OP 8: 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 <u>minimum performance threshold</u> of 28 Btu per gross square foot (2.6 Btu per gross square metre) of floor area per <u>degree day</u>.

Performance for Part 2 of this credit is assessed using <u>EUI-adjusted floor area</u>, a figure that accounts for significant differences in energy use intensity (EUI) between types of building space.

C. Applicability
This credit applies to all 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 *Section 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 <u>source-site ratio</u>.

STARS calculates total building energy consumption (source energy) 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.

Total building energy consumption (source energy) = [A – (B + D)] + (B × C) + (D × E)

A =   Total building energy consumption, all sources (MMBtu)

B =   Grid-purchased electricity for buildings (MMBtu)

C =   Source-site ratio for grid-purchased electricity (see *Section F. Measurement*)

D =   District steam/hot water for buildings (MMBtu)

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

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 conditioned floor area increased rather than decreased during the time period.

Points Earned = 6 × { [(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 28 Btu per gross square foot (2.6 Btu per gross square metre) per 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 12.6 Btu (i.e. 45 percent below the 28 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 a 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:

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

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

B = Total building energy consumption, performance year (Btu)

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

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

Scoring Example: Building Energy Consumption

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

Total building energy consumption (all sources), baseline year = 160,000 MMBtu

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

District steam/hot water for buildings, baseline year = 0 MMBtu

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

Total building energy consumption (all sources), performance year =170,000 MMBtu

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

District steam/hot water for buildings, performance year = 0 MMBtu

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

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

Source-site ratio for grid-purchased electricity = 3.14

Source-site ratio for district steam/hot water = 1.20

Scoring Example: Building Energy Consumption (Part 1)

Part 1

Source Energy

Total building energy consumption (source energy) = [A − (B + D)] + (B × C) + (D × E)

A = Total building energy consumption (MMBtu)
B = Grid-purchased electricity for buildings (MMBtu)
C = Source-site ratio for grid-purchased electricity
D = District steam/hot water for buildings (MMBtu)
E = Source-site ratio for district steam/hot water

Points Earned

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 ft^2
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 ft^2

Points Earned = 6 × { [(A/B) − (C/D)] / (A/B) }
$\qquad$ = 6 × { [(374,000/2,000,000) − (384,000/2,500,000)] / (374,000/2,000,000)}
$\qquad$ = 6 × [(0.187 − 0.1536) / 0.187]
$\qquad$ = 6 × (0.0334 / 0.187)
$\qquad$ = 6 × 0.1786
$\qquad$ = **1.07** points

Scoring Example: Building Energy Consumption (Part 2)

Part 2

EUI-Adjusted Floor Area

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

EUI-adjusted floor area = { A + [2 × (B + C)] + D }
                       = { 2,500,000 + [2 × (200,000 + 0)] + 100,000 }
                       = { 2,500,000 + [2 × (200,000)] + 100,000 }
                       = 2,500,000 + 400,000 + 100,000
                       = 3,000,000 ft^2

Points Earned

    A. Minimum performance threshold = 28 Btu per square foot per degree day (i.e. .000028 MMBtu)
    B. Total building energy consumption, performance year = 170,000 MMBtu
    C. EUI-adjusted floor area, performance year = 3,000,000 ft^2
    D. Total degree days (HDD + CDD), performance year = 6,000

Points Earned = 3⅓ × { [(A) – (B/C)/D] / A }
              = 3⅓ × { [(.000028) – (B/C)/D] / .000028 }
               = 3⅓ × { [(.000028) - (170,000/3,000,000) / 6,000] / (.000028) }
               = 3⅓ × { [.000028 – (.0567/6,000)] / .000028 }
               = 3⅓ × [(.000028 - .0000094) / .000028]
               = 3⅓ × (.0000186 / .000028)
            = **2.214** points

Total Points Earned = 1.07 + 2.214
                      = **3.28** points

E. Reporting Fields

Required

- □   Total building energy consumption (all sources), performance year (MMBtu)

- □   Grid-purchased electricity for buildings, performance year (MMBtu)

- □   District steam/hot water for buildings, performance year (MMBtu)

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

- □   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)

- □   Heating degree days, performance year (base 65 °F / 18 °C)

- □   Cooling degree days, performance year (base 65 °F / 18 °C)

- □   Source-site ratio for grid-purchased electricity

- □   Source-site ratio for district steam/hot water

- □   Start date, performance year or 3-year period

- □   End date, performance year or 3-year period

- □   Total building energy consumption (all sources), baseline year (MMBtu)

- □   Grid-purchased electricity for buildings, baseline year (MMBtu)

- □   District steam/hot water for buildings, baseline year (MMBtu)

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

- □   Start date, baseline year or 3-year period

- □   End date, baseline year or 3-year period

- □   An affirmation that the submitted information is accurate to the best of a responsible party's knowledge and contact information for the responsible party. The responsible party should be a staff member, faculty member, or administrator who can respond to questions regarding the data once submitted and available to the public.

Conditional

Required if end date of the baseline year/period is 2004 or earlier:

- □   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)

Optional

- ☐ A brief description of any of the following energy conservation and efficiency technologies or strategies employed by the institution:
    - o Building temperature standards
    - o Light Emitting Diode (LED) lighting
    - o Occupancy and/or vacancy sensors
    - o Passive solar heating
    - o Ground-source heat pumps
    - o Co-generation
    - o Building recommissioning or retrofit program
    - o Energy metering and management systems
    - o Program to replace energy-consuming appliances, equipment and systems with high efficiency alternatives
    - o Energy-efficient landscape design (e.g. the placement and selection of shade trees and wind breaks and the use of vegetation and reflective materials to reduce heat islands)
    - o Vending machine sensors, lightless machines, or LED-lit machines
    - o Other energy conservation and efficiency initiatives
- ☐ The website URL where information about the institution's energy conservation and efficiency initiatives is available
- ☐ Notes about the submission

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 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. Reporting on a sample or subset of buildings is not allowed for this credit.

In many contexts, building energy consumption will be a subset of total campus energy consumption, e.g. as reported in *OP 9: Clean and Renewable Energy*. Institutions that do not meter building energy consumption separately should report total campus energy consumption.

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 *Section 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) may be reported:

Energy Source	Canada	Europe	U.S. and elsewhere
Grid-purchased electricity	2.05	2.50	3.14
District steam/hot water	1.20	1.20	1.20

Institutions with more accurate national, regional or local ratios may report those figures in lieu of the above and should document the rationale for doing so in "Notes about the submission".

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

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.