ENERGY STAR® PortfolioManager® Technical Reference

Analysis and Key Findings from EPA's Review of the ENERGY STAR Model for K-12 School Properties

On August 26, 2018, EPA updated the ENERGY STAR score models and related performance metrics for U.S. buildings in ENERGY STAR Portfolio Manager® based on the most recent market data available. The data shows that energy use and business practices in U.S. commercial buildings have undergone substantial change since EPA last updated the ENERGY STAR score models. These important changes require that EPA update the score models so that they are as reflective as possible of current market trends and performance.

On September 13, 2018, EPA implemented a review period, during which we solicited feedback on the application of the models to various commercial building sectors and the resulting scores. The review period included three phases: gathering feedback; analyzing the models and evaluating score changes on buildings benchmarking in Portfolio Manager; and communicating the results. With this document, we are communicating the results and concluding our review period for the K-12 schools ENERGY STAR model.

During the feedback phase, we heard from several partners about trends they observed in the scores of their buildings. Four partners provided specific feedback about K-12 schools, noting that scores of individual buildings changed more than expected. This feedback was very helpful during the analysis phase in focusing our efforts on the factors that changed from the previous model. We looked at each of these factors extensively and determined that, while there is a wide variation in score changes, the model is scoring K-12 schools properly.

Background on Underlying Industry Data

The current model for K-12 schools was developed using data collected for the Energy Information Administration's (EIA) 2012 Commercial Building Energy Consumption Survey (CBECS). The previous model was developed using data from the 2003 CBECS. EPA had planned to update the model in the intervening years, using data from a 2007 CBECS. However, EIA did not publish the 2007 survey data, after determining that it did not meet their rigorous quality standards.

Between 2003 and 2012 the stock of K-12 school buildings in the United States experienced important changes, as illustrated in the table below. The estimated number of K-12 school buildings decreased by 5%, while the total floorspace increased by 26% -- in other words, the average K-12 school building was larger in 2012 than in 2003. Over this time, the average energy use per building decreased by 19% in terms of site energy use intensity (EUI) and 13% in terms of source EUI.

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Changes in U.S. K-12 School Buildings (CBECS Data) from 2003-2012

CBECS Year	Number of K-12 Buildings in US	Floorspace (million sf)	Average Site EUI	Average Source EUI*
2003	245,000	7,265	72.3	135
2012	232,000	9,175	58.4	118

**Calculated using new ENERGY STAR source factors from August 2018*

Review Period Key Findings

Key Finding #1: The model is working as intended

After extensive analysis, EPA has concluded that the K-12 school model is working as intended to deliver appropriate energy performance metrics. Based on these results, no further changes have been made to the performance metrics released in August 2018. ENERGY STAR certification for K-12 schools will resume on May 20, 2019.

Key Finding #2: The relationship between K-12 school energy use and computer density has changed

In 2003, data for the U.S. population of K-12 schools showed a statistically significant positive relationship between computer density and energy use per square foot. This relationship between computer density and energy use per square foot was no longer statistically significant in the current (2012) data after accounting for workers per square foot, cooking facilities, and other use details. Removing the adjustment for computer density means that K-12 schools with higher computer density were more likely to see greater score drops relative to the previous model. The average scores in Portfolio Manager with the current model demonstrate that it scores K-12 schools across the range of computer density values relatively evenly.

Key Finding #3: A majority of K-12 schools are using default values for number of workers

With the introduction of the current model, the Number of Workers on Main Shift became a required use detail that contributes to a user's ENERGY STAR score. Previously, this was an optional use detail, and most users chose to use default values to approximate their worker count. Now that this term is included in the model and impacts scores, it is important for users to replace default values with data based on actual activity at the K-12 school building.

We encourage users to enter the actual value for Number of Workers, as well as any other defaulted values — you may see significant changes in your K-12 school ENERGY STAR score.

The rest of this document provides additional details about the ENERGY STAR model for K-12 school properties and the results of the score review analysis.

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Summary of Review Period Feedback, Analysis, and Findings

During the review period, we solicited feedback from all ENERGY STAR stakeholders, including all Portfolio Manager users and ENERGY STAR partners. In total, we received nine survey responses from organizations that have K-12 properties as part of their building portfolio. Of these, four provided substantive feedback on the K-12 school model. All responses mentioned that the percentage of previously ENERGY STAR certified buildings that fell below a score of 75 with the new model was higher than expected.

An individual K-12 school's change in score is the result of interactions among the components of the model, and difficult to attribute to a single factor. The fuel mix of a building, the amount of energy used, the building activity level, and how the combination of these factors compares to the U.S. population of K-12 schools on a percentile scale all influence the change in score.

In developing the current K-12 school model, EPA analyzed the potential impact of dozens of factors on K-12 school energy use. The final model adjusts for those factors in the table below, which shows what changed from the previous to the current model.

Changes in K-12 School Model Adjustments

Adjustments in Previous K-12 School Model Based on 2003 CBECS	Kept?	Adjustments in Current K-12 School Model Based on 2012 CBECS
Open Weekends (yes/no)	✓	Open Weekends (yes/no)
Presence of Cooking (yes/no)	✓	Presence of Cooking (yes/no)
Whether or not the building is a high school (yes/no)	✓	Whether or not the building is a high school (yes/no)
Weather and Climate (Heating and Cooling Degree Days)	✓	Weather and Climate (Heating and Cooling Degree Days)
Percent of the Building that Can be Heated or Cooled	✓	Percent of the Building that Can be Heated or Cooled
N/A	NEW	Number of Workers on Main Shift per 1,000 square feet
Number of Personal Computers per 1,000 square feet	×	N/A
Building Size	×	N/A
Number of Walk-in Refrigerators	×	N/A

✓ Kept
× Deleted

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Our analysis found that two of these changes had a relatively large influence on score variation:

1) Number of Computers
2) Number of Workers

Both are discussed in detail below.

K-12 schools were receiving an adjustment for computer density that is no longer appropriate for current market conditions

Since the release of the previous K-12 school model, there have been significant changes in how technology is integrated into K-12 schools. Currently, computers have a widespread presence in many schools; some school districts assign each student their own personal laptop. Today's computers are more efficient and use less energy than those used in schools in the early 2000s. In some cases, computers are now charged at home and never actually use energy at the school building itself. Additionally, a variety of devices may be used in a similar capacity, such as desktop computers, laptops, Chromebooks/netbooks, tablets, iPads, etc.

Prior to the August 2018 update, the K-12 school model produced scores based, in part, on the relationship observed between energy use and computers in the 2003 CBECS data. This relationship no longer reflects market conditions. Consequently, many K-12 schools with a substantial number of new, efficient computing devices – and therefore a high value for computer density – were receiving a large energy adjustment, and therefore higher scores, under the previous K-12 school model.

Removing the adjustment for computer density means that buildings with high computer density were more likely to see large score drops. This does not indicate a bias against buildings with high computer density in the current ENERGY STAR scores. Rather, the current model better reflects the characteristics of today's K-12 school buildings.

In the table below, the second column shows that the previous ENERGY STAR score for K-12 schools in Portfolio Manager increased with computer density. K-12 schools with 0 to 2 computers per 1,000 square feet had an average score of 65, while schools with greater than 4 computers per 1,000 square feet had an average score of 80 under the previous model. The average scores in Portfolio Manager with the current model demonstrate that it scores K-12 schools of all computer densities relatively evenly. Similarly, the percent of properties scoring 75 or above with the current model is more even across all computer densities.

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ENERGY STAR Score vs. Computer Density (Portfolio Manager Buildings)

Computer Density (units per 1,000 sq. ft.)	Average Score Previous K-12 Model	Average Score Current K-12 Model	Percent scoring 75 or above (Previous Model)	Percent scoring 75 or above (Current Model)
0 – 2	65	56	46%	29%
2 – 4	73	58	59%	30%
4+	80	56	71%	28%

Number of Workers is now a required use detail and users should update default values

The use detail Number of Workers on Main Shift is now required to calculate an ENERGY STAR score. Previously, this was an optional field that was not included in the calculation of ENERGY STAR scores, and users could choose to use a default value based on the school's Gross Floor Area. Our analysis found that a majority of K-12 schools are using a default value for Number of Workers. These K-12 schools could see changes in their current scores once users replace the assigned default values with the actual number of workers.

Other variables were studied and found to be appropriately accounted for in the model

Prior to releasing the current score model in August 2018, EPA evaluated many other building and operating characteristics to ensure the model scores different types of K-12 schools appropriately. During the review period, we verified that the current model produces more balanced scores than the previous model for K-12 schools across various hours of operation, number of workers, school types (e.g., elementary, middle, or high school), climates, regions, year of construction, and more.

The results fall within the expected average score and percentile distribution

The ENERGY STAR score is intended to represent a percentile ranking of the K-12 school building population, with a score of 50 indicating a K-12 school with median energy performance, and a score of 75 – 100 indicating performance in the top 25% of the K-12 school building population.

In the current K-12 school ENERGY STAR model, the average score is 56, and 29% of K-12 schools score 75 or above. In the previous model, the average score was 70, and 54% of K-12 schools were scoring 75 or above, as illustrated in the table below.

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Average K-12 School Score and Percent Scoring ≥75 (Portfolio Manager buildings)

	Average ENERGY STAR Score	Percent scoring 75 or above
Previous K-12 School Model	70	54%
Current K-12 School Model	56	29%

Additional Resources

- General Information on ENERGY STAR Score Updates
- ENERGY STAR Score for K-12 Technical Reference
- Number of Workers on Main Shift