

47 Countries Whose Electricity Generation in 2021 or 2022 was 50-100% Wind-Water-Solar (WWS) (Including 10 With 97.3-100% WWS Generation) and 12 U.S. States That Produced the Equivalent of 53-97% of the Electricity They Consumed With WWS in 2023

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Table 1. (a) Population by country. (b) 2021 or 2022 electricity generation by country. (c) Percentage of the total electricity generated within a country that is generated by a WWS technology. All energy numbers are for 2021 unless specified with “(‘22)” after the country name.

	(a)	(b)	(c) Percentage of All Electricity Generated by WWS Technology					Total WWS (%)
	2021 Population (millions)	Electricity generation (GWh/y)	Hydro-power (%)	Wind (%)	Geothermal (%)	Utility PV+CSP (%)	Tidal/wave (%)	
1. Albania	2.81	8,963	99.54	0.00	0.00	0.46	0	100.00
2. Bhutan	0.78	11,000	100.00	0.00	0.00	0.00	0	100.00
3. Nepal	29.7	9,668	98.61	0.01	0.00	1.38	0	100.00
4. Paraguay	7.22	40,576	100.00	0.00	0.00	0.00	0	100.00
5. Iceland (‘22)	0.372	20,003	70.96	0.02	29.00	0.00	0	99.99
6. Ethiopia	117.9	15,515	96.13	3.62	0.00	0.22	0	99.96
7. Congo, DR	92.4	13,190	99.55	0.00	0.00	0.23	0	99.78
8. Costa Rica (‘22)	5.14	12,734	72.92	12.35	12.57	0.64	0	98.48
9. Norway (‘22)	5.41	146,799	88.12	10.09	0.00	0.16	0	98.38
10. Namibia	2.59	1,507	64.23	1.46	0.00	31.59	0	97.28
11. Zambia	18.9	17,637	91.13	0.00	0.00	0.84	0	91.97
12. Uganda	45.85	5,184	89.51	0.00	0.00	2.41	0	91.92
13. Tajikistan	9.75	20,720	90.04	0.00	0.00	0.00	0	90.04
14. Kenya	55	12,376	29.69	16.04	40.70	1.35	0	87.78
15. Kyrgyzstan	6.69	15,138	85.59	0.00	0.00	0.00	0	85.59
16. New Zealand (‘22)	5.12	44,697	58.75	6.41	19.11	0.58	0	84.86
17. Mozambique	32.2	18,863	82.00	0.00	0.00	0.37	0	82.37
18. Georgia	10.8	12,645	80.52	0.66	0.00	0.00	0	81.18
19. Ecuador	17.9	32,128	79.60	0.19	0.00	0.12	0	79.91
20. Brazil (‘22)	214.3	675,383	63.24	12.09	0.00	4.46	0	79.79
21. Venezuela	28.2	82,566	79.54	0.11	0.00	0.01	0	79.66
22. Panama	4.38	12,107	68.90	4.38	0.00	4.84	0	78.12
23. Luxembourg (‘22)	0.639	2,213	50.75	14.82	0.00	10.35	0	75.92
24. Angola	33.9	16,783	75.30	0.00	0.00	0.00	0	75.30
25. Lao, PR	7.38	44,915	73.24	0.00	0.00	0.14	0	73.38
26. Austria (‘22)	8.956	69,219	56.66	10.47	0.00	5.48	0	72.61
27. Colombia (‘22)	51.52	84,425	71.89	0.07	0.00	0.40	0	72.36
28. Zimbabwe	15.99	8,454	70.12	0.00	0.00	0.21	0	70.33
29. El Salvador	6.52	6,345	28.70	0.00	24.57	16.96	0	70.23

30. Canada ('22)	38.3	656,110	60.80	5.72	0.00	1.06	0	67.58
31. Uruguay	3.49	15,995	32.97	31.20	0.00	3.02	0	67.19
32. Korea, DPR	25.9	25,566	62.97	0.00	0.00	0.26	0	63.23
33. Croatia	3.899	15,212	47.52	13.56	0.59	0.98	0	62.65
34. Cameroon	27.2	7,940	61.80	0.00	0.00	0.58	0	62.38
35. Sudan	45.66	17,563	62.34	0.00	0.00	0.00	0	62.34
36. Sweden ('22)	10.4	173,195	40.59	19.10	0.00	1.13	0	60.83
37. Peru	33.72	56,774	56.17	3.21	0.00	1.41	0	60.79
38. Denmark ('22)	5.86	34,976	0.05	53.96	0.00	6.30	0	60.31
39. Lithuania ('22)	2.8	4,780	21.34	31.63	0.00	7.15	0	60.13
40. Latvia ('22)	1.884	4,990	55.09	3.81	0.00	0.82	0	59.72
41. Cambodia	16.59	10,158	52.39	0.00	0.00	6.33	0	58.72
42. Switzerland ('22)	8.7	65,029	52.03	0.23	0.00	5.66	0	57.92
43. Rwanda	13.46	977	55.78	0.00	0.00	1.84	0	57.63
44. Honduras	10.28	11,121	33.85	6.97	3.13	10.25	0	54.20
45. Portugal ('22)	10.33	48,614	18.07	27.29	0.40	7.14	0	52.90
46. Eswatini	1.192	579	52.50	0.00	0.00	0.17	0	52.68
47. Chile ('22)	19.49	87,729	23.29	10.11	0.53	16.14	0	50.06
Total >50% WWS	1,117	2,699,061	61.62	8.71	0.88	2.75	0	73.95
World ('21)	7,888.	28,519,666	15.47	6.54	0.33	3.63	0.0034	25.97
China	1,412	8,634,175	15.51	7.60	0.00	3.79	0	26.90
United States ('22)	331.9	4,501,875	6.36	9.77	0.44	4.19	0	20.75
Japan ('22)	125.7	1,012,884	9.19	0.95	0.29	9.36	0	19.79
India	1,408	1,635,167	9.93	4.72	0.00	4.62	0	19.27
Russia	143.4	1,159,418	18.66	0.29	0.04	0.19	0	19.18

Source: IEA (2024), except for Bhutan, which is from IRENA (2023) . Updated from Jacobson (2020). Data do not include rooftop (distributed) PV.

Table 2. (a) Population by country or state. (b) 2023 electricity consumption by U.S. states and 2020 electricity consumption by Scotland. (c) Percentage of the total electricity consumed that is produced in 2022 (for Scotland) or 2023 (for U.S. states) by WWS if no WWS electricity was exported (the equivalent percent of electricity consumed that is produced by WWS). (d) January 2024 residential electricity price rank by state (1 = state with lowest electricity price).

	(a)	(b)	(c) % Consumed Electricity From WWS if no WWS Exports						(d)	
	2023 Pop-ulation (million)	Electricity consump-tion (GWh/y)	Hydro-power (%)	Wind (%)	Geo-ther-mal (%)	Utility PV + CSP (%)	Roof PV (%)	Tidal/wave (%)	Total WWS (%)	Elect-ricity price rank
Scotland (2020/22)	5.46	32,518	15.94	85.37	0	1.21	--	0.03	102.56	
1. South Dakota ('23)	0.919	13,472	26.45	69.69	0	0.35	0.03	0	96.52	10
2. Montana ('23)	1.13	15,467	49.63	29.49	0	1.55	0.49	0	81.17	13
3. Iowa ('23)	3.21	54,796	1.37	76.41	0	0.95	0.71	0	79.44	12
4. Wash. State ('23)	7.95	88,702	68.59	8.57	0	0.41	0.58	0	78.15	8
5. Oregon ('23)	4.23	53,982	45.99	16.06	0.39	3.49	0.95	0	66.89	25
6. Kansas ('23)	2.94	41,419	0.03	66.30	0	0.20	0.31	0	66.84	18
7. New Mexico ('23)	2.11	28,696	0.41	51.92	0.13	8.79	2.45	0	63.69	24
8. Maine ('23)	1.40	11,231	27.25	21.82	0	5.18	5.40	0	59.67	45
9. Oklahoma ('23)	4.05	68,805	2.70	54.84	0	0.11	0.24	0	57.89	9
10. Wyoming ('23)	0.584	16,833	3.77	52.77	0	1.03	0.17	0	57.74	7
11. North Dakota ('23)	0.784	28,647	5.05	51.27	0	0	0.01	0	56.32	2

12. California ('23)	39.0	238,240	13.38	6.25	4.60	17.09	11.80	0	53.12	48
13. Nevada ('23)	3.19	38,349	3.40	0.76	11.20	25.38	4.41	0	45.15	35
14. Colorado ('23)	5.88	56,363	2.35	28.40	0	6.40	3.02	0	40.17	29
15. Idaho ('23)	1.90	25,509	26.45	9.11	0.34	3.34	0.93	0	40.17	3
16. Nebraska ('23)	1.98	33,447	2.54	35.73	0	0.25	0.15	0	38.66	1
17. Vermont ('23)	0.648	5,350	22.04	6.36	0	3.74	4.47	0	36.60	41
18. Hawaii ('23)	1.44	8,888	1.00	7.23	3.92	7.25	15.85	0	35.25	50
19. Texas ('23)	30.5	486,787	0.18	24.62	0	5.63	0.89	0	31.31	28
20. New York ('23)	19.6	139,061	19.92	3.53	0	1.78	2.86	0	28.08	42
21. Minnesota ('23)	5.74	66,482	1.08	22.06	0	3.00	0.49	0	26.63	26
United States ('23)	331.9	3,861,342	6.21	11.01	0.43	4.26	1.91	0	23.82	

Sources: Scottish Government (2023, 2021) for Scotland; and EIA (2024a) for U.S. states. Updated from Jacobson (2020). Price rank by state from EIA (2024b) 22-3 for U.S. states include Q4 2022 and Q1, Q2, Q3 2023. Roof PV is distributed (non-utility) PV.

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