# ENERGY STAR® PortfolioManager®

# Technical Reference

## Thermal Energy Conversions

## OVERVIEW

For consistency and comparability, all energy performance metrics in Portfolio Manager reports are expressed in either thousand British thermal units (kBtu) or billion joules (GJ) and are annualized to 12 calendar months. However, in most cases your energy bills are not presented in these units and are not tied to calendar months. Therefore, a series of procedures is applied to make these conversions.

Portfolio Manager offers three main meter types, based on the most common ways buildings receive energy:

- **Metered Delivery.** Metered energy is used for products that are supplied by an offsite utility and immediately consumed (i.e., electricity, natural gas, and district steam).

- **Bulk Delivery.** Bulk fuels are delivered, stored, and combusted on-site (e.g., fuel oil, propane, wood).

- **Onsite Renewable Electricity.** Onsite renewable electricity from solar or wind power is a unique meter type in Portfolio Manager. You should be able to monitor electricity consumption on a continuous basis.

Based on your particular energy suppliers and onsite systems, you may have a variety of different meter types that are reported in different units (e.g., gallons, kWh, therms, kBtu, etc.), which can be difficult to compare. To streamline the process for you, Portfolio Manager enables flexible entry options. You can enter monthly meters and onsite renewable meters with specific start and end dates, as on your bill, and you can also enter bulk purchases with a delivery date and quantity. For all of these fuel types (17 total meter types), Portfolio Manager includes the most common billing units so that you should be able to use the same units as you see on your bill.

To aggregate your consumption across multiple meters and to provide annual metrics in reports, Portfolio Manager will convert all fuels into a standard common unit (kBtu or GJ, whichever you select in your account settings), and will annualize them to whole calendar months. Annualizing data to calendar months enables quantities from different meters to be added together, and also enables weather normalization using monthly average weather conditions. All metrics in Portfolio Manager correspond to annual (12-month) periods. You may select which 12 calendar months you want to evaluate, but you cannot choose periods that start and end in the middle of the month.

The process from data entry through reporting is summarized in *Figure 1*. Standard conversion factors to compute kBtu, kWh, and GJ are presented together in *Figure 2*. You can use this for a quick reference on conversion. For a complete listing of all meter types in Portfolio Manager along with the corresponding input options and conversion factors, refer to *Figure 3*.

## Figure 1 – Overview of Process for Thermal Conversions and Annual Metrics

**1   User enters energy consumption into Portfolio Manager**

- Enter one meter for every type of energy you use (electricity, district steam, fuel oil, etc).
- Within the *Add Meter Wizard*, you can identify all of your meters in a single table.
- Select the correct unit for each meter – use the same units as you see on your bill.
- For every bill, enter the energy use. For bulk deliveries you are only required to enter the delivery date; for metered delivery you can enter the exact start and end dates from your bill.

**2   Portfolio Manager converts energy consumption to standard units**

- Each meter entry is multiplied by a conversion factor to express the total in kBtu or GJ.
- Conversion factors are provided in detailed tables at the end of this document.
  - Standard unit multipliers are used to convert billed units to kBtu.
  - Standard heat content assumptions are used for fuels tracked by mass or volume.

**3   Portfolio Manager computes energy consumption by calendar month**

- **Metered Fuels** – For each monthly meter value, the total quantity is divided by the total number of days in the billing period. In the case where the meter spans two months (e.g., January 15 to February 15), the kBtu/day value is multiplied by the number of days in each month to determine the portion of the energy that must be assigned to each calendar month.
  - If there are gaps in between your meters or if they overlap (i.e., one entry's start date is before the prior entry's end date) then metrics cannot be computed.
- **Bulk Delivery** – For bulk delivery the quantity is assigned to the calendar month in which the delivery was received. Months with no delivery are counted with zero consumption.

**4   Portfolio Manager computes annual energy for each energy type**

- Monthly values are added together across all meters of the same energy type. This provides annual total values by type (e.g., electricity, district steam, fuel oil).

**5   Portfolio Manager computes annual site energy use intensity (EUI)**

- Annual site energy is the sum of the annual total for each type of energy, from Step 4
- Annual site EUI is equal to the annual total site energy divided by building size (square foot or square meters)

**6   Portfolio Manager computes annual source energy use intensity (EUI)**

- Annual source energy is computed from site energy, where each individual energy type is multiplied by its source energy conversion factor. For these factors, visit www.energystar.gov/SourceEnergy.
- Annual source EUI is equal to the annual source energy divided by building size.

**7   Portfolio Manager computes additional metrics**

- Additional metrics such as greenhouse gas emissions, the ENERGY STAR score, and weather normalized energy are computed using the calendar month values, the annualized total site energy, and/or the annualized total source energy.
- Refer to the corresponding technical reference materials for more on those calculations.

*Figure 2 – Quick Reference Multipliers*

| | Multiplier to get kBtu (US & Canada) | Multiplier to get GJ (US & Canada) |
|---|---|---|
| kWh (thousand Watt-hours) | 3.412 | 0.00360 |
| MWh (million Watt-hours) | 3412 | 3.60 |
| kBtu (thousand Btu) | 1 | 0.00106 |
| MBtu/MMBtu (million Btu) | 1000 | 1.06 |
| GJ (billion joules) | 947.817 | 1 |

- These multipliers are standard conversion factors, independent of fuel-specific heat content that are used to convert between kWh, kBtu, and GJ.
- http://www.eia.doe.gov/basics/conversion_basics.html

*Figure 3 – Conversion Factors to kBtu by Meter Type for the U.S. and Canada*

| Meter Type | Input Unit Options | U.S. Property Assumptions[1] | | Canadian Property Assumptions[2] | |
|---|---|---|---|---|---|
| | | Multiplier to get kBtu | Heat Content | Multiplier to get kBtu | Heat Content |
| Electricity (Grid Purchase and Onsite Renewable) | kBtu (thousand Btu) | 1 | Not Applicable | 1 | Not Applicable |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | kWh (thousand Watt-hours) | 3.412 | | 3.412 | |
| | MWh (million Watt-hours) | 3,412 | | 3,412 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |
| Natural Gas | kBtu (thousand Btu) | 1 | 1,026 Btu/cf | 1 | 1,031.43 Btu/cf |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | cf (cubic feet) | 1.026 | | 1.031 | |
| | Ccf (hundred cubic feet) | 102.6 | | 103.143 | |
| | Kcf (thousand cubic feet) | 1,026 | | 1,031 | |
| | Mcf (million cubic feet) | 1,026,000 | | 1,031,430 | |
| | Therms | 100 | | 100 | |
| | cubic meters | 36.303 | | 36.425 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |
| Fuel Oil (No. 1) | kBtu (thousand Btu) | 1 | 0.139 MBtu/gallon | 1 | 0.139210 MBtu/gallon |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | Gallons (US) | 139 | | 139.210 | |
| | Gallons (UK) | 166.927 | | 167.184 | |
| | liters | 36.720 | | 36.775 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |

| Meter Type | Input Unit Options | U.S. Property Assumptions[1] | | Canadian Property Assumptions[2] | |
|---|---|---|---|---|---|
| | | Multiplier to get kBtu | Heat Content | Multiplier to get kBtu | Heat Content |
| Fuel Oil (No. 2) | kBtu (thousand Btu) | 1 | 0.138 MBtu/gallon | 1 | 0.139210 MBtu/gallon |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | Gallons (US) | 138 | | 139.210 | |
| | Gallons (UK) | 165.726 | | 167.184 | |
| | liters | 36.456 | | 36.775 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |
| Fuel Oil (No. 4) | kBtu (thousand Btu) | 1 | 0.146 MBtu/gallon | 1 | 0.139210 MBtu/gallon |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | Gallons (US) | 146 | | 139.210 | |
| | Gallons (UK) | 175.333 | | 167.184 | |
| | liters | 38.569 | | 36.775 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |
| Fuel Oil (No. 5 & No. 6)[3] | kBtu (thousand Btu) | 1 | 0.150 MBtu/gallon | 1 | 0.152485 MBtu/gallon |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | Gallons (US) | 150 | | 152.485 | |
| | Gallons (UK) | 180.137 | | 183.127 | |
| | liters | 39.626 | | 40.282 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |
| Diesel | kBtu (thousand Btu) | 1 | 0.138 MBtu/gallon | 1 | 0.137416 MBtu/gallon |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | Gallons (US) | 138 | | 137.416 | |
| | Gallons (UK) | 165.726 | | 165.029 | |
| | liters | 36.456 | | 36.301 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |
| Kerosene | kBtu (thousand Btu) | 1 | 0.135 MBtu/gallon | 1 | 0.135191 MBtu/gallon |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | Gallons (US) | 135 | | 135.191 | |
| | Gallons (UK) | 162.123 | | 162.358 | |
| | liters | 35.663 | | 35.714 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |

| Meter Type | Input Unit Options | U.S. Property Assumptions[1] | | Canadian Property Assumptions[2] | |
|---|---|---|---|---|---|
| | | Multiplier to get kBtu | Heat Content | Multiplier to get kBtu | Heat Content |
| Propane[4] | kBtu (thousand Btu) | 1 | 0.092 MBtu/gallon | 1 | 0.09089 MBtu/gallon |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | Cf (cubic feet) | 2.516 | | 2.516 | |
| | Ccf (hundred cubic feet) | 251.6 | | 251.6 | |
| | Kcf (thousand cubic feet) | 2,516 | | 2,516 | |
| | Gallons (US) | 92 | | 90.809 | |
| | Gallons (UK) | 110.484 | | 109.057 | |
| | liters | 24.304 | | 23.989 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |
| District Steam | kBtu (thousand Btu) | 1 | 1,194 Btu/Lb | 1 | 1,194 Btu/Lb |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | Lbs | 1.194 | | 1.194 | |
| | kLbs (thousand pounds) | 1,194 | | 1,194 | |
| | MLbs (million pounds) | 1,194,000 | | 1,194,000 | |
| | therms | 100.0 | | 100.000 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |
| | kg | 2.632 | | 2.632 | |
| District Hot Water | kBtu (thousand Btu) | 1 | Not Needed - No Volume Entry Units | 1 | Not Needed - No Volume Entry Units |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | Therms | 100 | | 100 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |
| District Chilled Water (All Types) | kBtu (thousand Btu) | 1 | Not Needed - No Volume Entry Units | 1 | Not Needed - No Volume Entry Units |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | Ton Hours | 12.0 | | 12.0 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |
| Coal (anthracite) | kBtu (thousand Btu) | 1 | 25.09 MBtu/ton | 1 | 23.818 MBtu/ton |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | Tons | 25,090 | | 23,818 | |
| | Lbs | 12.545 | | 11.909 | |
| | kLbs (thousand pounds) | 12,545 | | 11,909 | |
| | MLbs (million pounds) | 12,545,000 | | 11,909,055 | |
| | Tonnes (metric) | 27,658.355 | | 26,255 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |

| Meter Type | Input Unit Options | U.S. Property Assumptions[1] | | Canadian Property Assumptions[2] | |
| --- | --- | --- | --- | --- | --- |
| | | Multiplier to get kBtu | Heat Content | Multiplier to get kBtu | Heat Content |
| Coal (bituminous) | kBtu (thousand Btu) | 1 | 24.93 MBtu/ton | 1 | 21.496 MBtu/ton |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | Tons | 24,930 | | 21,496 | |
| | Lbs | 12.465 | | 10.748 | |
| | kLbs (thousand pounds) | 12,465 | | 10,748 | |
| | MLbs (million pounds) | 12,465,000 | | 10,748,245 | |
| | Tonnes (metric) | 27,482 | | 23,695 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |
| Coke | kBtu (thousand Btu) | 1 | 24.80 MBtu/ton | 1 | 21.50 MBtu/ton |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | Tons | 24,800 | | 24,790 | |
| | Lbs | 12.4 | | 12.395 | |
| | kLbs (thousand pounds) | 12,400 | | 12,395 | |
| | MLbs (million pounds) | 12,400,000 | | 12,394,876 | |
| | Tonnes (metric) | 27,339 | | 27,326 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |
| Wood | kBtu (thousand Btu) | 1 | 15.38 MBtu/Ton | 1 | 15.48 MBtu/Ton |
| | MBtu/MMBtu (million Btu) | 1,000 | | 1,000 | |
| | Tons | 17,480 | | 15,477 | |
| | Tonnes (metric) | 15,857 | | 17,061 | |
| | GJ (billion joules) | 947.817 | | 947.817 | |
| Other | kBtu (thousand Btu) | 1.0 | Not Needed - No Volume Entry Units | 1.0 | Not Needed - No Volume Entry Units |

Notes:
1. U.S. Heat Content Sources:
    a. Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al; Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410.

    b. Revised factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp. With Amendments from Memo: Table of Final 2013 Revisions to the Greenhouse Gas Reporting Rule (PDF) to 40 CFR part 98, subpart C: Table C–1 to Subpart C—Default CO2 Emission Factors and High Heat Values for Various Types of Fuel and Table C–2 to Subpart C—Default CH4 and N2O Emission Factors for Various Types of Fuel.

    c. District Heating: Letter communication from Robert P. Thornton, President, International District Energy Association to Felicia Ruiz, EPA CHPP Program Manager, August 15, 2008.

2. Canadian Heat Content Sources:

    a. Fossil Fuels: Report on Energy Supply and Demand - Text Table 1.1 - Energy Conversion Factors for 2009, Statistics Canada\

    b. District Heating: Letter communication from Robert P. Thornton, President, International District Energy Association to Felicia Ruiz, EPA CHPP Program Manager, August 15, 2008.

3. Fuel Oil Conversions

    a. It is possible to have different reference factors for both No.5 and No. 6 Fuel Oil.  However, at this time they are combined in a single entry option. Because No. 6 Fuel Oil is more common in commercial buildings, the reference data for No. 6 oil is used for properties with this meter type.

4. Propane Conversions

    a. Propane factors assume that propane is entered in a liquid form if entered in gallons or liters and in a gaseous form when entered in cf, ccf, or kcf.  The form of the propane (liquid or gas) does not affect the conversion when entered in units of heat (kBtu, MBtu, or GJ)

5. **Portfolio Manager uses "M" to represent million and "k" to represent thousand.** However, some utilities use "M" to represent thousand and "MM" to represent million. Unfortunately, there isn't an industry standard on this term. In some places, we've used MBtu/MMBtu to help those looking for "MMBtu."