Geography of Electricity Generation In the United States - 2011: Fuels and Prices

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Introduction.

The United States covers a huge geographic area and is, accordingly, endowed with a diverse variety of rich energy resources that are used for generating electricity. The degree to which each fuel is used varies from region to region. This report examines how much different fuels are utilized by each of the fifty states to produce electricity. It also takes a brief look at how the price of residential electricity varies from state to state, and how the price in some circumstances is associated with proximity to the source region of the dominant fuel.

The categories of fuels used to generate electricity include *coal, natural gas, other gases, nuclear, conventional hydroelectric, pumped-storage hydro, wind, petroleum, wood, other biomass, geothermal, solar,* and *other.* Some of these fuels, such as natural gas, are also extensively used for heating buildings, but only their use for generating electricity is examined here.

This report is based entirely on data provided on-line by the Energy Information Administration (EIA) of the U.S. Department of Energy, which requires, collects, and compiles reporting data from electricity producers across the nation. All sites with installed capacities of at least 1 MW are reported. Data used here from 2011 are the latest available from EIA, which have been fully quality-checked. EIA has similar data for earlier years dating back to 1990, from which historical trends can be tracked. In this report all the data are from the EIA category listed as "Total Electric Power Industry", although other categories and sub-categories are also available. Table 1, shown below (and in the Excel file attached to this report), contains the 2011 data for electrical generation in MWh and in percent of a state's total generation, derived from each of the thirteen fuels. Each state's average retail price for residential electricity in cents per kWh is also shown at the far right side of the table.

Simple maps and reduced data tables derived from the gigantic EIA data files reveal patterns of fuel use and electricity prices. Most of these patterns are unsurprising, but some are puzzling. It makes sense, for example, that states near the coal-mining area of Appalachia produce a very large fraction of their total electric production (96% in the case of West Virginia) by burning coal. Similarly, in the Pacific Northwest, hydroelectric power is dominant. For example, 79% of Washington's electricity is generated by huge hydroelectric plants in dams along the Columbia and other rivers, and the state enjoys some of the cheapest electric rates in the nation. But one may ask why Hawaii, which has good wind and solar resources, still relies on burning petroleum (which must be shipped into the islands) to produce 74% of its electricity. That's a vastly higher reliance on petroleum than any other state, and may explain why the price of electricity in Hawaii is the highest in the country at approximately triple the national average. And how about South Dakota? It may be the best-kept secret in the nation. South Dakota derives 55% of its electricity from hydro and 22% from wind, both of which are renewable. Thus, it just might be the greenest electricity state in the union.

The landscape is changing rapidly today for the nation's electricity generation. Next year, updated maps might be noticeably different from those included here for 2011. The dominance of coal as a fuel is decreasing while wind, natural gas, and solar (although solar is still very minor) are rising rapidly. Many energy experts regard natural gas as the "bridge" fuel that will allow the United States to evolve from electricity dominated today by coal to an electricity scene dominated in the future by renewable fuels. The ascent of natural gas in the fuels picture is the result of greatly expanded reserves because of recent full-blast implementation of "advanced" drilling technologies, such as hydraulic fracturing (Yergin 2012). The rise rate for non-hydro renewable fuels will depend on how rapidly the costs of those technologies continue to fall.

It should be obvious that calling this brief document a "Report" is overstating matters. More accurately, it should be called "Notes" or "Observations". However, a considerable amount of data analysis went into the document, and these notes and observations might form the nucleus for a future in-depth report by the author or one of its readers.

Lastly, this report's author, Brooks Martner, served as a remote teleconference guest lecturer in the "Principles and Varieties of Solar Energy" course noted on the cover page; though Martner was not formally a student in the course, he followed the lectures and reading assignments with interest.

References.

Yergin, Daniel, 2012: *The Quest: Energy, Security, and the Remaking of the Modern World.* Penguin Books, New York, NY, 820 pp.

Data Tables.

Table 1. Primary data – Electric generation by states and fuels – also price. (Use reader view magnification of about 300% to read the table).

	COAL	COAL	NAT GAS	NAT GAS	NUCLEAR		INDRO	INDRO	WIND	WIND	PETRO	PETRO		W000		NOMASS	GEOTHERM			OT GASES			PUMPED	PUMPED	OTHER	OTHER	TOTAL	TOTAL	PRICE 201
1.7	(MWh) 11.450.005	(%)	(NW1) 1.011.000.929	(79)	(MWb) 790.034.367	(%)	(MNAN) 319.354.923	2.25	(MWH) 128 179 598	2.32	(MWh) 30.102.245	074	(MWb) 37,449,057	(%)	(MWB) 19,221,763	0.42	(MWh) 15.363.625		(MWh) 17.565.200	(19)	(MWh) 1.317.695		(MWN) -5.855.792	(%)	(MWh) 14.105.040	(%)	4.100.656.050	(%)	ti 72 USA
1.0	655 385	6.65	1506.422	55.85	THE PLAY	19.17	1.348.748	1957	12.446	019	544.936	13.75	21/0432010	0.51	3.287	0.95	15.3630428	* 37	2,738	0.16	1,011,0090	0.04	-1.9/1.19/	4.14	14,195,941		6171.333	183.92	17.62 AK
	56.607.353	10.00	40,681,054		33,356,122	25.17	6.583.593	540	12,018	0.10	123.384	0.08	2.885.754	1.60	1,016	0.01			291,534	0.19					382,505	6.24	156.339.210	183.02	11.09 AL
	19.418190	42.30	12.546 632		14154.445	22.15	2.057.845	4.62			\$5,874	0.09	1.580.037	2.55	01.000	0.13				0.12			34.431	826	32.418	111	E1 387 576	102.03	5.02 AB
	0.702.297	6.42	22,252,730		31,277,06.3	21.87	9.174092	1.4	216.578	0.24	\$1245	0.05	141.626	0.12	46.824	0.94					8336	0.08	121.019	0.11	14754	6.01	108 125 357	182.03	11.08 44
	1.987187	0.99	00.573.831	4431	35.551.247	10.05	47 17.7 46.7	21.19	2751.007	3.95	912.572	0.45	1444500	172	2534.083		12552383	6.25	1656.967	0.83	111125	0.44	-68,793	-0.04	915.924	14	200 804 547	183.83	14.76 CA
13	1151682	16.32	12,786,332	13.81			2.082.621	4.05	\$ 206,322	10.11	22,218	0.04	172	0.00	61.520	0.12					184635	828	-243.379	0.0	63/64	0.32	51,432,554	103.03	11.27 00
	525.837	1.56	15.108.745	45.01	15.822,857	47.20	587,447	148			185,810	0.49	816	0.00	\$55,873	1.95							5.634	8.02	704.857	2.05	33,745,222	103.03	18.11 CT
			21.193	35.44							123875	6456															203.874	183.83	13.40 DC
	1,454.990	22.36	4,721,399	71.73					4,025	0.37	37,739	0.57			146732	2.20			206,254	3.16	8,290	0.13					6.593.195	182.83	13 70 28
	51.992.955	0.03	136.363.874	61.45	22 115 360	9.82	162.042	83.8			3281944	1.48	7.209 (03)	1.00	2134.965	1.35			£.151	0.30	125.725	0.05			3 385.051	1.53	221.894.574	183.83	11.51 PL
ŧ	00,158,342	95.21	28,543.634	21.27	32,306,181	25.99	2,705,055	237			\$51,235	0.44	1870.257	2.46	119,263	0.10							178,821	-0.57	27.86J	\$3.3	324774237	103.03	11.06 GA
	1.424830	15.26					93,141	8.67	346,612		7,823,925	2369			312/07	2.92	223.891	2.01	9.214	0.31	3581	003			366.951	2.41	18,723,333	103.03	34.68 HB
- 3	001123360	冠殿	597.183	1.75	5,215,229	9.25	255,252	147	10,705,127	19.30	141.830	025			1(4),592	0.29											\$6,371,312	102.03	10.46 bA
	\$2.412	0.50	1,110,744	\$.72			12,404,799	88.59	1.106.882	7.89	26	0.00	474,304	7.06	47,910	9.29	63,430	0.38							77.631	6.45	16,560,706	182.82	7.87 ID
	98.013.325	€12	5.555.800		35,372,196	42.12	140.462.03	8(7	6212.132	311	14240	0.04	519	0.00	\$37.560	0.32			318.548	0.16	14162	0.01			299.952	0.15	199.493.726	100.00	11 78 ML
	54,152,535	35.28	10.063.958	824			468,779	\$ 23	3.286.411	2.55	1,332,630	1.09			395,588	0.27			2185.387	1,79					369.055	0.35	122,131,414	102.83	10.06 IN
	1,855,940	69.79	2,535,037	553	7,310,680	10.14	14,745	6.63	3.795,579	8.20	\$1,528	0.12			98,763	013											45,353,340	108.00	NO AS KES
	1.855.030	33.19	1,545,525	152			2,969,312	3.02			1734,950	1.76	141,272	0.35	95,968	010									0.935	13.3	98,353.912	109.00	9.20 KY
	4.827.519	22.95	54,322,454		16.814,975	15.75	1,544,013	8.55	5.1.5		4,717,477	446	2,371,437	2.25	71,093	0.17			1,292,182	1.22	120				419 570	6.42	195,493,717	103.03	A1 101
	4.053.837	10.57	25.538.672	\$315	5,965,228	13.36	1,148,762	342	61,385	0.15	195.503	0.52	181.255	6.27	1.035110	2.73					4754	867	-443231	-1,16	859,514	2.26	28354321	183.82	14.67 MA
- 2	55150	50.36	2.318.880	43.05	14,397,437	34.43	2,547,123	6.09 24.91	276,713	0.85	228,967 177,505	0.65	168,432	21.98	379,950	0.81			154,648	0.37	2,796	0.01			298,583	2.71	41,818,368	103.02	13.31 MD 15.38 ME
	55190	6.103	12,582,854		32,819,467	3213		1.24	454,474	8.42	342,768	6.33	1.678.607	1.54		0.75			298175	0.25			-85.617	-0.07	353454	0.33	15.973.908	100.00	15.38 ME
	18.248.259	\$1.30	1,368,273		11.972.525	22.51	746.145	148	0,726,256	12.60	17.907	0.07	749,713	1.0	932.255	1.75	47.755	0.03	296179	0.29			-996,011	-6.67	314711	0.80	\$1123.361	100.00	10.00 LIN
	0.215850	82.50	4548230	473	9321.323	2.97	1,165,144	125	1,178,212	1.74	73.804	0.07	6	0.00	12147	0.07	47.765						167,298	0.18	21,367	10.0	94923.40	100 00	9.76 MO
	9,723,111	18.95	21.565.829		10.356,789	20.34	1.102.144	165	UNCER	1.45	36,341	0.00	1.542.778	2.91	3297	0.01							101.470	9.10	3.017	6.01	\$1.573.345	109.00	10.17 MS
	6 2 6 5 7 3 3 3 3 3	#1.12	418133	1.33	10.256.107		10.055.001	41.01	1.255.168	420	45352	153	1,786,779	4.41					20	0.00					332 911	111	38123543	100.00	5.75 MT
	8 258 352	10.91	11.155.211		43528,024	34.22	2.052.295	329	1,000,000		217.636	0.10	1.952.971	145	175,213	0.37				0.00	17,390	10.0			482,812	0.42	118.368.815	100.00	10.26 NC
	7 188 925	77.20	18 922	345			2 120 047	7.35	5235.588	1432	42115	0.12			9.062	0.95			29,160	0.11					44,295	6.53	35873300	100.00	
2	6365249	71.94	425.835	118	6.833.174	19.21	1.617.228	14	1.058.585	2.85	17,237	010			65.420	0.19											36 (195.351	100.00	9.32 NE
	2,298,233	11.30	6.657.503	3313	8.302.607	41.68	1.604.811	8.00	86.092	0.33	77.606	0.29	917,972	4.67	108.069	0.84									63.822	6.52	20.065.541	100.00	16.62 NH
	4.155.037	0.0	25,291,075	38.95	33 506,447	\$1.95	24.407	804	10.523	0.32	185.500	026			870,111	1.35			130125	0.52	\$8.872	0.11	156,778	0.30	643.575	0.55	\$4554306	100.00	16.23 NJ
- 2	7,143,853	71.98	0.565.954	22.44			184,765	0.51	2100/67	5.58	37,831	010			8.456	0.32					127,932	0.53					38,181,129	108.00	11.00 NM
	5.487.334	16.83	21.641.397	68.39			2,158,583	6.05			14213	0.64					2.145119	\$72	7.268.67	0.32	291.225	0.91			37.817	6.92	31.835.916	100.00	11.61 NV
	3,425,150	6.95	50,884755	35.92	12355,009	31.33	27,996,993	28.25	2,828,088	2.05	1,183,431	0.86	442,128	0.32	1.612,149	1.18					6.455	0.00	-305600	6.22	995,187	33.0	117.637,368.0	108.09	18.26 NY
	5.138.952	72.89	12.337.677		14,355,746	10.98	383,655	0.28	198,443	015	1,388,432	1.62	388.998	0.25	331,758	0.84			305,743	0.22	15,495	0.01			10.005	6.61	135,585,804	108.08	11.42 OH
	4,473,942	46.21	32,836,733	44.01			1.586.947	242	5305,265	2.51	15.540	0.02	225,725	0.30	(17.242	0.12							453,195	0.21	1,541	0.0	24585,714	108.00	
	1333510	5.50	8,497,730	1.824			42,714,821	78.68	4775,374	0.00	7,954	0.01	492,399	0.02	222,285	0.37					90	0.00			\$1,326	0.09	53.695.164	100.00	5.61 OR
. 10	08.683.892	4415	41,792,195		76146.617	35.45	3.217.216	1.45	1,754.465	0.79	441.724	019	627.305	0.26	1.853,448	0.73			616.163	0.27	23.144	0.01	-172243	-6.06	892.525	1.38	227.636139	108.00	
			8,578.934	9325			2411	828	2,912	0.33	12.6-92	0.16			127,405	1.45											8,722,273	108.08	14,33 FU
	14,762,541	33.16	12,536,343	12.55	\$2,902,576	\$1.30	1,554,181	151		12700	111.558	011	1,983.374	195	141,014	314							-210,143	-0.00	63.335	6.06	182,972,507	108.08	11.05 SC
	2.585.565	21.95	129313	1.03			6.003164	\$\$17	2518.368	22.24	2543	0.05				- 207			22202	200				-		1000	11.398.816	102.03	1.26 SD
	0,777,224	90.28 ¥.%	1,259,359		28,819,177	30.19	9,575,639	11.01	51,143	0.37	195,202 575,805	024	333,454	1.15	36,100	0.94			16,009	0.22		0.01	-660367	-0.01	1102	0.00	81,183,962 435,475,974	100.00	5.56 TN
	57.895.535	31.15	5,255,945	1287	33540.457	3.00	1,210,165	0.13	572,788	1.40	53.545	0.12	929.291	821	58.007	0.15	233.198		3395.940	0.06	28.639	0.01			164703	2.45	48,835,150	100.00	6.56 UT
		29.30	16,332,373		25547.997	35.32	1,210,165	182	5/2/10	1.42	53,542	0.12	1 485 311	211	799.018	110	233.190		32.638	0.36			-1481293	4.22	479,235	6.75	46,630,100	100.00	
1	auen 183	e 10	18.332.373	2753	487.355	20.50	1,210,303	2163	22.145	13.45	\$150	0.75	372.248	5.45	25,448	0.30					1.415	803	-14032.82	4.22	4191218	8.73	6,051105	100.00	
	\$223 \$95	454	4.849.517	421	4306,278	417	91,017,707	2163	8,212,108	541	12147	012	1 682 252	1.57	148,872	0.15			292.254	0.76	845	0.00	\$1.915	210	163.815	6.14	115,267,875	100.00	8.26 WA
	3532.732	63.10	6.240.335	385	11,559,701	1825		335	1.152,738	1.85	582,395	0.52	1 001 358	1.63	545-413	0.85			190.004	11.08			4.400		54,205	LOS	63283344	100.00	13.62 WI
	15.564132	90.10	251.485	3 3 2	11.002.000	10.60	1.453109	184	1.102.512	1.40	188,481	0.24	256	0.00	545,413	0.00			30.478	0.34					594,250	6.00	78.999.824	100.00	\$.39 WV
	0.561 441	25.30	-58.932	195			1.223.733	757	4611.068	9.85	55.450	012			2101	1.01			204.907	0.92					62102	6.12	47.633.421	100.00	5 11 WY
	COAL	COAL		NATGAS	NUCLEAR	NUKIFAR	FORDERD	HYDRO	WIND	WIND	PATRO	PSTRD	WOOD	WOOD	EROMASS I	DOMASS	GEOTHERM	GEOTHERM			SOLAR	SCRAF	PUMPED	PUMPED	OTHER		ICIAL	TOTAL	PRES 30
	(MWA)	(19)	(MWh)	(19)	(MMG)	(1)	(MINN)	[%]	(MWb)	(1)	(MWh)	(%)	(mwo.)	(%)		(%)			(MONT)	(19)		[%]		(%)	(WINT)	(%)	(newn-)	(9)	

The Excel spreadsheet file version of this table is an electronic attachment available with this report with the name: fuels_2011_allstates.xlsx .

The U. S. Energy Information Administration of the Department of Energy is a tremendous and vast resource for detailed information on the nation's evolving energy production and usage. It has thousands of data files and reports available on-line in a labyrinthine web site. Table 1 is a greatly reduced file constructed from the following two immensely larger EIA data files:

1990-2011 Net Generation by State by Type of Producer by Energy Source (EIA-906, EIA-920, and EIA-923)

and

1990-2011 Average Price by State by Provider (EIA-861).

Both are available on-line from the EIA in Excel spreadsheet files at: <u>http://www.eia.gov/electricity/data/state/</u>.

Maps and Discussion.

<u>Note</u>: Fuel utilization maps are produced such that states relying most heavily on a specific fuel are shaded pink, and those relying least on that fuel are shaded blue.

The first U.S. map on the following page shows:

Retail residential price of electricity by state.

Subsequent pages show U.S. maps of the percentage of electric production in each state generated from these fuels:

Coal Natural Gas Nuclear Hydroelectric Wind Petroleum Wood Biomass Geothermal Solar

No maps are shown for:

Other Gases Pumped Storage Other

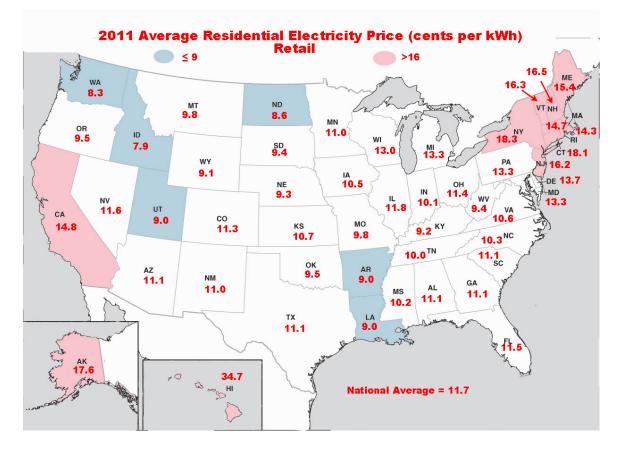


Figure 1. Map of the average retail **price** of residential electricity by state for the Total Electric Power Industry in 2011. Units are cents per kilowatt-hour. States with the highest prices are shaded pink; those with the lowest prices are shaded blue. The map was constructed from data compiled by the Energy Information Administration (EIA-861).

Notes on Price:

RETAIL RESIDENTIAL PRICE						
top five:	cents/kWh					
н	34.68					
NY	18.26					
СТ	18.11					
АК	17.62					
NH	16.52					
bottom five:						
LA	8.96					
UT	8.96					
ND	8.58					
WA	8.28					
ID	7.87					

1) Electricity is most expensive in the northeastern states and in California, Alaska, and Hawaii.

2) Hawaii has by far the most expensive electricity in the nation, at almost triple the national average.

3) Electricity is cheapest in the Pacific Northwest because of the abundance of nearby hydro power.

4) It is also very inexpensive in states near major coal-mining regions, such as West Virginia and Wyoming, and in Arkansas and Louisiana.

5) The national average retail price for residential electricity increased 12.5% from 10.4 to 11.7 cents per kilowatt-hour from 2006 to 2011.

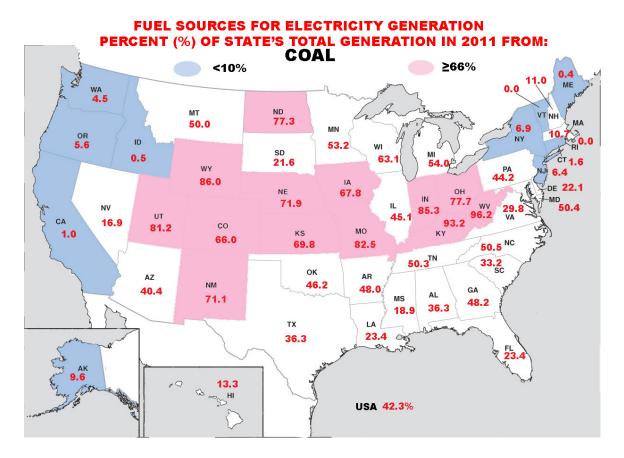


Figure 2. Map of the percent of each state's total electric power generation derived from using **coal** as the fuel source. Those states that rely most heavily on coal are shaded pink; those that rely least on coal are shaded blue. Data are for the Total Electric Power Industry. The map was constructed from data compiled by the Energy Information Administration (EIA-906, EIA-920, and EIA-923).

Coal includes anthracite, bituminous coal, subbituminous coal, lignite, waste coal, and synthetic coal.

Notes on Coal:

	COAL						
By Pe	ercent	By MWh					
top five:	%	top five:	MWh				
WV	96.16	тх	157,896,535				
кү	93.19	он	105,336,957				
WY	85.98	IN	104,152,598				
IN	85.28	PA	100,603,082				
МО	82.50	КҮ	91,656,030				
bottom five:							
СА	0.99	СТ	525,807				
ID	0.50	ID	83,412				
ME	0.35	ME	55,166				
RI	-	RI	-				
VT	-	VT	-				

1) Coal is the dominant fuel in most states located near major coal-mining regions, such as Appalachia and Wyoming. Proximity to the mines makes the cost of transporting coal by rail less expensive, and therefore makes its use more attractive.

2) For states far from the coal-mine regions the higher cost of transporting coal by rail to the local generating plants reduces those states' reliance on coal as they opt to use other, cheaper fuels.

3) It's surprising how little California depends on coal (1%). However, California's total electric production is so immense, that, in terms of megawatt-hours, California's 1% is greater than Delaware's 22% dependence on coal.

4) Texas produces the greatest number of megawatt-hours from coal, but coal constitutes only 36% of its total electric production.

5) The small states of Rhode Island and Vermont have avoided using coal entirely.

6) The nation's dependence on coal for generating electricity declined from 49% in 2006 to 42% in 2011.

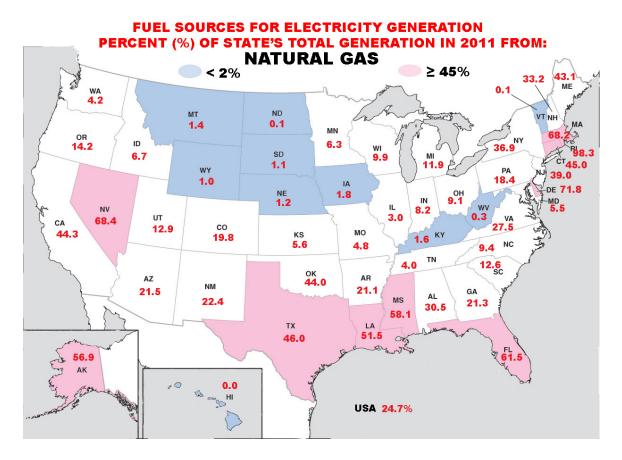


Figure 3. Map of the percent of each state's total electric power generation derived from using **natural gas** as the fuel source. Those states that rely most heavily on natural gas are shaded pink; those that rely least on natural gas are shaded blue. Data are for the Total Electric Power Industry. The map was constructed from data compiled by the Energy Information Administration (EIA-906, EIA-920, and EIA-923).

Notes on natural gas:

	NATURAL GAS						
By Pe	ercent	By MWh					
top five:	%	top five:	MWh				
RI	98.26	тх	200,500,149				
DE	71.79	FL	136,363,874				
NV	68.39	CA	88,973,831				
MA	68.16	LA	54,322,464				
FL	61.45	NY	50,804,755				
bottom five:							
WY	0.96	wv	251,465				
WV	0.32	SD	129,313				
ND	0.06	ND	19,902				
VT	0.05	VT	3,277				
ні	-	ні	-				

1) Rhode Island is almost entirely dependent on natural gas for generating electricity.

2) Hawaii doesn't use any natural gas for generating electricity.

3) Texas generates by far the greatest amount of electricity (MWh) of the fifty states by burning natural gas.

4) The use of natural gas is rising rapidly, both percentage-wise and in real terms (MWh). Nationally, it is up from 20% in 2006 to almost 25% of the total electric generation in 2011. This represents a gigantic increase in electricity.

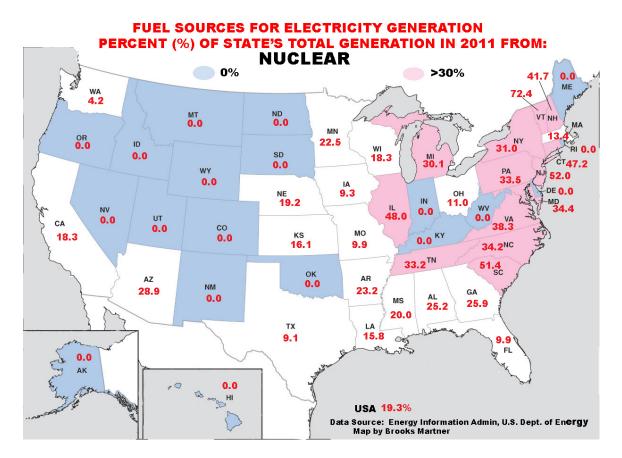


Figure 4. Map of the percent of each state's total electric power generation derived from using **nuclear** energy as the fuel source. Those states that rely most heavily on nuclear are shaded pink; those that rely least on nuclear are shaded blue. Data are for the Total Electric Power Industry. The map was constructed from data compiled by the Energy Information Administration (EIA-906, EIA-920, and EIA-923).

Notes on Nuclear:

	NUCLEAR						
By Pe	rcent	By MWh					
top five:	%	top five:	MWh				
VT	72.42	IL	95,823,196				
NJ	51.95	PA	76,146,617				
SC	51.38	SC	52,902,576				
IL	48.03	NY	42,695,009				
СТ	47.20	NC	40,526,834				
bottom five:							
many	-	many	-				

1) Several northeastern states rely heavily on nuclear energy to produce electricity.

2) Illinois and South Carolina are also big generators of nuclear electricity.

3) Most western states, with the exceptions of California, Arizona, and Washington do not have nuclear plants.

4) The nation's dependence on nuclear power remained steady at about 19% from 2006 to 2011.

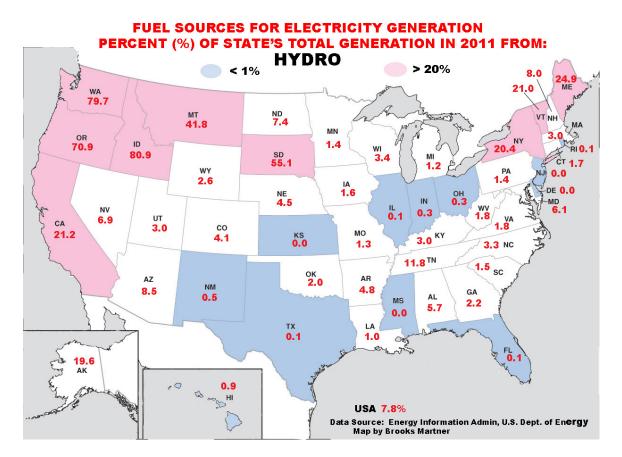


Figure 5. Map of the percent of each state's total electric power generation derived from using conventional **hydroelectric** generators as the fuel source. Those states that rely most heavily on hydro are shaded pink; those that rely least on hydro are shaded blue. Data are for the Total Electric Power Industry. The map was constructed from data compiled by the Energy Information Administration (EIA-906, EIA-920, and EIA-923).

The conventional hydroelectric data shown here do not include pumped-storage technologies.

Notes on Hydro:

HYDRO						
By Pe	ercent	By MWh				
top five:	%	top five:	MWh			
ID	80.90	WA	91,817,702			
WA	79.66	CA	42,557,467			
OR	70.88	OR	42,314,821			
SD	55.07	NY	27,996,988			
MT	41.81	ID	13,404,799			
bottom five:						
IL	0.07	NJ	24,407			
NJ	0.04	KS	14,745			
KS	0.03	RI	7,411			
DE	-	DE	-			
MS	-	MS	-			

1) Hydro is the dominant fuel for generating electricity in the Pacific Northwest.

2) More than half of South Dakota's electricity is generated from hydro power.

3) Logically, states with relatively flat terrain use almost no hydro power.

4) Hydroelectric power remained fairly steady at about 7.5% from 2006 to 2011.

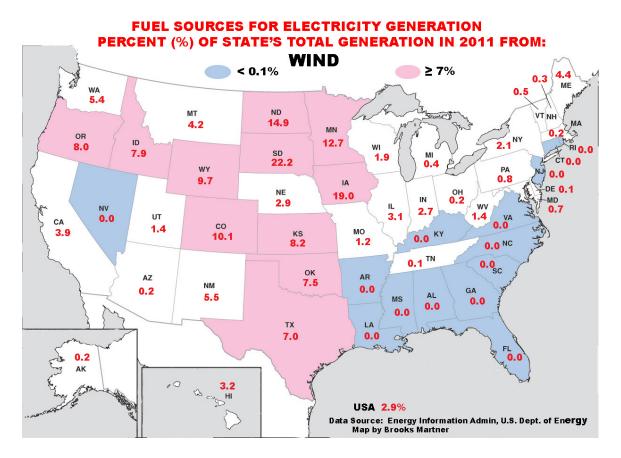


Figure 6. Map of the percent of each state's total electric power generation derived from using **wind** energy as the fuel source. Those states that rely most heavily on wind are shaded pink; those that rely least on wind are shaded blue. Data are for the Total Electric Power Industry. The map was constructed from data compiled by the Energy Information Administration (EIA-906, EIA-920, and EIA-923).

Notes on Wind:

	W	/IND	
By Pe	rcent		By MWh
top five:	%	top five:	MWh
SD	22.24	тх	30,548,087
IA	19.00	IA	10,709,177
ND	14.92	СА	7,751,837
MN	12.66	MN	6,725,695
со	10.11	WA	6,262,380
bottom five:			
many	-	many	-

1) Wind energy is utilized more heavily to generate electricity in states where windy weather is common, particularly in the Plains and High Plains states.

2) South Dakota produces more than one-fifth of its total electricity from wind.

3) Texas generates far more megawatt-hours of electricity from wind than any other state.

4) Southeastern states make almost no use of wind energy.

5) Use of wind energy has been increasing rapidly. Nationally, from 2006 to 2011 it increased by a factor of almost 5, in terms of megawatt-hours produced, and rose from 0.6% to 2.9% of the nation's total electricity generation. In some states the rise has been even more dramatic. As of 2011, wind is the fastest-growing renewable technology in terms of the increase in annual MWh of production.

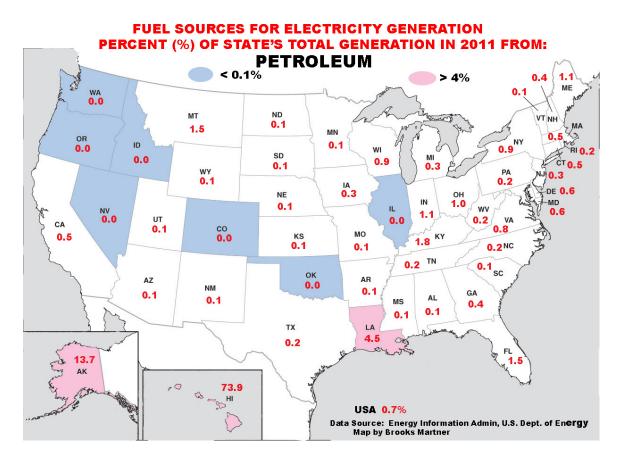


Figure 7. Map of the percent of each state's total electric power generation derived from using **petroleum** as the fuel source. Those states that rely most heavily on petroleum are shaded pink; those that rely least on petroleum are shaded blue. Data are for the Total Electric Power Industry. The map was constructed from data compiled by the Energy Information Administration (EIA-906, EIA-920, and EIA-923).

Petroleum includes distillate fuel oil (all diesel and No. 1, No. 2, and No. 4 fuel oils), residual fuel oil (No. 5 and No. 6 fuel oils and bunker C fuel oil), jet fuel, kerosene, petroleum coke, and waste oil.

Notes on Petroleum:

PETROLEUM							
By Pe	ercent	By MWh					
top five:	%	top five:	MWh				
ні	73.89	н	7,923,925				
AK	13.75	LA	4,707,477				
LA	4.46	FL	3,280,944				
КҮ	1.76	КҮ	1,734,950				
MT	1.53	ОН	1,388,432				
bottom five:							
IL	0.04	RI	13,640				
WA	0.03	VT	8,158				
ОК	0.02	OR	7,954				
OR	0.01	SD	7,543				
ID	0.00	ID	26				

1) Petroleum is used sparingly for electricity generation in most states – probably because it is too valuable for other uses, such as transportation, (gasoline) chemical manufacturing, and fertilizer products.

2) Only Hawaii, Alaska and Louisiana produce a significant fraction of their electricity by burning petroleum.

3) Hawaii is vastly more dependent on petroleum (almost 74%) than any other state.

4) Interestingly, in the petroleum-refinery states of Oklahoma and Texas, petroleum is barely used at all for generating electricity.

5) The use of petroleum for generating electricity is steadily declining. Nationally, it contributed 3.3% in 2001, 1.6% in 2006, and 0.7% in 2011.

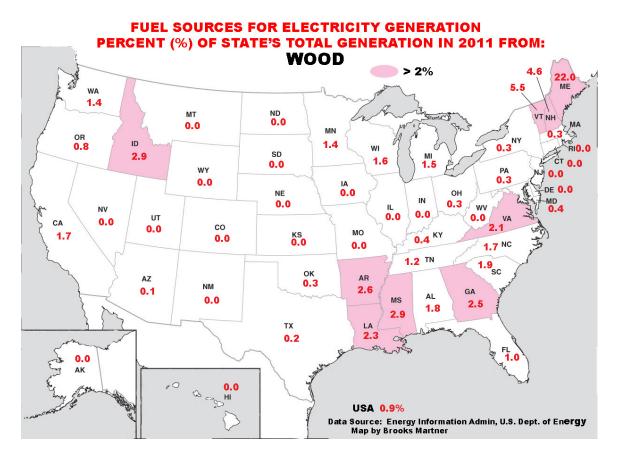


Figure 8. Map of the percent of each state's total electric power generation derived from using **wood** as the fuel source. Those states that rely most heavily on wood are shaded pink. Data are for the Total Electric Power Industry. The map was constructed from data compiled by the Energy Information Administration (EIA-906, EIA-920, and EIA-923).

Wood and Wood Derived Fuels includes paper pellets, railroad ties, utility poles, wood chips, bark, red liquor, sludge wood, spent sulfite liquor, and black liquor, with other wood waste solids and wood-based liquids.

Notes on Wood:

	WOOD						
By Pe	ercent	By MWh					
top five:	%	top five:	MWh				
ME	21.98	ME	3,511,418				
VT	5.49	CA	3,444,683				
NH	4.57	GA	3,070,257				
MS	2.91	AL	2,806,764				
ID	2.86	LA	2,371,437				
bottom five:							
many	-	many	-				

1) Wood is relied on for electricity generation more heavily in northern New England than elsewhere.

2) Maine produces 22% of its electricity by burning wood.

3) Southeastern states and Idaho also use wood extensively for producing electricity.

4) Nationally, the use of wood to generate electricity remained steady from 2006 to 2011 at about 0.9% of the total electric generation.

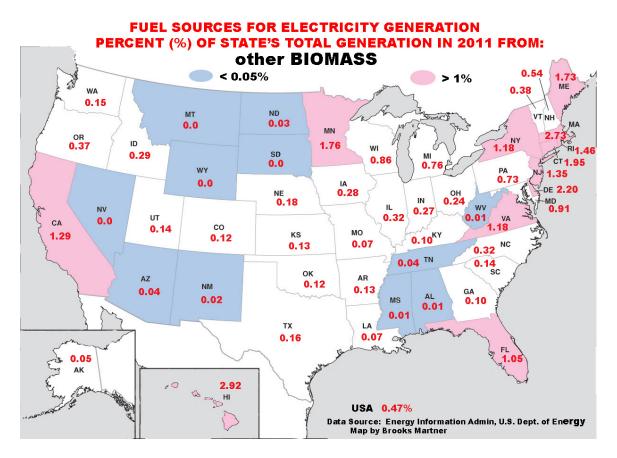


Figure 8. Map of the percent of each state's total electric power generation derived from using other **biomass** as the fuel source. Those states that rely most heavily on biomass are shaded pink; those that rely least on biomass are shaded blue. Data are for the Total Electric Power Industry. The map was constructed from data compiled by the Energy Information Administration (EIA-906, EIA-920, and EIA-923).

Other Biomass includes biogenic municipal solid waste, landfill gas, sludge waste, agricultural byproducts, other biomass solids, other biomass liquids, and other biomass gases (including digester gases and methane). It does not include wood.

Notes on Biomass:

BIOMASS							
By Pe	ercent	By MWh					
top five:	%	top five:	MWh				
н	2.92	CA	2,584,693				
MA	2.73	FL	2,334,985				
DE	2.20	PA	1,653,446				
СТ	1.95	NY	1,619,149				
MN	1.75	MA	1,039,130				
bottom five:							
AL	0.01	AK	3,287				
MT	-	MT	-				
NV	-	NV	-				
SD	-	SD	-				
WY	-	WY	-				

1) Biomass produces a few percent of the electricity generated in a few states in New England and elsewhere.

2) Hawaii has the greatest utilization of biomass in terms of percent and California is the greatest in terms of megawatt-hours of electricity produced.

3) Nationally, the reliance on biomass for generating electricity increased slightly from 0.39% in 2006 to 0.47% in 2011.

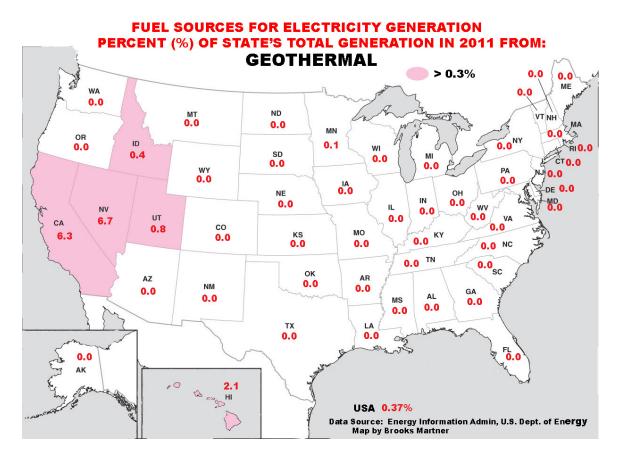


Figure 10. Map of the percent of each state's total electric power generation derived from using **geothermal** energy as the fuel source. Those states that rely most heavily on geothermal are shaded pink. Data are for the Total Electric Power Industry. The map was constructed from data compiled by the Energy Information Administration (EIA-906, EIA-920, and EIA-923).

Notes on Geothermal:

	GEOTHERMAL						
By Pe	ercent		By MWh				
top five:	%	top five:	MWh				
NV	6.72	СА	12,552,383				
СА	6.25	NV	2,146,119				
ні	2.09	UT	330,188				
UT	0.81	н	223,888				
ID	0.38	ID	63,490				
bottom five:							
many	-	many	-				

1) Only a few states use any geothermal energy to produce electricity.

2) California and Nevada each generate about 6-7% of their total electricity from geothermal energy.

3) California's generation of 12.5 million MWh from geothermal energy, although constituting only about 7% of its own total production, exceeds the total electric production from all fuels in several other states.

4) Nationally, the utilization of geothermal energy to generate electricity remained steady from 2006 to 2011 at about 0.35%.

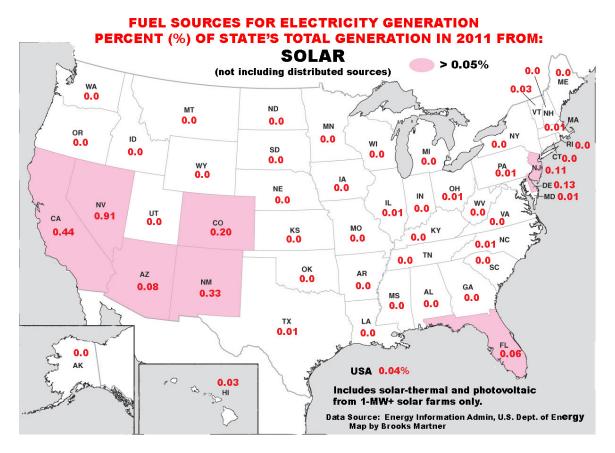


Figure 11. Map of the percent of each state's total electric power generation derived from using **solar** energy as the fuel source. Those states that rely more heavily on solar are shaded pink. Data are for the Total Electric Power Industry. The map was constructed from data compiled by the Energy Information Administration (EIA-906, EIA-920, and EIA-923).

Solar thermal and solar photovoltaic "farms" of 1-MW or more installed capacity are included here. However, distributed solar sites, such as rooftop, grid-tied PV arrays, (which probably generate more electricity than solar farms) are not included because of reporting challenges.

Notes on Solar:

	SO	LAR	
By Pe	ercent		By MWh
top five:	%	top five:	MWh
NV	0.91	СА	888,829
СА	0.44	NV	291,225
NM	0.33	NM	127,802
со	0.20	FL	125,726
DE	0.13	со	104,636
bottom five:			
many	-	many	-

1) Solar thermal and solar photovoltaic are included. However, unlike any other fuel in the EIA report data files (EIA-906, EIA-920, EIA-923) the majority of the total (actual) electric generation is from small, distributed sites, such as rooftop photovoltaic arrays. Since the EIA files only include generating sites with greater than 1 MW of capacity, and most distributed solar sites are less than 10 kW, data from the distributed solar sites are not included here. Thus, the overall contribution of solar, although very small, is underestimated in this map and data.

2) An EIA study estimates that the thousands of small distributed solar sites produced about 2.5 times more electricity than the few large solar farms in 2012, as described at: <u>http://www.eia.gov/todayinenergy/detail.cfm?id=8510</u>. As a very rough estimate, using the 2.5x factor, the complete-solar contribution nationally in 2011 may have been approximately 0.11%, rather than 0.04%.

But from 1MW+ solar farms alone:

3) States that utilize solar energy for electric generation to the greatest degree are located in the southwest part of the country where the solar insolation resource is also greatest.

4) Nevada has the largest utilization of solar in terms of percentage of total.

5) California produces far more electricity from solar than any other state.

6) Although still a tiny contributor to the nation's electricity, solar grew from about 0.01% in 2006 to 0.04% in 2011. If distributed solar (rooftop) sites are included, the 2011 number is estimated at ~0.11%.