EPA ENERGY STAR Score Update for Worship Facilities

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ENERGY STAR for Commercial Buildings

Agenda

- ENERGY STAR score overview
- Update to Worship Facility score using CBECS 2012
  - Objectives
  - New data available
  - Changes to the model
- Guidance moving forward

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The 1-100 ENERGY STAR score

ENERGY STAR Score Objectives

- Provide a comparative, national benchmark for your buildings energy performance
  - Provide a single score for a whole buildings energy use
  - Fairly compare buildings nationwide
  - Rank buildings relative to similar peer buildings
  - Compare buildings on a 1-100 percentile scale, where 50 represents median energy performance
- Identify and recognize best performers in the market
  - Score of 75 required to earn ENERGY STAR certification.
- Motivate organizations to develop a strategic approach to energy management
  - Buildings with low scores (under 25) have room for efficiency improvements and savings.
  - Track improvement with ENERGY STAR Score

ENERGY STAR Score Development Process

- **Analyze national survey data**
  - CBECS (Portfolio Manager Data is NOT used as an input)
- **Develop regression models**
  - Normalize for different business activities
  - Predict the average energy use for a building that operates just like yours (normalized mean)
- **Compare actual energy use with normalized mean from the model**
  - Actual < Normalized Mean → More efficient
- **Create scoring lookup table**
  - Lower ratio of actual EUI vs normalized mean results in higher ENERGY STAR Score

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What does a regression model look like?

- Example model

$$EUI = C_o + C_1 * Char_1 + C_2 * Char_2 + etc\ldots$$

  - Coefficient C_1 represents the average effect of the operational characteristic $Char_1$ on energy use intensity (EUI).
  - Coefficients provide adjustments for each operational characteristic

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EPA Criteria for Including Variables in Analysis

- Include key business activity/service provided variables
  - Examples: Workers, Cooking, Seating Capacity
- Do not include or normalize for variables for specific technology choices.
  - Examples: Lighting Technology, Window Type

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Example of Including Variables in model for score equitability

Predicted EUI = 106
Actual EUI = 70
ENERGY STAR Score = 66

Predicted EUI = 116
Actual EUI = 70
ENERGY STAR Score = 70

Operational Characteristic	Building #1		Building #2
Size	10,000	=	10,000
Seating Capacity	300	=	300
Weekly Operating Hours	40	=	40
% of Area Used for Food Preparation	5	<	8

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Example of Excluding Variables from model for score equitability

Predicted EUI = 106
Actual EUI = 70
ENERGY STAR Score = 66

Predicted EUI = 106
Actual EUI = 50
ENERGY STAR Score = 81

Operational Characteristic	Building #1		Building #2
Size	10,000	=	10,000
Seating Capacity	300	=	300
Weekly Operating Hours	40	=	40
% of Area Used for Food Preparation	5	=	5

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Data Available: New 2012 CBECS Survey Available

- Nationally representative survey of U.S. commercial buildings
- Collects energy usage data and building characteristics
- Published by EIA in 2016
  - More current data than 2003 CBECS used for current score
- Larger sample
  - 29% larger than 2003 (6,720 vs. 5,215 records)
- More buildings and bigger buildings in the U.S.
  - 14% increase in the total number of buildings
  - 22% increase in total building floor space

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Determining the Correct Model

- Statistical properties of CBECS data:
  - Regression model statistics (R^2)
  - Individual variable statistics (t-stats)

- Additional factors evaluated with both CBECS and Portfolio Manager
  - Distribution of scores
  - Scatterplots of score across key characteristics
  - Physical understanding of results
  - Relationship between EUI and score

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Objectives of Analysis and Score Update

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

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1-100 ENERGY STAR Score Update for Worship Facilities

Existing ENERGY STAR Worship Facility Score

- Developed using nationally representative CBECS 2003 data

- Contains adjustments for
  - o Seating Capacity
  - o Operating Hours and Days
  - o Computers
  - o Refrigeration
  - o Food Preparation
  - o Climate and Weather

- Updated Score scheduled to launch August 2018

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Update to Worship Facility Score - New 2012 CBECS Data

- **Decreased energy use**
  - Median energy use intensity for Worship Facilities has decreased from about 65 to about 56 kBtu/sqft a year
- **New variables in CBECS related to Worship Facilities**
  - Area devoted to commercial food preparation
  - Employee lounge, breakroom, or pantry

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New Worship Facility Model - Major Findings

Adjustments in Current Worship Facility Model - 2003 CBECS	Included in Updated Model - 2012 CBECS
Seating Capacity per 1000 sq. ft.	✓
Weekly Operating Hours	✓
Percent of the Building that is Heated and Cooled	✓
Weather and Climate (using Heating and Cooling Degree Days)	✓
Presence of Commercial Food Preparation (yes/no)	✓*
Number of Computers per 1000 sq. ft.	✗
Number of Open/Closed/Walk-in Refrigerators and Icemakers per 1000 sq. ft.	✗
Whether Facility is Open All 5 Weekdays (yes/no)	✗

** This is a percentage in the new model, rather than simply a Yes/No indicator.*

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New Worship Facility Model - Major Findings

- The average ENERGY STAR Score for Worship Facilities decreases by about 8 points
- Adjusts for fewer characteristics than previous model
  - Some characteristics found to no longer be statistically significant predictors of energy use
- New model still uses Seating Capacity per 1,000 sq. ft.
  - But a floor is now applied (next slide)
- New model adjusts for ***Percentage of Area*** used for Food Preparation
  - Rather than just a yes/no
- Model coefficients based off new updated 2012 data

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Adjusting for Seating Density

- CBECS 2012 data shows Seating Density is still a strong driver of energy use intensity in Worship Facilities

- However, Seating Density's effect on EUI is strongest for facilities with more than 40 seats per 1,000 sq. ft.

- New model uses adjusted seating density term with a floor at 40
  - Statistically significant
  - Provides adjustment for properties with higher-than-average seating density
  - Low-seating-density facilities are still scored equitably

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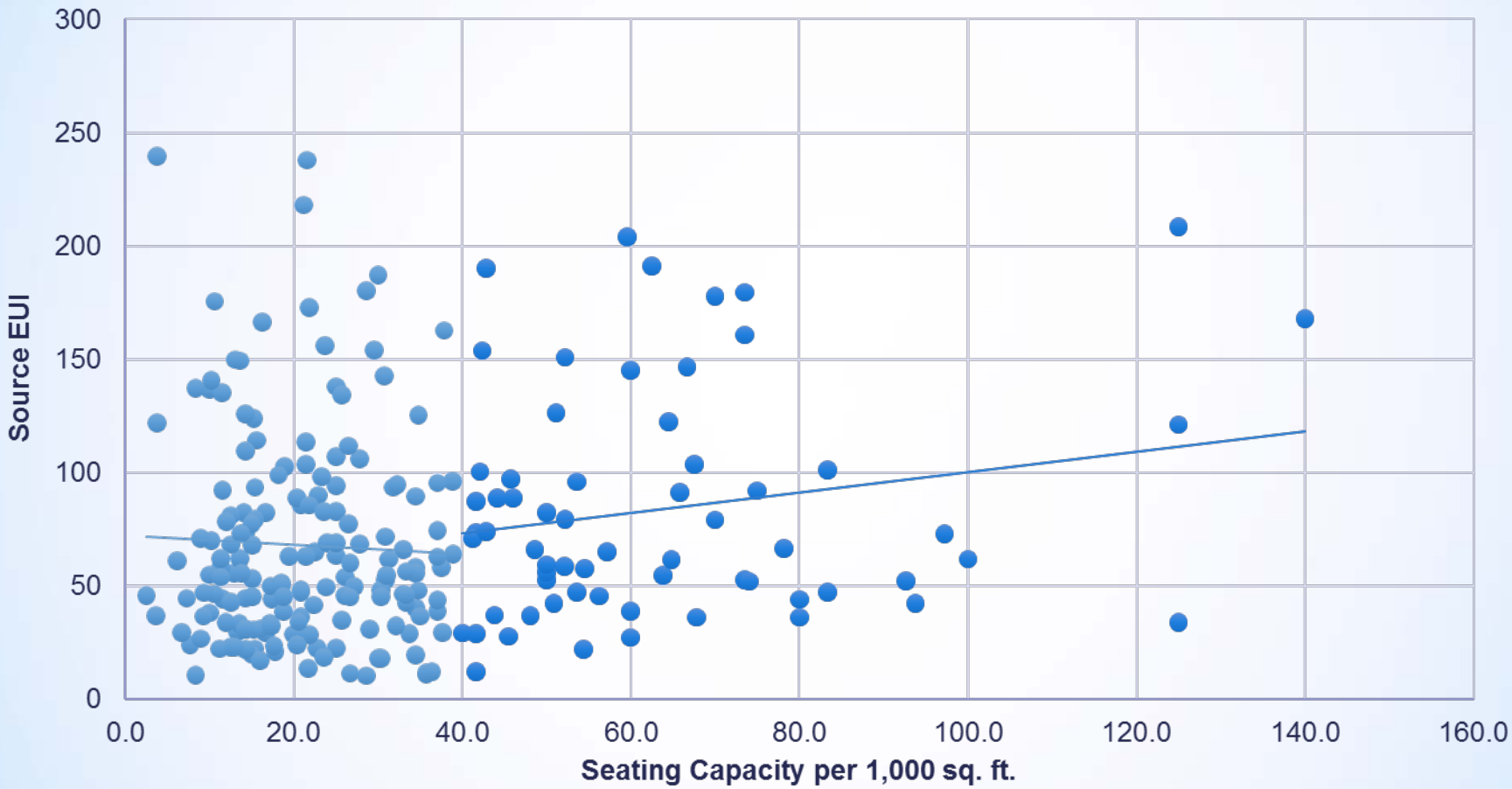
EUI vs. Seating Density – CBECS Data



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Adjusting for Food Preparation

- Existing model (2003 CBECS)
  - Adjusts for presence of commercial food preparation, as a "***Yes/No***" indicator.
  - Term was not significant for 2012 CBECS data.

- Updated Model (2012 CBECS)
  - 2012 CBECS includes new data on ***floor area*** devoted to food preparation.
  - New model adjusts for ***Percentage of Area*** used for Food Preparation
    - Capped at 10%

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Gross Floor Area Used for Food Preparation

- The Gross Floor Area Used for Food Preparation is the total size of all large/commercial kitchen areas used for the storage and preparation of food. This will be a subset of Gross Floor Area for the property. It should not include small kitchens, employee break rooms/pantries, concession stands, or service and seating areas.

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Entering Gross Floor Area Used for Food Preparation

- New field in Portfolio Manager that will go live with with the August 2018 score update.
- Initially the value will default to 0
  - No adjustment for food preparation
  - Inaccurate score for buildings that actually have food preparation space.
- If your property has food preparation space
  - You can login to Portfolio Manager and enter the area used for food preparation as soon as new scores launch in August 2018
  - Will result in the most accurate ENERGY STAR Score

Bias for or Against Business Characteristics

- Plot of ENERGY STAR Score vs. key building characteristics
  - Plots are examined to ensure there is no bias for or against any key characteristics.

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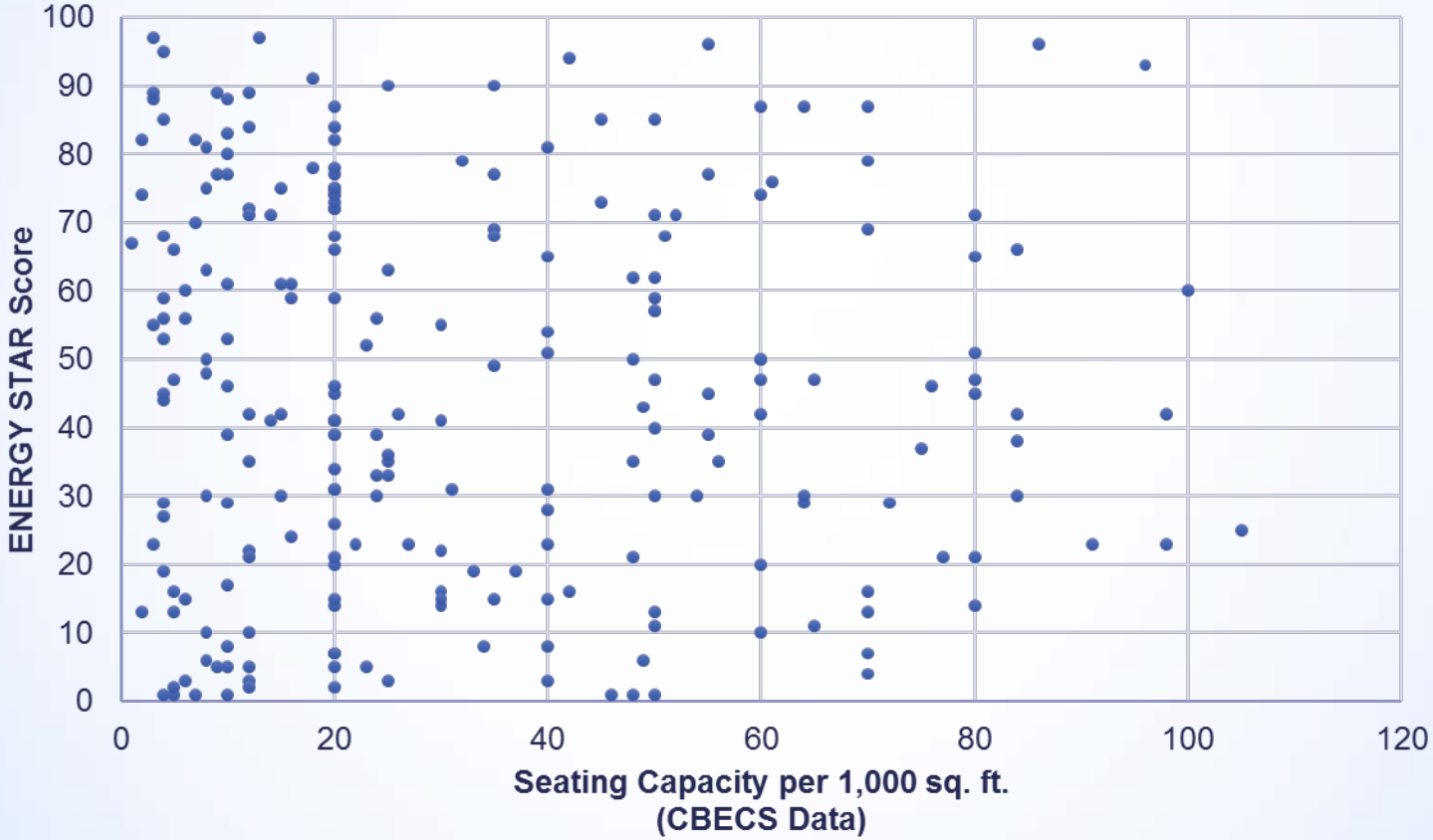
ENERGY STAR Score vs. Seating Density

- Seating Density included in model (with floor at 40).
- Scores are equitable across all values for Seating Density



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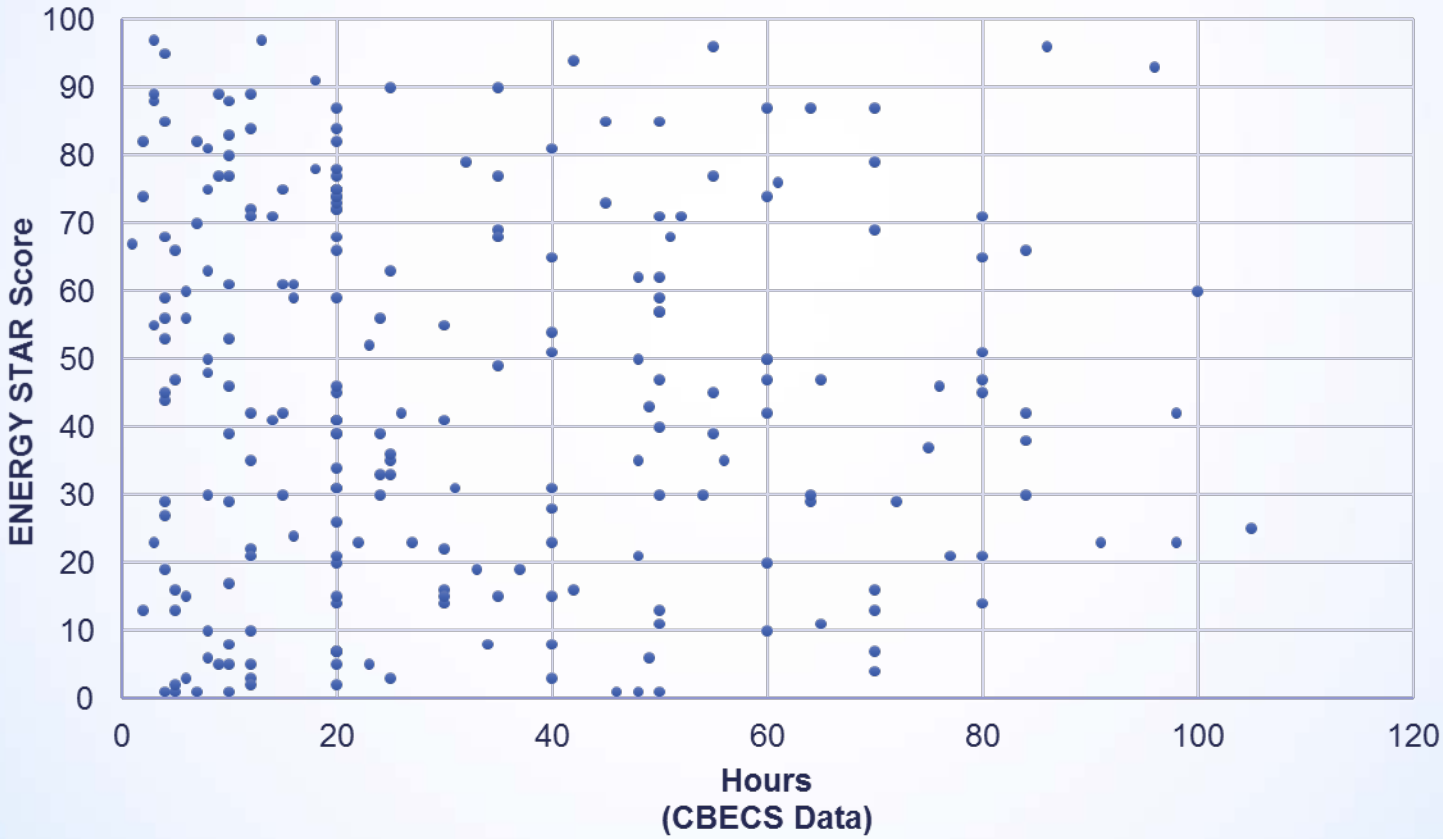
ENERGY STAR Score vs. Weekly Operating Hours

- Weekly operating hours included in model.
- Scores are equitable across all values for Weekly Operating hours



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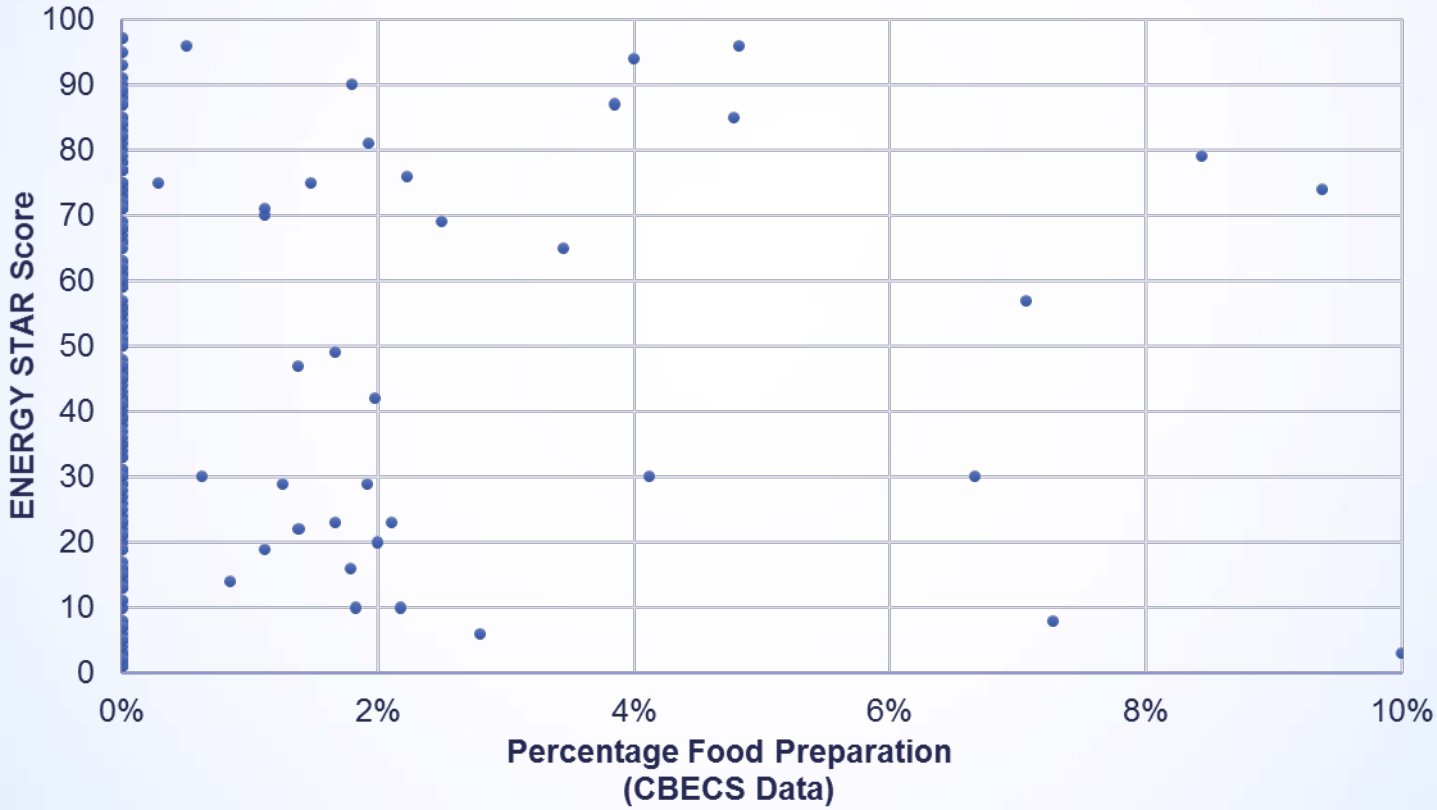
ENERGY STAR Score vs. Percentage of Area Used for Food Preparation

- % of area used for food preparation included in model.
- Scores are equitable across all values for % food preparation area



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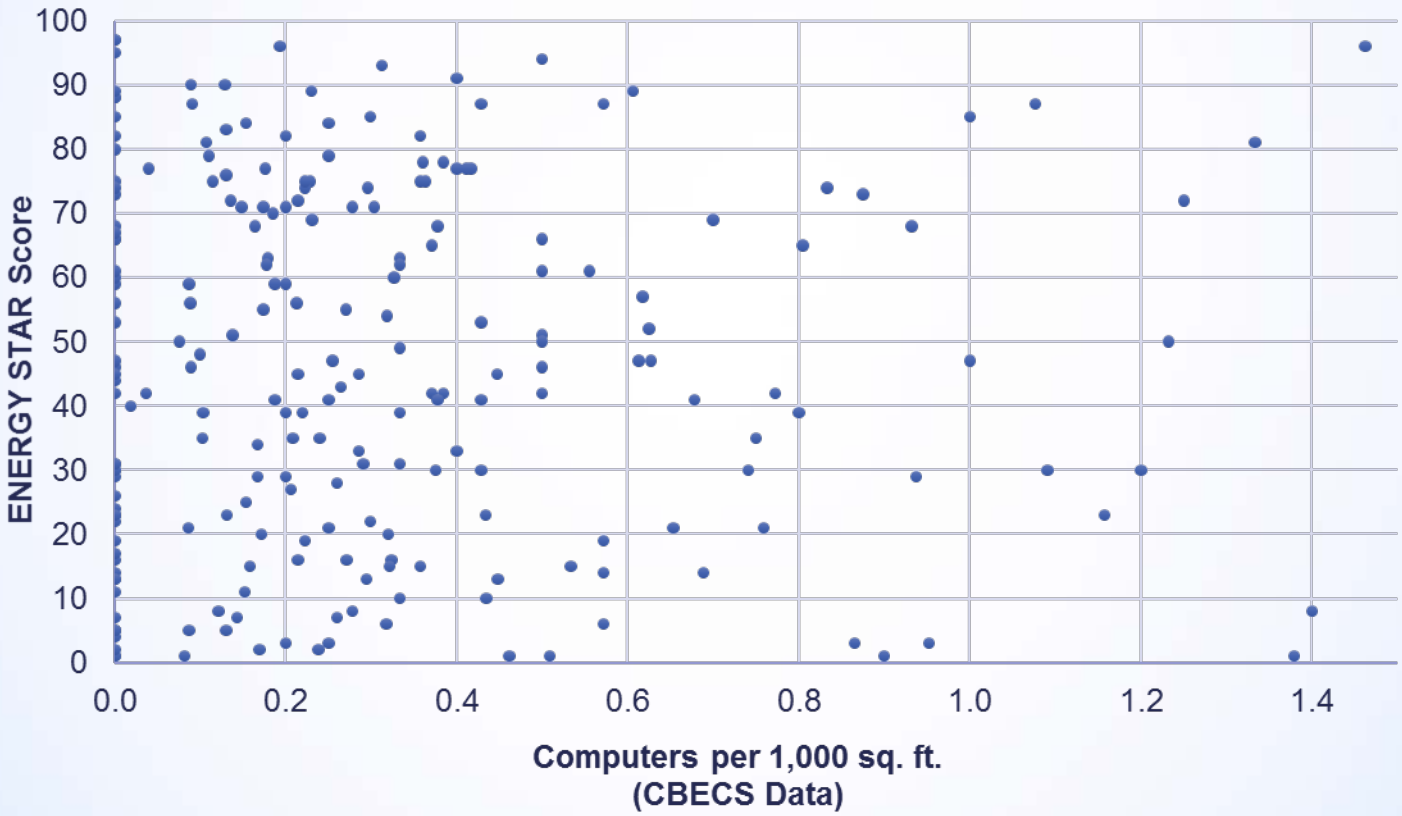
Business Characteristics NOT Included in the Model

- Analysis showed that certain characteristics were no longer needed in the model
  - Computer Density
  - Refrigeration Density
  - Whether Facility is Open All 5 Weekdays
- Still examined Graphs of score vs. characteristics NOT included in the regression model to ensure no bias.
  - ENERGY STAR Score is still equitable across all values of these characteristics

ENERGY STAR Score vs. Computer Density

- Computer Density not included in model.
- Scores are equitable across all values for Computer Density



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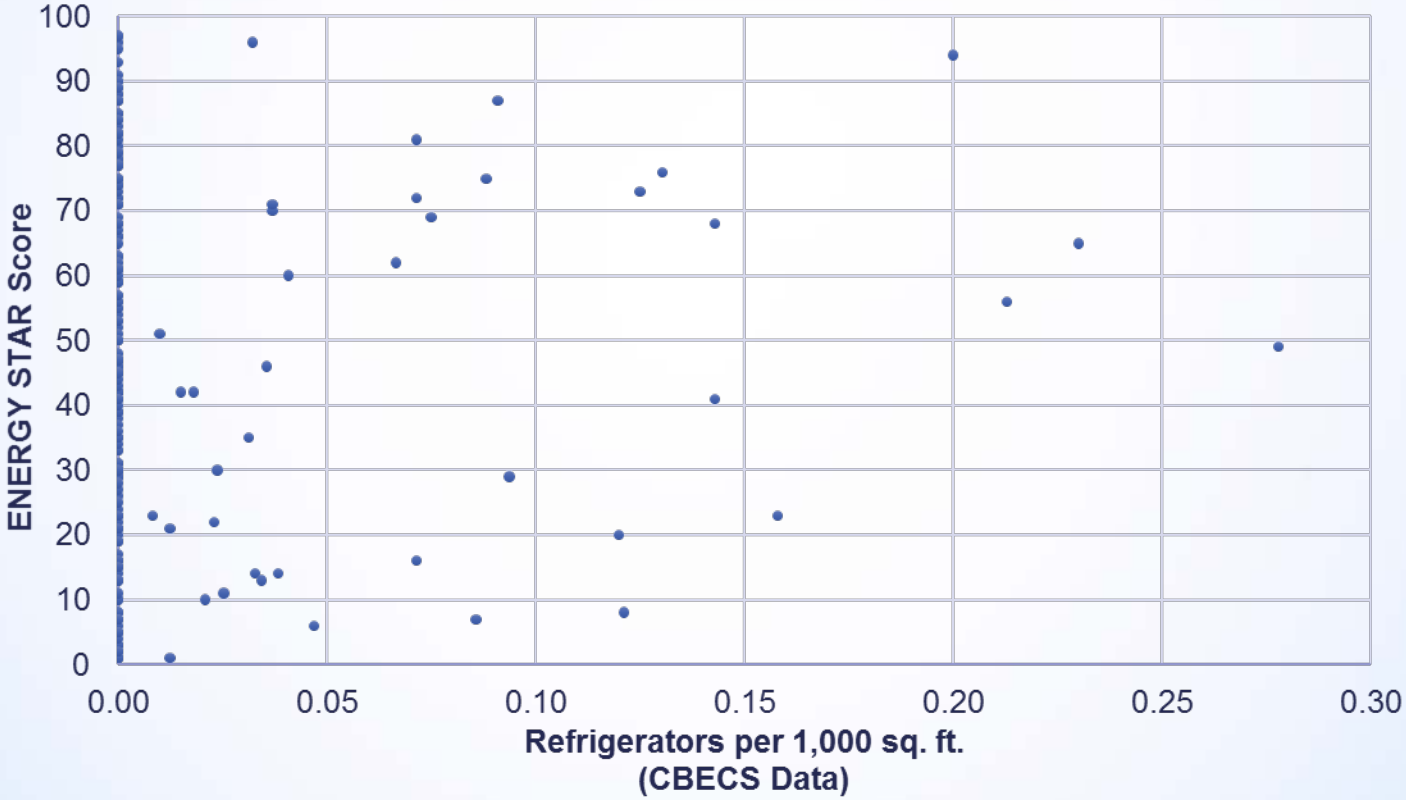
ENERGY STAR Score vs. Refrigeration Density

- Open/Closed/Walk-in Refrigeration Density not included in model
  - Statistically insignificant. Other variations of refrigeration variables were either insignificant or their physical interpretation did not make sense from an operations standpoint.
- Scores are equitable across all values for Refrigeration Density



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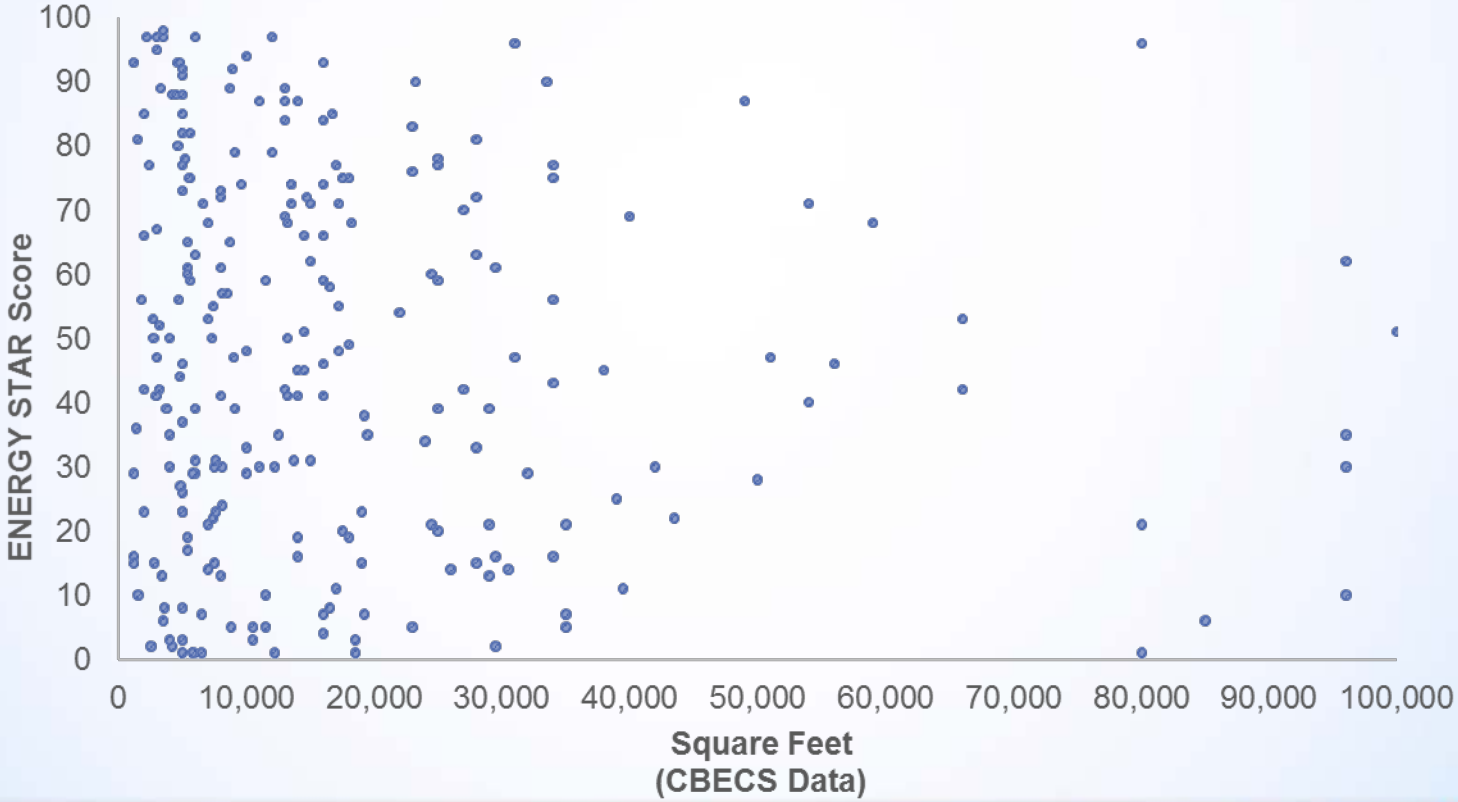
ENERGY STAR Score vs. Building Size

- Building Size (Gross Floor Area) not included in model.
- Scores are equitable across all values for Building Size



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Next Steps

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EPA Schedule for Score Revisions

- **Perform detailed analysis**
  - Started May 2016
  - Analyze energy performance by property type
  - Explore new variables captured by CBECS
  - Determine appropriate changes to regression models used for score calculations
- **Order of Analysis**
  - Office & Retail / Supermarket
  - Hotel & K-12 School
  - Warehouse & Worship Facility
- **Program new scores into Portfolio Manager**
  - Documentation / extensive testing
- **Release new scores to the public** (August *2018)*

What should you expect?

- **Expect some changes**
  - New user inputs in Portfolio Manager – “Gross Floor Area Used for Food Preparation”
  - ***The scores of your properties!***
- **EPA’s basic approach is not changing**
  - Provide a national level benchmark
  - Use regression models to assess/adjust for factors that impact energy consumption
  - Include variables that capture weather and business activity
  - Exclude technology variables, in order to reward technology that saves energy

Continue Benchmarking

- **There is time**
  - Score updates are not anticipated until August 2018.
  - We will give ample notice of the exact date.
- **Prepare for the update**
  - Buildings w/ food preparation - be prepared to enter % into Portfolio Manager August 2018
  - Score will be inaccurate until this information is entered
- **We will <u>not</u> revoke prior certifications**
  - All of your certified properties will still be on our registry.
  - If you have top performers that are not certified, now is a good time to pursue certification.

- Questions & Discussion

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