

# Energy Units

**1 Joule [J] = 1 Watt-second [Ws] = 1 V A s = 1 N m = 1 kg m<sup>2</sup>s<sup>-2</sup>.**

It takes about 1 J to raise a 100-g-apple 1 m. Energy units can be preceded by various factors, including the following:

kilo (k=10<sup>3</sup>), Mega (M=10<sup>6</sup>), Giga (G=10<sup>9</sup>), Tera (T=10<sup>12</sup>), Peta (P=10<sup>15</sup>), Exa (E=10<sup>18</sup>).

Thus, a kiloJoule (kJ) is 1000 Joules and a MegaJoule (MJ) is 1,000,000 Joules.

A related unit is the Watt, which is a unit of power (energy per unit time). Power units can be converted to energy units through multiplication by seconds [s], hours, [h], or years [yr].

For example, 1 kWh [kilowatt hour] = 3.6 MJ [MegaJoule]. With 1 kWh, about 10 liters of water can be heated from 20 °C to the boiling point.

There are many other energy units besides the "[Système International d'Unités \(SI\)](#)".

A "ton of coal equivalent" (tce) is frequently used in the energy business. 1 tce equals 8.141 MWh. It means that the combustion of 1 kg of coal produces the same amount of heat as electrical heating for one hour at a rate of 8.141 kW.

## More Units of Energy

1 cal<sub>IT</sub> = 4.1868 J, International Table calorie

1 cal<sub>th</sub> = 4.184 J, thermochemical calorie

1 cal<sub>15</sub> ≈ 4.1855 J, calories to heat from 14.5 °C to 15.5 °C

1 erg = 10<sup>-7</sup> J, cgs [centimeter-gram-second] unit

1 eV ≈ 1.60218 × 10<sup>-19</sup> J, electron volt

1 Eh ≈ 4.35975 × 10<sup>-18</sup> 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 × 10<sup>9</sup> J, ton of coal equivalent, 7000 kcal<sub>IT</sub>

1 toe = 41.868 × 10<sup>9</sup> J, ton of oil equivalent, 10000 kcal<sub>IT</sub>

Calories and/or kilocalories [cal and/or kcal] were historically often used to measure heat (energy) and are still used for this sometimes today. Heating a gram of water 1 °C requires 1 cal. Different definitions are often the result of inconsistent starting temperatures of the heating.

## Multiplication Table of Units

Symbol	Exponential	Prefix	Quantity
k	10 <sup>3</sup>	kilo	thousand
M	10 <sup>6</sup>	Mega	million
G	10 <sup>9</sup>	Giga	billion
T	10 <sup>12</sup>	Tera	trillion
P	10 <sup>15</sup>	Pet	quadrillion
E	10 <sup>18</sup>	Exa	quintillion

The unit Megagram is not used, since there is a special name for one million grams, one ton (t):  $1 \text{ t} = 1000 \text{ kg}$ .

### **Multiplication of the Units of Power with Units of Time**

When the Watt is multiplied by a unit of time, an energy unit is formed as follows:  $1 \text{ Ws} = 1 \text{ J}$ .

The use of the kilowatt-hour is more common:  $1 \text{ kWh} = 3600 \text{ kWs} = 3.6 \text{ MJ}$ .

Besides the second [s] and the hour [h], the day [d] and the year [yr] are also used, with  $1 \text{ yr} = 365.2425 \text{ d} = 31,556,952 \text{ s}$ .

So, for example, energy of one Megawatt-year can be written as  $1 \text{ MWyr} = 31.557952 \text{ TJ}$  (TeraJoule).

The annual consumption of  $1 \text{ toe/yr}$  corresponds to the daily consumption of  $31.557952 \text{ kWh/d}$ .