ENERGY STAR Score for Retail Stores & Supermarkets
Plan for Updates with 2012 CBECS

April 27, 2016

Alexandra Sullivan
ENERGY STAR for Commercial Buildings
Agenda

- CBECS Overview
- EPA Update Schedule
- ENERGY STAR Score Methodology
- Retail and Supermarket Update
  - Objectives
  - Changes in the CBECS Survey
  - Opportunities for Input
- Next Steps
## CBECS 2012 Overview

- **2012 survey sample size is over 6,700 observations**
  - 29% larger than 2003 survey

- **Estimate 5.6 million commercial buildings representing 87 billion ft\(^2\)**
  - 14% increase in the number of buildings since 2003
  - 22% increase in floor space since 2003

- **EIA Data**
  - For updates and available microdata: [http://www.eia.gov/consumption/commercial/](http://www.eia.gov/consumption/commercial/)
  - EIA has already published some energy comparisons for 2003 and 2012

- **EPA Analysis**
  - Some provisional energy data shared by EIA
  - Able to embark on preliminary analysis

### Top Market Sectors

<table>
<thead>
<tr>
<th>Rank</th>
<th>Sector</th>
<th>Floor Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Office</td>
<td>16.0 Billion ft(^2)</td>
</tr>
<tr>
<td>2</td>
<td>Warehouse</td>
<td>13.0 Billion ft(^2)</td>
</tr>
<tr>
<td>3</td>
<td>Education</td>
<td>12.2 Billion ft(^2)</td>
</tr>
<tr>
<td>4</td>
<td>Mercantile (Retail &amp; Mall)</td>
<td>11.3 Billion ft(^2)</td>
</tr>
<tr>
<td>5</td>
<td>Lodging</td>
<td>5.8 Billion ft(^2)</td>
</tr>
</tbody>
</table>
CBECS 2012: Energy Use by Sector

- EIA has published a 2003 to 2012 comparison chart

- On the whole the aggregate intensity of commercial buildings is going down

- No statistically significant change for Retail
  - Takes into account the magnitude and also the number of observations
EPA Schedule for Score Revisions

• **Perform detailed analysis** (~18 months)
  – Hundreds of regression model formulations
  – Explore new variables captured by CBECS
  – Compare CBECS and Portfolio Manager Data
  – Determine appropriate changes to regression models used for score calculations

• **Program new scores into Portfolio Manager** (~6 months)
  – Document software requirements
  – Program code changes to the system
  – Perform extensive testing

• **Release new scores to the public**

→ **Tentative target release in early 2018**
Order of Analysis by Property Type

- Office & Retail
- Supermarket & Medical Office
  - Will be important to compare results with Retail and Office
- Hotel & K-12 School
- Warehouse & House of Worship

→ **Plan to focus on two models at a time** (for 3-4 months each)

→ **Once all models are completed will have some cross-model analysis and finalization**
Retail Schedule: Specifics

- The intensive review of CBECS for Retail is at the start of our 18 month review process
- The model may be re-visited based on what we learn from other sectors
- Near the end of the process, all models will be updated with the most current possible source factors prior to release

<table>
<thead>
<tr>
<th>Activity</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Launch</td>
<td>April 2016</td>
</tr>
<tr>
<td>Intensive Development</td>
<td>April – July 2016</td>
</tr>
<tr>
<td>Consideration of Supermarkets and Convenience Stores</td>
<td>June – September 2016</td>
</tr>
<tr>
<td>Recommendations for Next CBECS</td>
<td>October – November 2016</td>
</tr>
<tr>
<td>Re-Assess Model Based on Other Property Types</td>
<td>Ongoing, As Needed</td>
</tr>
<tr>
<td>Incorporate Revised Source Energy Factors</td>
<td>June – August 2017</td>
</tr>
<tr>
<td>Program and Test in Portfolio Manager</td>
<td>August – December 2017</td>
</tr>
<tr>
<td>Launch new Score</td>
<td>Early 2018</td>
</tr>
</tbody>
</table>
ENERGY STAR Score Objectives

- Reduce greenhouse gas emissions from energy use in buildings
  - Relies on actual, measured energy bill data

- Evaluate whole building energy use
  - Accounts for combined effects of technology, operation, maintenance, and usage patterns
  - Recognizes that these factors all affect each other and the bottom line measured energy consumption

- Motivate organizations to develop a strategic approach to energy management

- Provide a comparative, national benchmark
  - Adjusts for weather and certain business choices (e.g. hours of operation) for fair comparisons
  - Ranks performance relative to existing buildings in the market

- Identify best performers in the market, like the ENERGY STAR on products, so consumers and businesses can make smart choices
ENERGY STAR Score Development Process

• **Analyze national survey data**
  – Commercial Building Energy Consumption Survey (CBECS)

• **Develop regression models**
  – Normalize for different business activities
  – Assign a “normalized mean” to each property based on its operation

• **Compare actual energy use with normalized mean from the model**
  – More efficient: Actual < Normalized Mean
  – Less efficient: Actual > Normalized Mean

• **Create scoring lookup table**
  – Scores are based on the distribution of energy performance across commercial buildings
  – One point on the ENERGY STAR scale represents one percentile of buildings
What does a regression model look like?

- Example model

\[
\text{Energy Intensity} = C_0 + C_1 \times \text{Workers per 1,000 ft}^2 + C_2 \times \text{Computers per 1,000 ft}^2 + C_3 \times \text{Hours of Operation} + C_4 \times \text{Heating Degree Days} + \ldots
\]

- Coefficients represent average responses
- Coefficients provide adjustments for each operational characteristic
  - *Does not* add the kWh of each piece of equipment
  - *Does* adjust energy based on correlation between operating characteristic and energy use
### EPA Criteria for Inclusion in Analysis

- Focus on business activity/service provided
- Do not include variables for specific technologies:
  - For example: if 100% LED lighting saves energy, we don’t want to compare properties with 100% LED only to each other; we want to compare them to everyone. The least efficient among the buildings with 100% LED may still be better than the typical building without.

<table>
<thead>
<tr>
<th>✓ Characteristics Included</th>
<th>× Characteristics Excluded</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Describe how a building operates</td>
<td>× Describe why a building performs a certain way</td>
</tr>
<tr>
<td>✓ Explain physical conditions and parameters</td>
<td>× Specify technologies used</td>
</tr>
<tr>
<td>✓ Are determined by the business activity and needs</td>
<td>× Reflect market conditions that may motivate behavior but are not related to thermodynamic performance</td>
</tr>
</tbody>
</table>

*Examples: Hours, Workers, Floor Area, Computers, Weather*  
*Examples: Lighting Technology, Window Type, Energy Price*
Specific Example of Two Retail Stores

- **What is the Same?**
  - Size
  - Climate zone
  - Energy Use

- **What is Different?**
  - Hours of Operation
  - Number refrigerated cases
  - Score

- **Why?**
  - Retail B is expected to use more energy
    - Longer hours
    - More refrigerators
  - Since it is expected to use more, but actually uses the same \(\rightarrow\) it scores better

<table>
<thead>
<tr>
<th></th>
<th>Store A</th>
<th>Store B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>50,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Hours of Operation</td>
<td>70</td>
<td>95</td>
</tr>
<tr>
<td>Number Open/Closed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refrigerated Display Cases</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Expected EUI (kBtu/ft²)</td>
<td>140</td>
<td>185</td>
</tr>
<tr>
<td>Actual EUI (kBtu/ft²)</td>
<td>110</td>
<td>110</td>
</tr>
<tr>
<td>ENERGY STAR Score</td>
<td>65</td>
<td>81</td>
</tr>
</tbody>
</table>
**ENERGY STAR Score Interpretation and Application**

**The Score Does**

- Evaluate actual billed energy use
- Normalize for operational characteristics (e.g., size, number of workers, operating hours, climate)
- Express the performance of a building compared to its peers, as described by a nationally representative survey

**The Score Does Not**

- Sum the energy use of each piece of equipment
- Evaluate buildings relative to others in Portfolio Manager
- Normalize for technology choices or market conditions (e.g., type of lighting, energy price)
- Explain why a building operates as it does
How does EPA pick the “best” model?

- No single statistic will identify the best model
- EPA will review many alternatives (100+)
- Statistical properties of CBECs to assess:
  - Regression model statistics (F, p, $R^2$)
  - Individual variable statistics (t-stats)
- Additional factors evaluated with both CBECs and Portfolio Manager
  - Distribution of scores
    - Average score
    - Percent in each 10-point bin
    - Number and percent above 75
  - Residual plots
  - Scatterplots of score as compared with key characteristics (size, workers, hours, etc)
  - Physical understanding of results
  - Relationship between EUI and score

➔ Your data in Portfolio Manager helps us test the models!
Objectives: Retail Model Update

- Leverage the most recent market data
  - This will show us if retail stores are becoming more or less efficient
  - If the market is getting more efficient, then it may become harder to qualify for ENERGY STAR

- Re-assess key drivers of energy use
  - Has the relationship between hours and energy intensity changed in the last 10 years?
  - Are there new variables in CBECS that we should be adjusting for going forward?

- Explore the similarities between Supermarket and Retail
  - How do these types compare in terms of energy and operation?
  - Is it possible to leverage a single model? Would this avoid confusion for big box stores that straddle the definition?
  - If a lower size threshold were possible, could convenience stores be covered with one of these property types?
New Information in the CBECS Survey

• Change in question about “registers”
  – 2003: About how many cash registers are used in this building?
  – 2012: About how many cash registers or "point-of-sales" terminals are used in this building?
  – The new question appears to cover a wider spectrum of devices, which could have a different correlation with energy

• New question about refrigerated storage about “Large Cold Storage Areas”
  – New category of refrigeration, separate from walk-in
  – May be helpful in understanding stores that sell refrigerated products

• Also possible that trends for factors like hours and workers have changed
  – May be different typical values or changes in the correlation with energy
What should you expect?

• **Expect some changes**
  – Median energy use for a retail store or supermarket
  – Correlations between energy use and key activities (hours, workers, refrigerators)
  – Variables included in EPA’s model
  – *The scores of your properties!*

• **EPA’s Methodology will not change**
  – Provide a national level benchmark
  – Use source energy to provide equitable scores for all fuel mixes
  – Leverage ordinary least squares (OLS) regressions to assess factors that impact energy consumption
  – Incorporate variables that capture weather and business activity
  – Exclude from analysis terms about technology, in order to reward technology that saves energy
Opportunities for Involvement

- **Main Webinar Series**
  - Updates approximately every 6 months until Portfolio Manager launch
  - Hear the latest findings
  - Participate in polls, Ask questions & Offer observations
  - Next session: May 12
    - [https://esbuildings.webex.com/](https://esbuildings.webex.com/)

- **Retail Webinar Series**
  - Two more webinars between now and July (*peak development*)
  - Learn more detail about analytical results
  - Respond to polls to share your opinions and recommendations
  - Next session in late May/early June (date TBD)
    - [https://esbuildings.webex.com/](https://esbuildings.webex.com/)

- **Portfolio Manager Help Desk**
  - [www.energystar.gov/BuildingsHelp](http://www.energystar.gov/BuildingsHelp)
  - Every time you ask a question about your score, you contribute to our process!
  - You can always email us with suggestions or observations about our score and your portfolio
Kick-off Survey

• Available until this Friday, April 29
  – https://www.surveymonkey.com/r/EnergyStar_Retail_Score

• Tell us what you really think!
  – What are important factors with respect to energy efficiency?
  – How do you think the market has changed in the last 10 years?
  – Is there anything in particular you want EPA to analyze?
Schedule Reminder

• **Spring/Summer 2016**
  – Bulk of Retail analysis will occur over next 3-4 months

• **Fall 2016 – Spring 2017**
  – Focus will be on other property types (hotel, K-12, etc.)
  – Based on our findings we may revisit our retail analysis

• **Summer 2017**
  – Re-estimate all models with updated source factors

• **Fall 2017**
  – Programming/Testing in Portfolio Manager

→ **Hope is to launch new scores in early 2018**
Next Steps

• Take our kick-off survey by this Friday!
  – https://www.surveymonkey.com/r/EnergyStar_RetailScore

• Attend the May 12 webinar for the latest updates pertinent to all sectors
  – https://esbuildings.webex.com/

• Be on the lookout for our next Retail webinar in early June
  – Date TBD

• If you see something, say something
  – Feel free to reach out with suggestions or questions at any time: www.energystar.gov/BuildingsHelp

• EPA will be hard at work with regression analysis for the next 18 months 😊
Questions & Discussion