ENERGY STAR® Portfolio Manager® 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	3.412	0.00360
MWh	3412	3.60
kBtu	1	0.00106
MBtu	1000	1.06
GJ	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	1	Not Applicable	1	Not Applicable
	MBtu	1,000		1,000	
	kWh	3.412		3.412	
	MWh	3,412		3,412	
	GJ	947.817		947.817	
Natural Gas	kBtu	1	1,026 Btu/cf	1	1,031.43 Btu/cf
	MBtu	1,000		1,000	
	cf	1.026		1.031	
	ccf	102.6		103.143	
	kcf	1,026		1,031	
	Mcf	1,026,000		1,031,430	
	Therms	100		100	
	cubic meters	36.303		36.425	
	GJ	947.817		947.817	
Fuel Oil (No. 1)	kBtu	1	0.139 MBtu/gallon	1	0.139210 MBtu/gallon
	MBtu	1,000		1,000	
	Gallons (US)	139		139.210	
	Gallons (UK)	166.927		167.184	
	liters	36.720		36.775	
	GJ	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	1	0.138 MBtu/gallon	1	0.139210 MBtu/gallon
	MBtu	1,000		1,000	
	Gallons (US)	138		139.210	
	Gallons (UK)	165.726		167.184	
	liters	36.456		36.775	
	GJ	947.817		947.817	
Fuel Oil (No. 4)	kBtu	1	0.146 MBtu/gallon	1	0.139210 MBtu/gallon
	MBtu	1,000		1,000	
	Gallons (US)	146		139.210	
	Gallons (UK)	175.333		167.184	
	liters	38.569		36.775	
	GJ	947.817		947.817	
Fuel Oil (No. 5 & No. 6)[3]	kBtu	1	0.150 MBtu/gallon	1	0.152485 MBtu/gallon
	MBtu	1,000		1,000	
	Gallons (US)	150		152.485	
	Gallons (UK)	180.137		183.127	
	liters	39.626		40.282	
	GJ	947.817		947.817	
Diesel	kBtu	1	0.138 MBtu/gallon	1	0.137416 MBtu/gallon
	MBtu	1,000		1,000	
	Gallons (US)	138		137.416	
	Gallons (UK)	165.726		165.029	
	liters	36.456		36.301	
	GJ	947.817		947.817	
Kerosene	kBtu	1	0.135 MBtu/gallon	1	0.135191 MBtu/gallon
	MBtu	1,000		1,000	
	Gallons (US)	135		135.191	
	Gallons (UK)	162.123		162.358	
	liters	35.663		35.714	
	GJ	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	1	0.092 MBtu/gallon	1	0.09089 MBtu/gallon
	MBtu	1,000		1,000	
	cf	2.516		2.516	
	ccf	251.6		251.6	
	kcf	2,516		2,516	
	Gallons (US)	92		90.809	
	Gallons (UK)	110.484		109.057	
	liters	24.304		23.989	
	GJ	947.817		947.817	
District Steam	kBtu	1	1,194 Btu/Lb	1	1,194 Btu/Lb
	MBtu	1,000		1,000	
	Lbs	1.194		1.194	
	kLbs	1,194		1,194	
	MLbs	1,194,000		1,194,000	
	therms	100.0		100.000	
	GJ	947.817		947.817	
	kg	2.632		2.632	
District Hot Water	kBtu	1	Not Needed - No Volume Entry Units	1	Not Needed - No Volume Entry Units
	MBtu	1,000		1,000	
	Therms	100		100	
	GJ	947.817		947.817	
District Chilled Water (All Types)	kBtu	1	Not Needed - No Volume Entry Units	1	Not Needed - No Volume Entry Units
	MBtu	1,000		1,000	
	Ton Hours	12.0		12.0	
	GJ	947.817		947.817	
Coal (anthracite)	kBtu	1	25.09 MBtu/ton	1	23.818 MBtu/ton
	MBtu	1,000		1,000	
	Tons	25,090		23,818	
	Lbs	12.545		11.909	
	kLbs	12,545		11,909	
	MLbs	12,545,000		11,909,055	
	Tonnes (metric)	27,658.355		26,255	
	GJ	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	1	24.93 MBtu/ton	1	21.496 MBtu/ton
	MBtu	1,000		1,000	
	Tons	24,930		21,496	
	Lbs	12.465		10.748	
	kLbs	12,465		10,748	
	MLbs	12,465,000		10,748,245	
	Tonnes (metric)	27,482		23,695	
	GJ	947.817		947.817	
Coke	kBtu	1	24.80 MBtu/ton	1	21.50 MBtu/ton
	MBtu	1,000		1,000	
	Tons	24,800		24,790	
	Lbs	12.4		12.395	
	kLbs	12,400		12,395	
	MLbs	12,400,000		12,394,876	
	Tonnes (metric)	27,339		27,326	
	GJ	947.817		947.817	
Wood	kBtu	1	15.38 MBtu/Ton	1	15.48 MBtu/Ton
	MBtu	1,000		1,000	
	Tons	17,480		15,477	
	Tonnes (metric)	15,857		17,061	
	GJ	947.817		947.817	
Other	kBtu	1.0	Not Needed - No Volume Entry Units	1.0	Not Needed - No Volume Entry Units
	GJ	947.817		947.817	

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)