

Physical units reflect measures of distances, areas, volumes, heights, weights, mass, force, and energy. Different types of energy are measured by different physical units:

- Barrels or gallons for petroleum
- Cubic feet for natural gas
- Tons for coal
- Kilowatthours for electricity

To compare different fuels, we need to convert the measurements to the same units.

How Big Is a Barrel?

A confusing unit of measure is a barrel. A barrel's capacity is determined by who uses the term and what it contains.

For example:

1 barrel (bbl) of petroleum or related products = 42 gallons  
1 barrel of Portland cement = 376 pounds  
1 barrel of flour = 196 pounds  
1 barrel of pork or fish = 200 pounds  
1 barrel of (U.S.) dry measure = 3.29122 bushels or 4.2104 cubic feet  
A barrel may be called a "drum," but a drum usually holds 55 gallons

## Units for Comparing Energy

Some popular units for comparing energy include British Thermal Units (Btu), barrels of oil equivalent, metric tons of oil equivalent, metric tons of coal equivalent, and terajoules.

In the United States, the Btu, a measure of heat energy, is the most commonly used unit for comparing fuels. Because energy used in different countries comes from different places, the Btu content of fuels varies slightly from country to country.

The Btu content of each fuel provided below and used in the energy calculator reflects the average energy content for fuels consumed in the United States.

### **Btu Content of Common Energy Units**

- 1 barrel (42 gallons) of crude oil = 5,800,000 Btu
- 1 gallon of gasoline = 124,000 Btu (based on U.S. consumption, 2008)
- 1 gallon of diesel fuel = 139,000 Btu
- 1 gallon of heating oil = 139,000 Btu
- 1 barrel of residual fuel oil = 6,287,000 Btu
- 1 cubic foot of natural gas = 1,028 Btu (based on U.S. consumption, 2008)
- 1 gallon of propane = 91,000 Btu
- 1 short ton of coal = 19,988,000 Btu (based on U.S. consumption, 2008)
- 1 kilowatthour of electricity = 3,412 Btu

### **Examples of Converting Different Energy Sources to Btu**

#### **Example 1:**

You have a natural gas furnace in your home that used 81,300 cubic feet of natural gas for heating last winter. Your neighbor has an oil furnace that used 584 gallons of heating oil last winter. To determine which home used more energy for heating, you can convert the natural gas and heating oil consumption figures into Btu, as follows:

Natural Gas: 81,300 cubic feet (your house)

x

1,028 Btu per cubic foot

= 83,576,400 Btu

Heating Oil: 584 gallons (neighbor's house)

x

139,000 Btu per gallon

= 81,176,000 Btu

Answer: You used more energy to heat your house!

### Example 2:

You work for an electric power company. Your company's power generators can run on one of two fuels: natural gas or residual fuel oil. Your job is to switch fuels when the cost of the fuel you are currently using becomes more expensive than the other fuel. This will keep costs down for you and your electricity customers. Your company's generators are currently using residual fuel

oil, but fuel oil prices have been going up much faster than natural gas prices. Based on the fuel costs below, you need to decide if it is time to switch to natural gas:

Natural Gas:

\$7.30 per thousand cubic feet

÷

1.028 million Btu per thousand cubic feet =

\$7.10 per million Btu

Residual fuel oil:

\$57.75 per barrel

÷

6.287 million Btu per barrel =

\$9.19 per million Btu

Answer: When you convert the fuels into the same units, you see that residual fuel oil now costs more than natural gas. You decide to switch to natural gas to save money.

### **What Is a Btu?**

A "British thermal unit" (Btu) is a measure of the heat content of fuels. It is the quantity of heat required to raise the temperature of 1 pound of liquid water by 1 °F at the temperature that water has its greatest density (approximately 39 °F).

### **Why Do We Use Btu?**

One practical way to compare different fuels is to convert physical units of measure (such as weight or volume) into a common unit of measurement based on the energy content of each fuel. The British thermal unit (Btu) is a widely used measure of energy content.

### **Using Btu for Comparing Home Heating Fuels**

How can you compare home heating fuel prices? You must compare the cost per heating value (Btu) of each fuel.

### **Using Btu for Comparing Electricity Generation Fuels**

Suppose you have been assigned the responsibility of purchasing fuel for a large electric utility company. You need to keep costs down for you and your electricity customers. Which fuel would you choose to generate electricity — coal, oil, or natural gas? In 2008, average prices of fuel delivered to electric power plants were:

- \$41.14 per short ton of coal
- \$64.89 per 42-gallon barrel of oil
- \$9.26 per thousand cubic feet of natural gas

The prices of each fuel look quite different, but you can compare the prices of their energy content by first converting to Btu.

A short ton of coal contains about 21 million Btu, a barrel of oil contains about 6 million Btu, and a thousand cubic feet (Tcf) of natural gas contains about 1 million Btu. After dividing price by energy content, you can see which fuel is least expensive:

	Price	Btu (Energy Content)	\$/Million Btu
Coal	\$41.14 per ton	21 million per short ton	\$1.96
Oil	\$64.89 per barrel	6 million per barrel	\$10.82
Natural Gas	\$9.26 per Tcf	1 million per Tcf	\$9.26

So coal is actually the least expensive fuel on a price-per-energy content basis.

Of course, cost is not the only factor to consider when selecting a fuel. Environmental restrictions and equipment costs are some of the other factors that should be taken into account.

### Btu Quick Facts

A single Btu is insignificant in terms of the energy use in a single household or in the Nation's energy consumption. In 2008, the United States used over 99 quadrillion (written out, 1 quadrillion is a 1 followed by 15 zeros) Btu of energy.

One quadrillion Btu is a very large amount of energy:

- One Btu is approximately equal to the energy released in the burning of a wood match.
- One million Btu equals about 8 gallons of motor gasoline.
- One billion Btu equals all the electricity that 300 households consume in one month.

- One trillion Btu is equal to 500 100-ton railroad cars of coal.
- One quadrillion Btu is equal to 172 million barrels of crude oil.