ENERGY STAR® Portfolio Manager® Technical Reference

ENERGY STAR Score for K-12 Schools in Canada

OVERVIEW

The ENERGY STAR Score for K-12 Schools applies to primary and secondary schools. This does not include college, cégep, or university classroom facilities and laboratories; vocational, technical or trade schools; or preschool or day care buildings. 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 schools applies to primary and secondary schools, from kindergarten to grade 12. The score applies to an entire school whether it is a single building or a campus of buildings. Individual buildings that are part of larger K-12 campuses cannot receive their own score.
- **Reference data.** The analysis for schools in Canada is based on data from the Survey on Commercial and Institutional Energy Use (SCIEU), which was commissioned by Natural Resources Canada (NRCan) and carried out by Statistics Canada.
- **Adjustments for weather and business.** The analysis includes adjustments for:
  - Building size
  - Gymnasium size
  - Whether it is a secondary school
  - Number of workers
  - Student seating capacity
  - Weather and climate (using heating and cooling degree days, retrieved based on postal code)
  - Percent of the building/campus that is heated and cooled
- **Release date.** This is the first release of the ENERGY STAR score for K-12 schools using Canadian data.

This document presents details on the development of the 1 - 100 ENERGY STAR score for K-12 school 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 K-12 Schools:

REFERENCE DATA & FILTERS

For the ENERGY STAR score for K-12 school properties in Canada, the reference data used to establish the peer building population is based on data from the Survey on Commercial and Institutional Energy Use (SCIEU), which was commissioned by Natural Resources Canada and carried out by Statistics Canada in late 2010 and early 2011. The consumption data for the survey was from the calendar year 2009. The raw collected data file for this survey is not publically available, but a report providing summary results is available on Natural Resources Canada's website at http://oee.nrcan.gc.ca/publications/statistics/scieu09/scieu_e.pdf.

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 K-12 schools and the rationale behind the filter. After all filters are applied, the remaining data set has 242 observations. Due to the confidentiality of the survey data, we are not able to identify the number of cases after each filter.

Figure 1 – Summary of Filters for the ENERGY STAR Score for K-12 Schools

Condition for Including an Observation in the Analysis	Rationale
Defined as category 3 in SCIEU – Kindergarten to Grade 12 Schools	The SCIEU survey covered the commercial and institutional sector and included buildings of all types. For this model, only the observations identified as main activity being schools are used.
Building must be at least 70% K-12 School	Building Type Filter – Definition of a School
Must have electric energy data	Program Filter – Basic requirement to be considered a functioning school is that it requires electrical consumption. Electricity can be grid-purchased or produced on site.
Must be at least 100 m²	Program Filter – Since Schools below 100 m² are uncommon, NRCan opted to select this cut-off as a program decision.
Must operate at least 30 hours per week	Program Filter – Basic requirement to be considered as full-time operation
Must operate at least 8 months per year	Program Filter – Basic requirement to be considered as full-time operation
Must have at least 1 employee and 2 students	Program Filter – Basic requirement for a functioning School. It must be occupied.
Must have at least 1 computer	Program Filter – Basic requirement for a functioning School. It must have at least one computer.
Must be built in 2008 or earlier	Data Limitation Filter – The survey reported the consumption for calendar year 2009. Therefore, if the building was being built in 2009, a full year of consumption data would not be available.
Must not include energy supplied to other buildings that was not quantified	Data Limitation Filter – No data collected on this consumption if the respondent identified that the building supplied energy to other buildings but did not provide the amount
Must not use any "other" fuels for which the consumption is not reported	Data Limitation Filter – No data collected on this consumption. The survey asked if additional energy consumption occurred in the building that was not reported. In those occurrences, the cases were removed from the analysis.

Condition for Including an Observation in the Analysis	Rationale
Must be heated in at least 70 % of the floor space	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 Source EUI that is greater than 0.15 and less than 7 GJ/m²	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 an employee density (employee per 100 m^2) that is less than or equal to 3	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 a student seating capacity density (students per 100 m^2) that is less than or equal to 50	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.

The goal of this analysis was to be representative of a typical school building being used for commercial or institutional purposes. An in-depth analysis was performed to evaluate the minimum size cut-off at 100 m² intervals, and there was no noticeable cut-off point as was seen in other models. However, there are very few schools smaller than 100 m² (approx. 1,076 ft²) of floor space, and since it is a very small size for a dedicated school, this value was selected as the minimum size to be eligible to receive a score.

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 has a different behaviour from the rest of the properties (e.g., office buildings smaller than 465 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. The ENERGY STAR score applies to an entire K-12 school whether it is a single building or a campus of buildings. Schools may have multiple buildings that are all integral to the primary activity. One building might contain classes, a second, the gymnasium, and another might be a portable. In this case, the campus can get an ENERGY STAR score as long as the energy for all the buildings is metered and reported. For cases where all the activities are contained within one building, that school can get a building ENERGY STAR 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. operating hours, number of workers, 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 schools.

Dependent Variable

The dependent variable is what we try to predict with the regression equation. For the K-12 school 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, including portables supplied by the main building. The regression analyzes the key drivers of source EUI – those factors that explain the variation in source energy use per square meters in K-12 schools. The unit for source EUI in the Canadian model is the Gigajoule per Square Meter (GJ/m²).

Independent Variables

The SCIEU data contains numerous building property operation questions that NRCan identified as potentially important for schools. Based on a review of the available variables in the SCIEU data, in accordance with the criteria for inclusion,[1] NRCan initially analyzed the following variables in the regression analysis:

- Gross building area (m²)
- Heating degree days (HDD)
- Cooling degree days (CDD)
- Average outdoor temperature (°C)
- Percentage of heated floor space
- Percentage of cooled floor space
- Presence of commercial food preparation area (Y/N)
- Floor space dedicated to commercial cooking area
- Presence of a gymnasium (Y/N)
- Floor space dedicated to gymnasium (m²)
- Year of construction
- Presence of an indoor pool (Y/N)
- Number of floors
- Weekly hours of operation
- Number of months in operation in 2009
- Number of workers on the main shift
- Student seating capacity
- Number of computers

[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 computer servers
- Number of vending machines
- Presence of community/evening activities (Y/N)
- Presence of a daycare (Y/N)
- Whether the school is a secondary school (a.k.a. high school)

NRCan and 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 meter* (as opposed to the gross number of workers) could be expected to be correlated with the energy use per square meter. Also, based on analytical results and residual plots, variables were examined using different transformations (such as the natural logarithm, abbreviated as Ln). The analysis consists 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:

- Presence of a secondary school (Yes/No)
- Natural logarithm of area
- Natural logarithm of number of employees
- Seating capacity (number of students)
- Natural logarithm of gymnasium size (m^2)
- Heating degree days times percent heated
- Cooling degree days times percent cooled

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

Secondary School Variable

The analysis demonstrated a tendency for secondary schools to have higher energy intensity than primary schools. Part of the analysis was to add a defining variable for secondary schools in order to differentiate from primary schools. This allowed the evaluation of variables that were applicable to secondary schools only. However, only the variable that indicated the presence of a secondary school was significant.

Climate (HDD and CDD)

The analysis looked at the heating degree days (HDD), the cooling degree days (CDD) and the average temperature, as well as products with percent heated and percent cooled. The initial findings were that there was a particularly strong correlation with HDD and by extension, HDD times Percent Heated. The value of HDD times Percent Heated was selected as the variable even though in practice, schools are typically entirely heated.

The analysis showed a slightly different behaviour with the CDD variables. In this case, the typical school is not air conditioned, and those that are typically only air condition small portions. Over 50% of the schools in the data set had less than 5% of the floor space air conditioned. As a result, the variable CDD by itself was not significant; however, when combined with the Percent Cooled, the variable did become significant. The reason behind this is twofold: first, not all schools are open during the summer months when cooling is mostly required; second, the schools that do have cooling do not necessarily have cooling throughout the entire building – it may be limited to specific areas, such as administrative offices.

The weather data for the Canadian model was taken from the U.S. National Climatic Data Center sources, which are the same sources used by EPA for U.S. buildings and were used to standardize how Portfolio Manager incorporates weather data.

Property Size

Several variables that were related to the size of the building were identified for further analysis. They included the area, natural logarithm of area, and number of floors. The strongest variable that was consistently significant was the natural logarithm of area (LnArea). This variable was always significant on its own. As with other variables, the combination of LnArea for all buildings and a separate one for secondary school was analyzed. In any of the iterations, only LnArea stayed significant throughout. The final model includes the LnArea.

Employees and Students

Initially four main variables were analyzed with regard to occupancy: number of workers, worker density, student seating capacity, and student seating capacity density. It was noticed that there were some interesting behaviours with regard to schools, which differ from other building types. For example, in the office model, the density of workers tends to be independent of the size of the buildings (e.g.: a larger building may have more employees but similar density as smaller ones). However, for schools, there was a definite trend that showed that larger schools had lower student density. Schools with higher occupancy, usually larger schools, generally used less energy per area (there is a negative correlation between size and energy). Because of these opposite trends, the density of workers (and the density of the student seating capacity) did not typically show up as statistically significant and/or had trends that impacted other variables such as building size. It was observed that regressions that included terms for the student seating capacity and the natural logarithm of the employees were more significant and reliable. Those two variables are included in the final model.

Hours/Months of Operation

The initial two variables related to period of occupancy that were evaluated were months in operation and weekly hours of operation. In both cases, there was a noticeable trend that larger schools had longer operating hours and were open for more months. So while schools with longer operating hours might be expected to be more energy intensive, they tended to be the larger schools, which had overall lower energy intensity. Therefore, the months and hours variables were not statistically significant and were not selected for the final regression model.

As well, another available variable was whether the school was used for community or evening use. As was the case with hours and months, the variable was not significant in any of the model iterations. The behavior is likely due to the high correlation between the size of the school and the presence of gymnasium (see below for additional information on gymnasium variables). Larger schools tend to have larger gymnasiums and to be in use for longer periods. Therefore, the driving variable is the size of the school in combination with the size of the gymnasium, rather than the occupancy periods.

Computers

It was noted that there was a correlation between the number of computers and the number of occupants, which is typically expected. NRCan analyzed several combinations of variables using computers and occupants including: number of computers per 100 m² and number of computers per occupant. Due to the correlation between computer and occupants, the number of computers was not a significant variable during the development of the model, and since the number of students and employees was more representative of a school environment, no computer variables appear in the final equation.

Gymnasiums

Information regarding the presence of a gymnasium and its size was available. To understand the effect of this characteristic, we investigated several variables related to the gymnasiums (percent of floor space dedicated to gymnasium, area of gymnasium and natural logarithm of gymnasium area [LnGymArea]). The LnGymArea was regularly significant in the regressions performed, and so was the presence of a gymnasium. The regression with LnGymArea was selected as it took into consideration the actual size of the gymnasium and was therefore more representative of the actual building receiving a score.

It was noted that while the LnArea had a negative coefficient, since larger schools tend to be less energy intensive, the LnGymArea had a positive coefficient, which was likely due to the higher ventilation and lighting intensity within that space.

Commercial Cooking

Two data points were available that were related to commercial cooking: the presence of commercial cooking and the percentage of the floor space dedicated to commercial cooking. Neither term was significant, and therefore neither was included in the model.

Pools

The data set had a small number of schools with indoor pools. The existing methodology for pools in Portfolio Manager is to calculate an engineering allowance for pools. Portfolio Manager subtracts the engineered estimate to rate the school as if it did not have a pool. The full description of this assessment is available here: www.energystar.gov/ScoreDetails.

The Canadian model uses the same approach as the U.S. model, and applies this engineered allowance.

Testing

Finally, NRCan further analyzed the regression equation using actual schools that have been entered in Portfolio Manager. This provided another set of buildings to examine, in addition to the SCIEU data, to see the average ENERGY STAR scores and distributions, and to assess the impacts and adjustments. While Portfolio Manager did not capture some of the new variables required in the Canadian scale and we used default values for those variables, this analysis provided a second level of verification to ensure that there was a homogenous distribution of scores with regard to region or to 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, 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 241 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, with the exception of Cooling Degree days times Percent Cooled, which is above the 93% confidence level, as shown by their respective significance level.

The regression equation has a coefficient of determination (R^2) value of 0.343, indicating that this equation explains 34.3% of the variance in source EUI for K-12 school 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[2] demonstrates that the equation actually explains 88.9% of the variation in total source energy of K-12 schools. 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	Mean	Minimum	Maximum
Source Energy Use per m² (GJ/m²)	1.073	0.185	3.453
Secondary School (Y/N)	N/A	0.000	1.000
Heating degree days times percent heated	4579.68	2915.23	7322.51
Cooling degree days times percent cooled	48.04	0.000	399.72
Natural Logarithm of building floor area	8.110	5.403	10.506
Natural Logarithm of number of employees	3.174	0.000	5.318
Number of student seating capacity	418.835	22.000	2500.000
Natural Logarithm of gymnasium floor area	4.983	0.000	8.626

[2] 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.

Figure 3 - Final Regression Results

Summary				
Dependent variable	Source Energy Intensity (GJ/m²)			
Number of observations in analysis	241			
R^2 value	0.343			
F statistic	17.34			
Significance (p-level)	<0.0001			
	Unstandardized Coefficients	**Standard Error**	**T Value**	**Significance (p-level)**
Constant	0.99610	0.02522	39.50	<0.0001
Secondary School (Y/N)	0.22734	0.05012	4.54	<0.0001
C_Heating Degree days x Percent Heated	0.00015782	0.00001946	8.11	<0.0001
C_Cooling Degree days x Percent Cooled	0.00053207	0.00029717	1.79	0.0747
C_Ln(Building Floor Area)	-0.36532	0.06263	-5.83	<0.0001
C_Ln(Number of Employees)	0.11120	0.05517	2.02	0.0450
C_Student Seating Capacity	0.00040116	0.00011036	3.64	0.0003
C_Ln(Gymnasium Floor Area)	0.02874	0.01218	2.36	0.0191

Notes:

- *The regression is a weighted ordinary least squares regression, weighted by the SCIEU variable "WTBS."*
- *The prefix C_ on each variable indicates that it is centered. The centered variable is equal to the difference between the actual value and the observed mean. The observed mean values are presented in Figure 2.*
- *The heating degree days and cooling degree days are sourced from the U.S. National Climatic Data Center*

ENERGY STAR SCORE LOOKUP TABLE

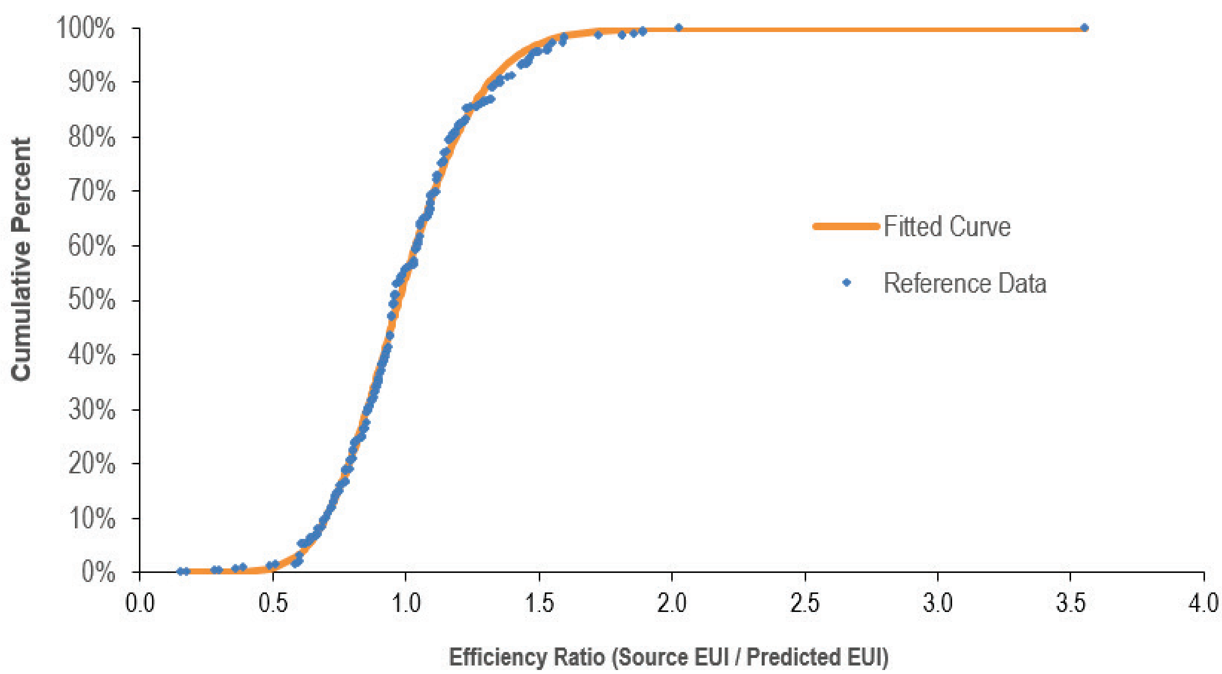
The final regression equation (presented in ***Figure 3***) yields a prediction of source EUI based on a building's operating characteristics. Some buildings in the SCIEU data sample use more energy than predicted by the regression equation, while others use less. The *actual* source EUI of each reference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

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

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 16.84137 and a scale parameter (beta) of 0.05897. For this fit, the sum of the squared error is 0.054373.

Figure 4 – Distribution for K-12 School



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 K-12 Schools

ENERGY STAR Score	Cumulative Percent	Energy > =	Efficiency Ratio <	ENERGY STAR Score	Cumulative Percent	Energy >=	Efficiency Ratio <
100	0%	0.0000	0.5178	50	50%	0.9735	0.9796
99	1%	0.5178	0.5613	49	51%	0.9796	0.9856
98	2%	0.5613	0.5902	48	52%	0.9856	0.9917
97	3%	0.5902	0.6126	47	53%	0.9917	0.9978
96	4%	0.6126	0.6313	46	54%	0.9978	1.0039
95	5%	0.6313	0.6475	45	55%	1.0039	1.0101
94	6%	0.6475	0.6619	44	56%	1.0101	1.0164
93	7%	0.6619	0.6750	43	57%	1.0164	1.0226
92	8%	0.6750	0.6871	42	58%	1.0226	1.0290
91	9%	0.6871	0.6983	41	59%	1.0290	1.0354
90	10%	0.6983	0.7089	40	60%	1.0354	1.0419
89	11%	0.7089	0.7189	39	61%	1.0419	1.0485
88	12%	0.7189	0.7284	38	62%	1.0485	1.0551
87	13%	0.7284	0.7375	37	63%	1.0551	1.0618
86	14%	0.7375	0.7463	36	64%	1.0618	1.0687
85	15%	0.7463	0.7547	35	65%	1.0687	1.0756
84	16%	0.7547	0.7628	34	66%	1.0756	1.0826
83	17%	0.7628	0.7707	33	67%	1.0826	1.0898
82	18%	0.7707	0.7784	32	68%	1.0898	1.0970
81	19%	0.7784	0.7859	31	69%	1.0970	1.1044
80	20%	0.7859	0.7932	30	70%	1.1044	1.1120
79	21%	0.7932	0.8004	29	71%	1.1120	1.1197
78	22%	0.8004	0.8074	28	72%	1.1197	1.1276
77	23%	0.8074	0.8142	27	73%	1.1276	1.1357
76	24%	0.8142	0.8210	26	74%	1.1357	1.1439
75	25%	0.8210	0.8277	25	75%	1.1439	1.1524
74	26%	0.8277	0.8342	24	76%	1.1524	1.1612
73	27%	0.8342	0.8407	23	77%	1.1612	1.1701
72	28%	0.8407	0.8471	22	78%	1.1701	1.1794
71	29%	0.8471	0.8535	21	79%	1.1794	1.1890
70	30%	0.8535	0.8597	20	80%	1.1890	1.1989
69	31%	0.8597	0.8659	19	81%	1.1989	1.2092
68	32%	0.8659	0.8721	18	82%	1.2092	1.2200
67	33%	0.8721	0.8782	17	83%	1.2200	1.2312
66	34%	0.8782	0.8843	16	84%	1.2312	1.2430
65	35%	0.8843	0.8903	15	85%	1.2430	1.2554
64	36%	0.8903	0.8963	14	86%	1.2554	1.2684
63	37%	0.8963	0.9023	13	87%	1.2684	1.2823
62	38%	0.9023	0.9083	12	88%	1.2823	1.2972
61	39%	0.9083	0.9142	11	89%	1.2972	1.3131
60	40%	0.9142	0.9201	10	90%	1.3131	1.3305
59	41%	0.9201	0.9261	9	91%	1.3305	1.3495
58	42%	0.9261	0.9320	8	92%	1.3495	1.3705
57	43%	0.9320	0.9379	7	93%	1.3705	1.3943
56	44%	0.9379	0.9438	6	94%	1.3943	1.4218
55	45%	0.9438	0.9497	5	95%	1.4218	1.4545
54	46%	0.9497	0.9557	4	96%	1.4545	1.4954
53	47%	0.9557	0.9616	3	97%	1.4954	1.5509
52	48%	0.9616	0.9676	2	98%	1.5509	1.6409
51	49%	0.9676	0.9735	1	99%	1.6409	>1.6409

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 K-12 schools:

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	700,000 kWh
Natural gas	85,000 m^3

Property Use Details	Value
Gross floor area (m^2)	8,250
Gross gymnasium floor area (m^2)	1,250
Workers on main shift[3]	70
Student seating capacity	850
Percent Heated	100
Percent Cooled	20
HDD (provided by Portfolio Manager, based on postal code)	4,600
CDD (provided by Portfolio Manager, based on postal code)	285
School is a secondary school	Yes

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	700,000 kWh	0.0036	2,520	1.96	4,939
Natural gas	85,000 m^3	0.03843	3,267	1.01	3,300
				Total Source Energy (GJ)	8,239
				Actual Source EUI (GJ/m^2)	**0.999**

[3] This represents the 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 logarithm 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 K-12 School 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	-	-	-	0.99610	0.99610
Secondary School (Y/N)	1	N/A	N/A	0.22734	0.22734
C_Heating Degree days x Percent Heated	4600	4579.68	20.32	0.00015782	0.003206
C_Cooling Degree days x Percent Cooled	57	48.04	8.96	0.00053207	0.004767
C_Ln(Building Floor Area)	9.018	8.110	0.908	-0.36532	-0.331711
C_Ln(Number of Employees)	4.248	3.174	1.074	0.1112	0.119429
C_Student Seating Capacity	850	418.835	431.165	0.00040116	0.172966
C_Ln(Gymnasium Floor Area)	7.131	4.983	2.148	0.02874	0.061734
				Predicted Source EUI (GJ/m²)	**1.254**

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 = 0.999 / 1.254 = 0.7967

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 0.7967 is less than 0.8004 but greater than 0.7932
- ***The ENERGY STAR score is 79.***