ENERGY STAR® PortfolioManager® Technical Reference

ENERGY STAR Score for Offices in Canada

OVERVIEW

The ENERGY STAR Score for Offices applies to office and financial 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. A statistical analysis of the peer building population is performed to identify the aspects of building activity that are significant drivers of energy use and then to normalize for those factors. The result of this analysis is an equation that predicts 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 two property types: office and financial office. The score applies to individual buildings only and is not available for campuses.
- **Reference data.** The analysis for offices in Canada is based on data from the Survey of Commercial and Institutional Energy Use (SCIEU), which was commissioned by Natural Resources Canada (NRCan) and carried out by Statistics Canada, and represents the energy consumption year 2014.
- **Adjustments for weather and business activity.** The analysis includes adjustments for:
    - Building size
    - Number of workers on the main shift
    - Hours of operation per week
    - Weather and climate (using heating and cooling degree days, retrieved based on postal code)
    - Percent of the building that is heated and cooled
- **Release date.** This is the second release of the ENERGY STAR score for Offices in Canada. The ENERGY STAR score for offices is updated periodically as more recent data becomes available:
    - Most Recent Update: February 2018
    - Original Release: July 2013

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 http://www.energystar.gov/ENERGYSTARScore. The subsequent sections of this document offer specific details on the development of the ENERGY STAR score for offices:

M144-285/3-2018E-PDF
978-0-660-24780-9

REFERENCE DATA & FILTERS

The ENERGY STAR score for office properties in Canada applies to office and financial property types. The reference data used to establish the peer building population is based on data from the Survey of Commercial and Institutional Energy Use (SCIEU), which was commissioned by Natural Resources Canada and carried out by Statistics Canada in late 2015 and early 2016. The energy data for the survey was from the calendar year 2014. The raw collected data file for this survey is not publically available, but a report providing summary results is available from Statistics Canada at
http://www.statcan.gc.ca/daily-quotidien/160916/dq160916c-eng.htm

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 and the rationale behind the filter. After all filters are applied, the remaining data set has 766 observations. Due to the confidentiality of the survey data, NRCan is not able to identify the number of cases after each filter.

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

Condition for Including an Observation in the Analysis	Rationale
Defined as category 1 in SCIEU – Office Building	The SCIEU survey covered the commercial and institutional sector and included buildings of all types. For this model, only the observations identified as primarily office building are used.
Building must be more than 50% office	Building Type Filter – To be considered part of the office peer group, the building must have a minimum office space.
Must have electric energy data	Program Filter – Offices that do not use electric energy are rare or non-existent and may indicate an omission in energy data. Electricity can be grid-purchased or produced on site.
Must have at least 1 worker	Program Filter – Basic requirement for a functioning office: it must be occupied.
Must have at least 1 computer	Program Filter – Basic requirement for a functioning office: it must have at least one computer.
Must operate at least 30 hours per week	Program Filter – Basic requirement to be considered as full-time operation.
Must operate at least 10 months per year	Program Filter – Basic requirement to be considered as full-time operation
Vacant space cannot exceed office space	Program Filter – Occupancy needs to be greater than 50% for offices to meet ENERGY STAR certification requirements.
Must be built in 2013 or earlier	Data Limitation Filter – The survey reported the energy for calendar year 2014. Therefore, if the building was being built in 2014, a full year of energy data would not be available.
Must not include energy supplied to other buildings	Data Limitation Filter – The survey asked whether the energy reported at the facility included energy supplied to other buildings such as a multi-building complex or portables. Usage data may not have been included, therefore buildings were removed.

Condition for Including an Observation in the Analysis	Rationale
Must not use any "wood" or "other" fuels for which the energy value is reported	Data Limitation Filter – The survey asked whether fuels other than purchased electricity, on-site generated electricity from renewable sources, natural gas, light fuel oil, diesel, kerosene, propane, district steam, district hot water or district chilled water were consumed in the facility. Either the type of energy was not defined or, in the case of wood, the provided units of energy were not easily convertible to Gigajoules (GJ) of energy; therefore, the energy content of these fuels could not be directly compared. In these occurrences, these observations were removed from the analysis.
Over 50% of the area must be heated	Analytical Filter – Observations less than or equal to 50% were not deemed realistic for the Canadian climate, which generally exceeds 2,000 HDD.
Source EUI must be greater than 0.35 GJ/m^2 and less than 3.75 GJ/m^2	Analytical Filter – Values determined to be outliers based on analysis of the data. Outliers are typically clearly outside normal operating parameters for a building of this type.
Must be at least 92.903 m^2 (1,000 sq. ft.)	Analytical Filter – The analysis could not model behaviours for buildings smaller than 92.903 m^2 (1,000 sq. ft.)
Worker density (workers per 100 m^2) must be greater than 0.35 and less than 10	Analytical Filter – Values determined to be outliers based on analysis of the data. Outliers are typically clearly outside normal operating parameters for a building of this type.
Must have less than 3 computers per person	Analytical Filter – Values determined to be outliers based on analysis of the data. Outliers are typically clearly outside the normal operating parameters for a building of this type.

Of the filters applied to the reference data, some are also eligibility requirements for calculating a score in Portfolio Manager. 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 available during the analysis, 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 has a different behaviour from the rest of the properties (e.g. offices that are smaller than 92.903 m^2 do not behave the same way as larger buildings), in which case an Analytical Filter is 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 performed 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, was analyzed using a weighted ordinary least squares regression, which evaluated energy use relative to business activity (e.g. number of workers, operating hours per week, area, and climate). This linear regression yielded 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 in Canada.

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 regression analyzes the key drivers of source EUI – those factors that explain the variation in source energy use per square metre in offices. The unit for source EUI in the Canadian model is the gigajoule per square metre (GJ/m^2) per year.

Independent Variables

The reference survey contained numerous property operation questions that NRCan identified as potentially important for offices. Based on a review of the available variables in the reference data, in accordance with the criteria for inclusion in Portfolio Manager,[1] NRCan initially analyzed the following variables in the regression analysis:

- Gross building area (m^2)
- Cooling degree days (CDD)
- Heating degree days (HDD)
- Percentage of floor space that is cooled
- Percentage of floor space that is heated
- Weekly hours of operation
- Number of workers during the main shift
- Presence of a commercial food preparation area (yes/no)
- Floor space dedicated to commercial food preparation (m^2)
- Floor space that is interior parking
- Floor space that is heated interior parking
- Number of walk-in refrigeration units
- Length of open refrigerated cases
- Length of closed refrigerated cases
- Length of open freezer cases
- Length of closed freezer cases
- Months in operation in 2014
- Number of commercial appliances (freezers, refrigerators, dishwashers, ovens, microwaves, washers, etc.)
- Number of computers
- Number of floors

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

- Number of elevators and escalators
- Presence of a pool (yes/no)
- Number of printers, photocopiers, fax machines and multi-functional devices
- Number of televisions / electronic displays / LCDs
- Number of vending machines
- Presence of associated exterior parking (yes/no)
- Server room area (m^2)
- Year of construction

NRCan, with the advice of the EPA, performed extensive review on all of these operational characteristics. In addition to reviewing each characteristic individually, characteristics were reviewed in combination with each other (e.g. Heating Degree Days times Percent Heated). As part of the analysis, some variables were reformatted to reflect the physical relationships of building components. For example, the number of workers on the main shift can be evaluated in a density format. The number of workers *per square metre* (as opposed to the gross number of workers) could be expected to be related to the energy use per square metre. Also, based on analytical results and residual plots, variables were examined using different transformations (such as the natural logarithm, abbreviated as Ln). The analysis consisted of multiple regression formulations. These analyses were structured to find the combination of statistically significant operating characteristics that explained the greatest amount of variance in the dependent variable: source EUI.

The final regression equation includes the following variables:

- Natural logarithm of the building floor area[2]
- Number of workers per 100 m^2 during the main shift
- Weekly operating hours[3]
- Number of heating degree days times percent of the building that is heated (HDD x % heated)[4]
- Natural logarithm of cooling degree days times percent cooled (Ln(CDD) x % cooled)

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 characteristics. That is, the mean energy for buildings that operate like your building.

Property Floor Area

Without an area term, it was found that the variance in average scores and EUIs for large office and small office subsets was too large. An area term was required for score equitability. *Area* was strongly correlated to number of floors and elevators, and was the preferred base term from a programmatic and consistency perspective. While both the *LnArea* and *Area* terms were significant, the *LnArea* term was most representative of the Area to EUI relationship. Unlike the 2009 office model, there was not a need for a second area term for correction. However, the building floor area adjustment was capped at a maximum value of 10,000 m^2 to further balance the average scores for large and small buildings, meaning that any property with a value above 10,000 m^2 will receive the same area-based predicted energy adjustment as a 10,000-m^2 building.

[2] The Area variable is subject to a maximum value. See detailed description below.
[3] The Hours variable is subject to a minimum value. See detailed description below.
[4] The HDD variable is subject to a minimum value. See detailed description below.

Workers and Computers

The *worker density* (workers per 100 m^2) and *computer density* (computers per 100 m^2) were each significant during the development of the office regression model. The high correlation between *worker density* and *computer density* allowed only one of the terms to be included in the model. *Worker density* is preferred from a program standpoint, because there is more confidence in gathering the value accurately and easily.

Weekly Operating Hours

Of all the terms selected, the weekly operating hours variable demonstrated the least significance in the SCIEU 2014 data. We tested a variety of hours terms including *Hours*, *168 hours (yes/no)*, *LnHours* and *Hours with a floor*. The adjustment for *Hours* has a minimum of 65 hours, because this lower limit provided the highest R^2 and was the most statistically significant. This means that any property with a weekly operating hours value below 65 will receive the same hours-based predicted energy adjustment as a building with weekly operating hours of 65 hours.

Climate (HDD and CDD)

The analysis looked at the *Heating Degree Days (HDD)*, *Cooling Degree Days (CDD)*, *percent of the building that is heated*, and *percent of the building that is cooled*.

There was a strong correlation between the EUI of the building and the *HDD* observed by the building. While both *HDD* and *HDD times percent heated* were significant, the regression performed slightly better with *HDD times percent heated*. Adding a minimum HDD value of 3,500 to the regression (meaning that any property with a value below 3,500 HDD will be assigned a value of 3,500) improved results, leading to increased equitability by climate zone.

As demonstrated in the 2009 version of the office model, initial findings indicated that the *CDD* and *percent cooled* terms were not consistently significant. This was again due to the much narrower range of CDDs across the Canadian climate as compared to the U.S. climate. Aligning with previous results, the *Ln(CDD) x percent cooled* term was the most consistently significant.

Testing

Finally, NRCan further analyzed the regression equation using actual data that has been entered in Portfolio Manager. This provided another set of buildings to examine, in addition to the SCIEU data, to see the ENERGY STAR scores and distributions, and to assess the impacts and adjustments. This analysis on a separate data set provided a second level of verification to ensure that there was a good distribution of scores. This analysis also provided confirmation that there are minimal biases with respect to the key operational characteristics such as building size, computer density, worker density, and heating and cooling degree days. It also confirmed that there was no regional bias or bias for the type of energy used for heating.

It is important to reiterate that the final regression equation is based on the nationally representative reference data from SCIEU 2014, not on 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 766 observations. The dependent variable is source EUI. Each independent variable is centered relative to the weighted 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 their respective significance levels.

The regression equation has a coefficient of determination (R^2) value of 0.158, indicating that this equation explains 15.8% of the variance in source EUI for office buildings. Because the final equation is structured with energy per unit area as the dependent variable, the explanatory power of the area is not included in the R^2 value, and thus this value appears artificially low. Re-computing the R^2 value in units of source energy[5] demonstrates that the equation actually explains 92.4% of the variation in total 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.

Figure 2 - Descriptive Statistics for Variables in Final Regression Equation

Variable	Minimum	Median	Maximum	Centering Term
Source energy per square metre (GJ/m^2)	0.398	1.547	3.719	1.602
Heating degree days x percent heated	2,100	4,355	8,294	4,641
Natural logarithm of cooling degree days x percent cooled	0	4.478	6.046	4.309
Number of workers per 100 m^2 during main shift	0.3622	2.559	9.967	2.833
Weekly operating hours	65	65	168	69.07
Natural logarithm of building floor area in m^2	4.580	7.016	9.210	7.014

Figure 3 - Final Regression Results

Summary	
Dependent variable	Source energy use intensity (GJ/m^2)
Number of observations in analysis	766
R^2 value	0.1587
Adjusted R^2 value	0.1532
F statistic	28.68
Significance (p-level)	< 0.0001

[5] The R^2 value in Source Energy is calculated as: 1 – (Residual Variation of Y) / (Total Variation of Y). The residual variation is the 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.

	Unstandardized Coefficients	Standard Error	T value	Significance (p-level)
Constant	1.602	0.02305	69.51	< 0.0001
C_Heating degree days x percent heated	0.0001658	0.00002811	5.90_	<0.0001
C_Natural Logarithm of Cooling degree days x percent cooled	0.08094	0.01561	5.18_	<0.0001
C_Number of workers per 100 m²	0.1046	0.01246	8.39	< 0.0001
C_Weekly operating hours	0.003206_	0.00138	2.32	0.0207
C_Natural Logarithm of Building floor area in m²	0.08044	0.02035	3.95	<0.0001

- *Notes:*
- *The regression is a weighted ordinary least squares regression, weighted by the SCIEU variable "SWEIGHT."*
- *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 adjustment for building floor area is capped at a maximum value of 10,000 m^2.*
- *The adjustment for weekly operating hours has a minimum of 65 hours, meaning that any property with a value below 65 will be assigned a value of 65 hours.*
- *The adjustment for heating degree days (HDD) has a minimum of 3500 HDD, meaning that any property with a value below 3,500 HDD will be assigned a value of 3,500.*
- *Heating and cooling degree days are sourced from Canadian weather stations included in the U.S. National Climatic Data Center system.*

ENERGY STAR SCORE LOOKUP TABLE

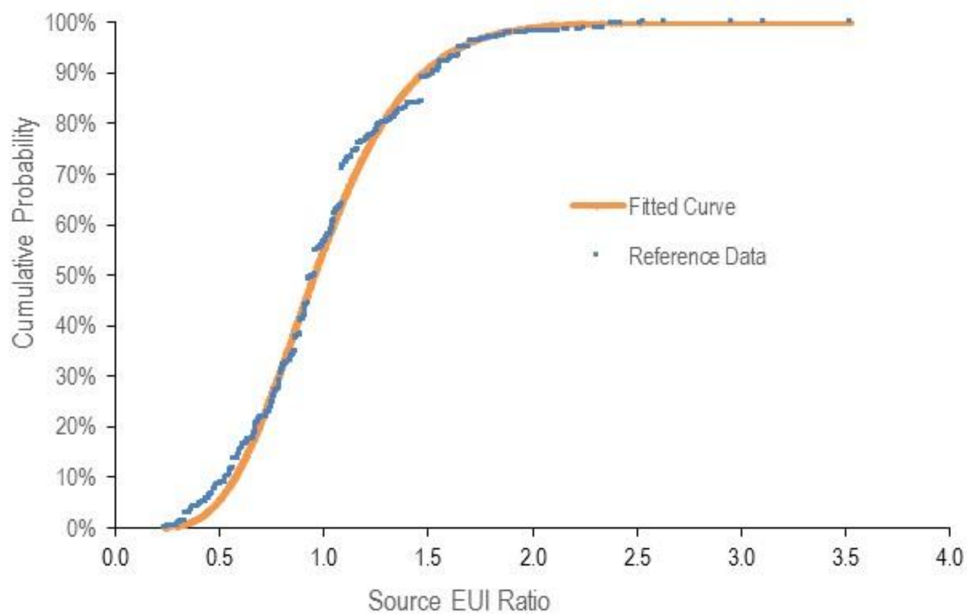
The final regression equation (presented in ***Figure 3***) yields a prediction of source EUI based on a building's operating characteristics. Some buildings in the SCIEU data sample use more energy than predicted by the regression equation, while others use less. The *actual* source EUI of each reference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

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

An efficiency ratio lower than one 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 7.762 and a scale parameter (beta) of 0.1285. For this fit, the sum of the squared error is 0.4861.

Figure 4 – 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% corresponds to the ratio for a score of 75; only 25% of the population has a ratio this small or smaller. The complete score lookup table is presented in ***Figure 5***.

Figure 5 – ENERGY STAR Score Lookup Table for Offices

ENERGY STAR Score	Cumulative Percent	Energy Efficiency Ratio	
		> =	<
100	0%	0.0000	0.3555
99	1%	0.3555	0.4056
98	2%	0.4056	0.4399
97	3%	0.4399	0.4671
96	4%	0.4671	0.4900
95	5%	0.4900	0.5102
94	6%	0.5102	0.5283
93	7%	0.5283	0.5449
92	8%	0.5449	0.5604
91	9%	0.5604	0.5748
90	10%	0.5748	0.5885
89	11%	0.5885	0.6015
88	12%	0.6015	0.6140
87	13%	0.6140	0.6260
86	14%	0.6260	0.6375
85	15%	0.6375	0.6487
84	16%	0.6487	0.6596
83	17%	0.6596	0.6702
82	18%	0.6702	0.6805
81	19%	0.6805	0.6906
80	20%	0.6906	0.7005
79	21%	0.7005	0.7103
78	22%	0.7103	0.7198
77	23%	0.7198	0.7293
76	24%	0.7293	0.7385
75	25%	0.7385	0.7477
74	26%	0.7477	0.7568
73	27%	0.7568	0.7658
72	28%	0.7658	0.7746
71	29%	0.7746	0.7835
70	30%	0.7835	0.7922
69	31%	0.7922	0.8009
68	32%	0.8009	0.8096
67	33%	0.8096	0.8182
66	34%	0.8182	0.8267
65	35%	0.8267	0.8353
64	36%	0.8353	0.8438
63	37%	0.8438	0.8523
62	38%	0.8523	0.8608
61	39%	0.8608	0.8692
60	40%	0.8692	0.8777
59	41%	0.8777	0.8862
58	42%	0.8862	0.8947
57	43%	0.8947	0.9032
56	44%	0.9032	0.9117
55	45%	0.9117	0.9203
54	46%	0.9203	0.9289
53	47%	0.9289	0.9375
52	48%	0.9375	0.9462
51	49%	0.9462	0.9549

ENERGY STAR Score	Cumulative Percent	Energy Efficiency Ratio	
		>=	<
50	50%	0.9549	0.9637
49	51%	0.9637	0.9725
48	52%	0.9725	0.9814
47	53%	0.9814	0.9904
46	54%	0.9904	0.9995
45	55%	0.9995	1.0086
44	56%	1.0086	1.0178
43	57%	1.0178	1.0271
42	58%	1.0271	1.0366
41	59%	1.0366	1.0461
40	60%	1.0461	1.0558
39	61%	1.0558	1.0656
38	62%	1.0656	1.0755
37	63%	1.0755	1.0856
36	64%	1.0856	1.0958
35	65%	1.0958	1.1062
34	66%	1.1062	1.1168
33	67%	1.1168	1.1276
32	68%	1.1276	1.1386
31	69%	1.1386	1.1499
30	70%	1.1499	1.1613
29	71%	1.1613	1.1731
28	72%	1.1731	1.1851
27	73%	1.1851	1.1974
26	74%	1.1974	1.2101
25	75%	1.2101	1.2231
24	76%	1.2231	1.2366
23	77%	1.2366	1.2504
22	78%	1.2504	1.2648
21	79%	1.2648	1.2796
20	80%	1.2796	1.2950
19	81%	1.2950	1.3111
18	82%	1.3111	1.3279
17	83%	1.3279	1.3454
16	84%	1.3454	1.3639
15	85%	1.3639	1.3833
14	86%	1.3833	1.4039
13	87%	1.4039	1.4259
12	88%	1.4259	1.4495
11	89%	1.4495	1.4749
10	90%	1.4749	1.5025
9	91%	1.5025	1.5329
8	92%	1.5329	1.5668
7	93%	1.5668	1.6053
6	94%	1.6053	1.6498
5	95%	1.6498	1.7032
4	96%	1.7032	1.7703
3	97%	1.7703	1.8620
2	98%	1.8620	2.0126
1	99%	2.0126	> 2.0126

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	3,000,000 kWh
Natural gas	200,000 m^3

Property Use Details	Value
Gross floor area (m^2)	20,000
HDD (provided by Portfolio Manager, based on postal code)	3,600
CDD (provided by Portfolio Manager, based on postal code)	425
Percent of the building that is heated	100%
Percent of the building that is cooled	100%
Workers on main shift[6]	250
Weekly operating hours	80

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 GJ Multiplier	Site GJ	Source Multiplier	Source GJ
Electricity	3,000,000 kWh	0.0036	10,800	1.96	21,168
Natural gas	200,000 m^3	0.03843	7,686	1.01	7,763
				Total Source Energy (GJ)	28,931
				Source EUI (GJ/m^2)	**1.447**

[6] This represents typical peak staffing level during the main shift. For example, in a office, if there are two daily 6-hour shifts of 25 workers each, the workers on main shift value is 25.

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 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 office regression equation to obtain a predicted source EUI.

Computing Predicted Source EUI

Variable	Actual Building Value	Reference Centering Value	Building Centered Variable	Coefficient	Coefficient x Centered Variable
Constant	-	-	-	1.602	1.602
HDD x % heated	3,600	4,641	-1040.63	0.000166	-0.177
Ln(CDD) x % cooled	6.05	4.310	1.743	0.0894	0.156
Number of workers per 100 m²	1.25	2.833	-1.58	0.1046	-0.166
Weekly operating hours	80	69.07	10.93	0.0032	0.035
Ln of Building floor area in m² *	9.21	7.014	2.196	0.0804	0.177
				Predicted Source EUI (GJ/m²)	1.632

**If the building gross floor area is larger than 10,000 m², then 10,000 m² is used.*

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 = 1.447 / 1.632 = 0.8865

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 0.8865 is less than 0.8947 but greater than 0.8862.
- ***The ENERGY STAR score is 58.***