



# ENERGY STAR Score for Office Plan for Updates with 2012 CBECS



**April 26, 2016**

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# Agenda

- CBECS Overview
- EPA Update Schedule
- ENERGY STAR Score Methodology
- Office Update
  - Objectives
  - Changes in the CBECS Survey
  - Opportunities for Input
- Next Steps



# CBECs 2012 Overview

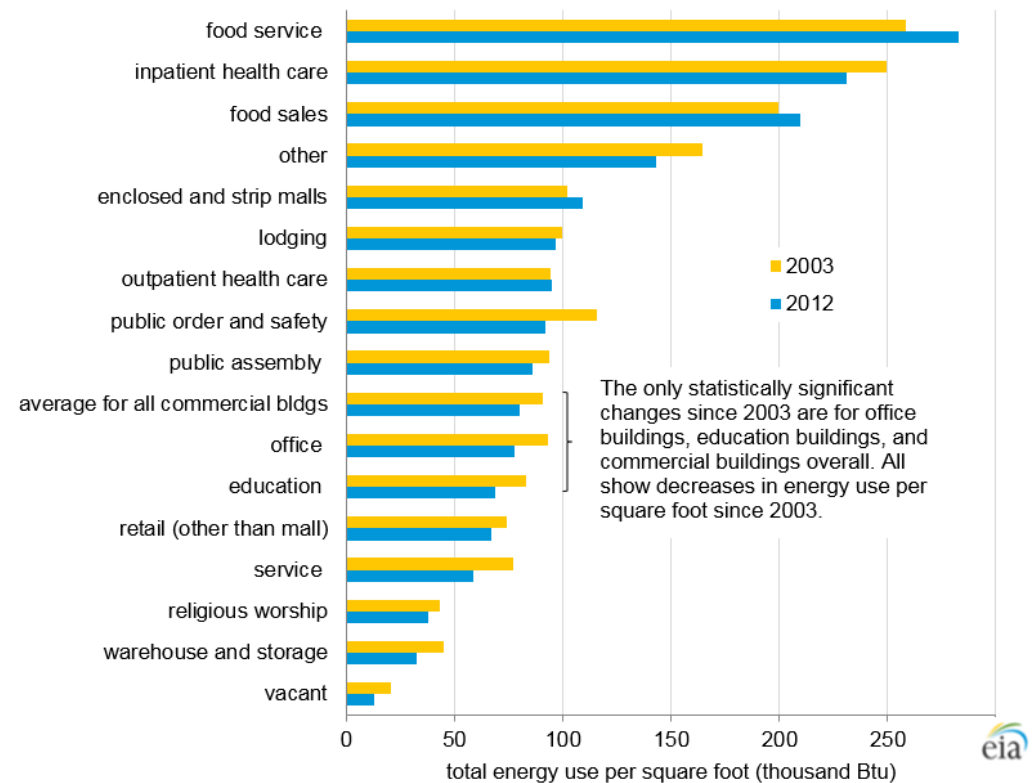
- **2012 survey sample size is over 6,700 observations**
  - 29% larger than 2003 survey
- **Estimate 5.6 million commercial buildings representing 87 billion ft<sup>2</sup>**
  - 14% increase in the number of buildings since 2003
  - 22% increase in floor space since 2003
- **EIA Data**
  - For updates 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	<b>Office</b> 16.0 Billion ft <sup>2</sup>
2	<b>Warehouse</b> 13.0 Billion ft <sup>2</sup>
3	<b>Education</b> 12.2 Billion ft <sup>2</sup>
4	<b>Mercantile (Retail &amp; Mall)</b> 11.3 Billion ft <sup>2</sup>
5	<b>Lodging</b> 5.8 Billion ft <sup>2</sup>



# CBECS 2012: Energy Use by Sector

- EIA has published a 2003 to 2012 comparison chart
- Offices
  - Overall intensity is lower in 2012
  - Difference is statistically significant
- Most sectors do not show a statistically significant change
  - Taking into account the magnitude and also the number of observations



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**



# Office Schedule: Specifics

- The intensive review of CBECS for Office 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 Medical Office	August – 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



# 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

$$\begin{aligned} \text{Energy Intensity} = & C_0 + \\ & C_1 * \text{Workers per 1,000 ft}^2 + \\ & C_2 * \text{Computers per 1,000 ft}^2 + \\ & C_3 * \text{Hours of Operation} + \\ & C_4 * \text{Heating Degree Days} + \dots \end{aligned}$$

- 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.

✓ Characteristics Included	✗ Characteristics Excluded
<ul style="list-style-type: none"> <li>✓ Describe how a building operates</li> <li>✓ Explain physical conditions and parameters</li> <li>✓ Are determined by the business activity and needs</li> </ul> <p><i>Examples: Hours, Workers, Floor Area, Computers, Weather</i></p>	<ul style="list-style-type: none"> <li>✗ Describe why a building performs a certain way</li> <li>✗ Specify technologies used</li> <li>✗ Reflect market conditions that may motivate behavior but are not related to thermodynamic performance</li> </ul> <p><i>Examples: Lighting Technology, Window Type, Energy Price</i></p>



# Specific Example of Two Offices

- **What is the Same?**
  - Size
  - Climate zone
  - **Energy Use**
- **What is Different?**
  - Number of workers, computers
  - Hours of Operation
  - **Score**
- **Why?**
  - Office B is expected to use more energy
    - More workers, computers
    - Longer hours
  - Since it is expected to use more, but actually uses the same → it scores better

	Office A	Office B
Size	200,000	200,000
Hours of Operation	50	110
Number of Workers	400	525
Number of Computers	410	550
Expected EUI (kBtu/ft <sup>2</sup> )	264.9	324.0
Actual EUI (kBtu/ft <sup>2</sup> )	193.3	193.3
ENERGY STAR Score	66	80



# 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<sup>2</sup>)
  - 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: Office Model Update

- Leverage the most recent market data
  - This will show us if offices 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 computers and energy intensity changed in the last 10 years?
  - Are there new variables in CBECS that we should be adjusting for going forward?



## New Information in the CBECS Survey

- **Three new variables in CBECS**

- Occupancy (%)
- Cubicle Space (%)
- Data Center size



*We do not yet know if these are correlated with energy use 😊*

- **Data Center opportunities**

- Looking at this data in CBECS and also in Portfolio Manager will help us better assess mixed use properties
- EPA is open to a new approach that may facilitate benchmarking of these properties without IT energy
- It is too early to say whether there will be any changes





# What should you expect?

- **Expect some changes**
  - Median energy use for an office
  - Correlations between energy use and key activities (hours, workers, computers)
  - Variables included in EPA's model
  - Adjustment/handling of data centers
  - ***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/>
- **Office Webinar Series**
  - Two webinars between now and July (*peak development*)
  - Two webinars in the fall (*Medical Office comparison and planning for next CBECS*)
  - Learn more detail about analytical results
  - Respond to polls to share your opinions and recommendations
  - Next session in early June (date TBD)
    - <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\\_Office\\_Score](https://www.surveymonkey.com/r/EnergyStar_Office_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 Office 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 office 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\\_OfficeScore](https://www.surveymonkey.com/r/EnergyStar_OfficeScore)
- Attend the May 12 webinar for the latest updates pertinent to all sectors
  - <https://esbuildings.webex.com/>
- Be on the lookout for our next 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](http://www.energystar.gov/BuildingsHelp)
- EPA will be hard at work with regression analysis for the next 18 months 😊

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## Questions & Discussion