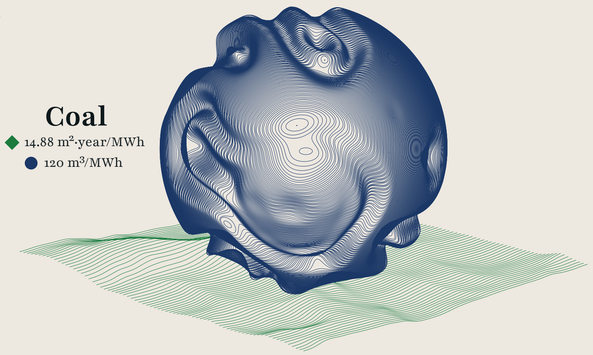
The Physical Cost of a Megawatt-Hour

Land and water consumed by electricity source across the full lifecycle

Every kilowatt-hour takes physical things from the world – land that could have been used for something else, and water that never returns to its source. Each source on this poster appears as a single form: a blue volume scaled to its lifetime water consumption, sitting on a green surface scaled to its lifetime land footprint. The source that wins on land rarely wins on water. No source wins on every measure.

Coal

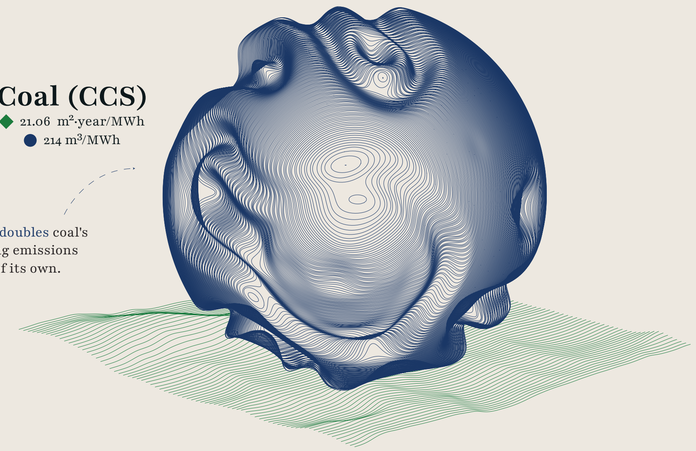
◆ 14.88 m^2·year/MWh
● 120 m^3/MWh



Coal (CCS)

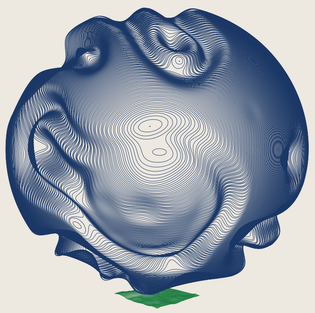
◆ 21.06 m^2·year/MWh
● 214 m^3/MWh

Carbon capture roughly doubles coal's water demand. Cleaning emissions has a physical cost of its own.



Nuclear

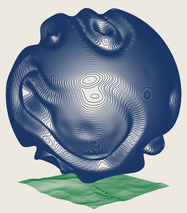
◆ 0.33 m^2·year/MWh
● 132 m^3/MWh



Nuclear's land footprint is the smallest of any source – 0.33 m^2·year/MWh, around 45× less than solar PV.

Gas

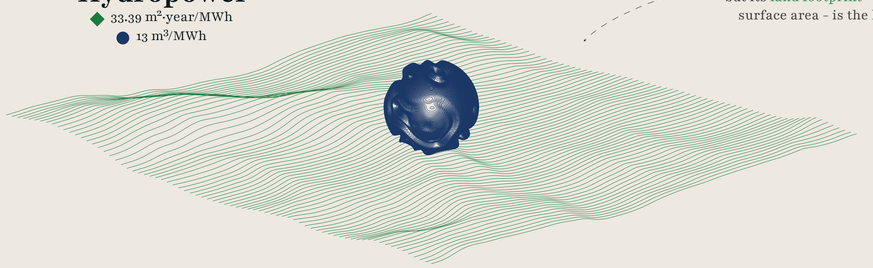
◆ 1.04 m^2·year/MWh
● 45 m^3/MWh



Hydropower

◆ 33.39 m^2·year/MWh
● 13 m^3/MWh

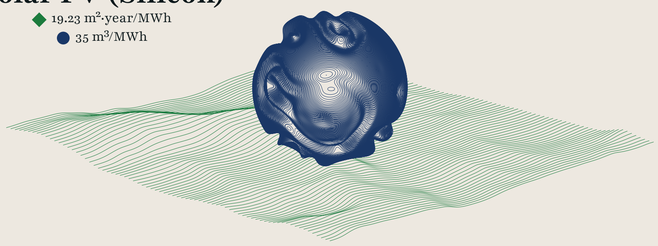
Hydropower's water consumption is low per MWh, but its land footprint – reservoir surface area – is the largest.



Two solar technologies with two physical profiles. Materials choice can change the footprint as much as the technology does.

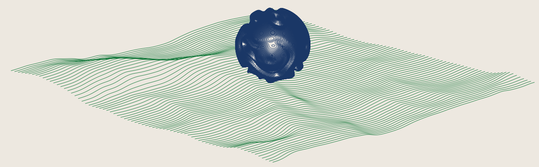
Solar PV (Silicon)

◆ 19.23 m^2·year/MWh
● 35 m^3/MWh



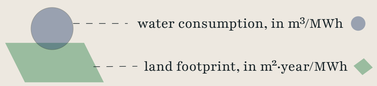
Solar PV (Cadmium)

◆ 12.65 m^2·year/MWh
● 8 m^3/MWh



Legend

Each source appears as an organic form: a green surface showing its lifetime land footprint, and a blue volume showing its lifetime water consumption sitting above it.



Methodology

Form area is proportional to lifetime water consumption (m^3/MWh); green surface area is proportional to lifetime land use (m^2·year/MWh). Water consumed is not water withdrawn. Thermal plants draw vast volumes for cooling and return most of it; what is counted here is only what is permanently lost. Nuclear's figure depends heavily on cooling design – coastal plants using seawater lose almost nothing, while inland plants with cooling towers lose the most. Siting alone can swing the figure by an order of magnitude.

Data: Our World in Data (2024), drawing on UNECE (2021) Lifecycle Assessment of Electricity Generation Options. Visualisation: Court Granville, 2026.