

The background of the slide is a close-up, high-contrast image of flames. The fire is bright orange and yellow, with dark, swirling patterns of smoke and heat. The flames are set against a solid black background, which makes the fire's colors stand out sharply. The overall effect is one of intense energy and heat.

Energy Basics

BioResources

BioFuels

Petroleum

Biomass Energy

Cord Wood: Stack of wood comprising 128 cubic feet (3.62 m³)

Standard dimensions are 4 x 4 x 8 feet

includes air space and bark

One cord contains approx. 1.2 U.S. tons (oven-dry)

= 2400 pounds

= 1089 kg

1.0 metric tonne wood = 1.4 cubic meters (solid wood, not stacked)

Energy content of wood fuel (HHV, bone dry)

= 18-22 GJ/t (7,600-9,600 Btu/lb)

Energy content of wood fuel (air dry, 20% moisture)

≅ 15 GJ/t (6,400 Btu/lb)

Energy content of agricultural residues (varying moisture content)

= 10-17 GJ/t (4,300-7,300 Btu/lb)

Metric tonne charcoal = 30 GJ

= 12,800 Btu/lb

Ethanol – Biodiesel Energy

Metric tonne ethanol	= 7.94 petroleum barrels = 1262 liters
LHV Ethanol energy content	= 11,500 Btu/lb = 75,700 Btu/gallon = 26.7 GJ/t = 21.1 MJ/liter.
HHV for ethanol	= 84,000 Btu/gallon = 89 MJ/gallon = 23.4 MJ/liter
Average ethanol density (average)	= 0.79 g/ml
Average metric tonne biodiesel	= 37.8 GJ typically 33.3 - 35.7 MJ/liter
Average biodiesel density	= 0.88 g/ml

Areas and Crop Yields

1.0 hectare = 10,000 m²
= 328 x 328 ft
= 2.47 acres

1.0 km² = 100 hectares
= 247 acres

1.0 acre = 0.405 hectares

1.0 US ton/acre = 2.24 t/ha

1 metric tonne/hectare = 0.446 ton/acre

100 g/m² = 1.0 tonne/hectare = 892 lb/acre

Target bioenergy crop yield might be:

5.0 US tons/acre (10,000 lb/acre)

= 11.2 tonnes/hectare (1120 g/m²)

1.0 US Bushel corn/sorgum = 56 lb, 25 kg

1.0 US Bushel wheat/soybeans = 60 lb, 27 kg (wheat or soybeans)

1.0 US Bushell barley = 40 lb, 18 kg (barley)

Fossil Fuel Energy

Barrel of oil equivalent (boe) \cong 6.1 GJ (5.8 million Btu), equivalent to 1,700 kWh.

Petroleum barrel = 42 U.S. gallons = 35 Imperial gallons = 159 liters

7.2 barrels oil \cong equivalent to one tonne of oil (metric) = 42-45 GJ.

Gasoline: US gallon = 115,000 Btu = 121 MJ = 32 MJ/liter (LHV).
HHV = 125,000 Btu/gallon = 132 MJ/gallon = 35 MJ/liter
Metric tonne gasoline = 8.53 barrels = 1356 liter = 43.5 GJ/t (LHV)
= 47.3 GJ/t (HHV)

Average gasoline density = 0.73 g/ml

Petro-diesel = 130,500 Btu/gallon = 36.4 MJ/liter = 42.8 GJ/t

Average petro-diesel density = 0.84 g/ml

Metric tonne coal = 27-30 GJ (bituminous/anthracite)

= 15-19 GJ (lignite/sub-bituminous)

Typical coal usually means bituminous coal, the most common fuel for power plants

\cong 27 GJ/t

Natural gas: HHV = 1027 Btu/ft³ = 38.3 MJ/m³

LHV = 930 Btu/ft³ = 34.6 MJ/m³

Therm natural gas/methane = 100,000 Btu = 105.5 MJ

Energy units

1.0 joule = 0.239 calories (cal)

1.0 calorie = 4.187 J

1.0 gigajoule (GJ) = 10^9 joules

= 0.948 million Btu

= 239 million calories

= 278 kWh

1.0 British thermal unit (Btu) = 1055 joules

1.0 Quad = One quadrillion Btu (10^{15} Btu)

= 1.055 exajoules (EJ)

≅ approximately 172 million barrels of
oil equivalent (boe)

1000 Btu/lb = 2.33 gigajoules per tonne (GJ/t)

Power Units

1.0 watt	= 1.0 joule/second
	= 3.413 Btu/hr
1.0 kilowatt (kW)	= 3413 Btu/hr
	= 1.341 horsepower
1.0 kilowatt-hour (kWh)	= 3.6 MJ
	= 3413 Btu
1.0 horsepower (hp)	= 550 foot-pounds per second
	= 2545 Btu per hour
	= 745.7 watts = 0.746 kW
1.0 U.S. ton (short ton)	= 2000 pounds
1.0 imperial ton (long ton or shipping ton)	= 2240 pounds
1.0 metric tonne (tonne)	= 1000 kilograms
	= 2205 pounds
1.0 US gallon	= 3.79 liter
	= 0.833 Imperial gallon
1.0 imperial gallon	= 4.55 liter
	= 1.20 US gallon
1.0 liter	= 0.264 US gallon
	= 0.220 Imperial gallon
1.0 US bushel	= 0.0352 m ³
	= 0.97 UK bushel