

Renewable Energy Resources and the Clean Power Plan

The Governor's Energy Summit

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Christine Risch



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Clean Power Plan Goals for Renewables

- EPA estimates for RE potential

EPA Building Block 3 - RE MWh Potential

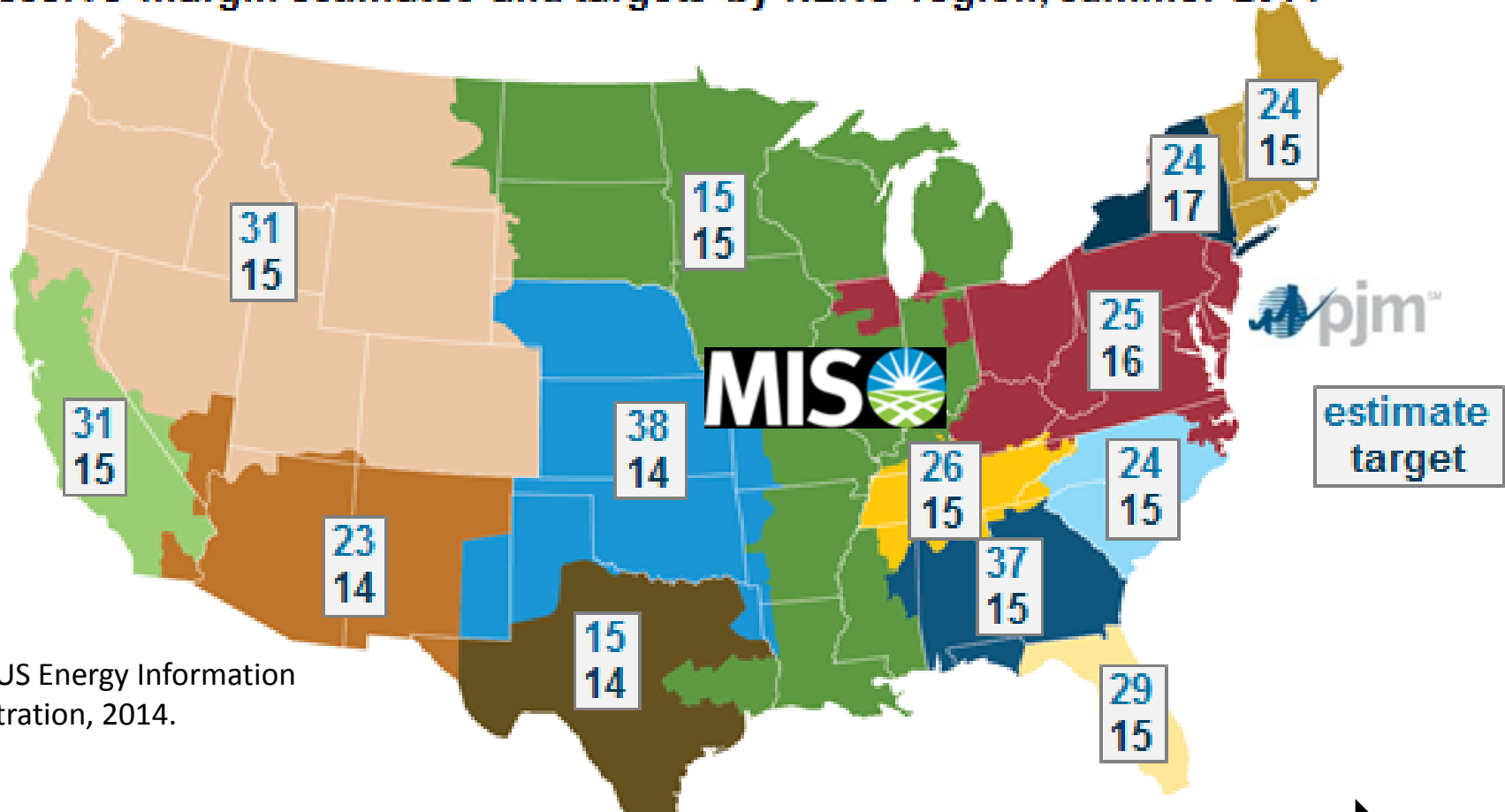
Region	2022	2026	2030
Eastern Interconnection	166,253,134	291,643,600	438,444,700
Western Interconnection	56,663,541	103,821,436	160,974,866
ERCOT	18,963,672	61,791,623	106,610,547

Source: EPA Final Clean Power Plan Rule, State Goal Visualizer.

- 2014 RE output from all utilities, IPPs, and C&I – 540 million MWh
 - 48% conventional hydro
 - 32% wind
 - 8% wood-derived
- An increase in current output of 45% in 2022 and 130% in 2030.
- EPA projects CPP to cause a 9% increase RE MWh - all non-hydro - in 2030 over current trends (project 790 million MWh in 2030 BAU).

Possible Carbon Trading Area

Reserve margin estimates and targets by NERC region, summer 2014



Source: US Energy Information Administration, 2014.

The Eastern Interconnection (minus Texas)

Solar Resources

City	State	kWh/Yr	% of Daggett
Daggett	CA	7,232	100%
Tucson	AZ	7,078	98%
Reno	NV	6,509	90%
Denver	CO	6,111	84%
Tampa	FL	5,924	82%
Atlanta	GA	5,827	81%
Boise	ID	5,821	80%
Birmingham	AL	5,603	77%
Roanoke	VA	5,476	76%
Minneapolis	MN	5,389	75%
Boston	MA	5,284	73%
Charleston	WV	5,033	70%
Pittsburgh	PA	4,862	67%
Seattle	WA	4,357	60%

Source: PV Watts. Data for a 4 kW PV array.

Wind Potential by State – Top Ten

- MISO and PJM States highlighted.

State Rank	State	2014 Installed Capacity (MW)	Potential Installed Capacity* (MW)	Potential Annual Generation (GWh)
1	Texas	14,098	1,901,530	6,527,850
2	Kansas	2,967	952,371	3,646,590
3	Montana	665	944,004	3,228,620
4	Nebraska	812	917,999	3,540,370
5	South Dakota	803	882,412	3,411,690
6	North Dakota	1,886	770,196	2,983,750
7	Iowa	5,688	570,714	2,026,340
8	Wyoming	1,410	552,073	1,944,340
9	Oklahoma	3,782	516,822	1,788,910
10	New Mexico	812	492,083	1,644,970

Sources: AWS TrueWind and NREL for potential and AWEA for installed MW.

* Based on resources with a gross capacity factor of $\geq 30\%$ at 80m above ground.

Wind Potential by State – Tier 2

- MISO and PJM States highlighted.

State Rank	State	2014 Installed Capacity (MW)	Potential Installed Capacity (MW)	Potential Annual Generation (GWh)
11	Minnesota	3,035	489,271	1,679,480
12	Colorado	2,593	387,220	1,288,490
13	Missouri	459	274,355	810,619
14	Illinois	3,568	249,882	763,529
15	Indiana	1,745	148,228	443,912
16	Wisconsin	648	103,757	300,136
17	Michigan	1,531	59,042	169,221
18	Ohio	435	54,920	151,881
19	California	5,917	34,110	105,646
20	Oregon	3,153	27,100	80,855

Sources: AWS TrueWind and NREL for potential and AWEA for installed MW.

* Based on resources with a gross capacity factor of $\geq 30\%$ at 80m above ground.

Wind Resources - Regional States

- MISO and PJM States highlighted.

State Rank	State	2014 Installed Capacity (MW)	Potential Installed Capacity (MW)	Potential Annual Generation (GWh)
18	Ohio	435	54,920	151,881
29	Pennsylvania	1,340	3,307	9,673
32	West Virginia	583	1,883	5,820
33	Virginia	0	1,793	5,395
34	Maryland	160	1,483	4,269
43	Kentucky	0	61	173

Sources: AWS TrueWind and NREL for potential and AWEA for installed MW.

* Based on resources with a gross capacity factor of $\geq 30\%$ at 80m above ground.

Power Purchase Agreements for Wind & Solar

Prices by region:

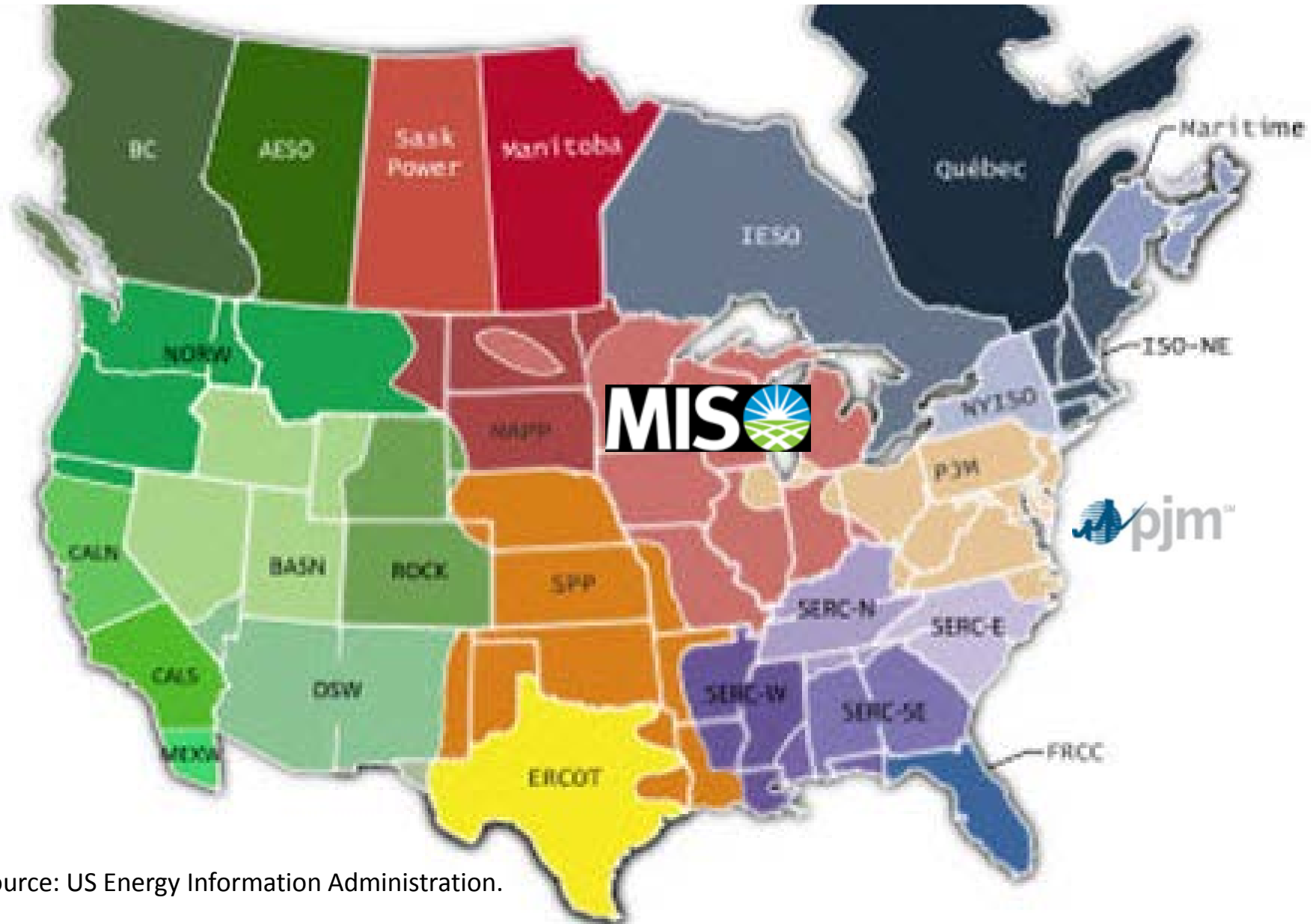
Wind: 2012-2014		
Region	\$/MWh	no PTC
Interior	\$ 22.40	\$ 45.40
Great Lakes	\$ 41.00	\$ 64.00
West	\$ 60.00	\$ 83.00
Northeast	\$ 55.00	\$ 78.00

Source: NREL, 2015.

Solar: 2014-2015		
State/Region	\$/MWh	w/o incentives
Southwest (97% of NREL obs)	\$45	?
Florida (single contract)	\$70	?
Georgia (single contract)	\$65	?
Alabama (single contract)	\$61	?
New York (Sol Systems review)	\$65 to \$120	?
Massachusetts (Sol Systems review)	\$90 to \$111	?

Source: NREL and Sol Systems, 2015.

Another View of Trading Regions



Source: US Energy Information Administration.

Thank you

Christine Risch

Director of Resource and Energy Economics

**Center for Business and Economic Research
Marshall University**

907 Third Avenue

Huntington, WV 25701

p 304.528.7226

christine.risch@marshall.edu

marshall.edu/cber



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