ENERGY STAR® Portfolio Manager® Technical Reference

Data Center Estimates in the United States and Canada

OVERVIEW

The ENERGY STAR score provides 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. In the United States, data centers are able to earn the ENERGY STAR score using an energy intensity metric that takes into consideration the IT Energy used by the data center (see the Technical Reference for the ENERGY STAR Score for Data Centers for more details). For data centers within a larger property, it can sometimes be difficult for property managers to obtain IT Energy. For this reason, the ENERGY STAR score can also be computed using estimates to adjust for the presence of data centers. In Canada, data centers are not eligible to earn the ENERGY STAR score, but estimates can be used for data centers located within larger properties. The goal of the ENERGY STAR score, when the data center estimates are used, is to rate the energy performance of the primary use of the building, not the data center.

- **Technical Approach.** Typical values for energy use per unit of floor area are used to estimate the energy use for the data center portion of the property. This estimated energy use is subtracted from the building's actual energy use, yielding an estimate of energy use of the building without a data center. This allows the building to be evaluated as though it does not have a data center.
- **Property Types.** Data centers can be entered as part of larger properties of all types (e.g., office, warehouse) and will be incorporated into the ENERGY STAR score for eligible property types. Data center refers to spaces specifically designed and equipped to meet the needs of high density computing equipment such as server racks, used for data storage and processing. Data center is intended for sophisticated computing and server functions; it should not be used to represent a server closet or computer training area.
- **Adjustments.** The data center estimated energy consumption is based on the energy use per unit floor area. Multiple reference data sources were reviewed to determine an appropriate value for the estimate.
- **Release Date.** The estimate for data centers was released in February 2018 for properties in Canada and will be released in August 2018 for properties in the United States.

This document presents details on how the ENERGY STAR score is computed when estimated energy consumption is used for data centers within a larger property. More information on the overall approach to develop ENERGY STAR scores is covered in our Technical Reference for the ENERGY STAR Score, available at www.energystar.gov/ENERGYSTARScore.

The subsequent sections of this document offer specific details on the development of the data center adjustment:

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TECHNICAL APPROACH

In the United States, data centers are able to earn the ENERGY STAR score using an energy intensity metric that takes into consideration the IT Energy used by the data center (see the Technical Reference for the ENERGY STAR Score for Data Centers, at www.energystar.gov/ScoreDetails). The metric used to assess energy performance is power usage effectiveness, or PUE. PUE is a standard measure of facility infrastructure efficiency in the IT industry. It is equal to the total energy consumption of a data center facility divided by the energy consumption used for the IT equipment, or IT Energy. While it is considered best practice for data centers to track PUE and IT Energy, it is sometimes difficult for property managers to obtain IT Energy for data centers located within a larger property. To provide flexibility for building operators in the U.S. that are facing this challenge, the ENERGY STAR score can also be computed using estimates to accommodate the presence of data centers. In Canada, estimates are used for all data centers, since a sufficient survey assessing data center PUE is not currently available.[1]

The estimates for data center energy consumption used in Portfolio Manager are based on source energy use intensity per unit floor area, or Source EUI. Multiple data sources were reviewed to determine how best to estimate Source EUI for data centers. In the United States, this included the 2012 Commercial Building Energy Consumption Survey (CBECS), conducted by the U.S. Department of Energy's Energy Information Administration, and survey data collected by EPA to develop the ENERGY STAR score for data centers, in coordination with major industry associations, including Uptime Institute, Green Grid, 7x24 Exchange and AFCOM. In Canada, this included data from Data Centre Dynamics, 2013 CENSUS Report: Global Data Centre Power 2013 and Global Data Centre Space 2013. Average EUI values for stand-alone data centers were reviewed. For the 2012 CBECS, data centers located within larger office buildings were also reviewed, using regression analysis to determine the additional EUI contribution associated with the data center. In additional to reference survey data, energy consumption for properties with data centers entered in Portfolio Manager was also reviewed.

The Source EUI for a data center is expected to vary based on the facility's operating conditions, primarily due to the density of IT equipment. However, based on limited data in the reference surveys, as well as anticipated challenges in collecting more detailed operating conditions from Portfolio Manager users, it was determined that using a single value of source EUI to estimate data center energy use would be more feasible than developing a more complex estimation method. Because of the variability in Source EUI values for data centers, as well as the fact that data center EUI values can be an order of magnitude larger than most commercial buildings, conservative estimates were chosen for use in Portfolio Manager. Data analyzed from both countries concluded that the same value for the data center energy use estimate could be used for the U.S. and Canada, with corrections for different source energy conversion factors. The data center energy use estimate is also consistent with the previous estimate for data center EUI used from 2010 to 2013 after EPA released the ENERGY STAR Score for Data Centers.

[1] For both the U.S. and Canada, when determining scores for a building that contains a data center, standard eligibility requirements apply, including 1) more than 50 percent of a building's gross floor area (excluding parking lots and garages) must be defined as an eligible property type for a score, and 2) the combined floor area of any property use types that do not have an ENERGY STAR score (including area using the data center estimate) can't exceed 25 percent of the building's total floor area.

DATA CENTER ESTIMATE

The value for the energy use per floor area used for the data center estimate is provided in ***Figure 1***. To predict the total data center source energy use at a property, this value is multiplied by the floor area of the data center. There is a cap on the estimate for data center energy use, which is applied to buildings that have a data center floor area in excess of 10% of the property's gross floor area. As shown in ***Figure 2***, these properties will have a predicted data center source energy that is equal to the energy use per floor area times 10% of the property's gross floor area. The cap is intended to limit the impact of estimated values on the score for a property, and results in a more conservative estimate for large data centers. Most data centers within larger properties are less than 10% of the total gross floor area, however, so the cap will not be applied frequently.

Figure 1 – Data Center Energy Use Per Unit Floor Area

	United States	Canada
Source Energy	2,000 kBtu/ft^2	21.8 GJ/m^2

Figure 2 – Data Center Source Energy Estimates

	United States	Canada
If Data Center Floor Area < 10% of Property Gross Floor Area	2,000 x Data Center Floor Area	21.8 x Data Center Floor Area
If Data Center Floor Area ≥ 10% of Property Gross Floor Area	2,000 x 10% of Property Gross Floor Area	21.8 x 10% of Property Gross Floor Area

Sub-metered Data Center IT Energy

While the data center estimate does not require the installation of a sub-meter or the entry of data center IT Energy data into Portfolio Manager, tracking data center IT Energy is still considered a best practice and is strongly encouraged. In the United States, data centers that measure IT Energy may use the ENERGY STAR Score for Data Centers. In Canada, while data center space is not eligible for an ENERGY STAR Score, entering IT Energy in Portfolio Manager can provide valuable information that may contribute to improvements to the data center benchmarking methodology in the future.

When benchmarking properties that include a data center, all energy consumption for the property, including the data center energy use, should be entered in Portfolio Manager and used to compute property metrics. The program aims to capture total building energy use and encourage reductions in energy use for the data center as well as the primary building type.

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 an example for an office with a data center in the U.S.:

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	5,000,000 kWh
Natural gas	4,000 therms

Office Use Details	Value
Office Gross floor area (ft²)	200,000
Weekly operating hours	80
Workers on main shift[2]	250
Number of personal computers	250
Percent of the building that is heated	100%
Percent of the building that is cooled	100%
HDD (provided by Portfolio Manager, based on postal code)	3,600
CDD (provided by Portfolio Manager, based on postal code)	425

Data Center Use Details	Value
Data Center area (ft²)	10,000

2 Portfolio Manager computes the actual source EUI

- Billed Source Energy is computed:
  - Total energy consumption for each fuel is converted from billing units into site and source energy.
  - Source energy values are added across all fuel types.

Fuel	Billing Units	Site kBtu Multiplier	Site kBtu	Source Multiplier	Source kBtu
Electricity	5,000,000 kWh	3.412	17,060,000	3.14	53,568,400
Natural gas	4,000 therms	100	400,000	1.05	420,000
				Total Source Energy (kBtu)	74,414,100

[2] This represents typical peak staffing level during the main shift. For example, in an office building occupied 16 hours per day, if there are two separate daily 8-hour shifts of 100 workers each, the Workers on main shift value is 100.

- Predicted Data Center Source Energy is determined.

  Predicted Data Center Source Energy
  = 10,000 ft² * 2000 kBtu/ft²
  = 20,000,000 kBtu

- Actual source energy for the purposes of the ENERGY STAR score is equal to billed source energy minus predicted data center energy.
  - The predicted energy for the data center is subtracted to enable a score for the office only.
  - 53,988,400 – 20,000,000 = 33,988,400 kBtu Source

- Actual Source EUI is equal to source energy divided by floor area (excluding the data center area).
  - 33,988,400 kBtu / 200,000 ft²
  - **Actual Source EUI = 169.94 kBtu/ft²**

  Note that the total building actual source EUI provided for reporting purposes includes the total building energy divided by the total building area, while the source EUI used to calculate the ENERGY STAR Score for the main property use excludes the data center area and the predicted data center energy.

3 Portfolio Manager computes the predicted source EUI

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

Computing Predicted Source EUI

Variable	Actual Building Value	Reference Centering Value	Building Centered Variable	Coefficient	Coefficient x Centered Variable
Constant	--	--	--	186.6	186.6
Ln (Square Foot)	12.21	9.535	2.675	34.17	91.40
Number of Computers per 1,000 ft²	1.250	2.231	-0.9810	17.28	-16.95
Ln (Weekly Operating Hours)	4.382	3.972	0.4100	55.96	22.94
Ln (Number of Workers per 1,000 ft²)	0.2230	0.5616	-0.3386	10.34	-3.501
HDD x Percent Heated	4937	4411	526.0	0.0077	4.050
CDD x Percent Cooled	1046	1157	-111.0	0.0144	-1.598
Small Bank x Ln (Square Foot)	0.0000	NA	0.0000	-64.83	0.0000
Small Bank x Ln (Number of Workers per 1,000 ft²)	0.0000	NA	0.0000	34.20	0.0000
Small Bank	0.0000	NA	0.0000	56.30	0.0000
				Predicted Source EUI (kBtu/ft²)	**282.9**

4 Portfolio Manager computes the energy efficiency ratio

- The ratio equals the actual source EUI (Step 2) divided by predicted source EUI (Step 3).
- Ratio = **169.9** / 282.9 = 0.6007

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 for offices.
- A ratio of 0.6007 is greater than 0.5931 but less than 0.6034.
- ***The ENERGY STAR score is 80.***