ENERGY STAR® PortfolioManager®

Technical Reference

# ENERGY STAR Score for Retail Stores in the United States

## OVERVIEW

The ENERGY STAR Score for Retail Stores applies to retail stores and wholesale clubs/supercenters. The objective of the ENERGY STAR score is to provide a fair assessment of the energy performance of a property relative to its peers, taking into account the climate, weather, and business activities at the property. To identify the aspects of building activity that are significant drivers of energy use and then normalize for those factors, a statistical analysis of the peer building population is performed. The result of this analysis is an equation that will predict the energy use of a property, based on its experienced business activities. The energy use prediction for a building is compared to its actual energy use to yield a 1 to 100 percentile ranking of performance, relative to the national population.

- **Property Types.** The ENERGY STAR score for retail stores applies to retail stores and wholesale clubs/supercenters. To receive an ENERGY STAR score, a retail store must be a *single store* that is at least *5,000 square feet* and has an *exterior entrance* to the public.
- **Reference Data.** The analysis for retail stores is based on data from the Department of Energy, Energy Information Administration's 2003 Commercial Building Energy Consumption Survey (CBECS).
- **Adjustments for Weather and Business Activity.** The analysis includes adjustments for:
  - Building Size
  - Number of Workers
  - Number of Personal Computers
  - Hours of Operation per Week
  - Number of Cash Registers
  - Number of Walk-in Refrigeration Units
  - Number of Open and Closed Refrigeration Cases
  - Weather and Climate (using Heating and Cooling Degree Days, retrieved based on Zip code)
  - Percent of the Building that is Heated and Cooled
- **Release Date.** The ENERGY STAR score for retail stores was released in October 2007.

This document presents details on the development of the 1 - 100 ENERGY STAR score for retail stores. More information on the overall approach to develop ENERGY STAR scores is covered in our Technical Reference for the ENERGY STAR Score, available at www.energystar.gov/ENERGYSTARScore. The subsequent sections of this document offer specific details on the development of the ENERGY STAR score for retail stores:

## REFERENCE DATA & FILTERS

For the ENERGY STAR score for retail stores, the reference data used to establish the peer building population in the United States is based on data from the Department of Energy, Energy Information Administration's (EIA) 2003 Commercial Building Energy Consumption Survey (CBECS). Detailed information on this survey, including complete data files, is available at: http://www.eia.doe.gov/emeu/cbecs/contents.html.

To analyze the building energy and operating characteristics in this survey data, four types of filters are applied to define the peer group for comparison and to overcome any technical limitations in the data: Building Type Filters, Program Filters, Data Limitation Filters, and Analytical Filters. A complete description of each of these categories is provided in our Technical Reference for the ENERGY STAR Score, at www.energystar.gov/ENERGYSTARScore. ***Figure 1*** presents a summary of each filter applied in the development of the ENERGY STAR score for retail stores, the rationale behind the filter, and the resulting number of properties in the data set after the filter is applied. After all filters are applied, the remaining data set has 182 properties.

***Figure 1 – Summary of Filters for the ENERGY STAR Score for Retail Stores***

| Condition for Including an Observation in the Analysis | Rationale | Number Remaining |
|---|---|---|
| PBAPLUS8=42 | Building Filter – CBECS defines building types according to the variable "PBAPLUS8." Retail Stores are coded as PBAPLUS8=42. | 291 |
| Must operate for at least 30 hours per week | EPA Program Filter – Baseline condition for being a full time retail store. | 282 |
| Must operate for at least 10 months per year | EPA Program Filter – Baseline condition for being a full time retail store. | 267 |
| Retail activity must characterize more than 50% of the floor space[1] | EPA Program Filter – In order to be considered part of the retail store peer group, more than 50% of the building must be defined as retail activity. | 259 |
| Must have square foot <=1,000,000 | Data Limitation Filter – CBECS masks surveyed properties above 1,000,000 square feet by applying regional averages. | 259 |
| If propane is used, the amount category (PRAMTC8) must equal 1, 2, or 3 | Data Limitation Filter – Cannot estimate propane use if the quantity is "greater than 1000" or unknown. | 250 |
| If propane is used, the maximum estimated propane amount must be 10% or less of the total source energy | Data Limitation Filter – Because propane values are estimated from a range, propane is restricted to 10% of the total source energy. | 243 |

[1] If the variable ONEACT8=1, this indicates that one activity occupies 75% or more of the building. If the variable ONEACT8=2, then the building can specify up to 3 activities (ACT18, ACT28, ACT38). One of these activities must (PBAX=11) or Public Order and Safety (PBAX=22), and must account for more than 50% of the floor area.

| Condition for Including an Observation in the Analysis | Rationale | Number Remaining |
|---|---|---|
| Must not use chilled water | Data Limitation Filter – CBECS does not collect quantities of chilled water. | 241 |
| Must have square foot >=5,000 | Analytical Limitation – Analysis could not model behavior for buildings smaller than 5,000 ft$^2$. | 182 |

The reasons for applying filters on the use and quantity of propane are worthy of additional discussion. In CBECS, major fuel use is reported in exact quantities. However, if a building uses propane, the amount of propane is reported according to the variable PRAMT8, which uses ranges rather than exact quantities (e.g., less than 100 gallons, 100 to 500 gallons, etc.). Therefore, the quantity must be estimated within the range. To limit error associated with this estimation, EPA applies two filters related to propane.

1. The quantity of propane expressed by PRAMT8 must be 1000 gallons or smaller.
2. The value of propane cannot account for more than 10% of the total source energy use. Because the exact quantity of propane is not reported, this cap ensures that the quantity of propane entered will not introduce undue error into the calculation of total energy consumption. In order to determine if the 10% cap is exceeded, the value at the high end of the propane category is employed (e.g., for the category of less than 100, a value of 99 is used). If the 10% cap is not exceeded, then EPA will use the value at the middle of the range to calculate total energy use for the regression analysis (e.g., for the category of less than 100, a value of 50 is used).

Of the filters applied to the reference data, some result in constraints on calculating a score in Portfolio Manager and others do not. Building Type and Program Filters are used to limit the reference data to include only properties that are eligible to receive a score in Portfolio Manager, and are therefore related to eligibility requirements. In contrast, Data Limitation Filters account for limitations in the data availability, but do not apply in Portfolio Manager. Analytical Filters are used to eliminate outlier data points or different subsets of data, and may or may not affect eligibility. In some cases, a subset of the data will have different behavior from the rest of the properties (e.g., retail stores smaller than 5,000 ft$^2$ do not behave the same way as larger stores), in which case an Analytical Filter will be used to determine eligibility in Portfolio Manager. In other cases, Analytical Filters exclude a small number of outliers with extreme values that skew the analysis, but do not affect eligibility requirements. A full description of the criteria you must meet to get a score in Portfolio Manager is available at www.energystar.gov/EligibilityCriteria.

Related to the filters and eligibility criteria described above, another consideration is how Portfolio Manager treats properties that are situated on a campus. The main unit for benchmarking in Portfolio Manager is the property, which may be used to describe either a single building or a campus of buildings. The applicability of the ENERGY STAR score depends on the type of property. To receive an ENERGY STAR score, a retail store must be a *single store* that is at least *5,000 square feet* and has an *exterior entrance* to the public. Eligible store configurations include: free standing stores; stores located in open air or strip centers (a collection of attached stores with common areas that are not enclosed); and mall anchors. Retail configurations not eligible to receive an ENERGY STAR score include: enclosed malls; individual stores located within enclosed malls; lifestyle centers; strip malls; and individual stores that are part of a larger non-mall building (i.e. office or hotel).

# VARIABLES ANALYZED

To normalize for differences in business activity, we perform a statistical analysis to understand what aspects of building activity are significant with respect to energy use. The filtered reference data set described in the previous section is analyzed using a weighted ordinary least squares regression, which evaluates energy use relative to business activity (e.g., operating hours, number of workers, and climate). This linear regression yields an equation that is used to compute energy use (also called the dependent variable) based on a series of characteristics that describe the business activities (also called independent variables). This section details the variables used in the statistical analysis for retail stores.

## Dependent Variable

The dependent variable is what we try to predict with the regression equation. For the retail store analysis, the dependent variable is energy consumption expressed in source energy use intensity (source EUI). This is equal to the total source energy use of the property divided by the gross floor area. The regressions analyze the key drivers of source EUI – those factors that explain the variation in source energy use per square foot in retail stores.

## Independent Variables

The reference survey collects numerous property operating characteristics that were identified as potentially important for retail stores. Based on a review of the available variables in the data, in accordance with the criteria for inclusion in Portfolio Manager[2], the following variables were analyzed:[3]

- SQFT8 – Square footage
- RGSTRN8 – Number of cash registers
- WKHRS8 – Weekly hours of operation
- NWKER8 – Number of employees during the main shift
- PCNUM8 – Number of personal computers
- SRVNUM8 – Number of servers
- PRNTRN8 – Number of printers
- RFGWIN8 – Number of walk-in refrigeration units
- RFGOPN8 – Number of open refrigerated cases
- RFGRSN8 – Number of residential refrigerators
- RFGCLN8 – Number of closed refrigerated cases
- RFGVNN8 – Number of refrigerated vending machines
- FDRM8 – Commercial food preparation area
- SNACK8 – Snack bar
- FASTFD8 – Fast food or small restaurant
- CAF8 – Cafeteria or large restaurant
- NFLOOR8 – Number of floors
- HDD658 – Heating degree days
- CDD658 – Cooling degree days

[2] For a complete explanation of these criteria, refer to our Technical Reference for the ENERGY STAR Score, at www.energystar.gov/ENERGYSTARScore.

[3] Note that the number 8 at the end of all variables indicates that the 2003 CBECS survey is the eighth survey conducted by the Energy Information Administration.

- HEATP8 – Percent heated
- COOLP8 – Percent cooled

We perform extensive review on all of these operational characteristics. In addition to reviewing each characteristic individually, characteristics are reviewed in combination with each other (e.g., Heating Degree Days times Percent Heated). As part of the analysis, some variables are reformatted to reflect the physical relationships of building components. For example, the number of workers on the main shift is typically evaluated in a density format. The number of workers *per square foot* (not the gross number of workers) is expected to be correlated with the energy use per square foot. In addition, based on analytical results and residual plots, variables are examined using different transformations (such as the natural logarithm, abbreviated as Ln). The analysis consists of multiple regression formulations. These analyses are structured to find the combination of statistically significant operating characteristics that explain the greatest amount of variance in the dependent variable: source EUI.

The final regression equation includes the following variables:

- Natural log of gross square foot
- Weekly operating hours
- Number of workers per 1,000 square feet
- Number of personal computers (PCs) per 1,000 square feet
- Number of cash registers per 1,000 square feet
- Number of walk in refrigeration units per 1,000 square feet
- Number of open and closed refrigeration cases per 1,000 square feet
- Heating degree days times Percent of the building that is heated
- Cooling degree days times Percent of the building that is cooled

These variables are used together to compute the predicted source EUI for retail stores. The predicted source EUI is the mean EUI for a hypothetical population of buildings that share the same values for each of these variables. That is, the mean energy use for a building that operates just like your building.

## Register Density Analysis

Following the launch of the regression model in 2007, additional analysis was performed on register density using both Portfolio Manager and CBECS data. This analysis showed that facilities with higher register density (number of cash registers per 1,000 square feet) have higher source EUI values on average. However, this relationship between source EUI and register density was only observed up to a certain register density value. Therefore, starting in 2010, when the regression model is applied in Portfolio Manager, the adjustment for register density within the regression equation is capped at a maximum adjustment at the value of 0.71 registers per 1,000 square feet. That is, the register density adjustment in the regression equation for a building with more than 0.71 registers per 1,000 square feet will be identical to the adjustment for a building that has 0.71 registers per 1,000 square feet.

## Testing

We test the regression equation using actual retail buildings that have been entered in Portfolio Manager. This provides another set of buildings to examine in addition to the CBECS data, to see the average ENERGY STAR scores and distributions, and to assess the impacts and adjustments. This analysis provides a second level of confirmation that the final regression equation produces robust results that are unbiased with respect to the key operational characteristics such as building size, computer density, worker density, operating hours, and heating and cooling degree days.

In addition to the analysis of CBECS data, EPA performed testing on supplemental data for approximately 600 stores shared with EPA by 10 retail organizations. The results of testing and analysis of this dataset showed that the performance distribution of the test stores was similar to that of the CBECS 2003 observations. This analysis also confirmed that the CBECS categories under "Store8" are not significant. This supplemental data helped EPA verify that the retail store regression equation provides a valid assessment of energy performance across a variety of retail stores. The ENERGY STAR score can be applied to most retail stores including: Department Stores, Discount Stores, Supercenters, Warehouse clubs, Drug Stores, Dollar Stores, Home Centers/Hardware Stores, and Apparel/Hard Line Specialty Stores. However, the analysis showed that the retail store regression equation cannot be used to evaluate the energy performance of Electronics Stores. The plug load requirement of these facilities makes it impossible to perform a peer comparison with other retailers.

Finally, the supplemental data included a variety of standalone retail stores, retail stores in strip malls, and anchor establishments at enclosed malls. Several of the organizations who shared data with EPA had facilities in more than one of these categories. Analysis across all three types of stores did not identify a bias, and therefore confirmed that the retail store regression equation can be used for free standing retail stores, retail stores located within strip mall facilities, and anchor establishments located at enclosed malls.

It is important to reiterate that the final regression equation is based on the nationally representative CBECS data, not the supplemental data collected by EPA.

## REGRESSION EQUATION RESULTS

The final regression is a weighted ordinary least squares regression across the filtered data set of 182 observations. The dependent variable is source EUI. Each independent variable is centered relative to the mean value, presented in ***Figure 2***. The final equation is presented in ***Figure 3***. All variables in the regression equation are significant at the 90% confidence level or better, as shown by the significance levels (a p-level of less than 0.10 indicates 90% confidence).

The regression equation has a coefficient of determination ($R^2$) value of 0.7098, indicating that this equation explains 70.98% of the variance in source EUI for retail stores. Because the final equation is structured with energy per square foot as the dependent variable, the explanatory power of square foot is not included in the $R^2$ value, thus this value appears artificially low. Re-computing the $R^2$ value in units of source energy[4], demonstrates that the equation actually explains 92.4% of the variation of source energy. This is an excellent result for a statistically-based energy model.

Detailed information on the ordinary least squares regression approach is available in our Technical Reference for the ENERGY STAR Score, at www.energystar.gov/ENERGYSTARScore.

[4] The $R^2$ value in Source Energy is calculated as: 1 – (Residual Variation of Y) / (Total Variation of Y). The residual variation is sum of $(\text{Actual Source Energy}_i - \text{Predicted Source Energy}_i)^2$ across all observations. The Total variation of Y is the sum of $(\text{Actual Source Energy}_i - \text{Mean Source Energy})^2$ across all observations.

*Figure 2 - Descriptive Statistics for Variables in Final Regression Equation*

| Variable | Mean | Minimum | Maximum |
|---|---|---|---|
| Source EUI (kBtu/ft²) | 153.1 | 6.660 | 1,009 |
| Ln (Square Foot) | 9.371 | 8.517 | 13.02 |
| Number of Computers per 1000 ft² | 0.3149 | 0.0000 | 2.000 |
| Weekly Operating Hours | 63.74 | 30.00 | 168.0 |
| Number of Workers per 1000 ft² | 0.6279 | 0.2500 | 4.000 |
| Number of Cash Registers per 1000 ft² | 0.1905 | 0.0000 | 1.400 |
| Number of Walk-in Refrigerators per 1000 ft² | 0.0038 | 0.0000 | 0.1110 |
| Number of Open and Closed Refrigerators per 1000 ft² | 0.0450 | 0.0000 | 1.000 |
| Heating Degree Days x Percent Heated | 3,811 | 0.0000 | 9,625 |
| Cooling Degree Days x Percent Cooled | 972.1 | 0.0000 | 5,206 |

*Figure 3 - Final Regression Results*

| Summary | | | | |
|---|---|---|---|---|
| Dependent Variable | Source Energy Intensity (kBtu/ft²) | | | |
| Number of Observations in Analysis | 182 | | | |
| R² value | 0.7098 | | | |
| Adjusted R² value | 0.6946 | | | |
| F Statistic | 46.74 | | | |
| Significance (p-level) | 0.0000 | | | |
| | **Unstandardized Coefficients** | **Standard Error** | **T value** | **Significance (p-level)** |
| Constant | 153.1 | 5.685 | 26.93 | 0.0000 |
| C_Ln (Square Foot) | 20.19 | 9.315 | 2.167 | 0.0316 |
| C_Weekly Operating Hours | 1.373 | 0.4209 | 3.263 | 0.0013 |
| C_Number of Workers per 1000 ft² | 61.76 | 15.54 | 3.975 | 0.0001 |
| C_PC Density | 70.60 | 20.80 | 3.394 | 0.0009 |
| C_Register Density | 249.1 | 33.79 | 7.372 | 0.0000 |
| C_Walk-in Refrigeration Density | 720.2 | 379.6 | 1.897 | 0.0595 |
| C_Refrigeration Density | 81.90 | 44.34 | 1.847 | 0.0665 |
| C_Heating Degree Days x Percent Heated | 0.0113 | 0.0036 | 4.274 | 0.0000 |
| C_Cooling Degree Days x Percent Cooled | 0.0125 | 0.0073 | 1.725 | 0.0863 |

*Notes:*

- *The regression is a weighted ordinary least squares regression, weighted by the CBECS variable "ADJWT8".*
- *The prefix C_ on each variable indicates that it is centered. The centered variable is equal to difference between the actual value and the observed mean. The observed mean values are presented in **Figure 2.***
- *The RgstrDen adjustment is capped at 0.71 cash registers per 1000 square feet.*

## ENERGY STAR SCORE LOOKUP TABLE

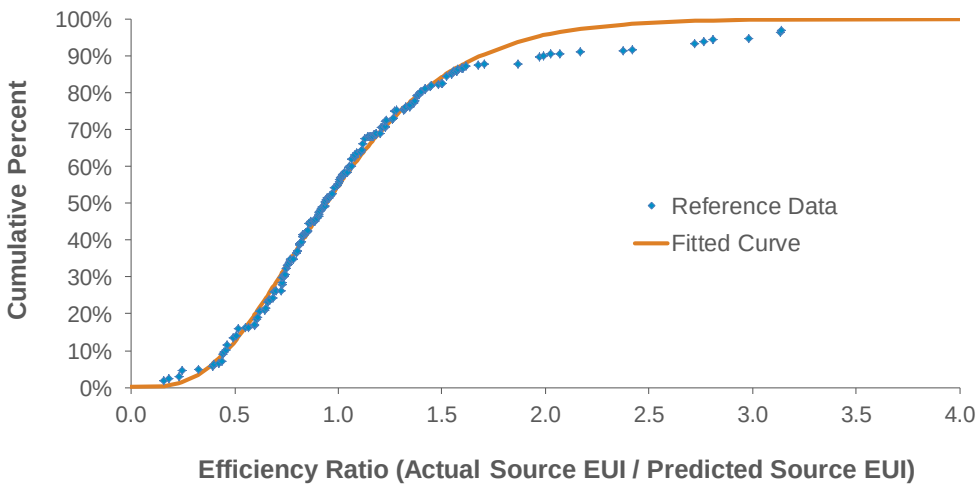
The final regression equation (presented in ***Figure 3***) yields a prediction of source EUI based on a building's operating characteristics. Some buildings in the reference data sample use more energy than predicted by the regression equation, while others use less. The *actual* source EUI of each reference data observation is divided by its *predicted* source EUI to calculate an energy efficiency ratio:

$$Energy\ Efficiency\ Ratio = \frac{Actual\ Source\ EUI}{Predicted\ Source\ EUI}$$

A lower efficiency ratio indicates that a building uses less energy than predicted, and consequently is more efficient. A higher efficiency ratio indicates the opposite.

The efficiency ratios are sorted from smallest to largest and the cumulative percent of the population at each ratio is computed using the individual observation weights from the reference data set. ***Figure 4*** presents a plot of this cumulative distribution. A smooth curve (shown in orange) is fitted to the data using a two parameter gamma distribution. The fit is performed in order to minimize the sum of squared differences between each building's actual percent rank in the population and each building's percent rank with the gamma solution. The final fit for the gamma curve yielded a shape parameter (alpha) of 4.259 and a scale parameter (beta) of 0.2397. For this fit, the sum of the squared error is 0.07394.

***Figure 4 – Distribution for Retail Stores***




The final gamma shape and scale parameters are used to calculate the efficiency ratio at each percentile (1 to 100) along the curve. For example, the ratio on the gamma curve at 1% corresponds to a score of 99; only 1% of the population has a ratio this small or smaller. The ratio on the gamma curve at the value of 25% will correspond to the ratio for a score of 75; only 25% of the population has ratios this small or smaller. The complete score lookup table is presented in ***Figure 5***.

*Figure 5 – ENERGY STAR Score Lookup Table for Retail Stores*

| ENERGY STAR Score | Cumulative Percent | Energy Efficiency Ratio > = | Energy Efficiency Ratio < |
|---|---|---|---|
| 100 | 0% | 0.0000 | 0.2115 |
| 99 | 1% | 0.2115 | 0.2586 |
| 98 | 2% | 0.2586 | 0.2923 |
| 97 | 3% | 0.2923 | 0.3197 |
| 96 | 4% | 0.3197 | 0.3433 |
| 95 | 5% | 0.3433 | 0.3643 |
| 94 | 6% | 0.3643 | 0.3836 |
| 93 | 7% | 0.3836 | 0.4014 |
| 92 | 8% | 0.4014 | 0.4181 |
| 91 | 9% | 0.4181 | 0.4339 |
| 90 | 10% | 0.4339 | 0.4490 |
| 89 | 11% | 0.4490 | 0.4635 |
| 88 | 12% | 0.4635 | 0.4774 |
| 87 | 13% | 0.4774 | 0.4909 |
| 86 | 14% | 0.4909 | 0.5040 |
| 85 | 15% | 0.5040 | 0.5168 |
| 84 | 16% | 0.5168 | 0.5292 |
| 83 | 17% | 0.5292 | 0.5414 |
| 82 | 18% | 0.5414 | 0.5534 |
| 81 | 19% | 0.5534 | 0.5651 |
| 80 | 20% | 0.5651 | 0.5767 |
| 79 | 21% | 0.5767 | 0.5881 |
| 78 | 22% | 0.5881 | 0.5994 |
| 77 | 23% | 0.5994 | 0.6105 |
| 76 | 24% | 0.6105 | 0.6215 |
| 75 | 25% | 0.6215 | 0.6325 |
| 74 | 26% | 0.6325 | 0.6433 |
| 73 | 27% | 0.6433 | 0.6541 |
| 72 | 28% | 0.6541 | 0.6648 |
| 71 | 29% | 0.6648 | 0.6754 |
| 70 | 30% | 0.6754 | 0.6860 |
| 69 | 31% | 0.6860 | 0.6966 |
| 68 | 32% | 0.6966 | 0.7071 |
| 67 | 33% | 0.7071 | 0.7176 |
| 66 | 34% | 0.7176 | 0.7281 |
| 65 | 35% | 0.7281 | 0.7386 |
| 64 | 36% | 0.7386 | 0.7491 |
| 63 | 37% | 0.7491 | 0.7596 |
| 62 | 38% | 0.7596 | 0.7701 |
| 61 | 39% | 0.7701 | 0.7807 |
| 60 | 40% | 0.7807 | 0.7912 |
| 59 | 41% | 0.7912 | 0.8018 |
| 58 | 42% | 0.8018 | 0.8125 |
| 57 | 43% | 0.8125 | 0.8232 |
| 56 | 44% | 0.8232 | 0.8339 |
| 55 | 45% | 0.8339 | 0.8447 |
| 54 | 46% | 0.8447 | 0.8556 |
| 53 | 47% | 0.8556 | 0.8665 |
| 52 | 48% | 0.8665 | 0.8776 |
| 51 | 49% | 0.8776 | 0.8887 |
| 50 | 50% | 0.8887 | 0.8999 |
| 49 | 51% | 0.8999 | 0.9112 |
| 48 | 52% | 0.9112 | 0.9226 |
| 47 | 53% | 0.9226 | 0.9341 |
| 46 | 54% | 0.9341 | 0.9458 |
| 45 | 55% | 0.9458 | 0.9576 |
| 44 | 56% | 0.9576 | 0.9695 |
| 43 | 57% | 0.9695 | 0.9816 |
| 42 | 58% | 0.9816 | 0.9938 |
| 41 | 59% | 0.9938 | 1.0063 |
| 40 | 60% | 1.0063 | 1.0189 |
| 39 | 61% | 1.0189 | 1.0317 |
| 38 | 62% | 1.0317 | 1.0447 |
| 37 | 63% | 1.0447 | 1.0579 |
| 36 | 64% | 1.0579 | 1.0714 |
| 35 | 65% | 1.0714 | 1.0851 |
| 34 | 66% | 1.0851 | 1.0992 |
| 33 | 67% | 1.0992 | 1.1135 |
| 32 | 68% | 1.1135 | 1.1281 |
| 31 | 69% | 1.1281 | 1.1430 |
| 30 | 70% | 1.1430 | 1.1583 |
| 29 | 71% | 1.1583 | 1.1740 |
| 28 | 72% | 1.1740 | 1.1902 |
| 27 | 73% | 1.1902 | 1.2067 |
| 26 | 74% | 1.2067 | 1.2238 |
| 25 | 75% | 1.2238 | 1.2414 |
| 24 | 76% | 1.2414 | 1.2595 |
| 23 | 77% | 1.2595 | 1.2783 |
| 22 | 78% | 1.2783 | 1.2978 |
| 21 | 79% | 1.2978 | 1.3180 |
| 20 | 80% | 1.3180 | 1.3390 |
| 19 | 81% | 1.3390 | 1.3610 |
| 18 | 82% | 1.3610 | 1.3840 |
| 17 | 83% | 1.3840 | 1.4081 |
| 16 | 84% | 1.4081 | 1.4336 |
| 15 | 85% | 1.4336 | 1.4605 |
| 14 | 86% | 1.4605 | 1.4891 |
| 13 | 87% | 1.4891 | 1.5197 |
| 12 | 88% | 1.5197 | 1.5525 |
| 11 | 89% | 1.5525 | 1.5881 |
| 10 | 90% | 1.5881 | 1.6269 |
| 9 | 91% | 1.6269 | 1.6698 |
| 8 | 92% | 1.6698 | 1.7177 |
| 7 | 93% | 1.7177 | 1.7723 |
| 6 | 94% | 1.7723 | 1.8359 |
| 5 | 95% | 1.8359 | 1.9124 |
| 4 | 96% | 1.9124 | 2.0092 |
| 3 | 97% | 2.0092 | 2.1426 |
| 2 | 98% | 2.1426 | 2.3637 |
| 1 | 99% | 2.3637 | >2.3637 |

# EXAMPLE CALCULATION

As detailed in our Technical Reference for the ENERGY STAR Score, at www.energystar.gov/ENERGYSTARScore, there are five steps to compute a score. The following is a specific example for the score for retail stores.

## 1 User enters building data into Portfolio Manager

- 12 months of energy use information for all energy types (annual values, entered in monthly meter entries)
- Physical building information (size, location, etc.) and use details describing building activity (hours, etc.)

| Energy Data | Value |
|---|---|
| Electricity | 400,000 kWh |
| Natural gas | 180 therms |

| Operational Use Data | Value |
|---|---|
| Gross floor area (ft²) | 50,000 |
| Weekly operating hours | 70 |
| Workers on the main shift[5] | 8 |
| Number of personal computers | 3 |
| Percent of the building that is heated | 100% |
| Percent of the building that is cooled | 100% |
| Number of cash registers | 6 |
| Number of walk-in refrigeration/freezer units | 0 |
| Number of open and closed refrigeration/freezer cases | 7 |
| HDD (provided by Portfolio Manager, based on Zip code) | 3,850 |
| CDD (provided by Portfolio Manager, based on Zip code) | 2,300 |

## 2 Portfolio Manager computes the actual source EUI

- Total energy consumption for each fuel is converted from billing units into site energy and source energy
- Source energy values are added across all fuel types
- Source energy is divided by gross floor area to determine actual source EUI

***Computing Actual Source EUI***

| Fuel | Billing Units | Site kBtu Multiplier | Site kBtu | Source kBtu Multiplier | Source kBtu |
|---|---|---|---|---|---|
| Electricity | 400,000 kWh | 3.412 | 1,364,800 | 3.14 | 4,285,472 |
| Natural gas | 180 therms | 100 | 18,000 | 1.05 | 18,900 |
| | | | | Total Source Energy (kBtu) | 4,304,372 |
| | | | | **Actual Source EUI (kBtu/ft²)** | **86.1** |

[5] This represents typical peak staffing level during the main shift. For example, in a space where there are two daily 8 hour shifts of 100 workers each, the Workers on Main Shift value is 100.

## 3 Portfolio Manager computes the predicted source EUI

- Using the property use details from Step 1, Portfolio Manager computes each building variable value in the regression equation (determining the natural log or density as necessary).
- The centering values are subtracted to compute the centered variable for each operating parameter.
- The centered variables are multiplied by the coefficients from the regression equation to obtain a predicted source EUI.

***Computing Predicted Source EUI***

| Variable | Actual Building Value | Reference Centering Value | Building Centered Variable | Coefficient | Coefficient * Centered Variable |
|---|---|---|---|---|---|
| Constant | -- | -- | -- | 153.1 | 153.1 |
| Square Feet | 10.82 | 9.371 | 1.449 | 20.19 | 29.25 |
| Weekly Operating Hours | 70.00 | 63.74 | 6.260 | 1.373 | 8.595 |
| Worker Density | 0.1600 | 0.6279 | -0.4679 | 61.76 | -28.90 |
| PC Density | 0.0600 | 0.3149 | -0.2549 | 70.6 | -18.00 |
| Register Density | 0.1200 | 0.1905 | -0.0705 | 249.1 | -17.56 |
| Walk In Refrigeration Density | 0.0000 | 0.0038 | -0.0038 | 720.2 | -2.737 |
| Open Closed Refrigeration Density | 0.1400 | 0.0450 | 0.0950 | 81.9 | 7.781 |
| Heating Degree Days x Percent Heated | 3,850 | 3811 | 39.00 | 0.0113 | 0.441 |
| Cooling Degree Days x Percent Cooled | 2,300 | 972.1 | 1,328 | 0.0125 | 16.60 |
| | | | | **Predicted Source EUI (kBtu/ft²)** | **148.6** |

## 4 Portfolio Manager computes the energy efficiency ratio

- The ratio equals the actual source EUI (Step 2) divided by predicted source EUI (Step 3)
- Ratio = 86.1 / 148.6 = 0.5795

## 5 Portfolio Manager uses the efficiency ratio to assign a score via a lookup table

- The ratio from Step 4 is used to identify the score from the lookup table
- A ratio of 0.5795 is greater than or equal to 0.5767 and less than 0.5881
- ***The ENERGY STAR score is 79***