ENERGY STAR® Portfolio Manager®

Technical Reference

ENERGY STAR Score for Offices in the United States

OVERVIEW

The ENERGY STAR Score for Offices applies to office, bank branch, financial office, and courthouse property types. 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 offices applies to four property types: office, financial office, bank branch, and courthouse. The score applies to individual buildings only and is not available for campuses.
- **Reference Data.** The analysis for offices is based on data from the Department of Energy, Energy Information Administration's 2012 Commercial Building Energy Consumption Survey (CBECS).
- **Adjustments for Weather and Business Activity.** The analysis includes adjustments for:
  - Building Size
  - Number of Computers
  - Number of Workers
  - Weekly Operating Hours
  - Weather and Climate (using Heating and Cooling Degree Days, retrieved based on Zip code)
  - Percent of the Building that is Cooled
  - Whether or not the Building is a Bank Branch (Small Banks show different performance)
- **Release Date.** The ENERGY STAR score for offices is updated periodically as more recent data becomes available:
  - Most Recent Update: July 2019
  - Previous Updates: August 2018, October 2007
  - Original Release: January 1999

This document presents details on the development of the 1 - 100 ENERGY STAR score for office properties. 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 offices:

REFERENCE DATA & FILTERS

For the ENERGY STAR score for office properties, 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) 2012 Commercial Building Energy Consumption Survey (CBECS). Detailed information on this survey, including complete data files, is available at: https://www.eia.gov/consumption/commercial/index.php.

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 offices, 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 886 properties.

Figure 1 – Summary of Filters for the ENERGY STAR Score for Offices

Condition for Including an Observation in the Analysis	Rationale	Number Remaining
PBAPLUS = 2, 3, 4 or 52	Building Type Filter – CBECS defines building types according to the variable "PBAPLUS." Offices are coded as PBAPLUS=2 and 4; Bank/Financial Institutions are coded as PBAPLUS=3; and Courthouses are coded as PBAPLUS=52.	1076
Must have at least 1 computer	EPA Program Filter – Baseline condition for being a functioning office building.	1072
Must have at least 1 worker	EPA Program Filter – Baseline condition for being a full time office building.	1072
Must operate for at least 30 hours per week	EPA Program Filter – Baseline condition for being a full time office building.	1065
Must operate for at least 10 months per year	EPA Program Filter – Baseline condition for being a full time office building.	1046
A single activity must characterize greater than 50% of the floor space[1]	EPA Program Filter – In order to be considered part of the office peer group, more than 50% of the building must be defined as an office, bank/financial institution, or courthouse.	1003

[1] This filter is applied by a set of screens. If the variable ONEACT=1, then one activity occupies 75% or more of the building. If the variable ONEACT=2, then the activities in the building are defined by ACT1, ACT2, and ACT3. One of these activities must be coded as Office/Professional (PBAX=11) or Public Order and Safety (PBAX=23), with a corresponding percent (ACT1PCT, ACT2PCT, ACT3PCT) that is greater than 50.

Condition for Including an Observation in the Analysis	Rationale	Number Remaining
Must report energy usage	EPA Program Filter – Baseline condition for being a full time office building.	1003
Must be less than or equal to 1,000,000 square feet	Data Limitation Filter – CBECS masks surveyed properties above 1,000,000 square feet by applying regional averages.	972
If propane is used, the amount category (PRAMTC) must equal 1, 2, or 3	Data Limitation Filter – Cannot estimate propane use if the quantity is "greater than 1000" or unknown.	959
If propane is used, the unit (PRUNIT) must be known	Data Limitation Filter – Cannot estimate propane use if the unit is unknown.	959
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.	957
Must not use chilled water, wood, coal, or solar	Data Limitation Filter – CBECS does not collect quantities of chilled water, wood, coal, or solar.	896
Server count must be known	Data Limitation Filter – CBECS codes missing responses for number of servers as '9995.'	892
Must have no more than 8 workers per 1,000 square feet	Analytical Filter – Values determined to be statistical outliers.	888
Banks must have Source EUI greater than 50 kBtu/ft^2	Analytical Filter – Values determined to be statistical outliers.	886

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 PRAMTC, 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 three filters related to propane.

1. The quantity of propane expressed by PRAMTC must be 1,000 gallons or smaller.
2. The unit (e.g., gallons) for the quantity of propane used must be known.
3. 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., hotels smaller than 5,000 ft^2 do not behave the same way as larger buildings), 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. For office properties, the score is based on individual buildings, because the primary function of the office is contained within a single building and because the properties included in the reference data are single buildings. In cases where multiple offices are situated together (e.g., an office park), each individual building can receive its own ENERGY STAR score, but the campus cannot earn a score.

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 offices.

Dependent Variable

The dependent variable is what we try to predict with the regression equation. For the office 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 offices.

Independent Variables

The reference survey collects numerous property operating characteristics that were identified as potentially important for offices. 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:

- SQFT – Square footage
- NFLOOR – Number of floors

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

- NELVTR – Number of elevators
- NESLTR – Number of escalators
- COURT – Food court
- MONUSE – Months in use
- OPNWE – Open on weekend
- WKHRS – Total hours open per week
- NWKER – Number of employees
- COOK – Energy used for cooking
- MANU – Energy used for manufacturing
- HEATP – Percent heated
- COOLP – Percent cooled
- SNACK – Snack bar or concession stand
- FASTFD – Fast food or small restaurant
- CAF – Cafeteria or large restaurant
- FDPREP – Commercial or large kitchen
- KITCHN – Small kitchen area
- BREAKRM – Employee lounge, breakroom, or pantry
- OTFDRM – Other food prep or serving area
- LABEQP – Laboratory equipment
- MCHEQP – Machine equipment
- POOL – Indoor swimming pool
- HTPOOL – Heated indoor swimming pool
- RFGWIN – Number of walk-in refrigeration units (also includes freezers)
- RFGOPN – Number of open case refrigeration units
- RFGCLN – Number of closed case refrigeration units
- RFGVNN – Number of refrigerated vending machines
- RFGICN – Number of ice makers
- PCTERMN – Number of computers
- LAPTPN – Number of laptops
- PRNTRN – Number of printers
- SERVERN – Number of servers
- TVVIDEON – Number of TV or video displays
- RGSTRN – Number of cash registers
- COPIERN – Number of photocopiers
- HDD65 – Heating degree days (base 65)
- CDD65 – Cooling degree days (base 65)

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:

- Square Footage
- Weekly Operating Hours
- Number of Workers per 1,000 Square Feet
- Number of Computers per 1,000 Square Feet
- Heating Degree Days
- Natural log of Cooling Degree Days times Percent of the Building that is Cooled
- Whether or not the Building is a Bank Branch (1 = yes, 0 = no)

These variables are used together to compute the predicted source EUI for offices. 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.

Bank Branch and Financial Office Analysis

Analysis reveals that bank branches and financial offices of 50,000 square feet or smaller have different average energy consumption. Due to this unique response, the final regression equation includes a Yes/No variable indicating whether the building is a bank branch/financial office that is 50,000 square feet or smaller (called a small bank).

The determination of this adjustment is based on a substantial analysis of the data and the differences among bank branches and financial offices. Working from the hypothesis that the larger and smaller bank branches and financial offices may differ in their energy consumption, we investigated a wide variety of regression formulations. These included regressions where all bank branches and financial offices were treated the same, and regressions where a size cut-off point was established between 20,000 and 100,000 square feet. For each division, the average energy consumption of the groups was examined, as were the regression results and the individual impacts of each operating characteristic. Analysis indicated that bank branches and financial offices of 50,000 square foot or smaller behave differently than their larger counterparts. These impacts have been incorporated into the regression equation accordingly.

Square Footage Analysis

Analysis revealed that larger office properties have higher source EUI values on average. This relationship between square footage and source EUI was only observed up to a certain square footage. Therefore, the final regression equation includes a square footage term, which is capped at maximum adjustment at the value of 100,000 square feet. That is, the square foot adjustment in the regression equation for a building larger than 100,000 square feet will be identical to the adjustment for a building that is 100,000 square feet.

Climate Analysis

Climate is one characteristic that was examined closely. EPA analyzed the relationship between EUI and both Cooling Degree Days (CDD) and Heating Degree Days (HDD). A combination of methods were used, which included running regression equations with CBECS 2012 data using various forms and combinations of CDD and HDD. The analysis found that CBECS shows a positive correlation between CDD and EUI, which was expected. However, CBECS does not show a positive correlation between HDD and EUI. Because of this, it was not possible to develop a robust regression equation that included HDD using just CBECS 2012 data.

Upon review of the resulting scores in Portfolio Manager, it was determined that properties in cold climates were disadvantaged by a model that does not include an HDD variable. This model is also unable to account for year-to-year variation in heating energy needs. Because of this, EPA determined it was necessary to introduce an adjustment for HDD into the scoring process. EPA identified an alternative method to account for heating energy that uses the Department of Energy's commercial reference buildings. See additional details on the methodology in the following section.

Testing

Finally, we test the regression equation using actual office 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, cooling degree days, and heating degree days.

It is important to reiterate that the final regression equation is based on the nationally representative reference data, not data previously entered into Portfolio Manager.

REGRESSION EQUATION RESULTS

The final regression is a weighted ordinary least squares regression across the filtered data set of 886 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 95% confidence level or better, as shown by the significance levels (a p-level of less than 0.05 indicates 95% confidence).

The regression equation has a coefficient of determination (R^2) value of 0.2200 indicating that this equation explains 22.00% of the variance in source EUI for office buildings. 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[3] demonstrates that the equation actually explains 64.84% of the variation of source energy of offices. 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.

[3] 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 (Actual Source Energy$_i$ – Predicted Source Energy$_i$)^2 across all observations. The Total variation of Y is the sum of (Actual Source Energy$_i$ – Mean Source Energy)^2 across all observations.

Figure 2 - Descriptive Statistics for Variables in Final Regression Equation

Variable	Mean	Minimum	Maximum
Source EUI (kBtu/ft^2)	153.7	4.743	1,245
Square Footage *(max value of 100,000)*	12,342	1,001	100,000
Weekly Operating Hours	54.09	32	168
Number of Workers per 1,000 ft^2	2.056	0.07500	7.992
Number of Computers per 1,000 ft^2	3.028	0.02703	14.06
Percent Cooled x Ln (Cooling Degree Days)	6.332	0	8.533

Figure 3 - Final Regression Results

Summary				
Dependent Variable	Source Energy Intensity (kBtu/ft^2)			
Number of Observations in Analysis	886			
R^2 value	0.2200			
Adjusted R^2 value	0.2147			
F Statistic	41.32			
Significance (p-level)	< 0.0001			
	Unstandardized Coefficients	Standard Error	T value	Significance (p-level)
Constant	143.1	3.546	40.37	<0.0001
C_Square Footage *(max value of 100,000)*	0.0006768	0.0001698	3.985	<0.0001
C_Weekly Operating Hours	0.6130	0.1314	4.667	<0.0001
C_Number of Workers per 1,000 ft^2	15.90	3.794	4.190	<0.0001
C_Number of Computers per 1,000 ft^2	10.13	2.433	4.161	<0.0001
C_Percent Cooled x Ln (Cooling Degree Days)	4.529	1.992	2.274	0.0232
Small Bank	82.87	10.03	8.260	<0.0001

Notes:

- *The regression is a weighted ordinary least squares regression, weighted by the CBECS variable "FINALWT".*
- *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**.*
- *Number of Computers per 1,000 ft^2 includes personal computer terminals, laptops, and servers.*
- *Small Bank is a yes/no variable (1 for yes, 0 for no) indicating whether a bank/financial institution is 50,000 ft^2 or smaller in size.*
- *The adjustment for Square Footage is capped at a maximum value of 100,000 ft^2.*

An alternative approach was identified to determine the adjustment necessary for HDD. This method uses the set of office buildings from the U.S. Department of Energy Commercial Reference Building Models. These reference buildings use energy modeling to provide complete descriptions of whole building energy use. EPA used data on building size, energy use, and climate information for offices across a range of sizes (small, medium, and large) and climate zones (16) to determine the relationship between HDD and EUI. EPA regressed source heating EUI on HDD to find an equation for the relationship between heating energy and HDD in the DOE modeled data. The equation showed that, on average, heating energy starts being necessary at an HDD value of 924, and that source heating EUI increases by 0.004693 for every HDD above that point. Thus, the resulting factor for estimating heating energy is 0.004693 kBtu/square foot/HDD.

To integrate this adjustment into the office model, the estimated heating energy for each office building is added to the normalized mean source EUI determined using the regression equation. The property's actual source EUI is divided by the adjusted normalized mean EUI to determine the energy efficiency ratio used in the lookup table.

Figure 4 – Heating Degree Day Adjustment

Adjustment	Value
Heating Degree Days	0.004693

Notes:
- *This adjustment is applied for properties with an HDD value of 924 and above.*

ENERGY STAR SCORE LOOKUP TABLE

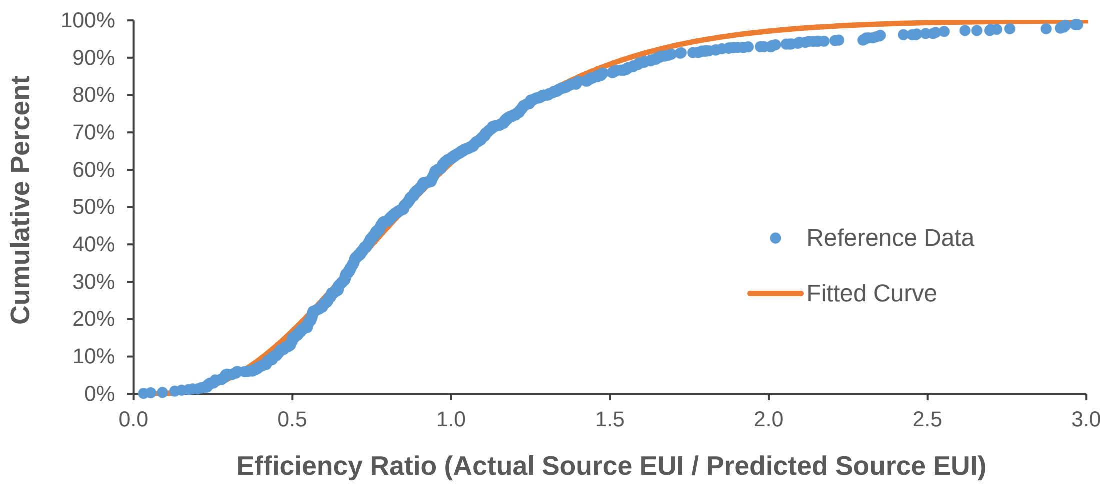
The final regression equation (presented in *Figure 3*) yields a prediction of source EUI based on a building's operating characteristics. Some buildings in the reference data sample use more energy than predicted by the regression equation, while others use less. The *actual* source EUI of each reference 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 5* 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 4.016 and a scale parameter (beta) of 0.2328. For this fit, the sum of the squared error is 0.2474.

Figure 5 – Distribution for Office



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 6*.

Figure 6– ENERGY STAR Score Lookup Table for Office

ENERGY STAR Score	Cumulative Percent	Energy Efficiency Ratio	
		>=	<
100	0%	0.0000	0.1932
99	1%	0.1932	0.2384
98	2%	0.2384	0.2708
97	3%	0.2708	0.2973
96	4%	0.2973	0.3202
95	5%	0.3202	0.3407
94	6%	0.3407	0.3595
93	7%	0.3595	0.3769
92	8%	0.3769	0.3932
91	9%	0.3932	0.4087
90	10%	0.4087	0.4234
89	11%	0.4234	0.4376
88	12%	0.4376	0.4513
87	13%	0.4513	0.4646
86	14%	0.4646	0.4774
85	15%	0.4774	0.4900
84	16%	0.4900	0.5022
83	17%	0.5022	0.5142
82	18%	0.5142	0.5260
81	19%	0.5260	0.5376
80	20%	0.5376	0.5490
79	21%	0.5490	0.5603
78	22%	0.5603	0.5714
77	23%	0.5714	0.5824
76	24%	0.5824	0.5933
75	25%	0.5933	0.6041
74	26%	0.6041	0.6148
73	27%	0.6148	0.6255
72	28%	0.6255	0.6361
71	29%	0.6361	0.6466
70	30%	0.6466	0.6571
69	31%	0.6571	0.6676
68	32%	0.6676	0.6780
67	33%	0.6780	0.6884
66	34%	0.6884	0.6989
65	35%	0.6989	0.7093
64	36%	0.7093	0.7197
63	37%	0.7197	0.7301
62	38%	0.7301	0.7406
61	39%	0.7406	0.7511
60	40%	0.7511	0.7616
59	41%	0.7616	0.7721
58	42%	0.7721	0.7827
57	43%	0.7827	0.7933
56	44%	0.7933	0.8040
55	45%	0.8040	0.8148
54	46%	0.8148	0.8256
53	47%	0.8256	0.8365
52	48%	0.8365	0.8475
51	49%	0.8475	0.8586
50	50%	0.8586	0.8697
49	51%	0.8697	0.8810
48	52%	0.8810	0.8924
47	53%	0.8924	0.9039
46	54%	0.9039	0.9155
45	55%	0.9155	0.9273
44	56%	0.9273	0.9392
43	57%	0.9392	0.9513
42	58%	0.9513	0.9636
41	59%	0.9636	0.9760
40	60%	0.9760	0.9886
39	61%	0.9886	1.0014
38	62%	1.0014	1.0144
37	63%	1.0144	1.0277
36	64%	1.0277	1.0411
35	65%	1.0411	1.0549
34	66%	1.0549	1.0689
33	67%	1.0689	1.0833
32	68%	1.0833	1.0979
31	69%	1.0979	1.1129
30	70%	1.1129	1.1282
29	71%	1.1282	1.1440
28	72%	1.1440	1.1601
27	73%	1.1601	1.1767
26	74%	1.1767	1.1939
25	75%	1.1939	1.2115
24	76%	1.2115	1.2297
23	77%	1.2297	1.2486
22	78%	1.2486	1.2681
21	79%	1.2681	1.2884
20	80%	1.2884	1.3096
19	81%	1.3096	1.3317
18	82%	1.3317	1.3548
17	83%	1.3548	1.3791
16	84%	1.3791	1.4047
15	85%	1.4047	1.4318
14	86%	1.4318	1.4606
13	87%	1.4606	1.4913
12	88%	1.4913	1.5244
11	89%	1.5244	1.5602
10	90%	1.5602	1.5994
9	91%	1.5994	1.6426
8	92%	1.6426	1.6910
7	93%	1.6910	1.7461
6	94%	1.7461	1.8104
5	95%	1.8104	1.8877
4	96%	1.8877	1.9855
3	97%	1.9855	2.1205
2	98%	2.1205	2.3444
1	99%	2.3444	> 2.3444

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 offices:

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	3,500,000 kWh
Natural gas	4,000 therms

Property Use Details	Value
Gross floor area (ft^2)	200,000
Weekly operating hours	80
Workers on the main shift[4]	300
Number of computers	300
Percent of the building that is cooled	100 %
HDD (provided by Portfolio Manager, based on Zip code)	4937
CDD (provided by Portfolio Manager, based on Zip code)	1046

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	3,500,000 kWh	3.412	11,942,000	2.80	33,437,600
Natural gas	4,000 therms	100	400,000	1.05	420,000
				Total Source Energy (kBtu)	33,857,600
				Actual Source EUI (kBtu/ft^2)	169.3

[4] This represents typical peak staffing level during the main shift. For example, in an office if 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, or applying any minimum or maximum values used in the regression model, as necessary).
- The centering values are subtracted to compute the centered variable for each operating parameter.
- The centered variables are multiplied by their coefficients and then summed 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	--	--	--	143.1	143.1
Square Foot *(max value of 100,000)*	100,000	12,342	87,658	0.0006768	59.33
Weekly Operating Hours	80	54.09	25.91	0.6130	15.88
Number of Workers per 1,000 ft^2	1.500	2.056	-0.5560	15.90	-8.840
Number of Computers per 1,000 ft^2	1.500	3.028	-1.528	10.13	-15.48
Percent Cooled x Ln (Cooling Degree Days)	6.953	6.332	0.6210	4.529	2.813
Small Bank	0.0000	--	0.0000	82.87	0.0000
Heating Degree Days	4937	924	4013	0.004693	18.83
				Predicted Source EUI (kBtu/ft^2)	215.6

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 = 169.3 / 215.6 = 0.7853

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 0.7853 is greater than or equal to 0.7827 and less than 0.7933.
- *The ENERGY STAR score is 57.*