THE *WATER* COSTS OF ENERGY (metric)

*How many liters of water does it take to produce a **kilowatt-hour** of electricity?*	
Energy source:	**ℓ/kWh**
***Hydroelectric** [1, 12]	211.982
	17.034
***Geothermal** [1, 12, 14]	5.300
	0.019
***Solar Thermal** (incl CSP) [1, 12]	3.407
	0.098
***Nuclear** [1, 12]	2.972
	2.120
Coal [1, 12]	1.931
	1.476
Natural Gas (SC) [1, 6, 14]	1.571
	0.000
Natural Gas (CC) [1, 6, 12]	0.738
	0.681
Biofuel [1, 12]	1.476
	1.325
Landfill [1]	1.325
Solar PV [1, 12, 13]	0.004
	0.000
Wind [7, 12, 13]	0.000
Micro Hydroelectric [8]	0.000
United States Avg [10, 12]	2.423
	1.893

*How many liters of water per month does **one household**'s monthly energy consumption use?*			
Energy source:	**AZ** [2]	**U.S.** [2]	**world** [3]
***Hydroelectric**	232,121	195,024	50,876
	18,653	15,672	4,088
***Geothermal**	5,803	4,876	1,272
	21	17	5
***Solar Thermal** (incl CSP)	3,731	3,134	818
	108	91	24
***Nuclear**	3,254	2,734	713
	2,321	1,950	509
Coal	2,114	1,776	463
	1,617	1,358	354
Natural Gas (SC)	1,720	1,445	377
	0	0	0
Natural Gas (CC)	808	679	177
	746	627	164
Biofuel	1,617	1,358	354
	1,451	1,219	318
Landfill	1,451	1,219	318
Solar PV	4	3	1
	0	0	0
Wind	0	0	0
Micro Hydroelectric	0	0	0
United States Avg	2,653	2,229	581
	2,073	1,741	454

*How many liters of water per month does **100,000 households**' monthly energy consumption use?*		
Energy source:	**ℓ/month U.S.**	**ℓ/month world**
***Hydroelectric**	19,502,380,800	5,087,577,600
	1,567,155,600	408,823,200
***Geothermal**	487,559,520	127,189,440
	1,741,284	454,248
***Solar Thermal** (incl CSP)	313,431,120	81,764,640
	9,054,677	2,362,090
***Nuclear**	273,381,588	71,316,936
	195,023,808	50,875,776
Coal	177,610,968	46,333,296
	135,820,152	35,431,344
Natural Gas (SC)	144,526,572	37,702,584
	0	0
Natural Gas (CC)	67,910,076	17,715,672
	62,686,224	16,352,928
Biofuel	135,820,152	35,431,344
	121,889,880	31,797,360
Landfill	121,889,880	31,797,360
Solar PV	348,257	90,850
	0	0
Wind	0	0
Micro Hydroelectric	0	0
United States Avg	222,884,352	58,143,744
	174,128,400	45,424,800

Ranges of averages are shown: high (darker boxes) and low (lighter boxes). Overall averages might or might not be in the middle.

Available at HarvestingRainwater.com/water-energy-carbon-nexus

Factoids: Per U.S. Energy Information Administration (EIA) data, **~7% of U.S. electricity generated is lost** during transmission/distribution. Greater transmission distances show greater losses. ✦ The country with lowest **per-capita monthly kWh usage is** Haïti: 2 kWh. Iceland's is highest: 4,172 kWh. France, Germany, Japan: ~625 kWh, Jordan: 174 kWh, China: 205 kWh, Australia: 935 kWh.[9] ✦✦ Of the total kWh usage for the United States, 37% goes to residential, 36% to commercial, & 27% to industrial purposes.[11]

***Renewable considerations:** Some proposed renewable energies, like wind & PV solar, don't use water or emit CO_2. But some 'carbon neutral' fuels use 2-3x more water than coal-fired power, including some concentrated solar (CSP), nuclear & geothermal energy. Carbon Capture & Storage (CCS) also greatly increases the water used by a power plant.[10]

REFERENCES: 1. Water Costs of Electricity in Arizona, AZ Water Institute's 2007 investigation by Pasqualetti & Kelley. Fact sheet ID: AWI-07-102 Pasqualetti. // 2. eia.doe.gov/cneaf/electricity/esr/table5.html 3. data.worldbank.org/indicator/EG.USE.ELEC.KH.PC // 5. 2008, census.gov // 6. Natural Gas (SC) =single-cycle natural gas, Natural Gas (CC) =combined-cycle natural gas. In a CC setting, exhaust of one heat engine is used as heat source for another, extracting more useful energy from the heat, increasing system's overall efficiency (Wikipedia). // 7. Brandy Lellou, Nature's Voice–Our Choice (via email 5/23/2011). "Water used in wind power is zero unless you look at the lifecycle costs (water used to manufacture turbines). But then you must do [this] for all equipment manufactured to produce energy." // 8. Ibid. Micro hydro in a river or pipeline, or below a natural waterfall is considered to have 0 consumptive water use as water is flowing through turbine, not standing." // 9. data.worldbank.org/indicator/EG.USE.ELEC.KH.PC 10. naturesvoice-ourchoice.org/waterenergy-nexus/water-use-in-power-production.html // 11. U.S. Energy Information Administration, eia.gov/cneaf/electricity/esr/table5.html, accessed 7/26/2011 // 12. "CO2 Emissions & Water Use Rates for U.S. Electrical Generation," accessed 7/22/2011 at naturesvoice-ourchoice.org/images/pdf/co2_and_water_use.pdf // 13. "Energy-Water Nexus in Texas," accessed 4/25/2011 at edf.org/documents/9479_Energy-WaterNexusinTexasApr2009.pdf // 14. "Water, Energy, CO2 for All eGRID Subregions" spreadsheet, via email from B. Lellou, Nature's Voice – Our Choice, 7/27/2011.

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