ENERGY STAR® PortfolioManager®

Technical Reference

ENERGY STAR Score for Indoor Ice Rinks in Canada

OVERVIEW

The ENERGY STAR score for indoor ice rinks in Canada applies to public or private buildings that include one or more ice sheets used for recreational or professional skating, hockey or ringette. 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 indoor ice rinks applies to public or private buildings that include one or more ice sheets used for recreational or professional skating, hockey or ringette. The ENERGY STAR score applies to entire indoor ice rinks, whether they are single buildings or campuses of buildings.
- **Reference data.** The analysis for indoor ice rinks in Canada is based on data from the *Survey of Energy Consumption of Arenas* (SECA), 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:
  - Number of full time equivalent workers
  - Number of months that the main indoor ice rink is in use
  - Total indoor ice rink size (m^2)
  - Average number of indoor ice resurfacings per rink per week
  - Number of ice rink spectator seats in the facility
  - Number of curling sheets in the facility
  - Weather and climate (using heating and cooling degree days, retrieved based on postal code)
- **Release date.** This is the first release of the ENERGY STAR score for indoor ice rinks in Canada.

This document presents details on the development of the 1 – 100 ENERGY STAR score for indoor ice rinks. 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 indoor ice rinks.

REFERENCE DATA & FILTERS

The ENERGY STAR score for ice rinks in Canada applies to public or private buildings that include one or more ice sheets used for recreational or professional skating, hockey or ringette. Buildings that are exclusively used for curling are not currently eligible to earn an ENERGY STAR score but can be benchmarked using this property type. The score does not apply to larger facilities primarily serving professional or collegiate functions and with significant spectator seating (≥5,000 seats). These facilities should most likely be benchmarked using the Entertainment/Public Assembly – Stadium – Indoor Arena property type, at https://portfoliomanager.energystar.gov/pm/glossary#IndoorArena. The reference data used to establish the peer building population is based on data from the *Survey on Energy Consumption of Arenas* (SECA), 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. Summary results for the entire sector, produced by Statistics Canada, are available online.

To analyze the building energy and operating characteristics in this survey data, four types of filters were 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 indoor ice rinks and the rationale behind the filter. After all filters were applied, the remaining data set has 1,195 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 Indoor Ice Rinks

Condition for Including an Observation in the Analysis	Rationale
Must have at least one indoor ice rink	Building Type Filter – In order to be considered part of the indoor ice rink peer group, as defined in the survey, the facility must have at least one indoor ice rink, used for hockey and/or skating.
Must not have more than 25% of the area defined as Fitness Centre, Gymnasium and/or Indoor Swimming Pool	Building Type Filter – In order to be considered part of the indoor ice rink peer group, the facility must not have more than 25% of its gross floor area used as a fitness centre, gymnasium (including racquet sport courts) and/or indoor swimming pool. In Portfolio Manager, these areas would fall under the property use type: Fitness Center / Health Club / Gym.
Must have electric energy data	Program Filter – Basic requirement to be considered an indoor ice rink is that it requires electrical energy. Electricity can be grid-purchased or produced on site.
Must have at least 1 full-time or part-time worker	Program Filter – Basic requirement for a full-time indoor ice rink. There must be at least one worker.
The main Ice Rink must operate at least 5 months per year	Program Filter – Basic requirement to be considered a full-time indoor ice rink
Must not use any "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, heating fuel oil, diesel or propane were consumed in the facility. While the unit of energy was defined, the type of energy was not; therefore the energy content of these fuels could not be directly compared. In these occurrences, these observations were removed from the analysis.
Must be built in 2013 or earlier	Data Limitation Filter – The survey reported the energy for calendar year 2014. Therefore, if the facility was built in 2014, a full year of energy data would not be available.

Condition for Including an Observation in the Analysis	Rationale
Must not have reported energy to other buildings	Data Limitation Filter – The survey asked whether the energy reported at the facility included energy supplied to outdoor pools, sports fields, exterior bubble domes, tennis courts, or annex buildings. The energy consumption for these usages could not be quantified. In the cases that reported energy was supplied to one of the described uses, the cases were removed from the analysis.
Must have reported all energy used in the facility	Data Limitation Filter – The survey asked if all the energy used at the facility was reported. In the case that part or all of the energy consumed at the facility was not reported or missing, these cases were removed from the analysis.
Must have a worker density less than or equal to 0.75 full-time equivalent workers per 100 square metres	Analytical Filter – Values determined to be outliers based on analysis of the data. Outliers are typically clearly outside normal operating parameters for a facility of this type.
Must have a rink area–to–building area ratio smaller than or equal to 90%	Analytical Filter – In order to be considered part of the indoor ice rink peer group, the ice surface cannot constitute more than 90% of the building area.
Must have a spectator seating density less than or equal to 200 spectator seats per 100 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 facility of this type.
Must have an average weekly number of resurfacings per rink less than or equal to 110	Analytical Filter – Values determined to be outliers based on analysis of the data. Outliers are typically clearly outside normal operating parameters for a facility of this type.
Must have a spectator seating capacity less than or equal to 5,000 seats	Analytical Filter – Values determined to be outliers based on analysis of the data. Outliers are typically clearly outside normal operating parameters for a facility of this type.

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 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, 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 part of a building, 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 indoor ice rink facility, whether it is a single building or a campus of buildings. Indoor ice rink facilities may have multiple buildings that are all integral to the primary activity. One building may contain an ice rink, another, a second ice rink and a third, a locker room. 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 indoor ice rink can get a building ENERGY STAR 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. number of workers, operating months per year, and climate). This linear regression yields an equation that is used to compute energy use intensity (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 indoor ice rinks in Canada.

Dependent Variable

The dependent variable is what we try to predict with the regression equation. For the indoor ice rink 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 indoor ice rinks. The unit for source EUI in the Canadian model is the gigajoule per square metre (GJ/m^2) per year.

Independent Variables

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

- Gross building area (m^2)
- Heating degree days (HDD)
- Cooling degree days (CDD)
- Average outdoor temperature (°C)
- Number of full-time and part-time workers
- Weekly hours of operation
- Months of operation per year
- Number of computers, computer servers and cash registers
- Presence of a gymnasium
- Main use of the rink(s)
- Area of ice rink(s)
- Presence of indoor and outdoor rink(s)
- Presence of ice refrigeration equipment
- Number of spectator seats
- Number of ice resurfacings per week
- Number of curling sheets
- Presence of a gymnasium and/or fitness centre
- Floor area of a gymnasium and/or fitness centre
- Presence of concession stands, restaurants and bars
- Number of concession stands, restaurants and bars

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

- Presence of a pool
- Area of a pool
- Number of interior parking spaces
- Number of heated interior parking spaces
- Number of exterior parking spaces

NRCan and EPA 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. number of spectator seats per number of rinks). As part of the analysis, some variables are reformatted to reflect the physical relationships of building components. For example, the number of workers 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 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:

- Average number of weekly ice resurfacings per rink
- Number of spectator seats per 100 square metres
- Natural logarithm of the number of months that the main rink is in use
- Number of full-time equivalent workers per 100 square metres
- Percentage of total building area that is covered by ice rinks
- Number of curling sheets
- Number of heating degree days (HDD)
- Number of cooling degree days (CDD)

These variables are used together to compute the predicted source EUI for indoor ice rinks. 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.

Worker Analysis

NRCan and EPA analyzed the part-time workers, the full-time workers, the full-time equivalent (FTE) workers and their densities (per 100 m^2). An increase in any worker variable resulted in an increase in EUI. The number of FTE workers per 100 m^2 is defined as the number of full-time workers plus one quarter of the number of part-time workers, (i.e. part-time workers were assumed to be working a quarter of a full-time worker's shift), per 100 m^2. The number of FTE workers per 100 m^2 was chosen as a variable since FTE density was consistently the most statistically significant worker variable.

Further analysis indicated that facilities with high FTE worker density did not behave like other facilities and reduced the stability of the statistical models. It was necessary to filter out observations with high FTE worker density (> 0.75 FTE workers per 100 m^2). For the purposes of ENERGY STAR score calculation, a worker density value of 0.75 workers per 100 m^2 will be assigned to facilities with FTE worker densities above this threshold.

Property Floor Area and Indoor Ice Area Analysis

Several variables related to the size of the building were evaluated, including the gross floor area and the indoor ice rink area. The variable that was consistently statistically significant was the percentage of indoor ice rink area, or the ratio between the indoor ice rink area and the building area. Analysis indicated that facilities with large indoor ice rink percentages did not behave the same way as the majority of the observations. As a result, buildings with indoor ice rink percentages greater than 90% were excluded from the regression analysis and cannot receive an ENERGY STAR score. It is important to note that the total building size is still used to calculate density variables such as the number of FTE workers per 100 m^2 and EUI.

Spectator Seating Capacity and High-Capacity Venue Analysis

The spectator seating capacity density (number of seats per 100 m^2) was consistently statistically significant during the development of the indoor ice rinks model. However, spectator seating density had to be at least 20 seats per 100 m^2 before it affected EUI. Therefore, a minimum spectator seating density was applied, and a spectator seating density value of 20 seats per 100 m^2 will be assigned to facilities with spectator seating densities below this threshold.

High-capacity venues, defined as facilities with spectator seating capacity greater than 5,000, have different operational characteristics than recreational rinks. While a spectator seating capacity variable could potentially normalize high seating capacity ice rinks, there was concern that this variable on its own would not adequately capture other important operational variables for these building types. Additional analysis specific to this building type is required, as these other potential variables were not captured in the SECA survey. Therefore, any indoor ice rink with a spectator seating capacity greater than 5,000 seats will not receive an ENERGY STAR score.

Swimming Pools, Gymnasiums and Fitness Centres Analysis

Several variables related to the use of gymnasium, fitness centres and swimming pools were evaluated during the analysis, including the months of use of these spaces and their respective areas. During the analysis, it was found that facilities that have swimming pools tend to consume more energy compared to facilities without swimming pools, due to certain operational difference such as hours of operation (e.g. most swimming pools are open 12 months, while most ice rinks are open only 8 months). Due to the number of operational differences, swimming pools, gymnasiums and fitness centres were not considered supporting spaces for indoor ice rinks. To properly benchmark facilities, users should benchmark their gymnasium, fitness centre and swimming pool areas, including associated spaces, under the Fitness Center/Health Club/Gym building type.

To be eligible for the ENERGY STAR score for indoor ice rink, less than 25% of facility space must be dedicated to swimming pools, gymnasiums or fitness centres.

Testing

Finally, NRCan further analyzed the regression equation using actual data that has been entered in Portfolio Manager and the results of the Canadian Recreation Facilities Council National Arena Census May 2005 – December 2005. This provided another set of buildings to examine, in addition to the SECA data, to see the ENERGY STAR scores and distributions, and to assess the impacts and adjustments. This analysis on a separate dataset provided a second level of verification to ensure that there was a good distribution of scores.

It is important to reiterate that the final regression equation is based on nationally representative reference data from SECA 2014, not on data previously entered into Portfolio Manager or collected as part of the 2005 census.

REGRESSION EQUATION RESULTS

The final regression is a weighted ordinary least squares regression across the filtered data set of 1,195 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 0.404, indicating that this equation explains 40.4% of the variance in source EUI for indoor ice rink facilities. 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 77.5% of the variation in total source energy of indoor ice rinks.

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)	0.09	1.69	8.41	1.91
Natural Logarithm of the number of months the main rink is open	1.61	1.95	2.48	2.02
Weekly ice resurfacings per rink	4	54.00	110	53.19
Number of spectator seats per 100 m^2	20.00	20.00	99.03	23.20
Number of FTE workers per 100 m^2	0.01	0.11	0.70	0.14
Percent of the facility that is covered by ice rinks	3.93	45.95	89.95	44.98
Heating degree days	2543	4935	11441	5107
Cooling degree days	0	115	419	131.12
Number of curling sheets	0	0	10.00	0.56

[2] 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 3 – Final Regression Results

Summary				
Dependent variable	Source energy intensity (GJ/m²)			
Number of observations in analysis	1,195			
R^2 value	0.404			
Adjusted R^2 value	0.399			
F statistic	100.41			
Significance (p-level)	< 0.0001			
	Unstandardized Coefficients	**Standard Error**	**T Value**	**Significance (p-level)**
Constant	1.9079	0.02394	79.71	<0.0001
C_Natural Logarithm of the number of months the main rink is open	1.6425	0.1189	13.82	<0.0001
C_Weekly ice resurfacings per rink	0.01029	0.00139	7.39	<0.0001
C_Number of spectator seats per 100 m²	0.01215	0.00298	4.08	<0.0001
C_Number of FTE workers per 100 m²	2.711	0.2829	9.58	<0.0001
C_Percent of the facility that is covered in ice	0.01142	0.00174	6.55	<0.0001
C_Heating degree days	1.140E-4	2.790E-5	4.08	<0.0001
C_Cooling degree days	0.001090	3.457E-4	3.16	0.0016
C_Number of curling sheets	0.04107	0.01760	2.33	0.0198

- *Notes:*
- *The regression is a weighted ordinary least squares regression, weighted by the SECA 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 Weekly ice resurfacings per rink is capped at a maximum value of 110.*
- *The adjustment for FTE workers per 100 m² is capped at a maximum value of 0.75.*
- *The adjustment for Spectator seating density has a minimum of 20 seats per 100 m², meaning any property with a value below 20 will be assigned a value of 20 seats per 100 m².*
- *The 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

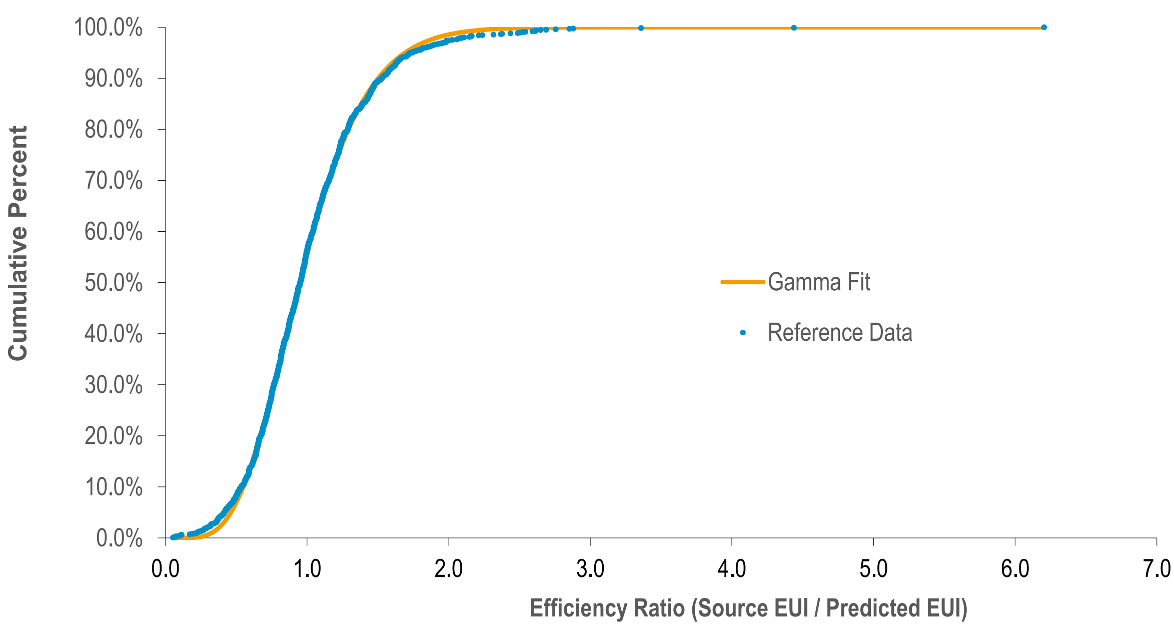
The final regression equation (presented in ***Figure 3***) yields a prediction of source EUI based on a building's operating characteristics. Some buildings in the SECA data sample use more energy than predicted by the regression equation, while others use less. The *actual* source EUI of each reference 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 (1) 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 6.844 and a scale parameter (beta) of 0.1453. For this fit, the sum of the squared error is 0.9406.

Figure 4 – Distribution for Indoor Ice Rinks



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 Indoor Ice Rinks

ENERGY STAR Score	Cumulative Percent	Energy Efficiency Ratio > =	Energy Efficiency Ratio <	ENERGY STAR Score	Cumulative Percent	Energy Efficiency Ratio >=	Energy Efficiency Ratio <
100	0%	0.0000	0.3259	50	50%	0.9465	0.9558
99	1%	0.3259	0.3762	49	51%	0.9558	0.9651
98	2%	0.3762	0.4109	48	52%	0.9651	0.9745
97	3%	0.4109	0.4385	47	53%	0.9745	0.9840
96	4%	0.4385	0.4619	46	54%	0.9840	0.9936
95	5%	0.4619	0.4825	45	55%	0.9936	1.0033
94	6%	0.4825	0.5011	44	56%	1.0033	1.0131
93	7%	0.5011	0.5181	43	57%	1.0131	1.0230
92	8%	0.5181	0.5340	42	58%	1.0230	1.0330
91	9%	0.5340	0.5489	41	59%	1.0330	1.0431
90	10%	0.5489	0.5630	40	60%	1.0431	1.0534
89	11%	0.5630	0.5764	39	61%	1.0534	1.0638
88	12%	0.5764	0.5893	38	62%	1.0638	1.0744
87	13%	0.5893	0.6017	37	63%	1.0744	1.0851
86	14%	0.6017	0.6137	36	64%	1.0851	1.0960
85	15%	0.6137	0.6253	35	65%	1.0960	1.1071
84	16%	0.6253	0.6366	34	66%	1.1071	1.1184
83	17%	0.6366	0.6476	33	67%	1.1184	1.1299
82	18%	0.6476	0.6584	32	68%	1.1299	1.1416
81	19%	0.6584	0.6689	31	69%	1.1416	1.1536
80	20%	0.6689	0.6792	30	70%	1.1536	1.1658
79	21%	0.6792	0.6893	29	71%	1.1658	1.1784
78	22%	0.6893	0.6993	28	72%	1.1784	1.1912
77	23%	0.6993	0.7091	27	73%	1.1912	1.2044
76	24%	0.7091	0.7189	26	74%	1.2044	1.2179
75	25%	0.7189	0.7284	25	75%	1.2179	1.2319
74	26%	0.7284	0.7379	24	76%	1.2319	1.2462
73	27%	0.7379	0.7473	23	77%	1.2462	1.2611
72	28%	0.7473	0.7566	22	78%	1.2611	1.2764
71	29%	0.7566	0.7659	21	79%	1.2764	1.2923
70	30%	0.7659	0.7750	20	80%	1.2923	1.3088
69	31%	0.7750	0.7842	19	81%	1.3088	1.3261
68	32%	0.7842	0.7932	18	82%	1.3261	1.3440
67	33%	0.7932	0.8023	17	83%	1.3440	1.3629
66	34%	0.8023	0.8113	16	84%	1.3629	1.3827
65	35%	0.8113	0.8202	15	85%	1.3827	1.4036
64	36%	0.8202	0.8292	14	86%	1.4036	1.4257
63	37%	0.8292	0.8381	13	87%	1.4257	1.4494
62	38%	0.8381	0.8471	12	88%	1.4494	1.4747
61	39%	0.8471	0.8560	11	89%	1.4747	1.5021
60	40%	0.8560	0.8649	10	90%	1.5021	1.5319
59	41%	0.8649	0.8739	9	91%	1.5319	1.5646
58	42%	0.8739	0.8828	8	92%	1.5646	1.6012
57	43%	0.8828	0.8918	7	93%	1.6012	1.6427
56	44%	0.8918	0.9008	6	94%	1.6427	1.6909
55	45%	0.9008	0.9099	5	95%	1.6909	1.7486
54	46%	0.9099	0.9189	4	96%	1.7486	1.8212
53	47%	0.9189	0.9281	3	97%	1.8212	1.9207
52	48%	0.9281	0.9372	2	98%	1.9207	2.0844
51	49%	0.9372	0.9465	1	99%	2.0844	> 2.0844

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 indoor ice rinks.

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	120,000 kWh
Natural gas	31,225 m^3

Property Use Details	Value
Gross floor area (m^2)	3,017
HDD (provided by Portfolio Manager, based on postal code)	6,097
CDD (provided by Portfolio Manager, based on postal code)	89
Area of the indoor ice rinks (m^2)	1,320
Number of indoor ice rinks	1
Number of ice resurfacings per week (total)	20
Number of months that the main indoor ice rink is open	5
Number of full-time equivalent workers	1
Number of curling sheets	4
Spectator seating capacity	300

2 Portfolio Manager computes the actual source EUI

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

Computing Actual Source EUI

Fuel	Billing Units	Site GJ Multiplier	Site GJ	Source Multiplier	Source GJ
Electricity	120,000 kWh	0.0036	432	2.05	886
Natural gas	31,225 m^3	0.03843	1200	1.02	1,224
				Total Source Energy (GJ)	2110
				Source EUI (GJ/m^2)	**0.699**

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 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	-	-	-	1.908	1.908
Natural Logarithm of the number of months the main rink is open	1.609	2.02	-0.4106	1.643	-0.674
Weekly ice resurfacings per rink	20	53.19	-0.3319	0.01029	-0.342
Number of spectator seats per 100 m^2	20	23.20	-3.20	0.01215	-0.039
Number of FTE workers per 100 m^2	0.03	0.14	-0.11	2.7113	-0.290
Percent of the facility that is covered in ice	43.75	44.98	-1.23	0.01142	-0.014
Number of curling sheets	4	0.56	3.44	0.0001140	0.141
Heating degree days	6097	5107	989.972	0.001090	0.113
Cooling degree days	89	131.12	-42.12	0.04107	-0.046
				Predicted Source EUI (GJ/m^2)	0.757

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 = 0.699 / 0.757= 0.9231

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 0.9231 is less than 0.9281 (requirement for a score of 53) but greater than 0.9189 (requirement for a score of 54).

The ENERGY STAR score is 53.