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

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ENERGY STAR for Commercial Buildings

EPA

Agenda

- CBECS Overview

- EPA Update Schedule

- ENERGY STAR Score Methodology

- Retail and Supermarket Update
  - Objectives
  - Changes in the CBECS Survey
  - Opportunities for Input
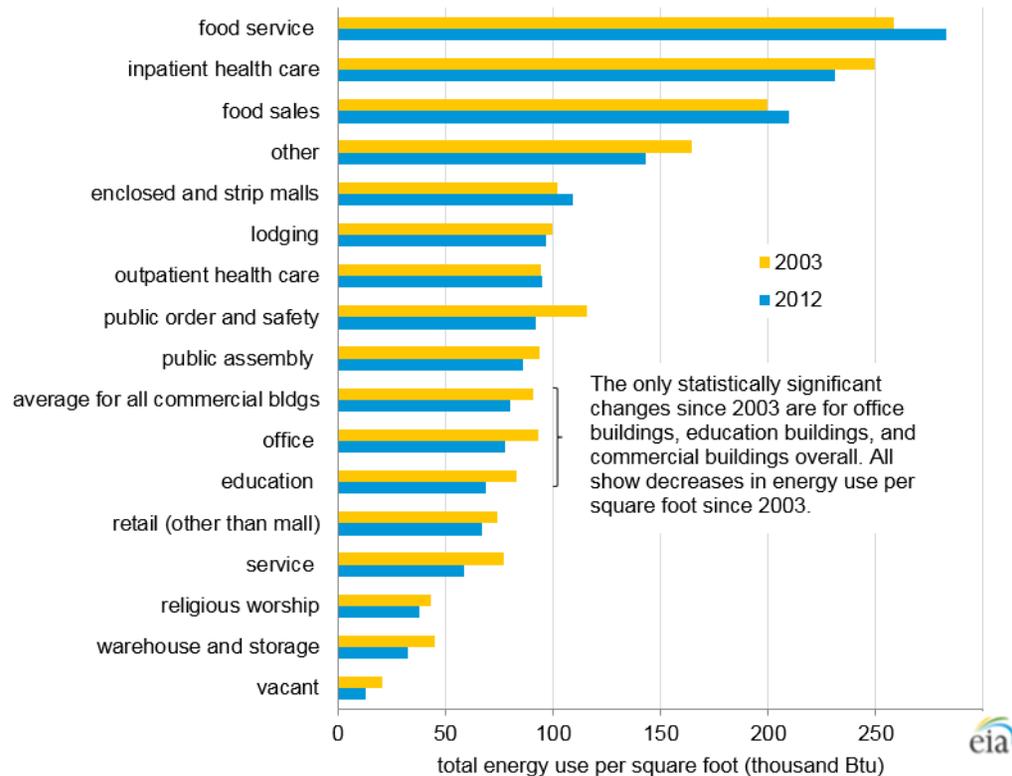
- Next Steps

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/
  - 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
1	**Office** 16.0 Billion ft2
2	**Warehouse** 13.0 Billion ft2
3	**Education** 12.2 Billion ft2
4	**Mercantile** (Retail & Mall) 11.3 Billion ft2
5	**Lodging** 5.8 Billion ft2

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

The only statistically significant changes since 2003 are for office buildings, education buildings, and commercial buildings overall. All show decreases in energy use per square foot since 2003.

total energy use per square foot (thousand Btu)

Source: U.S. Energy Information Administration, Commercial Buildings Energy Consumption Survey.

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

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

EPA

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

> **Energy Intensity =** C_0 +
> C_1* **Workers per 1,000 ft^2 +**
> C_2* **Computers per 1,000 ft^2 +**
> C_3* **Hours of Operation +**
> C_4* **Heating Degree Days + ...**

- – 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:
  - <u>For example</u>: 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.

✓ Characteristics Included	✗ Characteristics Excluded
✓ Describe how a building operates ✓ Explain physical conditions and parameters ✓ Are determined by the business activity and needs	✗ Describe why a building performs a certain way ✗ Specify technologies used ✗ Reflect market conditions that may motivate behavior but are not related to thermodynamic performance
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 → it scores better

	Store A	Store B
Size	50,000	50,000
Hours of Operation	70	95
Number Open/Closed Refrigerated Display Cases	2	7
Expected EUI (kBtu/ft2)	140	185
Actual EUI (kBtu/ft2)	110	110
ENERGY STAR Score	65	81

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/

- **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/

- **Portfolio Manager Help Desk**
  - 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