

Energy Conversion Chart

Energy Unit Conversions

Common conversions between different energy units including joules, kilowatt-hours, BTUs, and calories.

Energy Unit	Joules (J)	Kilowatt-hours (kWh)	BTU	Calories (cal)
1 Joule (J)	1 J	2.78×10^{-7} kWh	9.48×10^{-4} BTU	0.239 cal
1 Kilowatt-hour (kWh)	3,600,000 J	1 kWh	3,412 BTU	860,421 cal
1 BTU	1,055 J	2.93×10^{-4} kWh	1 BTU	252 cal
1 Calorie (cal)	4.184 J	1.16×10^{-6} kWh	3.97×10^{-3} BTU	1 cal
1 Kilocalorie (kcal)	4,184 J	1.16×10^{-3} kWh	3.97 BTU	1,000 cal
1 Megajoule (MJ)	1,000,000 J	0.278 kWh	947.8 BTU	239,006 cal

Power Unit Conversions

Common conversions between different units of power (energy per unit time).

Power Unit	Watts (W)	Kilowatts (kW)	Horsepower (hp)	BTU/hour
1 Watt (W)	1 W	0.001 kW	0.00134 hp	3.41 BTU/h
1 Kilowatt (kW)	1,000 W	1 kW	1.34 hp	3,412 BTU/h
1 Horsepower (hp)	745.7 W	0.7457 kW	1 hp	2,545 BTU/h
1 BTU/hour	0.293 W	0.000293 kW	0.000393 hp	1 BTU/h
1 Calorie/second	4.184 W	0.004184 kW	0.00561 hp	14.3 BTU/h

Energy Density Conversions

Energy content per unit mass or volume for different fuels and materials.

Material	MJ/kg	kWh/kg	BTU/lb
Coal (anthracite)	30 MJ/kg	8.33 kWh/kg	12,900 BTU/lb
Gasoline	46 MJ/kg	12.8 kWh/kg	19,800 BTU/lb
Natural Gas	55 MJ/kg	15.3 kWh/kg	23,700 BTU/lb
Hydrogen	142 MJ/kg	39.4 kWh/kg	61,100 BTU/lb
Lithium-ion Battery	0.36-0.875 MJ/kg	0.1-0.243 kWh/kg	155-375 BTU/lb
Wood (dry)	16.2 MJ/kg	4.5 kWh/kg	7,000 BTU/lb

Common Energy Equivalents

Item or Activity	Typical Energy (Joules)	Equivalent in kWh	Equivalent in BTU
Smartphone full charge	36,000 J	0.01 kWh	34.1 BTU

1 slice of bread (food energy)	284,000 J	0.079 kWh	269 BTU
Running 1 mile (70 kg person)	418,000 J	0.116 kWh	396 BTU
LED bulb (10W) for 1 hour	36,000 J	0.01 kWh	34.1 BTU
1 liter of gasoline	34,200,000 J	9.5 kWh	32,400 BTU
Average US home (daily use)	108,000,000 J	30 kWh	102,400 BTU

Conversion Formulas

Basic Energy Conversions:

- Joules to Kilowatt-hours: $\text{kWh} = \text{J} \div 3,600,000$
- Kilowatt-hours to Joules: $\text{J} = \text{kWh} \times 3,600,000$
- Joules to BTU: $\text{BTU} = \text{J} \div 1,055$
- BTU to Joules: $\text{J} = \text{BTU} \times 1,055$
- Joules to Calories: $\text{cal} = \text{J} \div 4.184$
- Calories to Joules: $\text{J} = \text{cal} \times 4.184$
- Kilowatt-hours to BTU: $\text{BTU} = \text{kWh} \times 3,412$
- BTU to Kilowatt-hours: $\text{kWh} = \text{BTU} \div 3,412$

Power Conversions:

- Watts to Kilowatts: $\text{kW} = \text{W} \div 1,000$
- Kilowatts to Watts: $\text{W} = \text{kW} \times 1,000$
- Watts to Horsepower: $\text{hp} = \text{W} \div 745.7$
- Horsepower to Watts: $\text{W} = \text{hp} \times 745.7$
- Kilowatts to Horsepower: $\text{hp} = \text{kW} \times 1.34$
- Horsepower to Kilowatts: $\text{kW} = \text{hp} \times 0.7457$

Energy and Power Relationship:

- Energy (kWh) = Power (kW) × Time (hours)
- Energy (J) = Power (W) × Time (seconds)
- Power (W) = Energy (J) ÷ Time (seconds)
- Power (kW) = Energy (kWh) ÷ Time (hours)

Practical Energy Comparisons

Household Energy Usage:

- Refrigerator: ~1.5 kWh per day (5,400,000 J)
- Electric water heater: ~12 kWh per day (43,200,000 J)
- Air conditioner (central): ~15 kWh per day (54,000,000 J)
- LED light bulb (10W): 0.01 kWh per hour (36,000 J)
- Laptop computer: 0.05 kWh per hour (180,000 J)
- Electric car charging: ~10-15 kWh per 50 miles (36,000,000-54,000,000 J)

Fuel Energy Content:

- 1 gallon of gasoline: ~33.7 kWh (121,320,000 J)
- 1 gallon of diesel: ~37.7 kWh (135,720,000 J)
- 1 kg of hydrogen: ~39.4 kWh (141,840,000 J)
- 1 cubic foot of natural gas: ~0.293 kWh (1,054,800 J)
- 1 kg of coal: ~8.1 kWh (29,160,000 J)

Note: The values in this chart are approximate. For precise scientific or engineering calculations, please consult international standards or reference materials.

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This chart is for reference only. For precise calculations, consider factors like efficiency, energy quality, and specific conditions.