

Capacity, generation and the capacity factor: a units primer

Placeholder standfirst. How installed power (GW) and delivered energy (TWh) differ, why they should never share an axis, and how one ratio connects them.

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DRAFT PLACEHOLDER

This article is design scaffolding. Its text explains standard definitions only and makes no research claims.

Summary

Placeholder summary paragraph. Energy statistics mix two kinds of quantity that are easy to confuse: how much a plant *could* produce at any instant, and how much it actually produced over a period. This primer sets out the units used throughout the site.

Power and energy

Capacity is a rate. It is the maximum power a plant or fleet can deliver, measured in watts and their multiples: kilowatts (kW), megawatts (MW) and gigawatts (GW).¹

¹ SI prefixes step by factors of 1,000: 1 GW = 1,000 MW = 1,000,000 kW.

Generation is an amount. It is the energy delivered over time, measured in watt-hours: kWh, MWh, GWh and terawatt-hours (TWh).

Primary energy, which includes fuels before conversion, is often reported in exajoules (EJ) or, in US statistics, quadrillion British thermal units (quads).²

² 1 EJ = 10^{18} J $\approx$ 277.8 TWh. 1 quad = 10^{15} Btu $\approx$ 1.055 EJ $\approx$ 293.1 TWh.

The site converts between these on request but never plots power and energy on the same axis.

The capacity factor

The capacity factor links the two. It compares the energy a unit actually produced in a period with what it would have produced running at full rated power for the whole period.

$$\text{CF} = \frac{E_{\text{actual}}}{P_{\text{rated}} \times T} \quad (1)$$
$$T = 8,760 \text{ h (non-leap year)}$$

Here E_{actual} is energy generated (MWh), P_{rated} is rated capacity (MW) and T is the length of the period in hours. The result is dimensionless and lies between 0 and 1.³

³ Use 8,784 h for a leap year. Capacity that changes during the year should be time-weighted; see Methodology §2.2.

A worked example

One gigawatt of capacity running at full output for a full year would deliver:

$$\begin{aligned} 1 \text{ GW} \times 8,760 \text{ h} &= 8,760 \text{ GWh} \\ &= 8.76 \text{ TWh} \end{aligned} \quad (2)$$

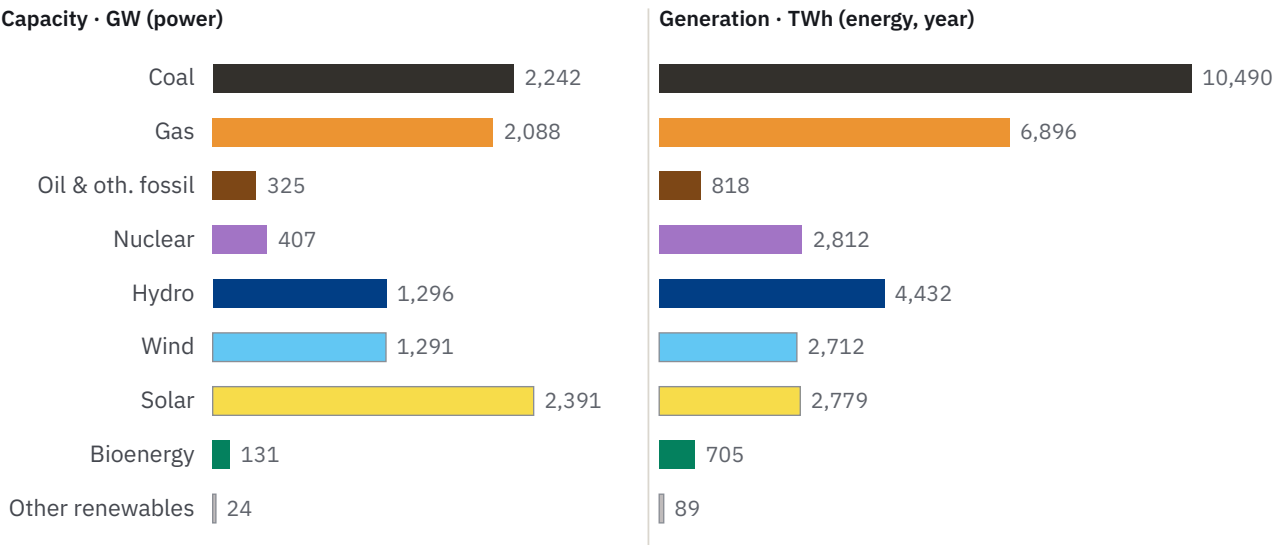
A unit that delivered 4.38 TWh from that 1 GW would have a capacity factor of 0.5, or 50 %. The numbers in this example are arithmetic, not observations.

Reading capacity and generation together

The figure below shows the two quantities in separate panels, on separate scales, for the world power system. The first panel is power; the second is energy. They are not comparable by length.

Figure 1. World installed capacity and electricity generation by source, 2025

Capacity in GW (power, left). Generation in TWh (energy over the year, right). Separate scales; bar lengths are not comparable across panels.



Source Ember, Yearly Electricity Data (CC BY 4.0) Retrieved 24 October 2026 Method Methodology §2.2

Unit reference

Table 1. Units used on this site

Quantity	Unit (symbol)	Equivalent
Power (capacity)	kilowatt (kW)	10^3 W

Quantity	Unit (symbol)	Equivalent
	megawatt (MW)	10^6 W
	gigawatt (GW)	10^9 W
Energy (generation)	kilowatt-hour (kWh)	3.6 MJ
	megawatt-hour (MWh)	10^3 kWh
	gigawatt-hour (GWh)	10^6 kWh
	terawatt-hour (TWh)	10^9 kWh = 3.6 PJ
	exajoule (EJ)	10^{18} J $\approx$ 277.8 TWh
Primary energy	quad (quad)	10^{15} Btu $\approx$ 1.055 EJ
Conversions follow the SI Brochure (BIPM, 2019); 1 Btu = 1,055.06 J (IT definition).		

Notes

1. SI prefixes step by factors of 1,000: 1 GW = 1,000 MW = 1,000,000 kW. ↩
2. 1 EJ = 10^{18} J $\approx$ 277.8 TWh. 1 quad = 10^{15} Btu $\approx$ 1.055 EJ $\approx$ 293.1 TWh. ↩
3. Use 8,784 h for a leap year. Capacity that changes during the year should be time-weighted. ↩

References

1. BIPM (2019). *The International System of Units (SI)*, 9th edition. Bureau International des Poids et Mesures.
2. Ember (2026). *Yearly Electricity Data*. ember-energy.org. Retrieved 24 October 2026. CC BY 4.0.
3. U.S. Energy Information Administration. *Glossary: capacity factor*. eia.gov/tools/glossary.
4. U.S. Energy Information Administration. *Units and calculators explained*. eia.gov/energyexplained.

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v1.1 · 14 August 2026 Placeholder change note, for example a corrected unit label in Figure 1.