

Those Pesky Energy Data

Before we move on, a short diversion into the world of numbers will help for what follows.

Energy is measured in a variety of ways, including joules, calories, Btus, watts and tonnes of oil equivalent. The watts, named after the Scottish inventor and engineer James Watt (1736–1819), are the easiest because they are organized as a family. One watt is the transfer of one joule of energy in one second. Here's the easy-to-remember version:

- Watt (Weeny Watt): 1 watt (one old-fashioned Xmas light bulb)

A child born in a wealthy country is likely to consume, waste and pollute more in his lifetime than fifty children born in developing nations.

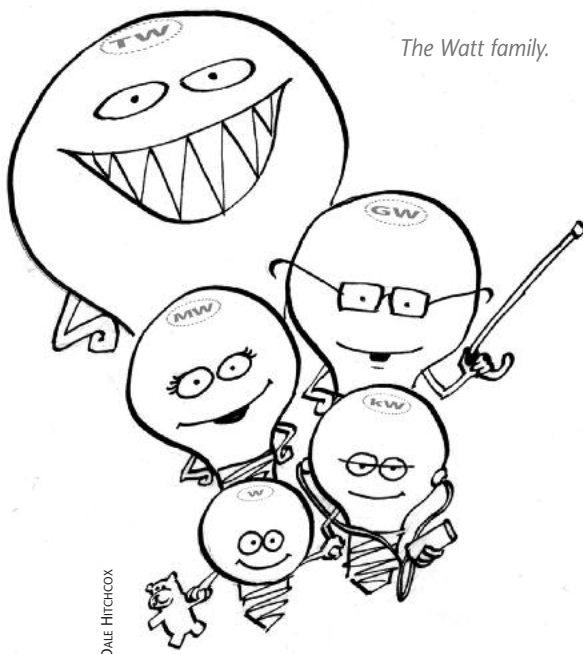
— George Carey,
Archbishop of Canterbury, UK

- Kilowatt (Kiddy Watt): 1,000 watts (KW)
- Megawatt (Mama Watt): 1000 kilowatts (MW)
- Gigawatt (Grandpa Watt): 1,000 megawatts (GW)
- Terawatt (Tyrannosaurus Watt): 1,000 gigawatts (TW)

Watts are a measure of capacity. Their cousins the Watt-hours are a measure of delivered energy. If a 500 MW coal-fired power plant produces power 23 hours a day, 365 days a year, it will produce 4.19 million megawatt-hours (MWh) a year. Wind turbines produce power 6–8 hours a day, and solar panels 5 hours a day, averaged over a year.

Napoleon introduced the metric system to eliminate the cheating that was rampant when every town in Europe had its own weights and measures. The metric system is easy, but the British and Americans didn't like Napoleon, so they stuck to the Imperial system, which measures energy in British thermal units (Btus). A Btu is the heat needed to raise the temperature of a pound of water by 1°F. So while the rest of the world measures large quantities of energy in exajoules (= joule x 10¹⁸), Americans measure it in quadrillion Btus, or "quads." A joule is the energy generated when a force of one Newton moves an object by one meter. One kilowatt-hour is 3412 Btus. A quad is 293 terawatt-hours.

To complicate things further, oil is measured in barrels and tonnes (1 tonne of oil = 7 to 11 barrels, depending on the fuel), natural gas in cubic feet and coal in short tons. This makes it hard to



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compare fuels, so the OECD describes energy in “Million tonnes of oil equivalent” (Mtoe). One tonne of oil equivalent is 41.868 gigajoules, which is the net heat content of 1 tonne of crude oil. 1 Mtoe = 4.1868 x 10⁴ TJ = 107 Gcal = 3.968 x 10⁷ MBtu = 11,630 GWh. Don’t you love this stuff?

More Muddling Math

In 2006, the world used 469 quads of primary energy (137,534 TWh) — a 15% increase since 2000 and a 39% increase since 1980. The breakdown is 36% from oil, 27% from coal, 23% from natural gas, 6% from hydro, 6% from nuclear, and just 1% from solar, wind, biomass and geothermal power combined. That’s what we have to change. The USA used 22% of the energy, Russia 7% and China 13%.

Americans use American gallons, but when Canadians talk about fuel-efficiency they assume British gallons, which are 20% larger, making Canadian cars seem more fuel-efficient than American cars. Hey, it all adds to the fun. A metric tonne (1,000 kilos) is also 10% larger than an American ton (2,000 pounds).

At least electricity is always measured in watts. In 2007, the world consumed 18,000 terawatt hours (TWh) of electricity, using 4 TW of installed capacity. Thirty-eight percent of the world’s primary energy was used to generate electricity — 68% from fossil fuels, 9% from hydro, 19% from nuclear, and 2.6% from solar, wind, biomass and geothermal.

- Amazing “kilowatt-hours into anything” calculator: wattsonschoools.com/calculator.htm
- Common conversion factors: tinyurl.com/ny58hc
- Energy A-Z: eia.doe.gov/a-z_index/Energya-z_a.html
- Energy Glossary: energy.ca.gov/glossary
- Energy Information Administration: eia.doe.gov
- International Energy Agency: iea.org
- Global and US electricity data: eia.doe.gov/fuelectric.html
- World Energy Overview: eia.doe.gov/iea/overview.html
- World Energy Review (BP): bp.com/worldenergy

	Total CO₂ (million tonnes)	% of global CO₂	CO₂ tonnes per person¹
Australia	417	1.4	20.6
USA	5900	20	19.8
Canada	614	2	18.8
Holland	260	0.9	15.8
Saudi Arabia	424	1.5	15.7
Taiwan	300	1.0	13.2
Russia	1704	5.8	12.0
Denmark	59	0.2	10.8
South Korea	515	1.8	10.5
Germany	857	2.9	10.4
Japan	1247	3.4	9.8
UK	586	2	9.6
Europe	4720	16	8.0
France	417	1.4	6.6
Sweden	57	0.2	6.4
China	6017	20.6	4.6
Mexico	435	1.5	4.0
Brazil	377	1.3	2.0
India	1293	4.4	1.2
Bangladesh	43	0.15	0.3
World	29,195	100	4.5