NORTHEAST-MIDWEST REGIONAL TRENDS IN STATE ELECTRICITY STATISTICS

How do electricity markets in Northeast-Midwest region states compare to those in other states, and why? The U.S. Energy Information Administration (EIA) routinely collects, analyzes, and disseminates a wide range of energy-related information for the nation. This abundant state-by-state information is vital for industry decision makers, policymakers, analysts, and the general public to understand, predict, and plan for changing U.S. electricity markets. However, further analysis and explanation is required to provide a regional view, which is so critical to energy policy and planning. In this *Note to the Coalitions*, we analyze recently-released 2009 EIA State Electricity Profiles for regional trends by several energy information categories. We conclude with possible explanations for those trends[1].

Key Energy Information Categories

The Energy Information Administration collects energy data in several categories, including sources, end uses, and markets. Our analysis focuses on the following categories of energy information:

Net summer capacity and *net generation:* Net summer capacity and net generation data help to characterize the electricity supply that is available/ generated to serve current demand in a state. *Net summer capacity* refers to the maximum level at which electric power can be supplied at a point in time in order to meet demand, as demonstrated by a multi-hour test during the peak demand period (June 1 through September 30). Most times, however, power plants do not generate at their full capacity. *Net generation* is the amount of gross electricity generation in a state, minus the electrical energy consumed by power station(s) in the generation process, i.e. for station service or auxiliary equipment, such as pumps or motors (EIA Glossary).

Average retail price, as used in this *Note*, refers to the average price paid by customers in all sectors (residential, commercial, industrial, or other) per kilowatthour of electricity. In the case of average prices by state, it is calculated by dividing the total monthly revenue (generated by customers) by the corresponding total monthly sales (amount of electricity sold) within a state (EIA *Electric Power Monthly* Glossary).

Emissions refer to releases of gases to the atmosphere as a result of electricity production (EIA Glossary). Such gases include Sulfur Dioxide, Nitrogen Oxide, and Carbon Dioxide.

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[1] Explanations for trends attained through consultation with EIA staff.

NEMW State Electricity Statistics

No Regional Trend in Net Summer Capacity and Net Generation

NEMW states[2] as a whole have about 33% of U.S. summer capacity and produce about the same percentage of total U.S. electricity generation. This total figure is only slightly disproportionate to the relative population in the region vis-à-vis the nation; the NEMW region's population makes up 38% of the U.S. population. However, individual states' capacity and generation varies and there is no clear regional trend, as Table 1 illustrates.

Table 1. Ranking by Net Summer Capacity and Net Generation, 2009

Rank	Ranking by Total Net Summer Capacity	(MW)	Rank	Ranking by Net Generation	(MWh)
1	Texas	103,037	1	Texas	397,167,910
2	California	65,948	2	**Pennsylvania**	219,496,144
3	Florida	59,073	3	Florida	217,952,308
4	**Pennsylvania**	45,611	4	California	204,776,132
5	**Illinois**	44,033	5	**Illinois**	193,864,357
6	**New York**	39,671	6	Alabama	143,255,556
7	Georgia	36,549	7	**Ohio**	136,090,225
8	**Ohio**	33,539	8	**New York**	133,150,550
9	Alabama	31,389	9	Georgia	128,698,376
10	**Michigan**	30,308	10	North Carolina	118,407,403
11	Washington	30,095	11	**Indiana**	116,670,280
12	**Indiana**	27,949	12	Arizona	111,971,250
13	North Carolina	27,618	13	Washington	104,470,133
14	Arizona	26,335	14	**Michigan**	101,202,605
15	Louisiana	25,987	15	South Carolina	100,125,486
16	South Carolina	23,971	16	Louisiana	90,993,676
17	Virginia	23,788	17	Kentucky	90,630,427
18	Tennessee	20,852	18	Missouri	88,354,272
19	Oklahoma	20,849	19	Tennessee	79,716,889
20	Missouri	20,829	20	Oklahoma	75,066,809
21	Kentucky	20,160	21	West Virginia	70,782,514
22	**New Jersey**	18,499	22	Virginia	70,082,066
23	**Wisconsin**	17,744	23	**New Jersey**	61,811,239
24	West Virginia	16,360	24	**Wisconsin**	59,959,060
25	Mississippi	15,820	25	Arkansas	57,457,739
26	Arkansas	15,275	26	Oregon	56,690,856
27	**Minnesota**	14,626	27	**Minnesota**	52,491,849
28	**Iowa**	14,579	28	**Iowa**	51,860,063
29	Oregon	13,985	29	Colorado	50,565,952
30	**Massachusetts**	13,699	30	Mississippi	48,701,484
31	Colorado	13,038	31	Kansas	46,677,308
32	Kansas	12,529	32	Wyoming	46,029,212
33	**Maryland**	12,482	33	**Maryland**	43,774,832
34	Nevada	11,396	34	Utah	43,542,946
35	**Connecticut**	8,028	35	New Mexico	39,674,339

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[2] Refers to the 18 Northeast-Midwest Coalition states.

Rank	Ranking by Total Net Summer Capacity	(MW)	Rank	Ranking by Net Generation	(MWh)
36	New Mexico	7,993	36	**Massachusetts**	38,966,651
37	Nebraska	7,768	37	Nevada	37,705,133
38	Wyoming	7,566	38	North Dakota	34,196,467
39	Utah	7,418	39	Nebraska	34,001,892
40	North Dakota	5,963	40	**Connecticut**	31,206,222
41	Montana	5,779	41	Montana	26,712,735
42	**Maine**	4,344	42	**New Hampshire**	20,164,122
43	**New Hampshire**	4,165	43	Maine	16,349,849
44	Idaho	3,758	44	Idaho	13,100,152
45	South Dakota	3,362	45	Hawaii	11,010,533
46	**Delaware**	3,362	46	South Dakota	8,196,531
47	Hawaii	2,565	47	**Rhode Island**	7,696,824
48	Alaska	2,012	48	**Vermont**	7,282,348
49	**Rhode Island**	1,780	49	Alaska	6,702,159
50	**Vermont**	1,126	50	**Delaware**	4,841,563
51	District of Columbia	790	51	District of Columbia	35,499
	NEMW TOTAL	335,545		NEMW TOTAL	1,296,878,783
	U.S. Total	1,025,400		U.S. Total	3,950,330,926
	NEMW as % of TOTAL	32.7%		NEMW as % of TOTAL	32.8%

MW = Megawatt.
MWh = Megawatthours.

A Trend toward Higher Average Retail Prices per kWh of Electricity

Nearly all Northeast-Midwest states are ranked in the top 25 for average retail price of electricity. Northeastern states, in particular, have some of the highest average electricity retail prices in the country.

Table 2. Ranking by Average Retail Price, 2009

Rank	Ranking by Avg. Retail Price	(cents/kWh)	Rank	Ranking by Avg. Retail Price	(cents/kWh)
1	Hawaii	21.21	26	Alabama	8.83
2	**Connecticut**	18.06	27	Georgia	8.81
3	**New York**	15.52	28	Tennessee	8.69
4	**Massachusetts**	15.45	29	North Carolina	8.48
5	**New Hampshire**	15.13	30	South Carolina	8.42
6	Alaska	15.09	31	Colorado	8.31
7	**New Jersey**	14.52	32	**Minnesota**	8.14
8	**Rhode Island**	14.23	33	New Mexico	8.09
9	California	13.24	34	Kansas	7.98
10	**Maine**	13.09	35	**Indiana**	7.62
11	**Maryland**	13.08	36	Arkansas	7.57
12	District of Columbia	12.97	36	Montana	7.57
13	**Vermont**	12.75	38	Oregon	7.48

Rank	Ranking by Avg. Retail Price	(cents/kWh)	Rank	Ranking by Avg. Retail Price	(cents/kWh)
14	**Delaware**	12.14	39	South Dakota	7.39
15	Florida	11.49	40	**Iowa**	7.37
16	Nevada	10.36	41	Missouri	7.35
17	Texas	9.86	42	Nebraska	7.21
18	**Pennsylvania**	9.60	43	Louisiana	7.06
19	Arizona	9.56	44	Oklahoma	6.94
20	**Michigan**	9.40	45	Utah	6.77
21	**Wisconsin**	9.38	46	West Virginia	6.65
22	**Illinois**	9.08	47	North Dakota	6.63
23	**Ohio**	9.01	48	Washington	6.60
24	Virginia	8.93	49	Kentucky	6.52
25	Mississippi	8.85	50	Idaho	6.51
			51	Wyoming	6.08

kWh = Kilowatt hours.

Several reasons account for this trend and are detailed below.

Reason 1: Gas Prices

A number of Northeastern and Mid-Atlantic states (MD, DE, NJ, NY, CT, MA, RI, VT, NH, ME) rely heavily on natural gas-fired generating capacity. In those states, gas prices are higher than most of the country at peak use time in winter and summer. This is due to limits on the capacity of pipelines into the region. In contrast, those states that have lower electric prices—such as those in the Midwest (OH, MI, IN, WI, MN, and IA)—are more likely to rely on lower-cost coal and when they do burn natural gas, it typically is at a lower price than in the Northeast.

Reason 2: Regional Transmission Organizations/Independent System Operators

Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs) must be taken into consideration when explaining differences in fuel costs. RTOs and ISOs are independent organizations—made up of generators, transmission companies, load-serving entities,[3] integrated utilities, and others—that operate bulk power systems and regional wholesale electricity markets. RTOs/ISOs originated in the 1990s in order to encourage competitive generation while ensuring reliability. According to the Energy Information Administration, by 2009, RTOs/ISOs managed 60% of the power supplied to load-serving entities in the continental U.S. As Figure 1, below, indicates, there are seven RTOs/ISOs in the U.S. Four out of the seven are in the NEMW region: ISO New England, the New York ISO, the PJM Interconnection, and the Midwest ISO.

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[3] Load-serving entities secure "energy and transmission service (and related Interconnected Operations Services) to serve the electrical demand and energy requirements of [their] end-use customers" (North American Electric Reliability Corporation 2008).

Figure 1. RTO/ISO Operating Regions
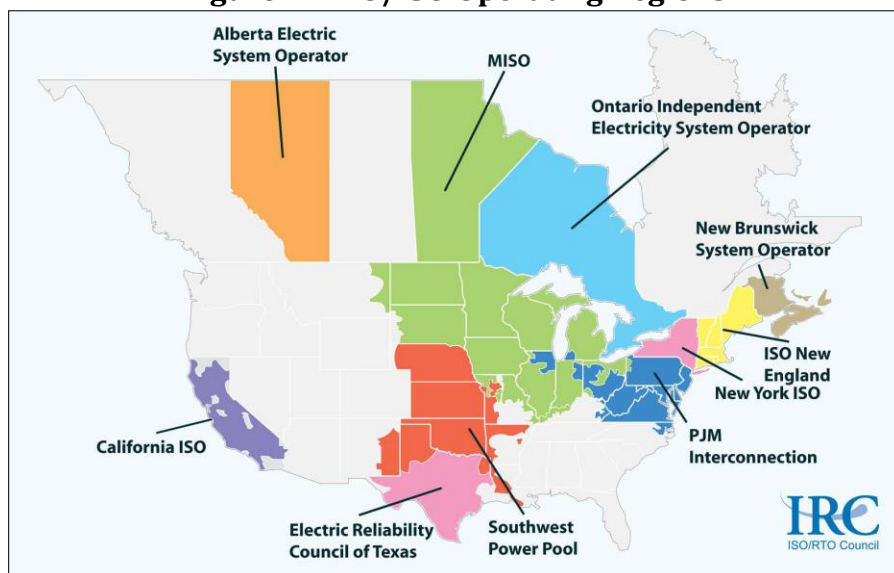
Source: ISO/RTO Council

Generators and load-serving entities must bid into RTO/ISO short-term markets in order to sell and buy power. Wholesale prices in these markets reflect the marginal, instead of average, costs of electricity production. Those states that buy power in RTO/ISO markets where natural gas is often the marginal fuel source have high average retail prices.

Reason 3: Differing State Regulatory Policies
Federal Energy Regulatory Commission (FERC) policies *and* state regulations also help to explain differences in retail prices. FERC regulates electricity wholesale sales and transmission pricing; RTO/ISOs in the NEMW region are thus regulated by FERC. States, on the other hand, regulate *utilities* that participate in RTO/ISOs. State regulators set retail rates in different ways. Rates have traditionally been based on cost-of-service; however, due to restructuring, many NEMW states have moved away from cost-of-service ratemaking (for power generation). These states allow retail consumers to choose a competitive supplier other than their local utility or take service arranged by state regulators through auctions or Requests for Proposals. (See this Interactive EIA map for specific state details).

Emissions: A Mixed Bag of Sub-Regional Trends

The Northeast-Midwest region produces a relatively low amount of Nitrogen Oxide and Carbon Dioxide emissions; the region accounts for about 33% of total U.S. emissions of those gases. This figure is slightly disproportionate to the population in the region vis-à-vis the nation; as previously mentioned, the NEMW population[4] makes up nearly 38% of the U.S. population. The region does, however, produce a disproportionately large percentage of the U.S. Sulfur Dioxide

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[4] Refers to the population of the 18 Northeast-Midwest Coalition states.

emissions (47%). Table 3 suggests that individual states in the NEMW region are located at both the highest and lowest ends of the emissions ranking. Northeastern states Rhode Island and Vermont, for example, consistently rank among the lowest emitters; Midwestern and Mid-Atlantic states such as Pennsylvania and Ohio are some of the highest.

Table 3. Ranking by Amount and Type of Emissions, 2009

Rank	Ranking by Sulfur Dioxide Emissions	(1000 Metric Tons)	Ranking by Nitrogen Oxide Emissions	(1000 Metric. Tons)	Ranking by Carbon Dioxide Emissions	(1000 Metric Tons.)
1	**Ohio**	624	Texas	199	Texas	242,864
2	**Pennsylvania**	585	**Pennsylvania**	120	**Pennsylvania**	116,621
3	Texas	419	Florida	116	**Ohio**	115,066
4	**Indiana**	384	**Indiana**	111	Florida	114,854
5	Georgia	295	**Ohio**	110	**Indiana**	111,113
6	**Michigan**	288	**Michigan**	91	**Illinois**	98,975
7	Alabama	285	California	83	Kentucky	86,155
8	**Illinois**	237	**Illinois**	78	Georgia	77,022
9	Missouri	236	Kentucky	74	Missouri	74,716
10	Kentucky	232	Georgia	74	**Michigan**	73,589
11	Florida	219	Oklahoma	73	Alabama	69,239
12	**Maryland**	197	Louisiana	69	West Virginia	65,928
13	West Virginia	167	Utah	68	North Carolina	64,845
14	**Wisconsin**	139	Wyoming	66	California	59,428
15	North Carolina	126	Arizona	62	Arizona	53,524
16	Tennessee	125	New Mexico	61	Louisiana	53,226
17	North Dakota	121	North Dakota	59	Oklahoma	51,986
18	Virginia	118	Colorado	54	Wyoming	44,684
19	South Carolina	105	Alabama	53	Wisconsin	44,233
20	Louisiana	98	Missouri	52	Tennessee	43,458
21	**Iowa**	92	**Minnesota**	49	**Iowa**	42,978
22	Oklahoma	92	**Wisconsin**	49	Colorado	38,989
23	Wyoming	76	Kansas	46	**New York**	38,130
24	Arkansas	75	**Iowa**	45	South Carolina	38,121
25	Nebraska	70	North Carolina	44	Utah	36,518
26	**Minnesota**	65	Nebraska	44	Kansas	36,207
27	**New York**	59	New York	44	Virginia	36,161
28	Kansas	47	Virginia	39	**Minnesota**	33,689
29	Mississippi	45	Arkansas	37	New Mexico	33,502
30	Colorado	43	West Virginia	35	North Dakota	32,608
31	**Massachusetts**	33	Tennessee	30	Arkansas	30,427
32	**Maine**	33	Mississippi	27	**Maryland**	25,659
33	Arizona	33	South Carolina	24	Nebraska	23,899
34	**New Hampshire**	31	**Maryland**	23	Mississippi	23,481
35	Utah	30	Hawaii	22	**Massachusetts**	19,683
36	Montana	23	Montana	21	Nevada	18,295
37	Hawaii	22	Washington	18	Montana	17,548
38	New Mexico	18	Alaska	17	**New Jersey**	16,086
39	**Delaware**	16	**Massachusetts**	17	Washington	13,526
40	Washington	13	Nevada	17	Oregon	9,406
41	Oregon	12	**New Jersey**	14	Hawaii	8,661

Rank	Ranking by Sulfur Dioxide Emissions	(1000 Metric Tons)	Ranking by Nitrogen Oxide Emissions	(1000 Metric. Tons)	Ranking by Carbon Dioxide Emissions	(1000 Metric Tons.)
42	**New Jersey**	12	Oregon	13	**Connecticut**	8,046
43	South Dakota	11	**Maine**	12	**New Hampshire**	5,507
44	Nevada	7	South Dakota	11	**Maine**	4,714
45	Idaho	5	**Connecticut**	6	Alaska	4,240
46	Alaska	4	**Delaware**	6	**Delaware**	4,143
47	California	3	**New Hampshire**	5	South Dakota	3,511
48	**Connecticut**	2	**Rhode Island**	3	**Rhode Island**	3,181
49	Dist. of Columbia	*	Idaho	2	Idaho	1,024
50	**Rhode Island**	*	**Vermont**	1	Dist. of Columbia	36
51	**Vermont**	*	Dist. of Columbia	*	**Vermont**	7
	NEMW TOTAL	2,797	NEMW TOTAL	784	NEMW TOTAL	761,420
	U.S. Total	5,970	U.S. Total	2,395	U.S. Total	2,269,508
	NEMW % of TOTAL	46.9%	NEMW % of TOTAL	32.7%	NEMW % of TOTAL	33.6%

* = Value is less than half of the smallest unit of measure (e.g., for values with no decimals, the smallest unit is 1 and values under 0.5 are shown as *).

Differences in emissions can generally be explained by differences in primary fuel types and pollution control equipment. By way of example, reasons for Sulfur Dioxide and Carbon Dioxide emissions trends are examined below.

Trend 1: Relatively High Sulfur Dioxide (SO_2) Emissions

Reason: Coal Generation
According to the U.S. Environmental Protection Agency, the combustion of sulfur-containing fossil fuels (especially coal) to generate electricity is the primary source of Sulfur Dioxide emissions. For the most part, the relatively high SO_2 emissions—especially in the Midwest—can be explained by greater coal usage to generate electricity. As indicated in Table 4, which lists NEMW states in order from greatest emissions to fewest emissions (ranked among 50-states and D.C.), a general pattern is that the greater the coal generation, the greater the SO_2 emissions. The Midwest relies particularly heavily on coal generation. The rankings of a few states, however, do not demonstrate such a clear-cut relationship between coal and SO_2 emissions. A few exceptions can explain this departure from the general pattern.

Exceptions: Differences in Coal Type and Scrubber Equipment
Differences in the type (and origin) of coal explains some variation in Sulfur Dioxide emissions. According to the U.S. Department of Energy, Eastern-origin coal like that which is found in Ohio, Pennsylvania, and West Virginia tends to have a higher sulfur content than that which is found in such western states as Wyoming and Montana. A second factor that explains why the coal generation ranks among states do not perfectly align with the Sulfur Dioxide ranks is that some

electric utilities have mitigated sulfur emissions by investing in flue gas desulfurization units, more commonly known as scrubbers.

Table 4. Coal Generation and Sulfur Dioxide Emissions by NEMW State, 2009.

State	Coal Generation		Sulfur Dioxide Emissions	
	(MWh)	Rank	(1000 Metric Tons)	Rank
Ohio	113,711,997	2	624	1
Pennsylvania	105,474,534	4	585	2
Indiana	108,311,698	3	384	4
Michigan	66,847,683	10	288	6
Illinois	89,966,860	5	237	8
Maryland	24,162,345	29	197	12
Wisconsin	37,279,995	18	139	14
Iowa	37,351,436	17	92	21
Minnesota	29,327,226	25	65	26
New York	12,758,873	34	59	27
Massachusetts	9,028,110	35	33	31
Maine	72,146	48	33	32
New Hampshire	2,885,668	41	31	34
Delaware	2,848,171	42	16	39
New Jersey	5,099,868	38	12	42
Connecticut	2,453,497	43	2	48
Rhode Island		50	*	50
Vermont		51	*	51

* = Value is less than half of the smallest unit of measure

Trend 2: Relatively Low Carbon Dioxide (CO_2) Emissions

Reason: Fossil Fuel Generation
The generation of electricity through fossil fuels (coal, oil and natural gas) is responsible for CO_2 emissions. The more that states utilize coal, natural gas, and petroleum to generate electricity, the greater their CO_2 emissions. It is important to note that although the region as a whole emits a smaller percentage (about 33%) of the nation's CO_2 than its proportion of the population (38%), some Midwest and Mid-Atlantic states (OH, PA, IN, IL, and MI) are in fact some of the largest emitters. As Table 5 illustrates, the ranks of fossil fuel generation and CO_2 are nearly perfectly aligned.

Table 5. Fossil Fuel Generation⁺ and Carbon Dioxide Emissions by NEMW State, 2009.

State	Coal, Gas & Oil Generation Carbon Dioxide Emission Equivalent		Carbon Dioxide Emissions	
	(MWh)	Rank	(1000 Metric Tons)	Rank
Pennsylvania	122,113,329	3	116,621	2
Ohio	116,360,571	4	115,066	3
Indiana	110,492,803	5	111,113	5
Illinois	92,526,738	6	98,975	6
Michigan	71,642,870	11	73,589	10
Wisconsin	40,403,378	20	44,233	19
Iowa	38,025,883	25	42,978	21
New York	38,704,996	24	38,130	23
Minnesota	30,948,384	30	33,689	28
Maryland	25,169,186	33	25,659	32
Massachusetts	21,710,067	36	19,683	35
New Jersey	16,846,419	37	16,086	38
Connecticut	8,040,217	42	8,046	42
New Hampshire	5,928,301	43	5,507	43
Maine	4,613,369	44	4,714	44
Delaware	3,841,960	46	4,143	46
Rhode Island	4,288,765	45	3,181	48
Vermont	2,524	50	7	51

MWh = Megawatthours
⁺ Fossil Fuel Generation refers to total coal, natural gas and petroleum generation. This total is adjusted to account for the fact that CO_2 emission rates vary by fuel (adjustment made by William Booth, EIA, May 2011).

Conclusion

Using recently released Energy Information Administration data, this *Note to the Coalitions* identifies and explains trends in electricity generation, price, and emissions in the Northeast and Midwest. Although individual states' energy capacity and generation varies, we detect strong regional patterns in electricity retail prices and emissions. High prices in the Northeast are attributable to multiple factors: primary fuel type and gas prices; the impact of Regional Transmission Organizations/Independent System Operators; and state regulatory policies. With respect to emissions, NEMW states are located at both the highest and lowest ends of the SO_2, NO_x, and CO_2 emissions rankings. Northeastern states Rhode Island and Vermont, for example, consistently rank among the lowest emitters; Midwestern and Mid-Atlantic states such as Pennsylvania and Ohio are some of the highest. Differences in emissions can generally be explained by differences in primary fuel types and pollution control equipment.