Presentation Agenda

• Overview of ENERGY STAR Score methodology
• Development of the Hospital ENERGY STAR Score model
• Details of the new model
  • What to expect and how to prepare
What is the ENERGY STAR 1-100 Score and how is it developed?
ENERGY STAR 1-100 Score

• Objectives:
  • Evaluate whole-building energy use
  • Provide a comparative, national benchmark
  • Identify top performers

• Principles:
  • Provide a percentile-based score that gives a comparison against “peer” buildings (buildings that operate just like yours)
  • Measure and compare variability in energy use among buildings
  • Adjust for various business activities to normalize (put all hospitals on a level playing field)
Score Development Process

• Analyze national building survey data

• Develop regression models
  • Normalize for different business activities (e.g., operating hours, weather)
  • Estimate the normalized mean energy use for a building that operates with the same characteristics (predicted average energy use for a building that operates just like yours)

• Compare actual energy use with the normalized means from the model to create energy efficiency ratios
  • If actual energy use is less than the normalized mean, the building is considered more efficient

• Create score lookup table
  • The cumulative distribution of efficiency ratios is plotted, and a best-fit curve is determined
  • The lookup table shows the energy efficiency ratio ranges at each percentile from 1 to 100
  • Lower ratio of actual energy vs. normalized mean energy results in a higher ENERGY STAR Score

• Test models on Portfolio Manager data and evaluate score changes
ENERGY STAR Regression Models

Energy Use Intensity = \( C_0 + C_1 \times \text{Char}_1 + C_2 \times \text{Char}_2 \ldots \)

- The constant \( C_0 \) represents the average EUI of the survey data
- Coefficients \( C_1 \) and \( C_2 \) represent the average effect of each operational characteristic (Char) on energy use intensity (EUI)
- Coefficients provide adjustments for each operational characteristic
  - *These do not* add the kWh of each piece of equipment
  - *These do* adjust normalized mean energy use based on correlation between operating characteristic and energy use
Hospital Model Update
Goals of Hospital Model Update

• Current model is getting old (compares today’s hospitals energy use and operations against 2008 dataset from ASHE Survey)

• Update to ASHE 2015 data for more up-to-date comparison
  • Do hospitals use more/less energy?
  • Has the relationship between energy use and business activities, weather, or climate changed?
  • Improve on any issues identified with the current model

• Limit market disruption for Hospital operators.
Hospital Model Update Timeline

2016 – 2017: ASHE survey data collection

Spring/Summer 2020: Discussing updates with stakeholders

February 2021: Updated model Release

November 2011: Current ENERGY STAR hospital model released

2018 – 2019: ENERGY STAR Model Development, including outreach and data verification with survey respondents

Fall 2020: Programming and testing in Portfolio Manager
Data Source

• The updated model was developed using data from the national ASHE 2015 Energy and Water Survey
  • Detailed information on building characteristics, use details, energy use, and water use
  • The same survey data is also being used to update the Medical Office Building model
• 173 hospitals provided complete responses to all fields considered necessary for the analysis (building size, key use details, energy usage, etc.)
Data Filtering

- **Completeness Filters**
  - Survey responses must provide annual energy data and report non-zero electric usage
  - Survey responses must report non-zero GFA, number of floors, number of staffed beds, and number of workers

- **Building Type, Analytical, and Program Filters**
  - Hospital type must be General Medical and Surgical (including Critical Access Hospitals and Cancer Centers)
  - Square footage of parking structures can’t exceed hospital GFA
  - Must have a GFA greater than 20,000 ft\(^2\)
  - Source EUI must be greater than 200 kBtu/ft\(^2\) and less than 700 kBtu/ft\(^2\)
  - Must have fewer than 1.2 staffed beds per 1,000 ft\(^2\)
  - Must have fewer than 0.015 MRI machines per 1,000 ft\(^2\)
# Data Source Summary

<table>
<thead>
<tr>
<th></th>
<th>ASHE 2008</th>
<th>ASHE 2015</th>
<th>Portfolio Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations (after filtering)</td>
<td>191</td>
<td>135</td>
<td>3,048</td>
</tr>
<tr>
<td>Average Source EUI</td>
<td>428</td>
<td>434</td>
<td>436</td>
</tr>
<tr>
<td>Average GFA</td>
<td>448,061</td>
<td>596,733</td>
<td>637,635</td>
</tr>
<tr>
<td>Average FTE density</td>
<td>2.60</td>
<td>2.53</td>
<td>2.58</td>
</tr>
<tr>
<td>Average CDD</td>
<td>1,392</td>
<td>1,569</td>
<td>1,571</td>
</tr>
<tr>
<td>Average HDD</td>
<td>4,463</td>
<td>3,860</td>
<td>4,076</td>
</tr>
<tr>
<td>Maximum HDD</td>
<td>10,990</td>
<td>9,704</td>
<td>12,298</td>
</tr>
</tbody>
</table>

*averages are weighted
ASHE Data Verification

- EPA and ASHE followed up with 20 survey respondents to verify survey responses for key use details
- 7 respondents confirmed the correct information for their property and these observations were returned to the data set
- This verification increased observation count and ensured the quality and accuracy of data
Survey Weights

• The filtered ASHE survey data included a disproportionately large number of responses from hospitals in the South and Midwest.

• To account for this, we calculated and applied survey sample weights by geographic region:

\[
\text{Observation weight} = \frac{\text{Total number of hospitals in the region}}{\text{Total number of survey responses from the region}}
\]

• The total number of hospitals in each region were obtained through market data from the Department of Homeland Security.
Survey Terms Tested

• Numerous models were tested to find the combination of statistically significant operating characteristics that best explain variance in energy use.

• The following ASHE fields were reviewed and considered for inclusion in the model:
  
  - Building Square Footage
  - Number of Floors
  - Number of Licensed Beds
  - Number of Staffed Beds
  - Number of Inpatient Days
  - Number of Outpatient Visits
  - Number of Full-time Equivalent Workers
  - Number of Workers on the Main Shift
  - Number of MRI Machines
  - Number of CAT/CT Scan Machines
  - Number of PET Machines
  - Number of Fixed X-Ray Machines
  - Number of Operating/Surgical Rooms
  - Number of Delivery Rooms
  - Number of Trauma Rooms
  - Number of Catheterization and Surgical X-Ray Rooms
  - Number of Intensive Care Unit Rooms
  - Presence of Commercial Kitchens
  - Presence of Onsite Laundry
  - Pounds of Laundry Processed Onsite
  - Cooling Degree Days
  - Heating Degree Days
  - Percent That Can Be Cooled
  - Percent That Can Be Heated
Weather Adjustment - Methodology

• Because heating and cooling are inversely related, it can be difficult to capture the full effects of both in a model.
  • Especially challenging with hospitals unique heating/cooling operations

• **DOE Commercial Building Reference** data was used to evaluate the relationship between HDD and heating energy use, and CDD and cooling energy use in reference hospitals.
  • Setting the HDD and CDD terms equal to the values found in this engineering analysis reduced score bias
  • This approach is consistent with the HDD adjustment used in the current ENERGY STAR model for offices
Updated Model

<table>
<thead>
<tr>
<th>Model Term</th>
<th>Current Hospital Model (Based on 2008 ASHE)</th>
<th>New Hospital Model (Based on 2015 ASHE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-time Equivalent Workers per 1,000 ft²</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Staffed Beds per 1,000 ft²</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>MRI Machines per 1,000 ft²</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Cooling Degree Days (CDD)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Heating Degree Days (HDD)</td>
<td>✗</td>
<td>✓</td>
</tr>
</tbody>
</table>
# Updated Model

<table>
<thead>
<tr>
<th>Model Term</th>
<th>Current Hospital Model Coefficient</th>
<th>New Hospital Model Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>427.9</td>
<td>433.6</td>
</tr>
<tr>
<td>Full-time Equivalent Workers per 1,000 ft²</td>
<td>24.04</td>
<td>21.55</td>
</tr>
<tr>
<td>Staffed Beds per 1,000 ft²</td>
<td>96.63</td>
<td>106.1</td>
</tr>
<tr>
<td>MRI Machines per 1,000 ft²</td>
<td>7,593</td>
<td>7,673</td>
</tr>
<tr>
<td>Cooling Degree Days (CDD)</td>
<td>0.01675</td>
<td>0.01825</td>
</tr>
<tr>
<td>Heating Degree Days (HDD)</td>
<td>✗</td>
<td>0.001752</td>
</tr>
</tbody>
</table>
• With a percentile model, we expect to see ~10% of properties in each of the above score bins.
• The updated model has a more even score distribution than the current model
• The average score change for Portfolio Manager hospitals is about +1.4 points
• ~95% of hospitals will experience score changes ranging from -2 to +5 points
Expected Score Changes

- The lack of spread in this graph indicates that expected score changes from the updated model are minor.
How to Prepare

- Document pre-update ENERGY STAR scores before February 21, 2020
  - All scores, including all historical scores, are updated each time EPA updates the models behind the 1-100 ENERGY STAR scores. After each score update, your previous scores are no longer accessible in Portfolio Manager.
  - To document pre-update scores, use Portfolio Manager to run a “Performance Highlights” standard report or create a custom report then download and save those reports.
  - Portfolio Manager will be unavailable on February 21, 2021 while EPA conducts the software release -- save reports before this date.

- Apply for ENERGY STAR Certification before the update…especially if your score is close to 75

- EPA will not rescind prior ENERGY STAR certifications.
Summary

- EPA plans to release the updated hospital model in Portfolio Manager on February 22, 2021.
  - Once the new model is released, all hospital scores will be calculated with the new model. If you would like to keep a record of scores from the current model, we encourage you to pull reports before the update.
  - EPA will notify users well in advance before the model goes live in Portfolio Manager.
- This model now includes an adjustment for heating degree days (HDD).
- Users will not be required to input any additional use details to receive a score.
  - HDD is calculated by Portfolio Manager based on your property’s address.
- Hospitals can expect to see relatively minor score changes, and most will experience slight score increases.
- Prior to February 21, 2020: Document pre-update scores as needed and apply for ENERGY STAR certification.