E.)
- Registered Architect (R.A.)
- Building Service Provider
- Utility Energy Program Representative
- Non-Utility Energy Program Representative
- Other (please specify)
Did you encounter any problems gathering the Required Data?

- Information was not readily available for some of the data fields: 60%
- Some data were too cost prohibitive and/or time consuming to obtain: 20%
- I did not know how to make proper measurements for some of the data fields: 10%
- I did not understand what was being requested for some of the data fields: 10%
- Other: 0%
Post-rating Questionnaire

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

- Less than 2 hours
- 2-4 hours
- 4-6 hours
- 6-8 hours
- 8-12 hours
- More than 12 hours
- I was not involved in data collection

Second Pilot | First Pilot
How would you rate the tool on overall ease of data input?

- Simple: 24%
- Moderate: 51%
- Complicated: 22%
- Very Difficult: 3%

What problems arose during data entry?

- No problems arose during data entry: 0%
- Navigational issues within the tool: 25%
- Tool would not accept the data as entered: 45%
- Tool was slow: 20%
- Other (please specify): 10%
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.)

- Yes, because the Asset Score Report provides useful recommendations showing economic value
- Yes, because the difference between a building’s Current Score and Potential Score could motivate me to invest in energy efficiency improvements
- Yes, because it provides insight into a building’s infrastructure (envelope, lighting, HVAC equipment)
- No (please explain in comment box below)
Interest in Future Use

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

- Very likely: 30%
- Somewhat likely: 34%
- Don't know: 18%
- Not likely: 18%
4) Next Steps
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

**AEDG/AERG**
- Findings are used to guide the development of recommendation engine (outside of FEDS).

**SEED**
- Standard Energy Efficiency Data Platform
  - Buildings in BPD are currently missing asset data.
  - Difficult to translate geometry. Expect to be developed in BEDES.

**Building Component Library**
- Measures in BCL have no cost data.

**Energy Plus Simulation**
- Data Exchange

**OpenStudio**
- Additional EEM Recommendations

**Portfolio Manager**
- Deep Retrofit Option
- Basic Building Info & Energy Consumption

**Private Sector Software Tools**
- Scoring (thru API)
- Verified Building Data
Useful Links

- **Asset Score Website**

- **Asset Scoring Tool**
  [buildingenergyscore.energy.gov/](http://buildingenergyscore.energy.gov/)

- **Asset Score Email Box**
  [asset.score@ee.doe.gov](mailto: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.