

Energy and Power

Energy is the capacity to do work. Energy is power integrated over time.

Energy = U = W = joules = watt-second

Work = Force x Distance

Power is the rate at which work is done, or energy is transmitted

Power = Work / time = W / t

P = watt = joules/second

[https://en.wikipedia.org/wiki/Power_\(physics\)](https://en.wikipedia.org/wiki/Power_(physics))

Types of Energy

Mechanical

Electrical

Thermal

Chemical

Electromagnetic fields

Mass

Nuclear

Kinetic Energy

Definition

The energy of a body or a system with respect to the motion of the body or of the particles in the system.

Relation to environment

Kinetic energy of an object is relative to other moving and stationary objects in its immediate environment.

Transferability

Kinetic energy can be transferred from one moving object to another, say, in collisions.

Examples

Flowing water, such as when falling from a waterfall.

SI Unit

Joule (J)

Determining factors

Speed/velocity and mass

Potential Energy

Potential Energy is the stored energy in an object or system because of its position or configuration.

Potential energy is not relative to the environment of an object.

Potential energy cannot be transferred.

Water at the top of a waterfall, before the precipice.

Joule (J)

Height or distance and mass

<http://vikaspedia.in/energy/energy-basics/common-units-of-energy-and-power>

Common Units of Energy and Power

1. Barrel of oil
2. Calorie
3. Horsepower
4. Joule (J)
5. Kilowatt-hour (kWh)
6. Kilowatt (kW)
7. Megajoule (MJ)
8. Megawatt (MW)
9. Unit of electricity
10. Volt (V)
11. Watt (Electric)
12. Watt (Thermal)
13. Watthour (Wh)
14. Related Resources

<http://home.uni-leipzig.de/energy/ef/03.htm>

More Units of Energy

1 cal_{IT} = 4.1868 J, International Table calorie

1 cal_{th} = 4.184 J, thermochemical calorie

1 cal₁₅ ≈ 4.1855 J, calories to heat from 14.5 °C to 15.5 °C

1 erg = 10⁻⁷ J, cgs [centimeter-gram-second] unit

1 eV ≈ 1.60218 × 10⁻¹⁹ J, electron volt

1 Eh ≈ 4.35975 × 10⁻¹⁸ J, Hartree, atomic energy unit

1 Btu = 1055.06 J, British thermal unit according to ISO, to heat 1 pound water from 63 °F to 64 °F

1 tce = 29.3076 × 10⁹ J, ton of coal equivalent, 7000 kcal_{IT}

1 toe = 41.868 × 10⁹ J, ton of oil equivalent, 10000 kcal_{IT}

http://www.energyadvocate.com/si_basic.htm

Basic & Derived SI Units

<https://www.physics.uci.edu/~silverma/units.html>

Energy Units and Conversions

1 Joule (J) is the MKS unit of energy, equal to the force of one Newton acting through one meter.

1 Watt is the power of a Joule of energy per second

Power = Current x Voltage ($P = I V$)

1 Watt is the power from a current of 1 Ampere flowing through 1 Volt.

1 kilowatt is a thousand Watts.

1 kilowatt-hour is the energy of one kilowatt power flowing for one hour. ($E = P t$).

1 kilowatt-hour (kWh) = 3.6×10^6 J = 3.6 million Joules

1 calorie of heat is the amount needed to raise 1 gram of water 1 degree Centigrade.

1 calorie (cal) = 4.184 J

(The Calories in food ratings are actually kilocalories.)

A BTU (British Thermal Unit) is the amount of heat necessary to raise one pound of water by 1 degree Fahrenheit (F).

1 British Thermal Unit (BTU) = 1055 J (The Mechanical Equivalent of Heat Relation)

1 BTU = 252 cal = 1.055 kJ

1 Quad = 10^{15} BTU (World energy usage is about 300 Quads/year, US is about 100 Quads/year in 1996.)

1 therm = 100,000 BTU

1,000 kWh = 3.41 million BTU

Power Conversion

1 horsepower (hp) = 745.7 watts

Gas Volume to Energy Conversion

One thousand cubic feet of gas (Mcf) -> 1.027 million BTU = 1.083 billion J = 301 kWh

One therm = 100,000 BTU = 105.5 MJ = 29.3 kWh

1 Mcf -> 10.27 therms

Energy Content of Fuels

Coal 25 million BTU/ton

Crude Oil 5.6 million BTU/barrel

Oil 5.78 million BTU/barrel = 1700 kWh / barrel

Gasoline 5.6 million BTU/barrel (a barrel is 42 gallons) = 1.33 therms / gallon

Natural gas liquids 4.2 million BTU/barrel

Natural gas 1030 BTU/cubic foot
Wood 20 million BTU/cord

CO2 Pollution of Fossil Fuels

Pounds of CO2 per billion BTU of energy::

Coal 208,000 pounds
Oil 164,000 pounds
Natural Gas 117,000 pounds

Ratios of CO2 pollution:

Oil / Natural Gas = 1.40
Coal / Natural Gas = 1.78

Pounds of CO2 per 1,000 kWh, at 100% efficiency:

Coal 709 pounds
Oil 559 pounds
Natural Gas 399 pounds