The Carbon Effect 2.0

Reassessing the Challenges for Public Power

Special Report

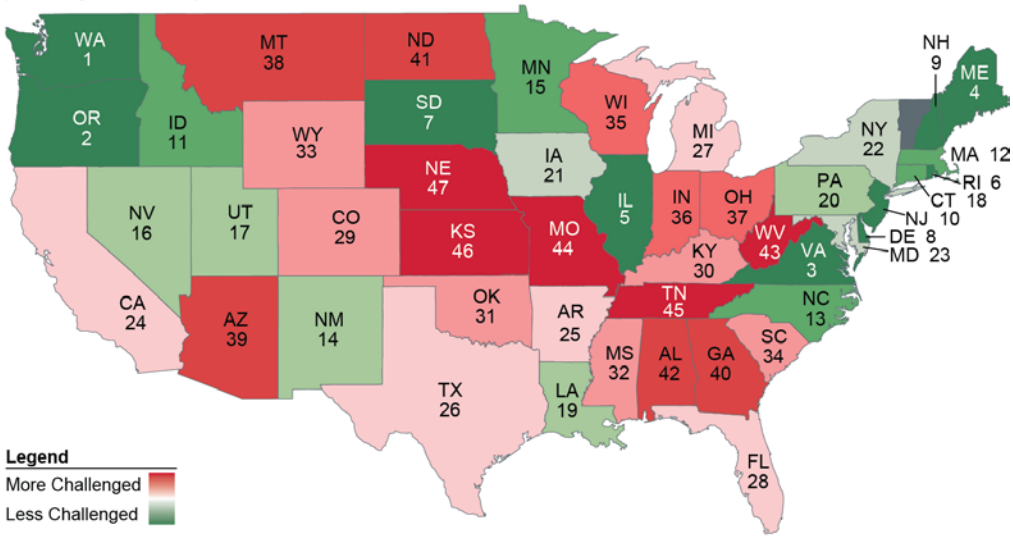
This report, originally published Oct. 14, 2015, was amended to correct state rankings on pages 1 and 3.

Carbon Compliance Remains a Challenge: Fitch Ratings believes preserving financial margins and credit quality, while complying with the EPA's final Clean Power Plan (CPP), remains most challenging for public power and cooperative utilities operating in states subject to sizable mandated carbon-reduction goals, high carbon-reduction costs and a relatively high cost of electricity.

Final Rules Shift Burden: Significant changes to the CPP's reduction goals and estimated carbon-reduction costs have shifted the relative challenge facing each state compared with the findings in Fitch's report *The Carbon Effect (Assessing the Challenges for Public Power)* published on Jan. 30, 2015. States facing the greatest challenge now include Kansas, Missouri, Nebraska, Tennessee and West Virginia based on the Fitch-calculated carbon cost recovery index (CCRI).

Carbon Cost Recovery Index

(Ranking the States)



Note: The labels reflect the rank of the index and state. Vermont has no sources of generation that are affected by the Clean Power Plan, therefore no goals have been established. Alaska and Hawaii have been excluded from Fitch's analysis.
Source: Fitch.

Effect on Credit Quality: Although the final rules appear less onerous than originally proposed and provide more time to comply, Fitch believes the effect on individual credit quality will continue to hinge on each utility's ability and willingness to recover compliance costs from end users.

Carbon-Reduction Goals Finalized: The EPA released the final CPP on Aug. 3, 2015, which includes carbon dioxide (CO2) reduction goals for each state. The final goals fall in a narrower band than originally proposed, broadly reflecting greater opportunities for regional cooperation and a more consistent approach among generating sources. States are now required to develop and implement compliance plans that achieve interim reduction goals beginning in 2022 rather than 2020.

Compliance Costs Remain Uncertain: Industry estimates of compliance costs remain broad. Although EPA annual cost estimates remain manageable, compliance scenarios reflect assumptions related to low-cost renewable energy and demand-side energy efficiency that Fitch believes are aggressive. Should these assumptions, together with the economics of gas-fired generation, prove overly optimistic, compliance costs could soar.

Related Research

Fitch Fundamentals Index - 2Q15 (July 2015)

U.S. Public Finance — Public Power — Fitch Analytical Comparative Tool (FACT) — June 2015 (July 2015)

U.S. Public Power (Peer Study) (July 2015)

The Carbon Effect (Assessing the Challenges for Public Power (January 2015)

2015 Outlook: U.S. Public Power and Electric Cooperative Sector (Steady as She Goes) (December 2014)

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Reason for the Update

Fitch released its report *The Carbon Effect (Assessing the Challenges for Public Power)* on Jan. 30, 2015. The report introduced a framework for analyzing the implications of the EPA's proposed rules for reducing carbon emissions. Recognizing the variables included in the analysis and the terms of the proposed rules were subject to change, it was always Fitch's intention to update the data, revise the analysis, recalculate the CCRI and publish the results periodically as appropriate.

President Obama and the EPA released the final CPP on Aug. 3, 2015, including final emission guidelines for existing fossil fuel-fired generating units and state-by-state emission goals. Significant changes in the mandated reductions and cost estimates outlined in the plan, as well as updated demographic and census data led Fitch to update its CCRI and provide the following update. As with the initial report, this update does not intend to reach any conclusions about the effect of reduction initiatives on individual utilities, or to predict any rating actions.

CCRI Methodology

Fitch's CCRI considers four variables: the relative magnitude of mandated reduction goals, estimated cost of carbon-reduction alternatives, average retail rates and the cost of electricity as a percentage of median household income (MHI) for each state, to assess the combined influence of these variables and effectively rank the states in terms of the challenge ahead.

For a more detailed description of Fitch's CCRI methodology see Page 9.

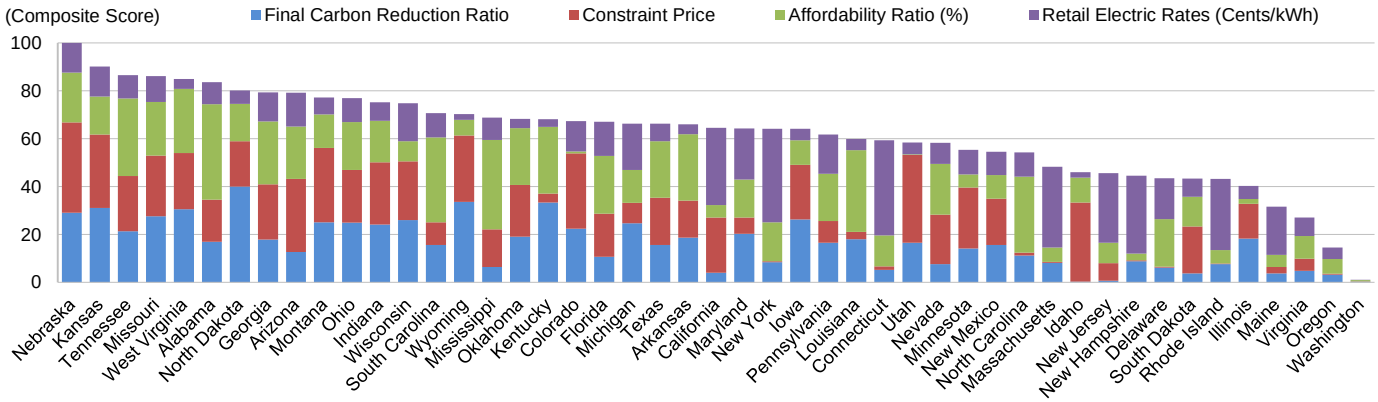
High-Cost, High-Rate States Face Greatest Challenges

Fitch continues to believe public power and cooperative utilities that operate in states subject to sizable mandated carbon-reduction goals, high carbon-reduction costs and high electric costs will be most challenged to maintain margins while complying with the CPP. For these utilities, meeting the goals and recovering related costs will likely require sizable rate increases on end users already burden by comparatively high electric costs or retail rates.

The latest CCRI now suggests Kansas, Missouri, Nebraska, Tennessee and West Virginia face the greatest challenges. All of these states, with the exception of Tennessee, rank among the most challenged based on the revised reduction goals. Washington and Oregon remain among the states that appear best suited to comply with the proposed rules and maintain margins, and are now joined by Virginia and Maine, largely due to reduction goals that exceed 2012 carbon emissions costs, carbon-reduction measures available at little or no incremental cost according to EPA figures, and electric rates and costs lower than national averages.

The CCRI scores for each state, including the relative rankings of each component, are included in Appendix A. A graphical representation is provided in the *State Scores for Weighted Components of the CCRI* chart below.

State Scores for Weighted Components of the CCRI



CCRI – Carbon cost recovery index. Note: Each component is normalized and scaled, with a total final score between 1 and 100.
Source: Fitch.

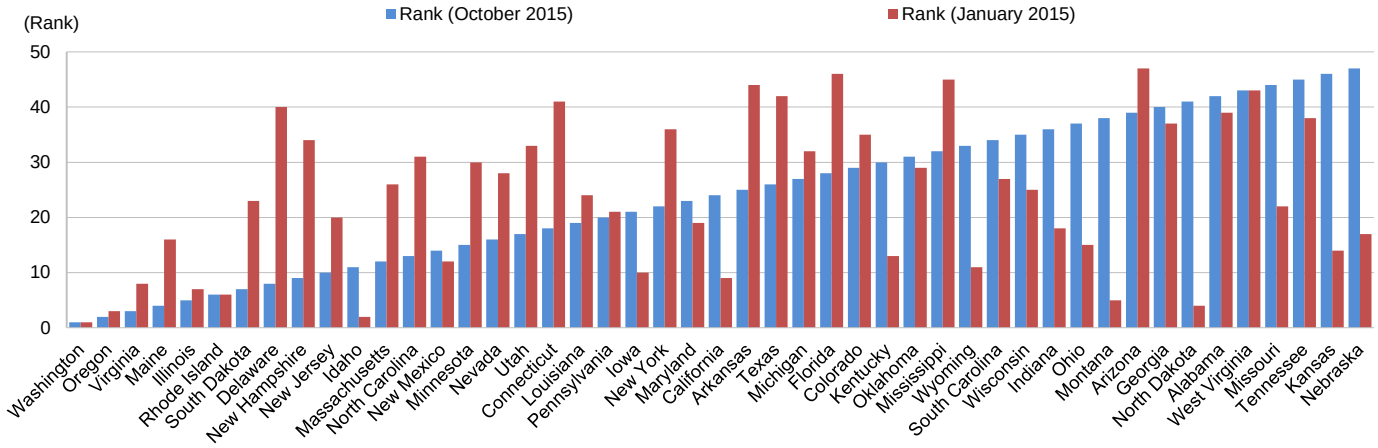
Revisions Drive Changes in Rank

Although Fitch's methodology is unchanged, the results of the recalculated CCRI are dramatically different from its initial findings, largely due to significant changes in the mandated reductions for certain states and revised cost estimates. Changes in electric rates and affordability also contributed to changes in relative ranking, but to a much lesser extent.

Of the five states currently identified among the most challenged, only West Virginia ranked among the most challenged in the initial index. Moreover, Nebraska is the only state that now ranks below the 37th percentile in all four factors examined, and was one of only five states to record lower rankings on all four variables compared with the initial index. In contrast, several state rankings improved as a result of meaningfully lower reduction requirements and reduction-cost estimates, including Arizona, Minnesota, New Hampshire and South Dakota. Broader improvement was observed for Delaware, Florida and North Carolina, which were the only states to record higher rankings on all four variables compared with the initial index.

The January 2015 and October 2015 rankings for each state are included in Appendix B. A graphical representation is provided in the *Change in CCRI Rank* chart below.

Change in CCRI Rank



Note: States are listed from least challenged (left side of chart) to most challenged (right side), based on October 2015 ranking.
Source: Fitch.

Cost Recovery and Maintaining Margins Key to Credit Quality

Fitch believes the final CPP rules are unlikely to have any near-term effects on public power and cooperative utilities. Low natural gas prices, competition from renewable energy and other stringent emission rules continue to drive the retirement of older, smaller coal-fired units that may have been affected by the rules, and these trends are expected to continue. However, over the longer term, compliance in states that rely heavily on coal-fired generation and have been slow to adopt renewable portfolio standards and energy-efficiency mandates will be more challenging and potentially costly.

The effect of the CPP on individual credit quality will continue to hinge on each utility's ability and willingness to recover compliance costs from end users through higher rates or charges.

Despite the autonomous rate-setting authority enjoyed by the vast majority of the public power and cooperative issuers rated by Fitch, an issuer's willingness to maintain and preserve robust margins in the wake of higher operating costs is uncertain. If the cost burden and related higher retail rates result in weaker financial metrics and reduced financial flexibility, downward rating pressure could materialize.

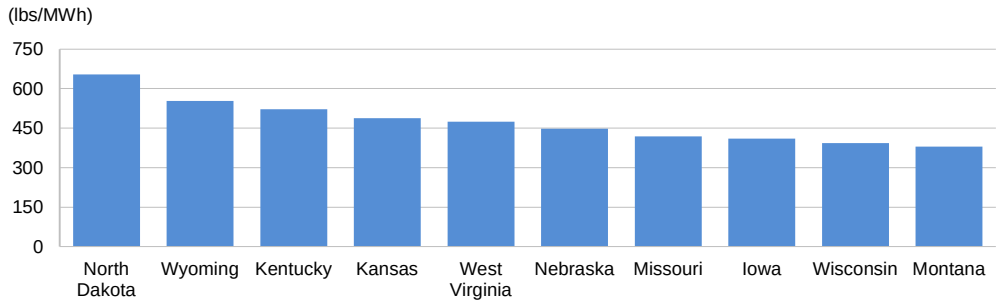
Reassessing the Challenges

The calculation of Fitch's CCRI considers four variables in the analysis: the relative magnitude of mandated reduction goals, estimated cost of carbon-reduction alternatives, average retail rates, and cost of electricity as a percentage of MHI for each state. For additional information on the CCRI and its methodology, please see *The Carbon Effect (Assessing the Challenges for Public Power)*.

Relative Carbon-Reduction Mandates

Fitch's evaluation of mandated reduction goals remains centered on the calculation of a carbon-reduction ratio (CRR) for each state, defined as the ratio of the anticipated reduction in carbon emissions required by the CPP (measured in pounds) to estimated 2030 net generation of electricity from all sources (measured in MWhs). The release of the final CPP facilitates this calculation through the introduction of mass-based state goals for carbon emissions as an alternative to rate-based goals. Although largely based on the emission rate goals, the mass-based goals express emissions limits measured in short tons. Separate, slightly higher mass-based goals for states that choose to include new gas-fired units toward compliance have also been established. For the purpose of this analysis, Fitch has focused on the difference between actual 2012 emissions and the mass-based goal, including the new source complement.

States with the Highest Carbon-Reduction Ratios
(State Mass Final Goal CO2 Reduction/Estimated 2030 Energy Output)



CO2 – Carbon dioxide.
Source: Fitch, EPA, EIA.

Calculated estimates for 2030 generation are also facilitated by the EPA's published estimates for incremental generation to support demand growth in its technical support documentation. Fitch believes measuring carbon reduction against total generation provides a broader indication of the relative burden. States with the highest CRRs ostensibly face the greatest required reduction measured against total electricity production from all sources. See Appendix C for additional details.

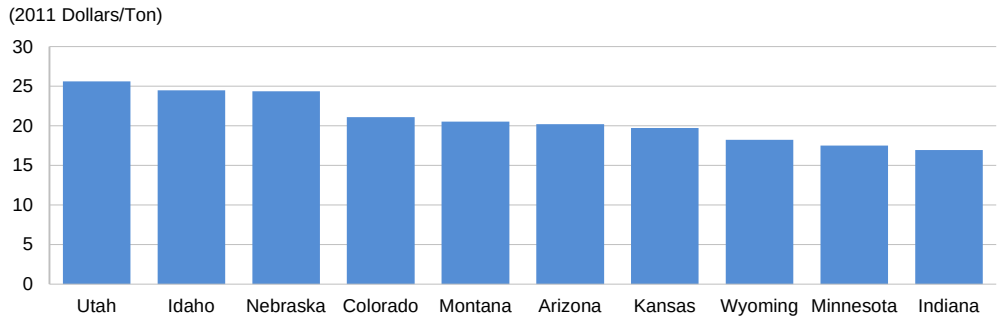
Cost of Carbon-Reduction Alternatives

Fitch has focused on the EPA's state-by-state estimates for the constraint shadow price for CO2, based on proposed emissions limits, in evaluating the cost of carbon-reduction alternatives. These figures, measured in terms of 2011 dollars/ton, provide an estimate of the marginal cost of carbon reduction for different time periods and have been remodeled by the EPA as part of its analysis of the CPP (the EPA's Integrated Planning Model, Mass-Based Illustrative CPP compliance scenario). Fitch uses the 2030 constraint shadow prices published by the EPA in its latest analysis to illustrate the relative cost of carbon reduction.

A higher carbon constraint shadow price indicates a higher marginal cost of carbon reduction, likely driven by fewer cost-effective opportunities for the dispatch of lower emitting generating units and the development of renewable resources.

States with the highest marginal cost of carbon reduction are summarized in the *States with the Highest Marginal Cost of Carbon Reduction* chart below and in detail in Appendix D.

States with the Highest Marginal Cost of Carbon Reduction

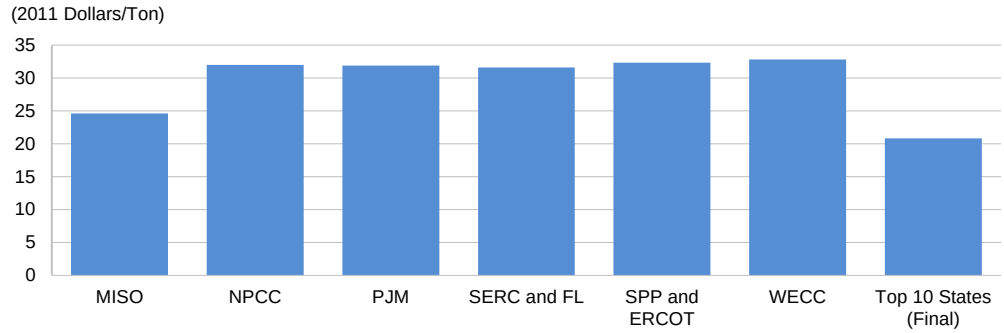


Source: EPA.

The results of the EPA's revised compliance scenario suggest constraint shadow prices that are significantly lower in many cases than those outlined earlier. Although partially driven by a lower natural gas price forecast, the lower cost estimates appear to reflect the expectation that compliance will be achieved through more regional and multistate cooperation versus a state-by-state approach. Cooperation may be more easily accomplished through the creation of emissions trading programs, which feature prominently in the final plan.

When comparing the current estimates to the EPA's earlier modeling assuming regional cooperation, costs are only modestly lower.

Regional Marginal Cost of Carbon Reduction



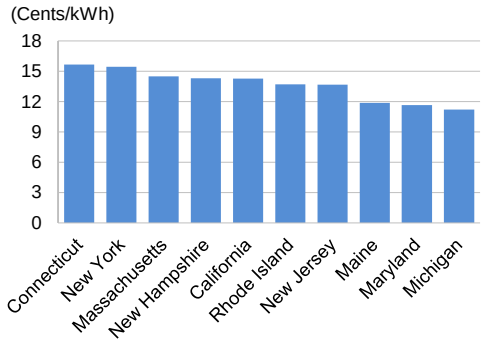
MISO – Midcontinent Independent System Operator. NPCC – Northeast Power Coordinating Council.
PJM – PJM Interconnection LLC. SERC – Southeastern Electric Reliability Council. SPP – Southwest Power Pool.
ERCOT – Electric Reliability Council of Texas. WECC – Western Electricity Coordinating Council.
Source: EPA.

The total cost of compliance with the CPP remains a factor of both the relative volumetric reduction — as measured by the CRR — and the unit cost of reduction alternatives. However, Fitch continues to examine these variables separately given the potential pitfalls of using the data for reasons other than their intended use and the possibility of distorted results. Nonetheless, states with the greatest mandated reductions and the highest cost carbon-reduction measures are expected to bear a disproportionately high share of nationwide costs.

Electric Rates and Affordability

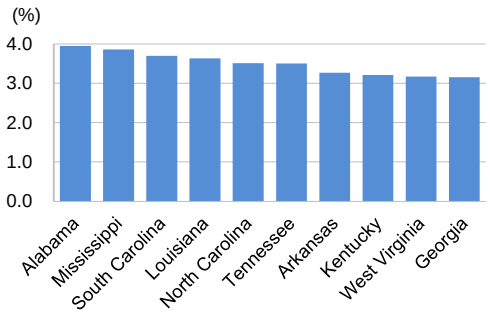
Fitch believes public power and cooperative utilities operating in states where the relative cost of electricity is highest generally face the greatest pressure to avoid rate increases. In its assessment of a utility's willingness to increase rates, Fitch considers two variables: average retail rates and the cost of electricity as a percentage of MHI.

Highest Average Retail Electric Rates



Source: EIA.

Highest Average Annual Cost of Electric/Median Household Income



Source: EIA, U.S. Census.

Changes in ranking from Fitch's earlier analysis based on updated census and U.S. Energy Information Agency (EIA) data were generally limited, and driven by changes in retail prices, as well as consumption and income levels. In states where affordability is a concern or political pressure exists, a reluctance to increase rates could contribute to financial strain, even in states where compliance costs are relatively low. See Appendix E for additional details.

Finalizing the Clean Power Plan

The EPA released its final version of the CPP on Aug. 3, 2015, outlining its rules for reducing carbon emissions from existing power plants. The final rules build upon the EPA's initial proposal released in June 2014, and reflect the agency's response to more than four million public comments and critical issues raised by a variety of stakeholders. Changes in the plan are designed to address the timetable for interim compliance, grid reliability and lack of recognition for early adopters, among other concerns.

Although the final rules preserve many of the approaches and fundamental concepts introduced in the initial draft, changes in certain methodologies have resulted in state reduction goals that are meaningfully different than those proposed in June 2014, with some being more stringent and some being more lenient.

What Has Changed

Timing

The final rule provides more time than initially proposed to comply. States now have until Sept. 6, 2016 and Sept. 6, 2018 to submit their initial and final compliance plans, respectively, and until 2022 (rather than 2020) before interim compliance goals take effect. Moreover, the rules allow states to apply reduction measures in a more gradual way throughout the interim compliance period if determined to be more cost-effective and feasible than the multiyear step-down goals offered in the plan.

Goal-Setting Methodology

Consistent with its earlier determinations and authority under section 111(d) of the Clean Air Act, the EPA developed the final goals using the best system of emission reduction measures and related building blocks. However, in the final plan, only three of the original four building blocks were applied — increased efficiency at existing coal-fired power plants, increased generation from lower emitting existing natural gas plants and substituting generation from non-emitting renewable resources for reduced generation from existing coal-fired plants. Demand-side energy efficiency was eliminated as a building block and is instead expected to be a significant component of state compliance plans.

The goal-setting formula was also simplified and heavily influenced by the more regional approach to compliance envisioned by the EPA. Applying the building blocks to all of the affected generating units in each of three regions — the eastern interconnection, western interconnection and Electricity Reliability Council of Texas interconnection — performance rates for each region were determined. The most readily achievable rates for coal and natural gas plants were then used to determine individual statewide rate-based and mass-based goals based on each state's own mix of affected units. Energy efficiency, new nuclear generation and existing renewable energy sources are no longer included in the goal-setting methodology.

Although the resulting states' final goals fall in a narrower band than earlier proposed, the goals still vary widely, reflecting the diversity in each state's resource mix. Final goal emission rates range from 771 lbs./MWh in states where the only affected units are natural gas-fired (Rhode Island, Idaho), to 1,305 lbs./MWh where affected units are entirely coal or oil-fired (Montana, North Dakota, West Virginia).

Regional Versus State Compliance

Inherent throughout the final plan is a more regional approach to not only goal setting, but also compliance. The final rules still provide states with broad flexibility to achieve their emission-reduction goal using any measures available, and should allow states to build upon their progress made to date in reducing emissions. States may also participate in the development of a multistate compliance plan in lieu of an individual plan. However, the final plan also facilitates the use of emissions trading programs as a cost-effective means of compliance, similar to other Clean Air Act programs. In addition to introducing mass-based goals to foster interstate trading, the final plan also provides states with the opportunity to make their units trading ready, allowing individual power plants to use out-of-state reductions to achieve compliance, without the need for more formal state-to-state coordination.

Just Say No

At least six states — Indiana, Louisiana, Oklahoma, Texas, West Virginia and Wisconsin — have reportedly threatened not to submit state implementation plans for compliance, often citing the complexity and cost of doing so. However, the final plan authorizes the EPA to promulgate a federal implementation plan if any state fails to submit a plan or submits a plan that fails to comply with the CPP requirements. The EPA intends to adopt only one federal plan (rate based or mass based), but will include a model emissions trading program to facilitate compliance in either case.

Reliability

The final CPP also addresses a wide range of concerns expressed about electric system reliability, particularly if the retirement of coal capacity in response to the plan is excessive. In

addition to the longer lead time for compliance and flexibility of interim goals, the CPP requires states to consider the reliability impact of their implementation plans, allows states to seek revisions to their plans if unanticipated or significant reliability issues arise, and provides for a reliability safety valve to keep reliability critical generation online outside the constraints of carbon emissions. The EPA, Department of Energy and Federal Energy Regulatory Commission have also agreed to coordinate their efforts at the federal level to help ensure reliability.

Framing the Cost of Compliance

Cost estimates for complying with the CPP continue to vary widely despite the release of the final rules. Earlier estimates based on the proposed rules ranged from $5.5 billion to $73 billion per annum, including costs related to demand-side energy-efficiency programs, monitoring, reporting and recordkeeping, and higher energy production costs in many cases. The Southwest Power Pool Inc. (SPP) estimated in a recent study that individual state compliance would require total capital costs of $16.9 billion, or $3.3 billion per annum, largely driven by the need for new capacity by 2030. Compliance on a regional basis would require only $13.3 billion of capital costs.

The EPA has revised its estimates for 2030 compliance costs at approximately $8.4 billion under the rate-based approach and $5.1 billion under the mass-based approach, which are largely in line with earlier estimates. However, more telling is that the EPA projects implementing the CPP using its mass-based goals will result in a nationwide retail price of electricity in 2030 that is only 0.01% higher (10.3 cents/kWh) than its base case estimate. Prices are only modestly higher (0.80%; 10.4 cents/kWh) using the rate-based goals.

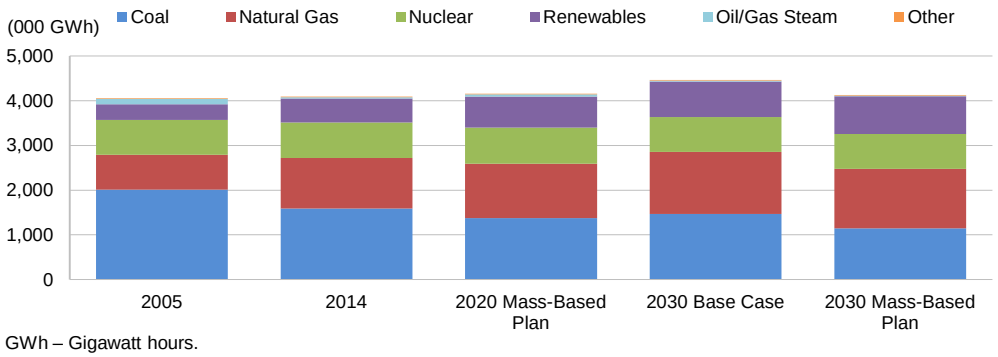
The EPA modeling reflects delivered coal and natural gas prices that remain low by historical standards, and more expansive use of lower cost renewable energy and demand-side energy efficiency. Under the mass-based scenario, delivered natural gas prices trend upward from $4.42 (2011 dollars per million British thermal units) in 2016, but remain under $5.90 through 2030 as natural gas-fired generation grows to an estimated 32% of total energy supply in 2030. Nonhydro renewable energy is expected to grow nearly 60% between 2016 and 2030, led primarily by growth in wind and solar energy. Renewable energy, aided by anticipated growth in hydroelectric production, is expected to account for 20.5% of total energy supply in 2030 and 26.9% in 2040. Renewable energy production accounted for only 15.4% of 2030 energy supply in the EPA's April 2014 modeling and 13% of actual energy supply in 2014.

The effect of energy efficiency is most evident in the EPA's assertion that under the mass-based scenario, the average electric bill will actually decrease by 7.7% by 2030, largely driven by an 8.0% decline in consumption as a result of the plan.

Fitch believes the EPA's assumptions related to energy efficiency, renewable penetration and cost are aggressive. Should these assumptions, together with the economics of gas-fired generation, prove overly optimistic, compliance costs could soar.

A summary of the EPA's forecast generation mix is provided in the *Historical and Projected Nationwide Generation Mix* chart below.

Historical and Projected Nationwide Generation Mix



GWh – Gigawatt hours.
Source: EPA, EIA.

Legal Challenges Certain, but Pressure Will Persist

Legal challenges to the CPP are certain and could defer implementation. However, regardless of the political landscape and outcome of the judicial review process, Fitch believes pressures to reduce carbon emissions will persist over the long term and remain a challenge that public and cooperative utilities will have to address for years to come.

Updating the Analytical Framework

The findings in this report are based on the most recent updates to the framework Fitch developed for analyzing the effect of the EPA's rules to reduce carbon emissions on public power and cooperative utilities. The variables included in this analysis and the application of the final rules still remain subject to change. Fitch will therefore continue to assess future opportunities to update demographic, census and operating data, as well as revise the analysis, recalculate the CCRI and publish the results periodically as appropriate.

Methodology for Calculating the CCRI

The CCRI score for each state is a composite measure of four components: The CRR, average marginal CO2 costs, average retail price of electricity and the affordability ratio as defined in Appendices C–E. The first step in the construction of the composite measure is a calculation of the mean and standard deviation of each component, and the assignment of Z-scores to each metric.

The four corresponding Z-scores for each state are then equally weighted and summed to arrive at a composite Z-score, which reflects the relative influence of each component. Finally, the component Z-scores are rescaled to produce final CCRI scores, where the minimum score is 1 and maximum score is 100.

Appendix A — Carbon Cost Reduction Index Calculations

State	Carbon Reduction Ratio (lbs/MWh)[a]	Rank	Average Marginal CO2 Costs — 2030[b]	Rank	Average Retail Price of Electricity (Cents/kWh)[c]	Rank	Average Annual Cost of Electric/ Median Household Income[c] (%)	Rank	Carbon Cost Recovery Index	Rank
Nebraska	447.6	42	24.3	45	9.7	30	2.8	31	0.83	47
Kansas	487.2	44	19.7	41	9.7	31	2.5	26	0.62	46
Tennessee	295.0	33	14.8	31	9.1	22	3.5	43	0.54	45
Missouri	418.6	41	16.2	37	9.4	27	2.9	33	0.53	44
West Virginia	474.4	43	15.0	34	7.9	6	3.2	40	0.51	43
Alabama	210.1	25	11.2	22	9.0	19	4.0	47	0.48	42
North Dakota	654.2	47	12.0	24	8.2	11	2.5	25	0.40	41
Georgia	232.9	28	14.9	32	9.7	29	3.2	39	0.38	40
Arizona	131.3	19	20.2	42	10.1	33	2.9	34	0.38	39
Montana	379.6	38	20.5	43	8.6	14	2.4	22	0.34	38
Ohio	370.6	37	14.2	29	9.2	23	2.8	30	0.33	37
Indiana	360.6	36	16.9	38	8.7	16	2.6	27	0.29	36
Wisconsin	393.2	39	15.9	36	10.5	35	2.1	14	0.28	35
South Carolina	184.8	21	5.9	18	9.2	25	3.7	45	0.20	34
Wyoming	552.8	46	18.2	40	7.6	2	2.0	11	0.19	33
Mississippi	7.5	11	10.2	21	9.1	21	3.9	46	0.16	32
Oklahoma	261.1	30	14.2	30	7.9	5	3.0	37	0.14	31
Kentucky	522.0	45	2.1	12	7.7	4	3.2	38	0.14	30
Colorado	333.9	34	21.1	44	9.9	32	1.6	1	0.12	29
Florida	92.8	17	11.8	23	10.2	34	3.0	35	0.12	28
Michigan	358.7	35	5.3	16	11.2	38	2.4	20	0.10	27
Texas	192.2	22	13.0	25	8.7	15	3.0	36	0.10	26
Arkansas	251.4	29	10.0	19	7.9	7	3.3	41	0.09	25
California	(41.3)	5	15.4	35	14.3	43	1.9	9	0.06	24
Maryland	274.2	32	4.2	14	11.7	39	2.5	24	0.06	23
New York	42.1	15	0.0	6	15.4	46	2.5	23	0.05	22
Iowa	409.9	40	15.0	33	8.1	9	2.2	17	0.05	21
Pennsylvania	205.9	24	5.7	17	10.6	36	2.8	29	0.00	20
Louisiana	232.4	27	1.8	11	8.0	8	3.6	44	(0.04)	19
Connecticut	(20.7)	8	0.7	9	15.7	47	2.3	18	(0.05)	18
Utah	230.7	26	25.6	47	8.2	10	1.6	2	(0.07)	17
Nevada	36.8	13	13.9	27	9.0	20	2.9	32	(0.07)	16
Minnesota	174.7	20	17.5	39	9.4	28	1.9	10	(0.14)	15
New Mexico	199.7	23	13.1	26	9.3	26	2.2	16	(0.16)	14
North Carolina	101.9	18	0.6	8	9.2	24	3.5	42	(0.16)	13
Massachusetts	40.4	14	0.0	5	14.5	45	1.9	7	(0.29)	12
Idaho	(114.7)	1	24.5	46	7.6	3	2.3	19	(0.34)	11
New Jersey	(107.0)	2	4.8	15	13.7	41	2.1	13	(0.35)	10
New Hampshire	56.1	16	0.0	7	14.3	44	1.7	3	(0.38)	9
Delaware	4.7	10	0.0	3	10.9	37	2.8	28	(0.40)	8
South Dakota	(40.8)	6	14.0	28	8.9	17	2.4	21	(0.40)	7
Rhode Island	31.4	12	0.0	4	13.7	42	1.9	6	(0.40)	6
Illinois	269.3	31	10.1	20	8.3	12	1.7	4	(0.47)	5
Maine	(41.4)	4	1.7	10	11.9	40	1.9	8	(0.66)	4
Virginia	(11.4)	9	3.5	13	9.0	18	2.2	15	(0.76)	3
Oregon	(35.5)	7	0.0	2	8.4	13	2.1	12	(1.03)	2
Washington	(69.2)	3	0.0	1	7.1	1	1.8	5	(1.32)	1

[a]See Appendix B. [b]See Appendix C. [c]See Appendix D.
Source: Fitch.

Appendix B — Carbon Cost Recovery Index and Ranking Changes

	Carbon Cost Recovery Index Ranking		
	January 2015	October 2015	
State	Proposed Clean Power Plan	Final Clean Power Plan	Change in Ranking
Alabama	39	42	(3)
Arizona	47	39	8
Arkansas	44	25	19
California	9	24	(15)
Colorado	35	29	6
Connecticut	41	18	23
Delaware	40	8	32
Florida	46	28	18
Georgia	37	40	(3)
Idaho	2	11	(9)
Illinois	7	5	2
Indiana	18	36	(18)
Iowa	10	21	(11)
Kansas	14	46	(32)
Kentucky	13	30	(17)
Louisiana	24	19	5
Maine	16	4	12
Maryland	19	23	(4)
Massachusetts	26	12	14
Michigan	32	27	5
Minnesota	30	15	15
Mississippi	45	32	13
Missouri	22	44	(22)
Montana	5	38	(33)
Nebraska	17	47	(30)
Nevada	28	16	12
New Hampshire	34	9	25
New Jersey	20	10	10
New Mexico	12	14	(2)
New York	36	22	14
North Carolina	31	13	18
North Dakota	4	41	(37)
Ohio	15	37	(22)
Oklahoma	29	31	(2)
Oregon	3	2	1
Pennsylvania	21	20	1
Rhode Island	6	6	—
South Carolina	27	34	(7)
South Dakota	23	7	16
Tennessee	38	45	(7)
Texas	42	26	16
Utah	33	17	16
Virginia	8	3	5
Washington	1	1	—
West Virginia	43	43	—
Wisconsin	25	35	(10)
Wyoming	11	33	(22)

Source: Fitch.

Appendix C — Carbon-Reduction Ratio Calculations

State	2012 CO2 Emissions (Million Short Tons)	2030 Final Goal CO2 Emissions per CPP (Million Short Tons)	Final Goal CO2 Emissions Reduction (Million Short Tons)	Final Goal CO2 Emissions Reduction (lbs)	2012 Energy Output (TWh)	Estimated 2030 Energy Output (TWh)	Carbon Reduction Ratio
North Dakota	33.37	21.10	12.27	24,533,888,000	36.13	37.50	654.24
Wyoming	50.00	33.47	16.53	33,055,452,000	49.59	59.80	552.77
Kentucky	91.37	63.79	27.58	55,159,292,000	89.95	105.67	521.98
Kansas	34.35	22.22	12.13	24,253,692,000	44.42	49.78	487.17
West Virginia	72.32	51.86	20.46	40,929,192,000	73.41	86.28	474.39
Nebraska	27.16	18.46	8.70	17,394,456,000	34.22	38.86	447.59
Missouri	78.19	56.05	22.13	44,266,652,000	91.80	105.74	418.63
Iowa	38.22	25.28	12.93	25,869,720,000	56.68	63.11	409.93
Wisconsin	42.32	28.31	14.01	28,016,830,000	63.74	71.25	393.23
Montana	17.92	11.96	5.97	11,932,980,000	27.80	31.44	379.58
Ohio	102.36	74.61	27.75	55,503,206,000	129.75	149.76	370.62
Indiana	101.17	76.94	24.23	48,452,980,000	114.70	134.35	360.65
Michigan	69.86	48.09	21.77	43,538,944,000	108.17	121.39	358.68
Colorado	42.38	31.82	10.56	21,121,122,000	52.56	63.26	333.89
Tennessee	41.24	28.66	12.57	25,144,098,000	77.72	85.23	295.02
Maryland	20.17	14.50	5.67	11,347,308,000	37.81	41.38	274.20
Illinois	96.11	67.20	28.91	57,820,726,000	197.57	214.72	269.29
Oklahoma	52.76	41.00	11.76	23,510,452,000	77.90	90.05	261.09
Arkansas	39.94	30.69	9.25	18,501,600,000	65.01	73.58	251.44
Georgia	62.85	46.94	15.91	31,817,484,000	122.31	136.60	232.92
Louisiana	49.07	35.85	13.22	26,440,150,000	103.41	113.77	232.40
Utah	30.82	25.30	5.52	11,039,230,000	39.40	47.85	230.72
Alabama	75.57	57.64	17.94	35,875,028,000	152.88	170.75	210.11
Pennsylvania	116.66	90.93	25.72	51,449,544,000	223.42	249.86	205.91
New Mexico	17.34	13.23	4.11	8,218,508,000	36.64	41.15	199.71
Texas	245.98	198.11	47.87	95,745,992,000	429.81	498.06	192.24
South Carolina	35.90	26.30	9.60	19,197,312,000	96.76	103.90	184.76
Minnesota	28.02	22.93	5.09	10,178,586,000	52.19	58.27	174.68
Arizona	40.47	32.38	8.09	16,170,474,000	110.90	123.18	131.28
North Carolina	58.57	51.88	6.69	13,376,686,000	116.68	131.33	101.85
Florida	118.61	106.64	11.97	23,931,770,000	221.10	257.90	92.79
New Hampshire	4.64	4.06	0.58	1,160,184,000	19.26	20.69	56.06
New York	34.81	31.72	3.09	6,184,904,000	135.77	146.85	42.12
Massachusetts	13.13	12.30	0.83	1,650,042,000	36.20	40.84	40.40
Nevada	15.49	14.72	0.77	1,538,416,000	35.17	41.85	36.76
Rhode Island	3.74	3.58	0.15	305,562,000	8.31	9.74	31.38
Mississippi	25.90	25.67	0.24	475,174,000	54.58	63.16	7.52
Delaware	4.81	4.78	0.02	49,284,000	8.63	10.42	4.73
Virginia	27.37	27.83	(0.46)	(920,130,000)	70.74	80.39	(11.45)
Connecticut	6.66	7.06	(0.40)	(806,202,000)	36.12	38.98	(20.68)
Oregon	7.67	8.82	(1.15)	(2,300,090,000)	60.93	64.86	(35.46)
South Dakota	3.33	3.58	(0.25)	(503,144,000)	12.03	12.33	(40.81)
California	48.20	52.82	(4.62)	(9,240,112,000)	199.52	223.97	(41.26)
Maine	1.80	2.11	(0.31)	(626,438,000)	14.43	15.14	(41.37)
Washington	7.36	11.56	(4.20)	(8,400,596,000)	116.84	121.45	(69.17)
New Jersey	13.04	16.88	(3.84)	(7,672,310,000)	65.26	71.70	(107.01)
Idaho	0.71	1.64	(0.93)	(1,867,082,000)	15.50	16.28	(114.65)

CO2 – Carbon dioxide. TWh – Terawatt hours. Note: Carbon reduction ratio is the final goal CO2 emissions reduction divided by estimated 2030 energy output (lbs/MWh).
Source: EPA, EIA.

Appendix D — Marginal Cost of Carbon Reduction

State	Marginal CO2 Costs (2011 $/Ton) 2030
Utah	25.59
Idaho	24.47
Nebraska	24.35
Colorado	21.09
Montana	20.49
Arizona	20.18
Kansas	19.70
Wyoming	18.22
Minnesota	17.47
Indiana	16.91
Missouri	16.18
Wisconsin	15.91
California	15.40
West Virginia	15.04
Iowa	15.04
Georgia	14.91
Tennessee	14.83
Oklahoma	14.24
Ohio	14.19
South Dakota	13.99
Nevada	13.94
New Mexico	13.10
Texas	13.02
North Dakota	11.96
Florida	11.76
Alabama	11.19
Mississippi	10.18
Illinois	10.08
Arkansas	10.05
South Carolina	5.94
Pennsylvania	5.71
Michigan	5.30
New Jersey	4.75
Maryland	4.15
Virginia	3.52
Kentucky	2.13
Louisiana	1.79
Maine	1.72
Connecticut	0.73
North Carolina	0.55
Delaware	0.00
Massachusetts	0.00
New Hampshire	0.00
New York	0.00
Oregon	0.00
Rhode Island	0.00
Washington	0.00

CO2 – Carbon dioxide. Note: Marginal costs are from EPA Integrated Planning Model results from mass-based Clean Power Plan compliance scenario reporting the shadow price on the lbs/MWH emissions rate constraint.
Source: EPA.

Appendix E — Electric Rates and Affordability Ratios

State	Electric Cost Affordability				Retail Electric Rates (Cents/kWh)[a]
	Average Monthly Residential Electric Bill ($)[a]	Average Yearly Residential Electric Bill ($)	Median Household Income ($)[b]	Affordability Ratio[c] (%)	
Alabama	136.4	1,636.3	41,381	4.0	9.0
Arizona	122.8	1,474.2	50,602	2.9	10.1
Arkansas	108.6	1,303.7	39,919	3.3	7.9
California	90.2	1,082.3	57,528	1.9	14.3
Colorado	84.9	1,018.9	63,371	1.6	9.9
Connecticut	132.1	1,584.8	67,781	2.3	15.7
Delaware	122.3	1,467.0	52,219	2.8	10.9
Florida	121.5	1,458.4	47,886	3.0	10.2
Georgia	124.7	1,496.0	47,439	3.2	9.7
Idaho	98.4	1,180.2	51,767	2.3	7.6
Illinois	80.6	966.8	57,196	1.7	8.3
Indiana	110.4	1,325.3	50,553	2.6	8.7
Iowa	100.3	1,203.6	54,855	2.2	8.1
Kansas	107.9	1,294.2	51,485	2.5	9.7
Kentucky	113.0	1,355.4	42,158	3.2	7.7
Louisiana	120.0	1,439.8	39,622	3.6	8.0
Maine	79.1	949.6	50,121	1.9	11.9
Maryland	136.6	1,639.6	65,262	2.5	11.7
Massachusetts	101.0	1,211.7	62,963	1.9	14.5
Michigan	97.0	1,163.4	48,801	2.4	11.2
Minnesota	96.5	1,158.1	60,907	1.9	9.4
Mississippi	131.5	1,577.9	40,850	3.9	9.1
Missouri	122.0	1,463.8	50,311	2.9	9.4
Montana	88.9	1,066.2	44,132	2.4	8.6
Nebraska	125.7	1,508.5	53,774	2.8	9.7
Nevada	109.9	1,319.3	45,369	2.9	9.0
New Hampshire	102.7	1,231.9	71,322	1.7	14.3
New Jersey	108.1	1,297.2	61,782	2.1	13.7
New Mexico	76.6	918.8	42,127	2.2	9.3
New York	113.2	1,358.0	53,843	2.5	15.4
North Carolina	120.5	1,446.2	41,208	3.5	9.2
North Dakota	109.8	1,318.2	52,888	2.5	8.2
Ohio	107.1	1,284.9	46,398	2.8	9.2
Oklahoma	110.6	1,326.6	43,777	3.0	7.9
Oregon	96.6	1,158.9	56,307	2.1	8.4
Pennsylvania	124.3	1,491.5	53,952	2.8	10.6
Rhode Island	91.5	1,097.7	57,812	1.9	13.7
South Carolina	134.9	1,618.3	43,749	3.7	9.2
South Dakota	108.2	1,298.6	54,453	2.4	8.9
Tennessee	124.2	1,491.0	42,499	3.5	9.1
Texas	133.3	1,599.9	53,027	3.0	8.7
Utah	82.8	993.5	62,967	1.6	8.2
Virginia	125.4	1,504.4	67,620	2.2	9.0
Washington	90.5	1,086.6	60,106	1.8	7.1
West Virginia	106.4	1,277.3	40,241	3.2	7.9
Wisconsin	95.2	1,142.5	55,258	2.1	10.5
Wyoming	90.8	1,090.2	55,700	2.0	7.6

[a]2013 EIA data. [b]2013 U.S. Census data. [c]Affordability ratio is the average yearly residential bill divided by median household income.
Source: EIA, U.S. Census.