

OP 5: Building Energy Consumption

6 points available

A. Credit Rationale

This credit recognizes institutions that have reduced their building energy usage.

B. Criteria

Part 1

Institution has reduced its total building energy consumption per gross square foot/metre of floor area compared to a baseline.

Part 2

Institution's annual building energy consumption is less than the [minimum performance threshold](#) of 65 Btu per gross square foot per Fahrenheit [degree day](#) (389 Btu per gross square metre per Celsius degree day).

Performance for Part 2 of this credit is assessed using [EUI-adjusted floor area](#), a figure that accounts for significant differences in energy use intensity (EUI) between types of building space (see G. Standards and Terms).

C. Applicability

This credit applies to institutions.

D. Scoring

Each part is scored independently. Points earned are calculated according to the formulas below. Please note that users do not have to calculate the number of points earned themselves; points will be calculated automatically when the data listed under E. Reporting Fields is entered in the online Reporting Tool.

Part 1

Institutions earn the maximum of 3 points available for Part 1 of this credit by reducing building energy consumption per gross square foot/metre of floor area by 50 percent compared to a baseline. Partial points are awarded based on the reduction achieved. For example, an institution that reduced building energy consumption per gross square foot/metre of floor area by 25 percent would earn 1.5 points (half of the points available for Part 1 of this credit).

Scoring for Part 1 is based on source energy, a figure that accounts for the energy used off-site to generate and transport grid-purchased electricity and district steam/hot water to the institution. For scoring purposes, grid-purchased electricity and district steam/hot water are converted to source energy through the use of an appropriate [source-site ratio](#).

The STARS Reporting Tool calculates total building energy consumption (source energy) according to the following formula:

$$\text{Total building energy consumption (source energy)} = (A \times B) + C + (D \times E) + F$$

A = Grid-purchased electricity (MMBtu)

B = Source-site ratio for grid-purchased electricity (see F. Measurement)

C = Electricity from on-site renewables (MMBtu)

D = District steam/hot water (MMBtu)

E = Source-site ratio for district steam/hot water (see F. Measurement)

F = Energy from all other sources (MMBtu)

Points earned for Part 1 of this credit are calculated according to the formula below. STARS awards only positive points; points will not be deducted if building energy consumption per gross square foot/metre of floor area increased rather than decreased during the time period.

$$\text{Points Earned} = 6 \times \{ [(A/B) - (C/D)] / (A/B) \}$$

A = Total building energy consumption (source energy), baseline year (MMBtu)

B = Gross floor area of building space, baseline year (gross square feet/metres)

C = Total building energy consumption (source energy), performance year (MMBtu)

D = Gross floor area of building space, performance year (gross square feet/metres)

Part 2

An institution earns the maximum of 3 points available for Part 2 when its annual building energy consumption is 90 percent or more below the minimum performance threshold of 65 Btu per gross square foot per Fahrenheit degree day (389 Btu per gross square metre per Celsius degree day).

Incremental points are awarded based on the institution's performance below the threshold. For example, an institution whose annual building energy consumption per gross square foot per degree day is 35.75 Btu (i.e., 45 percent below the 65 Btu threshold) would earn 1.5 points (half of the points available for Part 2).

Scoring for Part 2 of this credit is based on site energy and an EUI-adjusted floor area figure that accounts for significant differences in energy use intensity (EUI) between types of building space.

Points earned for Part 2 of this credit are calculated according to the following formula:

$$\text{Points Earned} = 3\frac{1}{3} \times \{ [(A) - (B/C)/D] / A \}$$

A = Minimum performance threshold (in MMBtu per square foot/metre per degree day)

B = Total building energy consumption (site energy), performance year (MMBtu)

C = EUI-adjusted floor area, performance year (square feet/metres)

D = Total degree days, performance year (heating + cooling)

E. Reporting Fields

Required

- ☐ Figures needed to determine total building energy consumption during the performance year:
 - ☐ Grid-purchased electricity, performance year (MMBtu)

- Electricity from on-site renewables, performance year (geothermal, low-impact hydro, solar, wave/tidal, or wind installations) (MMBtu)
 - District steam/hot water, performance year (MMBtu)
 - Energy from all other sources (excluding transportation fuels), performance year (e.g., natural gas, fuel oil, propane/LPG, district chilled water, coal/coke, biomass) (MMBtu)
- Total building energy consumption (all sources excluding transportation fuels), performance year (MMBtu)
- Figures needed to determine total building energy consumption during the baseline year:
 - Grid-purchased electricity, baseline year (MMBtu)
 - Electricity from on-site renewables, baseline year (geothermal, low-impact hydro, solar, wave/tidal, or wind installations) (MMBtu)
 - District steam/hot water, baseline year (MMBtu)
 - Energy from all other sources (excluding transportation fuels), baseline year (e.g., natural gas, fuel oil, propane/LPG, district chilled water, coal/coke, biomass) (MMBtu)
 - Total building energy consumption (all sources excluding transportation fuels), baseline year (MMBtu)
- Start date, performance year or 3-year period
- End date, performance year or 3-year period
- Start date, baseline year or 3-year period
- End date, baseline year or 3-year period
- If end date of the baseline year/period is 2004 or earlier provide:*
 - A brief description of when and why the building energy consumption baseline was adopted (e.g., in sustainability plans and policies or in the context of other reporting obligations)
- [Gross floor area of building space](#), performance year (gross square feet/metres)
- Gross floor area of building space, baseline year (gross square feet/metres)
- Source-site ratio for grid-purchased electricity (see *F. Measurement*)
- Heating degree days, performance year (Fahrenheit degree days, base 65 °F / Celsius degree days, base 18 °C)
- Cooling degree days, performance year (Fahrenheit degree days, base 65 °F / Celsius degree days, base 18 °C)
- Floor area of laboratory space, performance year (square feet/metres)
- Floor area of healthcare space, performance year (square feet/metres)
- Floor area of other [energy intensive space](#), performance year (square feet/metres)

Optional

- Documentation (e.g. spreadsheet or utility records) to support the performance year energy consumption figures reported above (upload)
- A brief description of any of the following energy conservation and efficiency technologies or strategies employed by the institution:
 - Initiatives to shift individual attitudes and practices in regard to energy efficiency (e.g., outreach and education efforts)
 - Energy use standards and controls (e.g., building temperature standards, occupancy and vacancy sensors)

- Light Emitting Diode (LED) lighting and other energy-efficient lighting strategies
- Passive solar heating, geothermal systems, and related strategies
- Co-generation, e.g. combined heat and power (CHP)
- Initiatives to replace energy-consuming appliances, equipment and systems with high efficiency alternatives (e.g., building re-commissioning or retrofit programs)
- The website URL where information about the programs or initiatives is available
- Additional documentation to support the submission (upload)
- Data source(s) and notes about the submission
- Contact information for a responsible party (a staff member, faculty member, or administrator who can respond to questions regarding the data once it is submitted and available to the public)

F. Measurement

Timeframe

Performance Year

Report the most recent data available from the three years prior to the anticipated date of submission. Institutions may use the most recent single year for which data is available or an average from throughout the period. Institutions may choose the annual start and end dates that work best with the data they have (e.g., fiscal or calendar year), as long as data are reported from a consecutive 12-month (or 3-year) period.

Report degree day and building space figures from the same time period as that from which energy consumption data are drawn (e.g., the consecutive 12-month or 3-year period that most closely overlaps with the building energy consumption performance period). Institutions may use average building space from throughout the period or a snapshot at a single representative point during the period.

Baseline Year

Report data from the baseline year, which may be:

- Any year from 2005 to the present
- A baseline year, 1990 to 2004, that the institution has adopted as part of its sustainability plans or policies or in the context of other reporting obligations

Recommended best practices for defining a baseline include:

- Using the average of three consecutive years to reduce the impact of outliers.
- Using the same baseline year for multiple credits to reduce reporting requirements. For example, institutions using 2005 for all STARS credits that are baseline-based would only have to calculate baseline weighted campus user data once.
- Ensuring that baseline and performance year data are valid and reliable (e.g., that the data were gathered in the same manner)

Institutions without valid and reliable historical data should use performance year data for both the baseline and performance year. Following this approach, an institution would not be able to claim points for reductions during its first STARS submission, but would be able to use its newly established baseline for subsequent submissions.

Institutions may choose the start and end dates that work best with the data they have (e.g., fiscal or calendar year), as long as data are reported from a consecutive 12-month (or 3-year) period. Report degree day and building space data from the same period as that from which energy consumption data are drawn (e.g., the consecutive 12-month or 3-year period that most closely overlaps with the building energy consumption baseline period). Institutions may use average building space from throughout the period or a snapshot at a single representative point during the period.

Sampling and Data Standards

Include all building energy consumption, i.e. all stationary energy that was consumed by the institution (as the institution is defined in the overall STARS institutional boundary). Transportation fuels are excluded. Reporting on a sample or subset of buildings is not allowed for this credit.

Institutions that convert fuel on-site (e.g., on-campus cogeneration facilities and boilers) should report only the amount of fuel purchased/converted toward the total energy consumption figure, not the resulting heat, steam, hot/chilled water or electricity.

All reported energy consumption figures should be based on site energy (the amount of energy consumed by campus buildings) rather than source energy (the amount of energy consumed on campus plus the energy used off-site to generate and transport the energy to the institution). Source energy will be calculated automatically when the data listed under E. Reporting Fields is entered in the online Reporting Tool,

Consistent with [U.S. EPA's Portfolio Manager](#) and available national standards, the following source-site ratios (i.e., primary energy factors) are used:

Energy Source	Canada	Australasia, Latin America	Europe	U.S., Africa, Asia
Grid-purchased electricity	2.05	2.25	2.50	3.14
Electricity from on-site renewables	1	1	1	1
District steam/hot water	1.20	1.20	1.20	1.20
Energy from all other sources	1	1	1	1

Institutions located outside the U.S. and Canada that have available national or regional primary energy factors (PEFs) for grid-purchased electricity may report those figures in lieu of the above and should document the source of the data in "Data source(s) and notes about the submission". Please note that PEFs should be calculated on the basis that the PEF for on-site renewable energy equals 1 (as opposed to zero).

To aggregate energy consumption data from multiple sources, figures should be converted into MMBtu (one million British thermal units—a standard measure of energy) using the following equivalents:

Energy Unit	MMBtu Equivalent
1 kWh	0.003412
1 MWh	3.412
1 therm	0.1
1 kBtu	0.001
1 ton-hour	0.012
1 MJ	0.000948

A unit conversion tool that includes more detailed conversion factors (e.g., for liquid fuels) is [available in the online STARS Reporting Tool](#) (.xls).

Heating and cooling degree day data should use a base of 65 °F (18 °C) and be reported for the institution's main campus location. Degree day data may be downloaded from [DegreeDays.net](#) (global data), [Weather Data Depot](#) (U.S. data), [U.S. NOAA/National Weather Service](#) (U.S. data), or another official source of national or international weather data.

G. Standards and Terms

Degree day

Degree days are a representation of outside air-temperature data widely used to normalize the effect of outside air temperature on building energy consumption. According to [Degree Days.net](#):

"Heating degree days", or "HDD", are a measure of how much (in degrees), and for how long (in days), outside air temperature was lower than a specific "base temperature" (or "balance point"). They are used for calculations relating to the energy consumption required to heat buildings.

"Cooling degree days", or "CDD", are a measure of how much (in degrees), and for how long (in days), outside air temperature was higher than a specific base temperature. They are used for calculations relating to the energy consumption required to cool buildings.

Energy intensive space

Energy intensive space includes "laboratory space", "healthcare space", and "other energy intensive space". "Other energy intensive space" is reported separately from laboratory space and healthcare space and may include data centers, food production space, convenience stores, and other facilities that the institution has determined to have an average energy use intensity (EUI) that is at least twice that of office/administrative space. (Energy use intensity is a unit of measurement that represents the energy consumed by a building relative to its size, e.g. 1,000 MMBtu per square metre). For more information, see [ENERGY STAR Portfolio Manager Technical Reference: U.S. Energy Use Intensity by Property Type](#).

EUI-adjusted floor area

EUI-adjusted floor area is a figure that adjusts each institution's actual floor area to account for significant differences in energy use intensity (EUI) between types of building space. Energy use intensity is a unit of

measurement that represents the energy consumed by a building relative to its size, for example 1,000 MMBtu per square metre.

STARS calculates the figure according to the following formula. Please note that users will not have to calculate this figure themselves; the result will be calculated automatically when data are entered into the online Reporting Tool.

$$\text{EUI-adjusted floor area} = \{ A + [2 \times (B + C)] + D \}$$

A = Gross floor area of building space (square feet/metres)

B = Floor area of laboratory space (square feet/metres)

C = Floor area of healthcare space (square feet/metres)

D = Floor area of other energy intensive space (square feet/metres)

Gross floor area of building space

Gross floor area of building space refers to the total amount of building space that is included within the institutional boundary. Any standard definition of building space may be used (e.g., ASHRAE, ANSI/BOMA, IECC) as long as it is used consistently. Parking structures are included. For guidance on calculating gross square footage of a building, you may also consult [3.2.1 Gross Area](#) of the U.S. Department of Education's *Postsecondary Education Facilities Inventory and Classification Manual*.

Buildings within the overall STARS boundary that the institution leases entirely (i.e., the institution is the only tenant) should be included.

Buildings that are not owned by the institution and in which the institution is one of multiple tenants may be excluded. If the institution chooses to include such buildings, it must include all multi-tenant buildings that are included in the institution's overall STARS boundary and in which the institution is a tenant; institutions cannot choose to include some leased spaces and omit others. If an institution chooses to include leased spaces, the institution should count only the square footage of building space it occupies and not the entire building.

Healthcare space

The total amount of building space within the institutional boundary that may be categorized as "Health Care Facilities" (e.g., codes in the 800 series under the [Space Use Codes](#) in the U.S. Department of Education's *Postsecondary Education Facilities Inventory and Classification Manual*). To simplify reporting, institutions with hospitals may report all floor area within hospitals as healthcare space.

Laboratory space

The total amount of building space within the institutional boundary that may be categorized as "research laboratories" (e.g., code 250 under the [Space Use Codes](#) in the U.S. Department of Education's *Postsecondary Education Facilities Inventory and Classification Manual*). To simplify reporting, institutions may report all floor area within buildings that contain research laboratories as laboratory space.

Minimum performance threshold

Minimum performance thresholds are benchmarks against which campus performance may be assessed for scoring purposes. The thresholds used in this version of STARS were calculated at the first decile for institutions reporting under STARS 2.0 as of July 31, 2015 and rounded to the nearest hundredth. In other words, 90 percent of institutions rated under STARS 2.0 before July 31, 2015 performed better than the minimum threshold. Extreme outliers were excluded from the calculations.

Source-site ratio

Also known as "primary energy factor (PEF)", the [U.S. Environmental Protection Agency](#) (EPA) defines source-site ratio in the following way:

Most building managers are familiar with site energy, the amount of heat and electricity consumed by a building as reflected in utility bills. Site energy may be delivered to a facility in one of two forms: primary and/or secondary energy. Primary energy is the raw fuel that is burned to create heat and electricity, such as natural gas or fuel oil used in onsite generation. Secondary energy is the energy product (heat or electricity) created from a raw fuel, such as electricity purchased from the grid or heat received from a district steam system. A unit of primary and a unit of secondary energy consumed at the site are not directly comparable because one represents a raw fuel while the other represents a converted fuel. Therefore, in order to assess the relative efficiencies of buildings with varying proportions of primary and secondary energy consumption, it is necessary to convert these two types of energy into equivalent units of raw fuel consumed to generate that one unit of energy consumed on-site. To achieve this equivalency, EPA uses the convention of source energy.

When primary energy is consumed on site, the conversion to source energy must account for losses that are incurred in the storage, transport and delivery of fuel to the building. When secondary energy is consumed on site, the conversion must account for losses incurred in the production, transmission, and delivery to the site. The factors used to restate primary and secondary energy in terms of the total equivalent source energy units are called the source-site ratios.

Scoring Example: Building Energy Consumption

The following data describe Example University (U.S.):

Grid-purchased electricity, baseline year = 100,000 MMBtu

Electricity from on-site renewables = 0 MMBtu

District steam/hot water, baseline year = 0 MMBtu

Energy from all other sources = 60,000 MMBtu

Gross floor area of building space, baseline year = 2,000,000 ft²

Grid-purchased electricity, performance year = 100,000 MMBtu

Electricity from on-site renewables = 30,000 MMBtu

District steam/hot water, performance year = 0 MMBtu

Energy from all other sources = 40,000 MMBtu

Gross floor area of building space, performance year = 2,500,000 ft²

Total degree days (HDD + CDD), performance year = 6,000 degree-days (°F)

Part 1

Source Energy

Total building energy consumption (source energy) = (A × B) + C + (D × E) + F

A = Grid-purchased electricity (MMBtu)

B = Source-site ratio for grid-purchased electricity (3.14)

C = Electricity from on-site renewables (MMBtu)

D = District steam/hot water (MMBtu)

E = Source-site ratio for district steam/hot water (1.2)

F = Energy from all other sources (MMBtu)

Points Earned for Part 1

- A. Total building energy consumption, baseline year (source energy) = 374,000 MMBtu
[(100,000 MMBtu grid-purchased electricity × 3.14) + 60,000 MMBtu from other sources]
- B. Gross floor area of building space, baseline year = 2,000,000 ft²
- C. Total building energy consumption, performance year (source energy) = 384,000 MMBtu [(100,000 MMBtu grid-purchased electricity × 3.14) + 70,000 MMBtu from other sources]
- D. Gross floor area of building space, performance year = 2,500,000 ft²

$$\begin{aligned}\text{Points earned} &= 6 \times \{ [(A/B) - (C/D)] / (A/B) \} \\ &= 6 \times \{ [(374,000/2,000,000) - (384,000/2,500,000)] / (374,000/2,000,000) \} \\ &= 6 \times [(0.187 - 0.1536) / 0.187] \\ &= 6 \times (0.0334 / 0.187) \\ &= 6 \times 0.1786 = 1.07 \text{ points}\end{aligned}$$

Part 2

EUI-Adjusted Floor Area

- A. Gross floor area of building space, performance year = 2,500,000 ft²
- B. Floor area of laboratory space, performance year = 200,000 ft²
- C. Floor area of healthcare space, performance year = 0
- D. Floor area of other energy intensive space, performance year = 100,000 ft²

$$\begin{aligned}
\text{EUI-adjusted floor area} &= \{ A + [2 \times (B + C)] + D \} \\
&= \{ 2,500,000 + [2 \times (200,000 + 0)] + 100,000 \} \\
&= \{ 2,500,000 + [2 \times (200,000)] + 100,000 \} \\
&= 2,500,000 + 400,000 + 100,000 \\
&= 3,000,000 \text{ ft}^2
\end{aligned}$$

Points Earned for Part 2

- A. Minimum performance threshold = 65 Btu per square foot per degree day (i.e., .000065 MMBtu)
- B. Total building energy consumption, performance year = 170,000 MMBtu
- C. EUI-adjusted floor area, performance year = 3,000,000 ft²
- D. Total degree days (HDD + CDD), performance year = 6,000

$$\begin{aligned}
\text{Points earned} &= 3\frac{1}{3} \times \{ [(A) - (B/C)/D] / A \} \\
&= 3\frac{1}{3} \times \{ [(.000065) - (B/C)/D] / .000065 \} \\
&= 3\frac{1}{3} \times \{ [(.000065) - (170,000/3,000,000) / 6,000] / (.000065) \} \\
&= 3\frac{1}{3} \times \{ [.000065 - (.0567/6,000)] / .000065 \} \\
&= 3\frac{1}{3} \times [(.000065 - .0000094) / .000065] \\
&= 3\frac{1}{3} \times (.0000556 / .000065) = 2.85 \text{ points}
\end{aligned}$$

Total Points Earned

$$\begin{aligned}
&= 1.07 + 2.85 \\
&= 3.92 \text{ points}
\end{aligned}$$