

Analysis and Key Findings from EPA's Review of the ENERGY STAR Model for U.S. Office Properties

On August 26, 2018, EPA updated the ENERGY STAR score models and related performance metrics for 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 changed 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 office ENERGY STAR model.

During the feedback phase, we heard from many partners about trends they observed in the scores of their buildings. About 20 of these partners provided feedback about office properties, noting that scores of individual buildings changed in unexpected ways. Those with portfolios spanning different regions of the U.S. reported a trend of greater score reductions in colder climates. This feedback was very helpful during the analysis phase in focusing our efforts on the factors that changed from the previous model, particularly the exclusion of heating degree days (HDD). The analysis found that an adjustment is needed to account for energy used for heating. Therefore, EPA is reintroducing HDD into the scoring process, which results in more equitable scores for office properties in all climates.

Schedule for Release of Revised Scores

Office building scores, including adjustments for HDD where applicable, will be live in Portfolio Manager on July 22, 2019. At that time, users may see score increases for some office buildings located in colder climates — no buildings will experience decreases in score as a result of this adjustment. If you'd like to be able to document the changes from your current scores, be sure to download current scores prior to July 21, 2019, as Portfolio Manager will be unavailable that day to allow for the release of the updated score model. If you have any questions about revised scores, please review the information at www.energystar.gov/scoreupdates, or contact EPA at www.energystar.gov/buildingshelp.

On July 31, 2019, EPA plans to resume ENERGY STAR certification for office buildings.

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Background on Underlying Industry Data

The August 2018 office model was developed using data collected for the Energy Information Administration's (EIA) 2012 Commercial Building Energy Consumption Survey (CBECS). The previous office 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 offices in the United States experienced important changes, as illustrated in the table below. The estimated number of office buildings increased by 23%, while the average energy use decreased by 16% in terms of site energy use intensity (EUI) and 12% in terms of source EUI.

Changes in U.S. Office Buildings (CBECS Data)

CBECS Year	Number of Office Buildings in U.S.	Floorspace (million sf)	Average Site EUI	Average Source EUI*
2003	824,000	12,208	92.9	202.1
2012	1,012,000	15,952	77.8	177.2

*Calculated using new ENERGY STAR source factors from August 2018

Review Period Key Findings

Key Finding #1: An adjustment for heating energy is necessary to score properties in Portfolio Manager equitably

EPA analysis confirmed that buildings in colder climates score lower using the August 2018 model, on average, than those in mild or warm climates. This trend, combined with the fact that this model cannot account for year-to-year variation in heating energy needs because it does not include an HDD term, warrants the reintroduction of HDD to the scoring process.

Key Finding #2: The model appropriately evaluates energy performance

With the exception of heating energy, EPA has concluded that the office model appropriately evaluates the energy performance of office buildings. With the re-introduction of HDD as described below, the model will work as intended to deliver appropriate energy performance metrics for office properties across the country.

The rest of this document provides additional details about the ENERGY STAR model for office properties, results of the score review analysis, and details the new adjustment for HDD.

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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 46 survey responses from organizations that have office properties as part of their building portfolio. Of these, 21 provided substantive feedback on the office model.

Most noted that certain properties experienced much larger drops than the average, with several pointing to regional differences.

An individual office's change in score is the result of interactions among the components of the model, and usually 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 office properties on a percentile scale all influence the change in score.

In the development and review of the office model, EPA analyzed the potential impact of dozens of factors on office energy use. The revised model, with the inclusion of HDD, adjusts for those listed in the table below, which shows that the factors included are now consistent with those in the previous model.

Changes in Office Model Adjustments

Adjustments in Previous Office Model Based on 2003 CBECS	Kept?	Adjustments in Revised Office Model Based on 2012 CBECS
Building Size	✓	Building Size
Weekly Operating Hours	✓	Weekly Operating Hours
Number of Workers on Main Shift per 1,000 square feet	✓	Number of Workers on Main Shift per 1,000 square feet
Number of Personal Computers per 1,000 square feet	✓	Number of Personal Computers per 1,000 square feet
Weather and Climate (HDD and CDD)	✓	Weather and Climate (HDD and CDD)

Approach for including heating degree days

In developing the August 2018 model, EPA sought to keep HDD as a variable and tested various methods for including it. However, it was not possible to identify a positive statistically significant relationship between HDD and EUI in the CBECS data. Once EPA determined during the review period that HDD should be included, it was necessary to find an alternative approach that is both technically credible and limits further market disruption.



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The following two-step approach meets these criteria:

1. Determine the relationship between HDD and EUI using the Department of Energy’s commercial reference buildings ([U.S. Department of Energy Commercial Reference Building Models of the National Building Stock](#)), which include a range of sizes and climate zones. The resulting factor for estimating heating energy is 0.0047 kBtu/square foot/HDD.
2. For each building, add the estimated heating energy based on step 1 to the normalized mean resulting from the current model (more details on how the normalized mean – or predicted EUI – is calculated can be found [here](#)).

Applying this approach for office buildings in Portfolio Manager increases the average score and the percent of buildings scoring 75 or greater.

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

	Average ENERGY STAR Score	Percent scoring 75 or above
Previous Office Model	62	42%
August 2018 Office Model	53	27%
Revised Office Model (with HDD Adjustment)	57	32%

The table below demonstrates that this approach results in more equitable scores in colder areas, i.e. those that experience higher HDD levels. In general, the higher the HDD level experienced by the building, the greater the increase in score will be relative to the current score. No scores decrease as a result of the HDD adjustment.

ENERGY STAR Score vs. HDD (Portfolio Manager Buildings)

HDD Range	Average ENERGY STAR Score (August 2018 model)	Average Score with HDD Adjustment (Revised model)	Percent scoring 75 or above (August 2018 model)	Percent scoring 75 or above (Revised model)
1 to 4,000	55	57	30%	32%
4,000 to 8,000	52	58	24%	32%
8,000 +	44	55	19%	30%

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

Prior to releasing the score model in August 2018, EPA evaluated many other building and operating characteristics to ensure the model scores different types of office properties appropriately. During the review period, we verified that the revised model produces balanced scores for office properties across various hours of operation, number of workers and computers, building sizes, year of construction, and more.

Additional data on large buildings does not affect results

Before publishing the CBECS data, EIA masks certain characteristics for buildings over 1M square feet in order to protect their confidentiality. EPA does not use these buildings in ENERGY STAR model development because doing so would prohibit others from replicating the models. During the review period, however, EPA consulted with EIA to evaluate the impact of including this data and confirmed that it would not alter the model results. In the future, EPA will work closely with EIA to conduct these additional analyses prior to score release.

Additional Resources

- [General Information on ENERGY STAR Score Updates](#)
- [ENERGY STAR Score for Offices Technical Reference](#)