



<http://www.extension.iastate.edu/agdm/wholefarm/html/c6-86.html>

## Energy Measurements and Conversions



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[British thermal unit](#) [Joule](#) [Electricity](#) [Power](#) [Liquid Fuels](#) [Barrels of petroleum](#) [Biomass](#) [Natural gas](#) [Coal](#) [Fuel Usage](#)

Deka = ten  
Hecto = hundred

Kilo = thousand

Mega = million

Giga = billion

Tera = trillion

### British thermal unit (Btu) measurements and conversions

Approximate definition: A British thermal unit is defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit (Wikipedia).

1 British thermal unit (Btu) = 252 International Table calories

1 calorie = .00397 Btus

1 Btu = 1,055 joules

1 Btu = 1.055 kilojoules

1 kilojoule = .9479 Btus

1 therm = 100,000 Btus

1 dekatherm = 10 therms

1 dekatherm = 1,000,000 Btus

1 kilowatt hour of electricity = 3,412 Btu

1 horsepower = 2,545 Btu per hour

Convertit: <http://www.convertit.com/Go/ConvertIt/Measurement/Converter.ASP>

Energy Information Administration:

[http://www.eia.doe.gov/kids/energyfacts/science/energy\\_calculator.html](http://www.eia.doe.gov/kids/energyfacts/science/energy_calculator.html)

Energy and Work Conversion – Unit Converter:

[http://www.unitconversion.org/unit\\_converter/energy.html](http://www.unitconversion.org/unit_converter/energy.html)

### Joule measurements and conversions

Approximate Definition: the energy required to lift a small apple (102g) one meter against Earth's gravity (Wikipedia).

1 joule = .0009478 Btus

1 Btu = 1,055.05585 joules

1 kilojoule = one thousand joules

1 kilojoule = .947817 Btus

1 Btu = 1.055 kilojoules

1 watt hour = 3,600 joules

1 kilowatt hour = 3.6 megajoules

1 megajoule = one million joules  
1 terajoule = one million megajoules

Online conversions: <http://www.onlineconversion.com/energy.htm>  
Convertit.com: <http://www.convertit.com/Go/ConvertIt/Measurement/Converter.ASP>  
Energy and Work Conversion – Unit Converter:  
[http://www.unitconversion.org/unit\\_converter/energy.html](http://www.unitconversion.org/unit_converter/energy.html)

## Electricity measurements and conversions

### Watt

Approximate definition: A human climbing a flight of stairs is doing work at the rate of about 200 watts (Wikipedia).

1 watt = 1 joule per second  
1 watt = 3.412 Btu per hour  
1 Btu per hour = .293 watts  
1 kilowatt (kW) = one thousand watts  
1 kilowatt = 3,412 Btu per hour  
1 kilowatt = 1.341 horsepower  
1 horsepower = .746 kilowatts  
1 megawatt (MW) = one million watts  
1 gigawatt (GW) = one billion watts  
1 terawatt (TW) = one trillion watts  
1 gigawatt = one million kilowatts

### Watt hours

Approximate definition: One watt-hour is the amount of (usually electrical) energy expended by a one-watt load (e.g., light bulb) drawing power for one hour (Wikipedia).

1 watt second = 1 joule  
1 watt minute = 60 joules  
1 watt hour (Wh) = 3,600 joules  
1 watt hour = 3.6 kilojoules  
1 kilowatt hour = one thousand watt hours  
1 kilowatt hour (kWh) = 3.6 megajoules  
1 megajoule = .278 kilowatt hours  
1 kilowatt hour = 3,412 Btus  
1 kilowatt hour = 1.34 horsepower hours  
1 horsepower hour = .746 kilowatt hours  
1 megawatt hour (MWh) = one million watt hours  
1 gigawatt hour (GWh) = one billion watt hours  
1 terawatt hour (TWh) = one trillion watt hours  
1 gigawatt hour = one million kilowatt hours  
1 terawatt hour = one billion kilowatt hours  
1 terawatt hour = one million megawatt hours

Online conversions: <http://www.onlineconversion.com/energy.htm>  
Convertit.com: <http://www.convertit.com/Go/ConvertIt/Measurement/Converter.ASP>  
Energy Information Administration:  
[http://www.eia.doe.gov/kids/energyfacts/science/energy\\_calculator.html](http://www.eia.doe.gov/kids/energyfacts/science/energy_calculator.html)  
Energy and Work Conversion – Unit Converter:  
[http://www.unitconversion.org/unit\\_converter/energy.html](http://www.unitconversion.org/unit_converter/energy.html)

## Power measurements and conversions

1 Btu per second = .9478 kilowatts  
1 Btu per second = .7068 horsepower

1 Btu per second = .6971 metric horsepower  
1 Btu per second = 3.968 kilocalories per second  
1 kilowatt = 1.055 Btu per second  
1 kilowatt = .7457 horsepower  
1 kilowatt = .7355 metric horsepower  
1 kilowatt = 4.184 kilocalories per second  
1 horsepower = 1.341 kilowatts  
1 horsepower = .9863 metric horsepower  
1 horsepower = 5.615 kilocalories per second  
1 horsepower = 1.415 Btu per second  
1 metric horsepower = 1.014 horsepower  
1 metric horsepower = 1.360 kilowatts  
1 metric horsepower = 5.692 kilocalories per second  
1 metric horsepower = 1.434 Btu per second

Biomass Energy Data Book, U.S. Department of Energy:

[https://cta.ornl.gov/bedb/appendix\\_a.shtml](https://cta.ornl.gov/bedb/appendix_a.shtml)

Power Conversion – Unit Converter: [http://www.unitconversion.org/unit\\_converter/power.html](http://www.unitconversion.org/unit_converter/power.html)

Online Power Conversion: <http://www.convert-me.com/en/convert/power>

Energy and Work Conversion – Unit Converter:

[http://www.unitconversion.org/unit\\_converter/energy.html](http://www.unitconversion.org/unit_converter/energy.html)

## Liquid fuel measurements and conversions

### Gasoline

1 gallon = 125,000 Btu – HHV \*  
1 gallon = 131.9 megajoules – HHV \*  
1 gallon = 115,400 Btu – LHV \*  
1 gallon = 121.7 megajoules – LHV \*  
1 gallon = .002791 metric tons  
1 barrel = 5,250,000 Btu – HHV \*  
1 barrel = 5,539 megajoules – HHV \*  
1 barrel = 4,846,800 Btu – LHV \*  
1 barrel = 5,113 megajoules – LHV \*  
1 barrel = .1172 metric tons  
1 liter = 33,025 Btu – HHV \*  
1 liter = 34.8 megajoules – HHV \*  
1 liter = 30,489 Btu – LHV \*  
1 liter = 32.2 megajoules – LHV \*

### Diesel fuel

1 gallon = 138,700 Btu – HHV \*  
1 gallon = 146.3 megajoules – HHV \*  
1 gallon = 128,700 Btu – LHV \*  
1 gallon = 135.8 megajoules – HHV \*  
1 gallon = .003192 metric tons  
1 barrel = 5,825,400 Btu – HHV \*  
1 barrel = 6,146 megajoules – HHV \*  
1 barrel = 5,405,400 Btu – LHV \*  
1 barrel = 5,703 megajoules LHV \*  
1 barrel = .1341 metric tons  
1 liter = 36,645 Btu – HHV \*  
1 liter = 38.7 megajoules – HHV \*  
1 liter = 34,003 Btu – LHV \*  
1 liter = 35.9 megajoules – LHV \*

### Ethanol

1 gallon = 84,600 Btu – HHV \*  
1 gallon = 89.3 megajoules – HHV \*

1 gallon = 75,670 Btu – LHV \*  
1 gallon = 79.8 megajoules – LHV \*  
1 barrel = 3,553,200 Btu – HHV \*  
1 barrel = 3,749 megajoules -- HHV \*  
1 barrel = 3,178,140 Btu – LHV \*  
1 barrel = 3,353 megajoules – LHV \*  
1 liter = 22,351 Btu – HHV \*  
1 liter = 23.6 megajoules – HHV \*  
1 liter = 19,992 Btu – LHV \*  
1 liter = 21.1 megajoules – LHV \*  
Ethanol average density = .79 grams per milliliter  
Ethanol average density = .79 metric tons per cubic meter

#### **Bio-diesel**

1 gallon = 126,206 Btu – HHV \*  
1 gallon = 133.1 megajoules – HHV \*  
1 gallon = 117,093 Btu – LHV \*  
1 gallon = 123.5 megajoules – LHV \*  
1 barrel = 5,300,652 Btu – HHV \*  
1 barrel = 5,592 megajoules – HHV \*  
1 barrel = 4,917,906 Btu – LHV \*  
1 barrel = 5,188 megajoules – LHV \*  
1 liter = 33,344 Btu – HHV \*  
1 liter = 35.2 megajoules – HHV \*  
1 liter = 30,936 Btu – LHV \*  
1 liter = 32.6 megajoules – LHV \*  
1 metric ton of biodiesel = 37.8 gigajoules  
Bio-diesel average density = .88 grams per milliliter  
Bio-diesel average density = .88 metric tons per cubic meter

#### **Residual Fuel**

1 gallon = 149,700 Btu – HHV \*  
1 gallon = 157.9 megajoules – HHV \*  
1 gallon = 138,400 Btu – LHV \*  
1 gallon = 146.0 megajoules – LHV \*  
1 barrel = 6,287,400 Btu – HHV \*  
1 barrel = 6,633 megajoules – HHV \*  
1 barrel = 5,812,800 Btu – LHV \*  
1 barrel = 6,133 megajoules – LHV \*  
1 liter = 39,551 Btu – HHV \*  
1 liter = 41.7 megajoules – HHV \*  
1 liter = 36,565 Btu – LHV \*  
1 liter = 38.6 megajoules – LHV \*

#### **LP Gas (liquefied petroleum gas – propane)**

1 gallon = 91,300 Btu – HHV \*  
1 gallon = 96.3 megajoules – HHV \*  
1 gallon = 83,500 Btu – LHV \*  
1 gallon = 88.1 megajoules – LHV \*  
1 barrel = 3,834,600 Btu – HHV \*  
1 barrel = 4,046 megajoules – HHV \*  
1 barrel = 3,507,000 Btu – LHV \*  
1 barrel = 3,700 megajoules – LHV \*  
1 liter = 24,121 Btu – HHV \*  
1 liter = 25.4 megajoules – HHV \*  
1 liter = 22,061 Btu – LHV \*  
1 liter = 23.3 megajoules – LHV \*

### **Methanol**

- 1 gallon = 64,600 Btu – HHV \*
- 1 gallon = 68.2 megajoules – HHV \*
- 1 gallon = 56,560 Btu –LHV \*
- 1 gallon = 59.7 megajoules – LHV \*
- 1 barrel = 2,713,200 Btu – HHV \*
- 1 barrel = 2,862 megajoules – HHV \*
- 1 barrel = 2,375,520 Btu -- LHV \*
- 1 barrel = 2,506 megajoules – LHV \*
- 1 liter = 17,067 Btu – HHV \*
- 1 liter = 18.0 megajoules – HHV \*
- 1 liter = 14,943 Btu – LHV \*
- 1 liter = 15.8 megajoules – LHV \*

### **Butane**

- 1 gallon = 103,000 Btu – HHV \*
- 1 gallon = 108.7 megajoules – HHV \*
- 1 gallon = 93,000 Btu – LHV \*
- 1 gallon = 98.1 megajoules – LHV \*
- 1 barrel = 4,326,000 Btu – HHV \*
- 1 barrel = 4,564 megajoules – HHV \*
- 1 barrel = 3,906,000 Btu -- LHV \*
- 1 barrel = 4,121 megajoules – LHV \*
- 1 liter = 27,213 Btu – HHV \*
- 1 liter = 28.7 megajoules – HHV \*
- 1 liter = 24,571 Btu – LHV \*
- 1 liter = 25.9 megajoules – LHV \*

Biomass Energy Data Book, U.S. Department of Energy:

[https://cta.ornl.gov/bedb/appendix\\_a.shtml](https://cta.ornl.gov/bedb/appendix_a.shtml)

## **Barrels of petroleum or related products (bbl) measurements and conversions**

### **Crude Oil**

- 1 barrel = 42 gallons
- 1 drum = 55 gallons
- 1 metric drum = 52.8 gallon
- 1 gallon = .0182 drum
- 1 gallon = .0189 metric drum
- 1 gallon = 138,100 Btu – HHV \*
- 1 gallon = 145.7 megajoules – HHV \*
- 1 gallon = 131,800 Btu – LHV \*
- 1 gallon = 139.0 megajoules – LHV \*
- 1 gallon = .003247 metric tons
- 1 barrel = 5,800,200 Btu – HHV \*
- 1 barrel = 6,119 megajoules – HHV \*
- 1 barrel = 5,535,600 Btu – LHV \*
- 1 barrel = 5,840 megajoules – LHV \*
- 1 barrel = .13637 metric tons
- 1 liter = 36,486 Btu – HHV \*
- 1 liter = 38.5 megajoules – HHV \*
- 1 liter = 34,822 Btu – LHV \*
- 1 liter = 36.7 megajoules – LHV \*

1 barrel of crude oil = 44.60 gallons of petroleum products

	<u>Gallons</u>	<u>Percent</u>
Finished motor gasoline	19.40	44
Distillate fuel oil	10.50	24

Kero-type jet fuel	4.12	9
Petroleum coke	2.23	5
Still gas	1.81	4
Residual fuel oil	1.68	4
Liquefied refiner gas	1.51	3
Asphalt and road oil	1.34	3
Other	2.01	4

### Refined petroleum products

- 1 metric ton motor gasoline = 8.53 barrels
- 1 metric ton LP-gas (liquefied petroleum gas) (propane) = 11.6 barrels
- 1 metric ton natural gas = 10 barrels
- 1 metric ton NGL (natural gas liquids) = 10.4 barrels

### Liquid fuels

- 1 cubic meter = 6.289 barrels
- 1 barrel = 159 liters
- 1 barrel = 42 US gallons
- 1 U.S. gallon = 231 cubic inches
- 1 U.S. gallon = .1337 cubic feet
- 1 U.S. gallon = 3.785 liters
- 1 U.S. gallon = .8321 imperial gallons
- 1 U.S. gallon = .0238 barrels
- 1 U.S. gallon = .003785 cubic meters
- 1 liter = 61.02 cubic inches
- 1 liter = .03531 cubic feet
- 1 liter = .2642 U.S. gallons
- 1 liter = .22 imperial gallons
- 1 liter = .00629 barrels
- 1 liter = .001 cubic meters

### Flow Rate

- 1 barrel per hour = 137.8 cubic feet per day
- 1 barrel per hour = 49,187 cubic feet per year
- 1 barrel per hour = 1,008 U.S. gallons per day
- 1 barrel per hour = 367,920 U.S. gallons per year
- 1 barrel per hour = 839.3 imperial gallons per day
- 1 barrel per hour = 306,345 imperial gallons per year
- 1 barrel per hour = 3,815 liters per day
- 1 barrel per hour = 1,392,475 liters per year
- 1 gallon per hour = .5712 barrels per day
- 1 gallon per hour = 207.92 barrels per year
- 1 liter per hour = .1510 barrels per day
- 1 liter per hour = 55.10 barrels per year

Biomass Energy Databook, U.S. Department of Energy:

[https://cta.ornl.gov/bedb/appendix\\_a.shtml](https://cta.ornl.gov/bedb/appendix_a.shtml)

### Biomass measurements and conversions

- 1 pound of switchgrass = 7,341 Btu
- 1 pound of bagasse = 6,065 Btu
- 1 pound of rice hulls = 6,575 Btu
- 1 pound of poultry litter = 6,187 Btu
- 1 cord of stacked wood = 4 feet x 4 feet x 8 feet
- 1 cord of stacked wood = 128 cubic feet
- 1 cord of stacked wood weighs about 1.2 short tons

1 cord of stacked wood weighs about 1,090 kilograms  
1 metric ton of wood = 1.4 cubic meters (solid wood)  
1 ton of wood fuel (bone dry) = 18 to 22 gigajoules – HHV \*  
1 pound of wood fuel (bone dry) = 7,600 to 9,600 Btu – HHV \*  
1 ton of wood fuel (air dry – 20% moist.) = about 15 gigajoules  
1 pound of wood fuel (air dry – 20% moist.) = about 6,400 Btu  
1 ton of agricultural residue (varying moist.) = 10 to 17 gigajoules  
1 pound of agricultural residue (varying moist.) = 4,300 to 7,300 Btu  
1 metric ton of charcoal = 30 gigajoules  
1 pound of charcoal = 12,800 Btus

Bioenergy Feedstock Information Network: <http://bioenergy.ornl.gov>  
Biomass Energy Databook, U.S. Department of Energy:  
[https://cta.ornl.gov/bedb/appendix\\_a.shtml](https://cta.ornl.gov/bedb/appendix_a.shtml)

### Natural gas measurements and conversions

1 cubic foot – wet = 1,109 Btu  
1 cubic foot – dry = 1,027 Btu  
1 cubic foot – dry = 1,087 kilojoules  
1 cubic foot – compressed = 960 Btu  
1 pound = 20,551 Btu  
1 gallon – liquid = 90,800 Btu – HHV \*  
1 gallon – liquid = 87,600 Btu – LHV \*  
1 million cubic feet = 1,027,000 Btu  
1 metric ton liquefied natural gas (LNG) = 48,700 cubic feet of natural gas  
1 short ton = 53,682.56 cubic feet  
1 long ton = 60,124.467 cubic feet  
1 cubic foot = .028317 cubic meters  
1 cubic meter – dry = 36,409 Btu  
1 cubic meter – dry = 38.140 megajoules  
1 cubic meter = 35.314 cubic feet

Energy Information Administration:  
[http://www.eia.doe.gov/kids/energyfacts/science/energy\\_calculator.html](http://www.eia.doe.gov/kids/energyfacts/science/energy_calculator.html)  
Biomass Energy Databook, U.S. Department of Energy:  
[https://cta.ornl.gov/bedb/appendix\\_a.shtml](https://cta.ornl.gov/bedb/appendix_a.shtml)

### Coal measurements and conversions

1 pound = 10,377 Btu  
1 pound of coal = 10.948 megajoules  
1 short ton (2,000 lbs.) of coal = 20,754,000 Btu  
1 short ton = 21,897 megajoules  
1 short ton = .907 metric tons  
1 metric ton = 22,877,388 Btu  
1 metric ton = 24,137 megajoules  
1 metric ton = 1.102 short tons

Energy Information Administration:  
[http://www.eia.doe.gov/kids/energyfacts/science/energy\\_calculator.html](http://www.eia.doe.gov/kids/energyfacts/science/energy_calculator.html)  
Measurement Converter: <http://www.convertit.com/Go/ConvertIt/Measurement/Converter.ASP>

## Fuel usage measurements and conversions

1 mile per gallon = .264 miles per liter  
1 mile per gallon = .425 kilometers per liter  
1 mile per gallon = 235 liters per 100 kilometers  
1 mile per gallon = 100 gallons per 100 miles  
1 mile per liter = 3.79 miles per gallon  
1 mile per liter = 1.609 kilometers per liter  
1 mile per liter = 62.15 liters per 100 kilometers  
1 kilometer per liter = 2.35 miles per gallon  
1 kilometer per liter = .6215 miles per liter  
1 kilometer per liter = 100 liters per 100 kilometers  
1 kilometer per liter = 42.5 gallons per 100 miles

Biomass Energy Data Book, U.S. Department of Energy:

[https://cta.ornl.gov/bedb/appendix\\_a.shtml](https://cta.ornl.gov/bedb/appendix_a.shtml)

Fuel Consumption Converter – Unit Converter:

[http://www.unitconversion.org/unit\\_converter/fuel-consumption.html](http://www.unitconversion.org/unit_converter/fuel-consumption.html)

\* Energy contents are expressed as either High (gross) Heating Value (HHV) or Lower (net) Heating Value (LHV). LHV is closest to the actual energy yield in most cases. HHV (including condensation of combustion products) is greater by between 5% (in the case of coal) and 10% (for natural gas), depending mainly on the hydrogen content of the fuel. For most biomass feed-stocks this difference appears to be 6-7%. The appropriateness of using LHV or HHV when comparing fuels, calculating thermal efficiencies, etc. really depends upon the application. For stationary combustion where exhaust gases are cooled before discharging (e.g. power stations), HHV is more appropriate. Where no attempt is made to extract useful work from hot exhaust gases (e.g. motor vehicles), the LHV is more suitable. In practice, many European publications report LHV, whereas North American publications use HHV (Source: Bioenergy Feedstock Network -- <http://bioenergy.ornl.gov/>)

## References:

Energy Kids Page, Energy Information Administration,

([http://www.eia.doe.gov/kids/energyfacts/science/energy\\_calculator.html](http://www.eia.doe.gov/kids/energyfacts/science/energy_calculator.html))

Energy Information Administration, (<http://www.eia.doe.gov/>)

Wikipedia, ([http://en.wikipedia.org/wiki/Main\\_Page](http://en.wikipedia.org/wiki/Main_Page))

Measurement Converter, Convertit.com, (<http://www.convertit.com/Go/ConvertIt/>)

Bioenergy Feedstock Information Network, (<http://bioenergy.ornl.gov/>)

Iowa Energy Center, Iowa State University, (<http://www.energy.iastate.edu/>)

Biomass Energy Datebook, U.S. Department of Energy,

([https://cta.ornl.gov/bedb/appendix\\_a.shtml](https://cta.ornl.gov/bedb/appendix_a.shtml))

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