

Analysis and Key Findings from EPA's Review of the ENERGY STAR Model for Warehouse and Distribution Center 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 warehouse and distribution center ENERGY STAR model.

During the feedback phase, we heard from several partners about trends they observed in the scores of their buildings. Two partners provided specific feedback about warehouses, noting that scores of individual buildings changed in unexpected ways. 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 the model is scoring warehouses properly.

Background on Underlying Industry Data

The current model for Warehouse and Distribution Centers 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 warehouse buildings in the United States experienced important changes, as illustrated in the table below. The estimated number of warehouse buildings increased by 33%, while the average energy use decreased by 27% in terms of site energy use intensity (EUI) and 12% in terms of source EUI.



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Changes in U.S. Warehouse and Storage Buildings (CBECS Data)

CBECS Year	Number of Warehouse Buildings in US	Floorspace (million sf)	Average Site EUI	Average Source EUI*
2003	597,000	10,078	45.2	82.4*
2012	796,000	13,077	32.8	72.4*

*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 Warehouse and Distribution Center 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 warehouses and distribution centers will resume on May 1, 2019.

Key Finding #2: Large warehouses no longer use more energy per square foot

In 2003, data for the US population of warehouses showed a statistically significant positive relationship between building size and energy use per square foot. This relationship between size and energy use per square foot was no longer statistically significant and is not seen in the current (2012) data. Removing the adjustment for warehouse size means that larger warehouses were more likely to see greater score drops relative to the previous model, and the average scores in Portfolio Manager with the current model demonstrate that it scores warehouses of all sizes relatively evenly.

Key Finding #3: A significant portion of warehouses could raise their ENERGY STAR scores by replacing default values with actual use details

Analysis also showed that, for a significant portion of warehouses in Portfolio Manager, default values for certain use details are influencing scores. With the introduction of the current model, the Percent Used for Cold Storage value was defaulted to 0 for all non-refrigerated warehouses/Distribution Centers and to 50 for all refrigerated warehouses. These default values are intentionally conservative. We encourage users to enter the actual values for cold storage, as well as any other defaulted values – you may see significant changes in your warehouse ENERGY STAR scores.

The rest of this document provides additional details about the ENERGY STAR model for Warehouse and Distribution Center 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 Portfolio Manager users and ENERGY STAR partners. In total, we received nine survey responses from organizations that have warehouse properties as part of their building portfolio. Of these, two provided substantive feedback on the warehouse model. Both responses mentioned that the EPA-published average score drop of seven was not a good indicator of what to expect for individual warehouses, and that certain properties experienced much larger drops than the average.

An individual warehouse’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 warehouses on a percentile scale all influence the change in score.

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

Changes in Warehouse Model Adjustments

Adjustments in Previous Warehouse Model Based on 2003 CBECS	Kept?	Adjustments in Current Warehouse Model Based on 2012 CBECS
Number of Workers per 1,000 square feet	✓	Number of Workers per 1,000 square feet
Weekly Operating Hours	✓	Weekly Operating Hours
Percent of the Building that is Heated and Cooled	△	Percent of the Building that is Heated and Cooled/Cold Storage
Weather and Climate (using Heating and Cooling Degree Days)	✓	Weather and Climate (using Heating and Cooling Degree Days)
Whether or not the Building is a Refrigerated Warehouse	△	Percent Cold Storage Space
Number of Walk-in Refrigerators per 1,000 square feet		
Square Feet	✗	N/A

✓ Kept △ Kept with changes ✗ Deleted

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

- 1) Warehouse size (square feet)
- 2) Refrigeration



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Both are discussed in detail below.

Larger warehouses were receiving an adjustment for size that is no longer reflected in current CBECS data

In 2003, data for the US population of warehouses showed a statistically significant positive relationship between building size and energy use per square foot; in other words, the larger the warehouse, the more energy per square foot it was expected to use. This relationship between size and energy use per square foot was no longer statistically significant and is not seen in the current (2012) data, as the table below illustrates.

Source Energy Use Intensity vs. Building Size (Based on CBECS Data)

Building Size (sq. ft.)	Average Source EUI CBECS 2003	Average Source EUI CBECS 2012
0 - 50k	79	71
50k to 100k	77	64
100k to 500k	110	77
500k +	151	60

Removing an adjustment for warehouse size means that larger warehouses were more likely to see greater score drops. This does not mean there is a bias against larger warehouses in the current ENERGY STAR scores. Instead, the current model better reflects the characteristics of today’s warehouse buildings.

In the table below, the second column shows that the previous ENERGY STAR score for warehouses in Portfolio Manager increased with warehouse size, reflecting the characteristics of these buildings in 2003. Buildings under 50,000 square feet had an average score of 50, while buildings above 500,000 had an average score of 74 under the previous model. Larger buildings were receiving an adjustment based on market conditions observed in 2003 that are no longer present in 2012, as seen in the nationally representative CBECS data. The average scores in Portfolio Manager with the current model demonstrate that it scores warehouses of all sizes relatively evenly. Similarly, the percent of properties scoring 75 or above with the current model is more even across all warehouse sizes.



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ENERGY STAR Score vs. Building Size (Portfolio Manager Buildings)

Building Size (sq. ft.)	Average Score Previous Warehouse Model	Average Score Current Warehouse Model	Percent scoring 75 or above (Previous Model)	Percent scoring 75 or above (Current Model)
0 - 50k	50	49	25%	20%
50k to 100k	64	53	45%	30%
100k to 500k	69	54	54%	27%
500k +	74	53	63%	24%
All	59	51	38%	24%

Percent Used for Cold Storage is a new, more appropriate variable for capturing refrigeration

In the current model, adjustments for walk-in refrigeration and refrigerated warehouses were replaced by an adjustment for percent of the warehouse used for cold storage. Percent used for cold storage is a new variable available for the first time in CBECS 2012; it is a more specific measure of refrigeration than the variables used in the previous model. Cold storage includes all the walk-in refrigeration and refrigerated warehouse space; adding your actual values can have a substantial positive influence on your building’s score.

Because of the combination of the change in the adjustment for refrigeration and the conservative initial default value, non-refrigerated warehouse/distribution centers with walk-in refrigerators as well as all refrigerated warehouses were more likely to experience large score drops relative to the previous model. These warehouses should see increases in their current scores once users replaced the assigned default values with the correct percent of total square feet used for cold storage.

Other variables were studied and found to be accounted for appropriately 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 warehouses appropriately. During the review period, we verified that the current model produces more balanced scores than the previous model for warehouses across various hours of operation, number of workers, climates, regions, year of construction, and more.

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The results fall within the expected average score and percentile distribution

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

In the current warehouse ENERGY STAR model, the average score is 51, and 24% of warehouses score 75 or above. In the previous model, the average score was 59, and 38% of warehouses were scoring 75 or above, as illustrated in the table below.

Average Warehouse Score and Percent Scoring ≥ 75 (Portfolio Manager buildings)

	Average ENERGY STAR Score	Percent scoring 75 or above
Previous Warehouse Model	59	38%
Current Warehouse Model	51	24%

Additional Resources

- [General Information on ENERGY STAR Score Updates](#)
- [ENERGY STAR Score for Warehouses Technical Reference](#)
- [Definition of Percent Used for Cold Storage](#)