SPP Clean Power Plan Compliance Assessment

April 8, 2015

SPP Engineering

Southwest Power Pool

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Executive Summary

Following the Environmental Protection Agency's (EPA) issuance in June 2014 of the proposed Clean Power Plan (CPP) – which would cut by 30 percent existing power plant carbon emissions from 2005 levels by 2030 – Southwest Power Pool (SPP) performed a reliability impact assessment evaluating the impacts of the plan's projected generation-unit retirements on the reliability of the SPP region's bulk power system. SPP published its assessment and submitted comments based on that assessment to the EPA on Oct. 9, 2014[1].

In January 2015, SPP's Strategic Planning Committee (SPC) directed SPP staff to proceed with a second CPP assessment to identify impacts on existing and planned resources, identify at-risk generation in SPP's region, evaluate resource-planning measures to facilitate compliance with the proposed carbon emission goals, and estimate compliance costs. The SPC instructed staff to analyze regional compliance first, followed by a state-by-state compliance assessment. This report includes information and results from the regional compliance analysis. A future revision will include additional results and information from the state-by-state analysis.

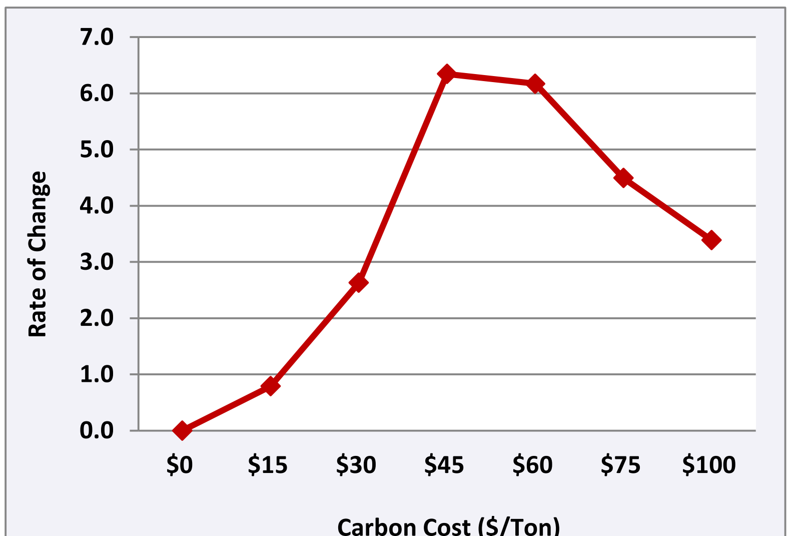

Figure 1: Rate of Change of SPP Emissions Rate per Carbon Cost

An estimate of SPP's regional share of the state carbon emissions goals was used to evaluate a range of carbon-reduction measures for the SPP region. A vital part of the analysis was identifying and applying an effective carbon cost adder, which, when coupled with modifications to current resource plans, provided a look at what may be needed to meet SPP's regional emissions goal by 2030. To determine an effective carbon cost adder, SPP evaluated the relationship between emission rate reductions and a series of carbon cost increases. As seen in Figure 1, a $45/ton carbon cost adder was determined to be most effective[2] based on the carbon emission rate reduction achieved per increase in carbon cost adder applied.

A 2030 compliance case was developed incorporating a $45/ton carbon cost adder and adding 5.6 gigawatts (GW) of wind resources and 1.2 GW of gas-fueled resources above currently planned

[1] SPP's comments and reliability assessment report can be found at http://www.spp.org/publications/2014-10-09_SPP%20Comments_EPA-HQ-OAR-2013-0602.pdf
and http://www.spp.org/publications/CPP%20Reliability%20Analysis%20Results%20Final%20Version.pdf

[2] It is possible that a carbon cost adder higher than $30/ton and less than $45/ton would have been found to be more effective but for purposes of this analysis SPP only evaluated carbon cost adders in increments of $15/ton, except for the final increment of $25/ton.

capacity. As shown in Figure 2, the compliance case analysis indicated an ability to meet SPP's estimated regional goal of 1,309 lbs/megawatt-hour (MWh) of CO_2 emissions by 2030.

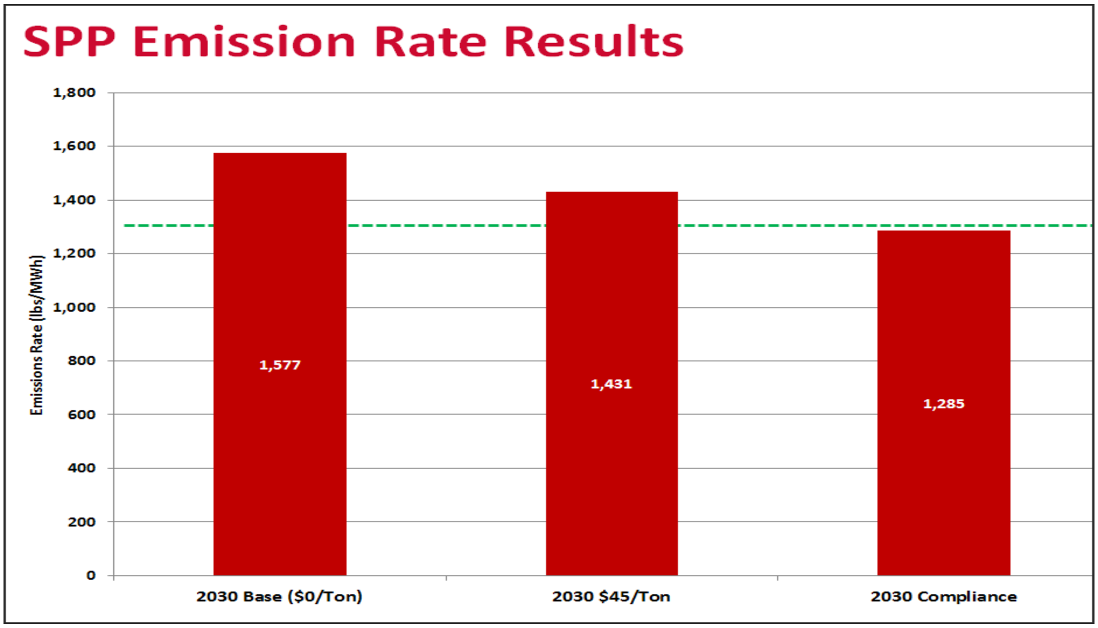

Figure 2: Emission Rate Results under Assessed Scenarios

In the 2030 compliance scenario, SPP's analysis assumed approximately 2,200 megawatts (MW) of coal retirements incremental to those retirements already planned, based on those generators operating below a 30 percent capacity factor after application of a $45/ton carbon cost adder (see Figure 3). This assumption may be conservative considering that SPP's analysis indicates nearly all existing coal-fired generation in the region would operate above 80% capacity factor without a carbon cost adder but approximately 12,200 MW of coal-fired generation would operate below 80% capacity factor with a $45/ton cost adder. Based on that observation and identification of an additional 1,700 MW of generation retirements contained in updated resource planning information, SPP concludes that up to 13,900 MW of generation beyond that assumed in its most recent transmission planning models is at risk for retirement.

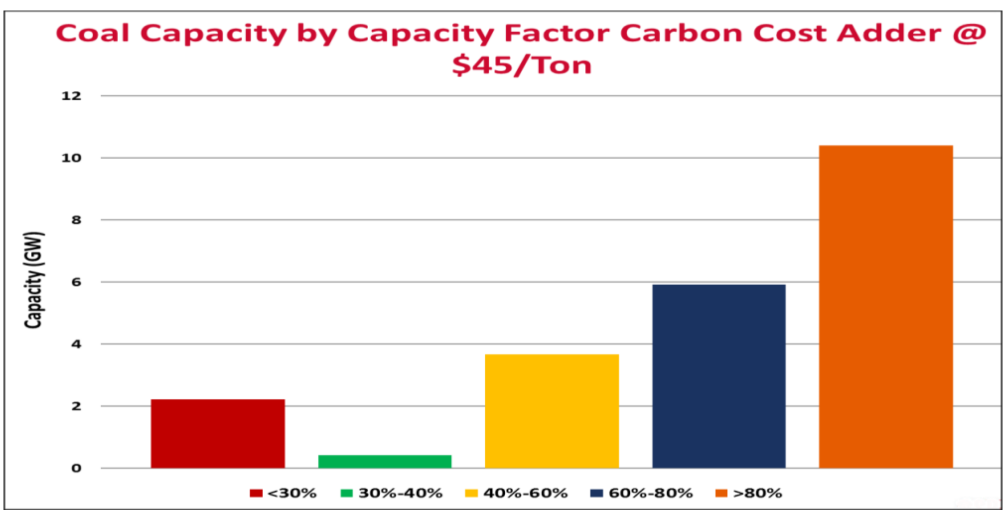

Figure 3: Coal Capacity by Capacity Factor at $45/Ton Carbon Cost

Table 1 below shows that the approach SPP developed to comply with the CPP on a regional basis would result in $600 million per year of increased energy costs and $13.3 billion in total capital costs (in 2015 dollars) for the SPP region. These values equate to annual compliance costs of $2.9 billion. As described above and in more detail later in this report, regional compliance was achieved with application of a $45/ton carbon cost adder and the addition of 6.9 GW of generating capacity beyond that included in currently available utility resource plans.

Scenario	CO2 Emissions (billion tons)	System Production Cost Delta (2015$B)	Carbon Cost Adder Price ($/ton)	Change in Capital Cost of Resource Plan (2015$B)	Incremental Capacity (GW)
Base Case - Current Resource Plan	407	-	$0	-	-
Carbon Price Case - Current Resource Plan	344	$1.4	$45	-	-
Compliance Resource Plan Case	336	$0.6	$45	$13.3	6.9

*2015 dollars

Table 1: Summary of Scenario Results

Background

The U.S. Environmental Protection Agency (EPA) released the CPP[3] on June 2, 2014. This proposed rule expects to reduce greenhouse gas emissions in the form of carbon dioxide (CO_2) from existing fossil-fueled electric generating units, and proposes cutting existing power-plant carbon emissions 30 percent by the year 2030, from 2005 levels. As currently proposed, the CPP will be implemented through state-developed plans that meet carbon reduction goals set by the EPA for each state. The goals established for each state are based on EPA's assumptions about what can be accomplished through generator-efficiency improvements, redispatch from coal to gas fueled generation, increased reliance on renewable resources, sustenance of nuclear generation, and increased energy efficiency. While the state goals are established based on these assumptions, the EPA offers states flexibility as to how they accomplish their goals. State plans will be required as early as 2016 but may be deferred until 2018, subject to collaborative approaches and regional solutions. The EPA's state-specific carbon-reduction goals are proposed to be effective on an interim basis in 2020 with final goals effective by 2030.

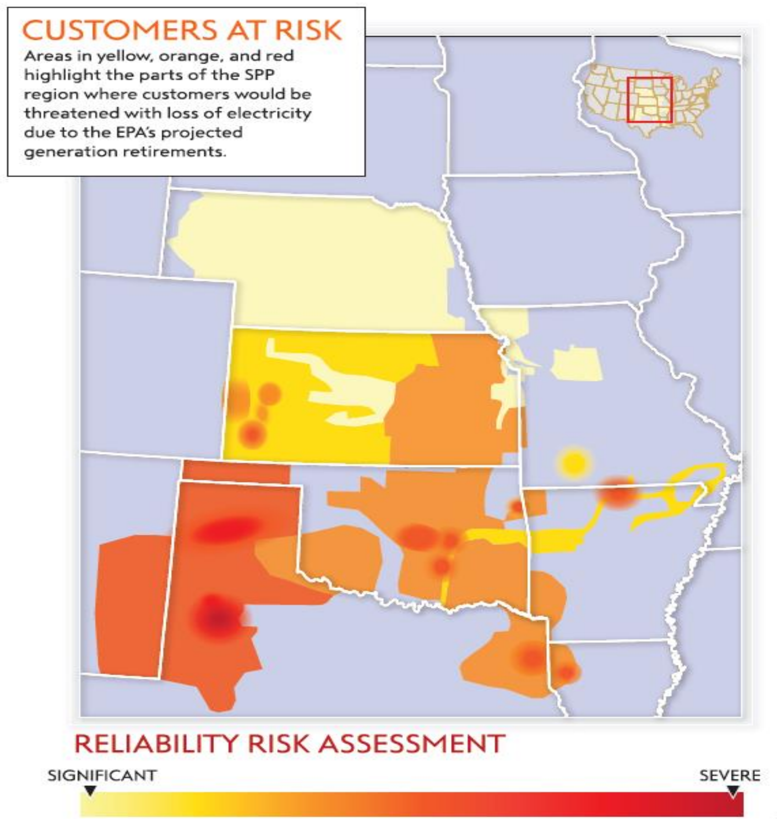

Figure 4: Areas in SPP at Risk for Loss of Electricity

The EPA projected the retirement of approximately 9,000 MW of Electric Generating Unit (EGU) capacity currently relied upon to serve load in the SPP region. These projected EGU retirements represent approximately 6,000 MW of additional retired capacity beyond that currently expected by 2020.

SPP published results in October 2014 of an assessment[4] of reliability impacts on the region's electric grid as a result of the proposed CPP. SPP's analysis revealed the EGU retirements projected by the EPA will cause significant reactive power deficiencies and numerous overloaded facilities that will need to be mitigated with additional generation and transmission infrastructure. Figure 4 highlights the parts of the SPP region where customers could be threatened with electricity losses due to the EPA's projected generation retirements.

[3] Clean Power Plan Proposed Rule: http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule
[4] Reliability Impact of EPA's Proposed Clean Power Plan. http://www.spp.org/publications/CPP%20Reliability%20Impact%20Oct%2014.pdf

The SPP Strategic Planning Committee (SPC) in January directed SPP staff to further assess the CPP's reliability and economic impacts on the SPP region. Specifically, staff was asked to evaluate resource mix and dispatch expectations indicative of compliance with the CPP on a regional basis and on a state-by-state basis. The SPC instructed SPP's analysis to focus first on regional compliance, and then state-by-state compliance. Staff was also asked to develop an indicative timeline of actions and activities necessary to ensure compliance with the CPP.

This report includes information and results from SPP's regional compliance analysis. A future revision will include additional information and results from the state-by-state analysis.

Overview of Clean Power Plan

The EPA's proposed CPP only applies to existing fossil-fueled generators, defined as fossil fuel generators in service or under construction as of Jan. 8, 2014. Natural gas combined-cycle units (CCs) and combustion turbines (CTs) under construction after Jan. 8, 2014 are considered new resources and are not automatically subject to the proposed CPP. Instead, these units are subject to New Source Performance Standards (NSPS) under Section 111(b) of the Clean Air Act.

The EPA has proposed, however, that states may opt to include new resources in their Section 111(d) compliance plans. The proposed CPP sets emissions rate targets for each state, expressed as pounds of CO_2 emitted per megawatt-hour of energy generated (lbs/MWh). Power produced by renewable energy resources and verifiable energy savings from energy efficiency would count toward a reduction in a state's emission rate.

Compliance with the EPA's proposed CPP is set to begin in 2020 with interim goals applied over a 10-year period and final goals to be achieved by 2030. During the interim period, states are allowed to average emissions, either "banking" earlier emissions reductions to be used in later years of the interim period, or "borrowing" reductions that must be repaid in later years of the interim period. Compliance with the final goals begins in 2030.

Compliance Plan Submission

The EPA proposed the implementation timeline shown below in Figure 5. States that decide to comply with the proposed CPP on a stand-alone basis must submit their compliance plans for approval by June 30, 2016. States that decide to comply with the proposed CPP on a multi-state or regional basis must also submit compliance plans by June 30, 2016. The EPA, however, has provided states the opportunity to request extensions to their compliance plans' filing dates. States complying on a stand-alone basis can request a one-year extension to June 30, 2017; states complying on a multi-state or regional basis may request a two-year extension to June 30, 2018.

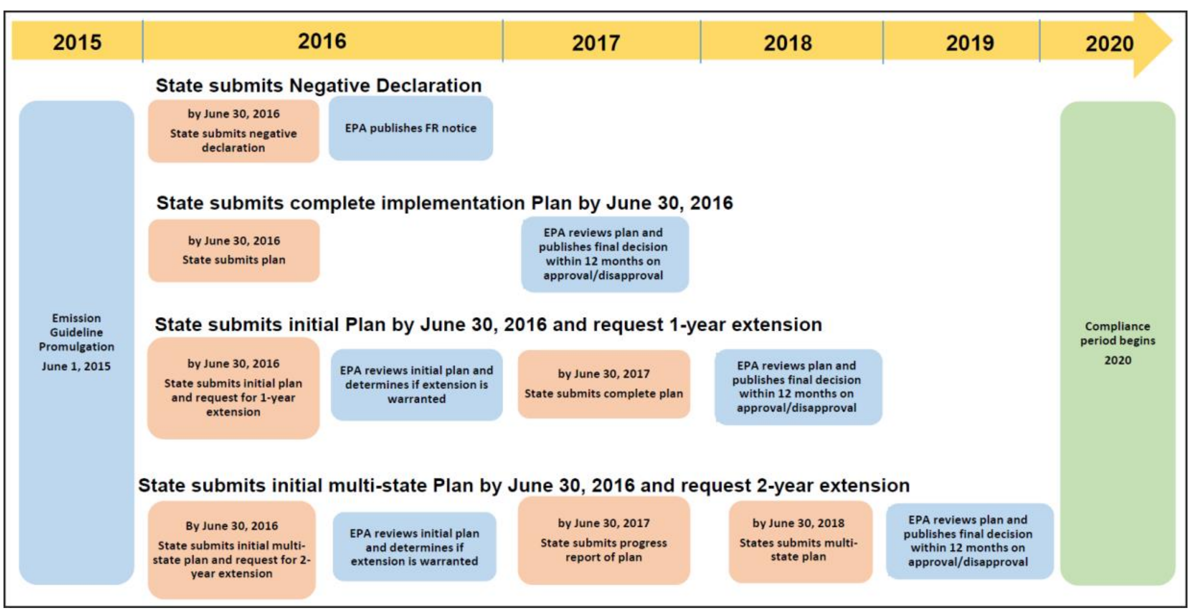

Figure 5: EPA Proposed Implementation Timeline

CPP Building Blocks

The EPA developed goals for each state based on use of four "building blocks" it described as the best system of emission reductions under the Clean Air Act[5] (see Figure 6). While the EPA refers to these building blocks as the best system, it does not require states to follow these steps exclusively. The EPA gives states the freedom to develop their own plans for compliance that may include elements of the building blocks or proposed methods outside EPA's recommendations. The EPA sets the state-specific goals and allows the states the flexibility to formulate their compliance plans necessary for meeting those goals.

Building Block	Value Allocated in Goal-Setting Formula
Make fossil fuel power plants more efficient • Improve equipment and processes to get as much electricity as possible from each unit of fuel • Using less fossil fuel to create the same amount of electricity means less carbon pollution.	Average heat rate improvement of 6% for coal steam electric generating units (EGUs)
Use low-emitting power sources more • Using lower-emitting power plants more frequently to meet demand means less carbon pollution.	Dispatch to existing and under-construction natural gas combined cycle (NGCC) units to up to 70% capacity factor
Use more zero- and low-emitting power sources • Expand renewable generating capacity, which is consistent with current trends. • Using more renewable sources, including solar and wind, and low-emitting nuclear facilities, means less carbon pollution.	Dispatch to new clean generation, including new nuclear generation under construction, moderate deployment of new renewable generation, and continued use of existing nuclear generation
Use electricity more efficiently • Reducing demand on power plants is a proven, low-cost way to reduce emissions, which will save consumers and businesses money and mean less carbon pollution.	Increase demand-side energy efficiency to 1.5% annually

Figure 6: Proposed CPP Building Blocks

[5] EPA Fact Sheet: Clean Power Plan. http://www2.epa.gov/sites/production/files/2014-05/documents/20140602fs-setting-goals.pdf

SPP's Regional Compliance Assessment Methodology

The objectives of the regional compliance assessment were to:

1. Evaluate the CPP's impact on existing resources and publically available resource plans under a regional compliance approach.
2. Evaluate and report on effects of regional compliance with final goals.

The following steps were taken to assess SPP regional compliance with the proposed CPP:

- Develop a regional carbon emission goal by estimating SPP's share of the EPA's proposed carbon emissions goals for the states with generation operating in SPP.
- Develop a 2030 Business-as-Usual (BAU) Reference Case.
    - Incrementally apply resource changes from publically available data.
- Evaluate a range of carbon-reduction measures for the SPP region.
    - Apply a carbon cost adder to effectively drive generation dispatch toward the regional carbon emission goal.
    - Implement incremental resource plan changes capable of meeting the regional emission goal.
    - Test potential energy efficiency measures.
- Identify impacts on existing and planned resources.
- Develop an indicative timeline relying on data SPP already has for transmission planning, development, and construction activities, along with information gathered from members, regulators, and other public sources for activities that SPP is not typically involved with.

Data Collection

Data concerning plans for new, retrofitted, converted, and retired generation was collected by researching Integrated Resource Plans (IRPs) and other publically available information for entities operating in the SPP region and surrounding areas.

The IRP data, EPA modeling assumptions, and public data were compiled by adding retirements, retrofits, conversions, and new generation to a spreadsheet. This information was compared against generation data contained in SPP's 2015 Integrated Transmission Plan 10-Year Assessment (ITP10) economic model. Differences in retirement dates, commission dates, and capacities between the researched data and the 2015 ITP10 model were flagged for review. This review identified 1.7 GW of coal retirements and 1.3 GW of coal-to-gas conversions by 2030 not present in the ITP10 model. SPP also identified an additional 925 MW of reduced coal capacity by assuming a 5 percent impact from planned activities expected to result in generating facility de-ratings.

Model Development

A 2030 BAU model was developed using previous stakeholder reviewed resource and load projections for the 2015 ITP10 2024 Future 1 and Regional Cost Allocation Review (RCAR) II 2034 models. The ITP10 resource plan was developed using Ventyx's (an ABB Company) Strategist zonal capacity expansion software. This resource plan maintains a minimum 12 percent capacity margin[6] for each load zone per SPP Criteria. The RCAR II 2034 study model's resource plan was developed by maintaining the same CC-to-CT ratio as the 2013 Integrated Transmission Plan 20-Year Assessment (ITP20) Future 1 2033 resource plan. Wind requirements to meet statutory/ regulatory state mandates and goals were extrapolated based on the SPP's 2015 Renewable Survey.

SPP member IRPs and other publicly available data described in the data-collection section were included in developing the BAU reference case to address the vintage of the study models leveraged in its development.

Additional generating units were needed to achieve resource adequacy due to the 2030 study year's retirements and those identified in IRPs and other public sources. Each zone's peak-load obligation was extrapolated to the 2030 study year and a corresponding resource need based on capacity margin requirements was calculated. If the generation assigned to each zone was below the calculated resource need, units were added. SPP used a combination of advanced CCs and advanced CTs, as defined by U.S. Energy Information Administration (EIA) prototypes, to make up any shortfalls. Rather than use the Strategist tool to select the combination of units, a CC-to-CT capacity ratio of approximately 1.0 was used; this ratio is reflective of the Strategist-selected units for the 2013 ITP20 Future 1 2033 model, and was used to develop the RCAR II 20-year resource plan. Eight 400-MW CCs and 17 210-MW CTs were used in the BAU reference case, along with the 2015 ITP10 Future 1 2024 resource plan. Figure 7 shows the resource adjustments for the 2030 BAU reference case.

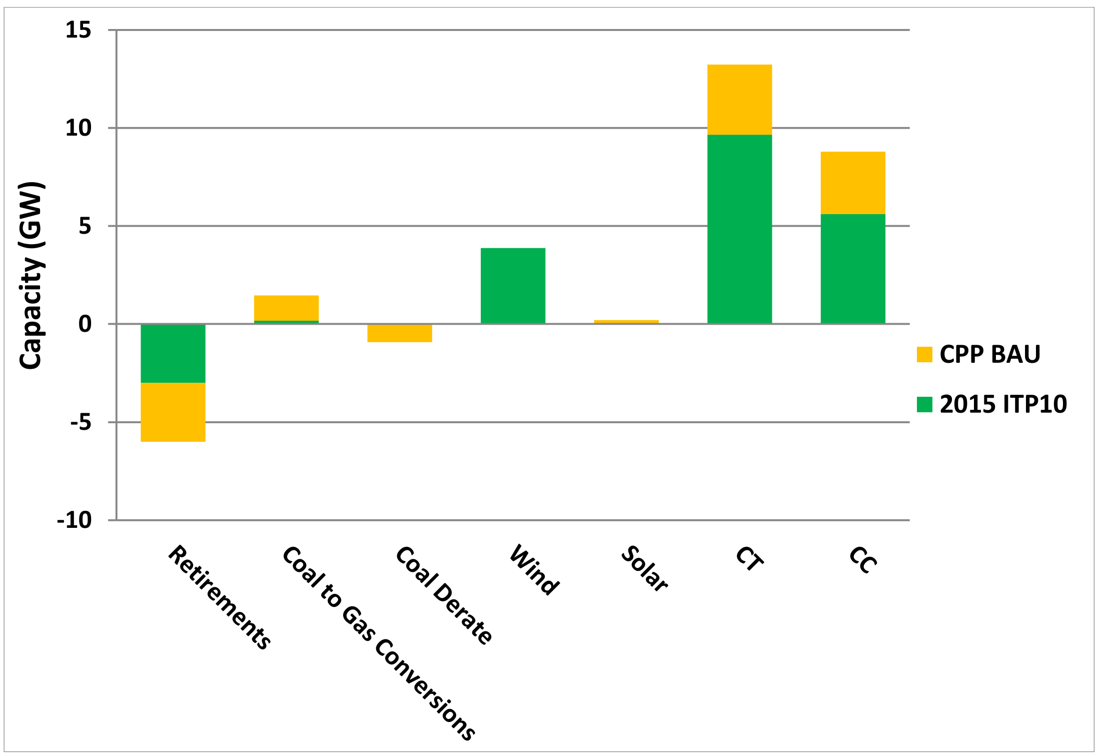

Figure 7: 2030 Reference Case Resource Plan

[6] The Western Area Power Administration, Basin Electric Power Cooperative, Heartland Consumer Power District, and Corn Belt Power Cooperative of the Integrated System were included as a part of the SPP region in this analysis but resource needs for these companies followed the Mid-Continent Area Power Pool (MAPP) criteria for the 2015 ITP10 resource plan.

Developing the SPP Regional Carbon Emissions Goal

The SPP regional carbon emissions goal (lbs/MWh) was derived using the same methodology used by the EPA in developing each of the state carbon emission goals. The baseline emission rate for SPP was established by determining the emission rates of affected generation operating in the SPP region contained in the EPA's baseline data. SPP's portion of the output of affected fossil-fueled and nuclear units operating in multiple regions was derived from the percentage utilized by SPP entities. The ratio of all SPP member-owned generation to the state's total generating capacity, excluding wind capacity, was used to apportion a state's Renewable Energy and Energy Efficiency impacts on the SPP regional goal.

An SPP regional emissions rate target of 1,309 lbs/MWh was determined by using these assumptions and the same EPA calculations used to determine individual state targets. Figure 8 shows the comparison of the EPA-developed state targets to the SPP-derived regional target.

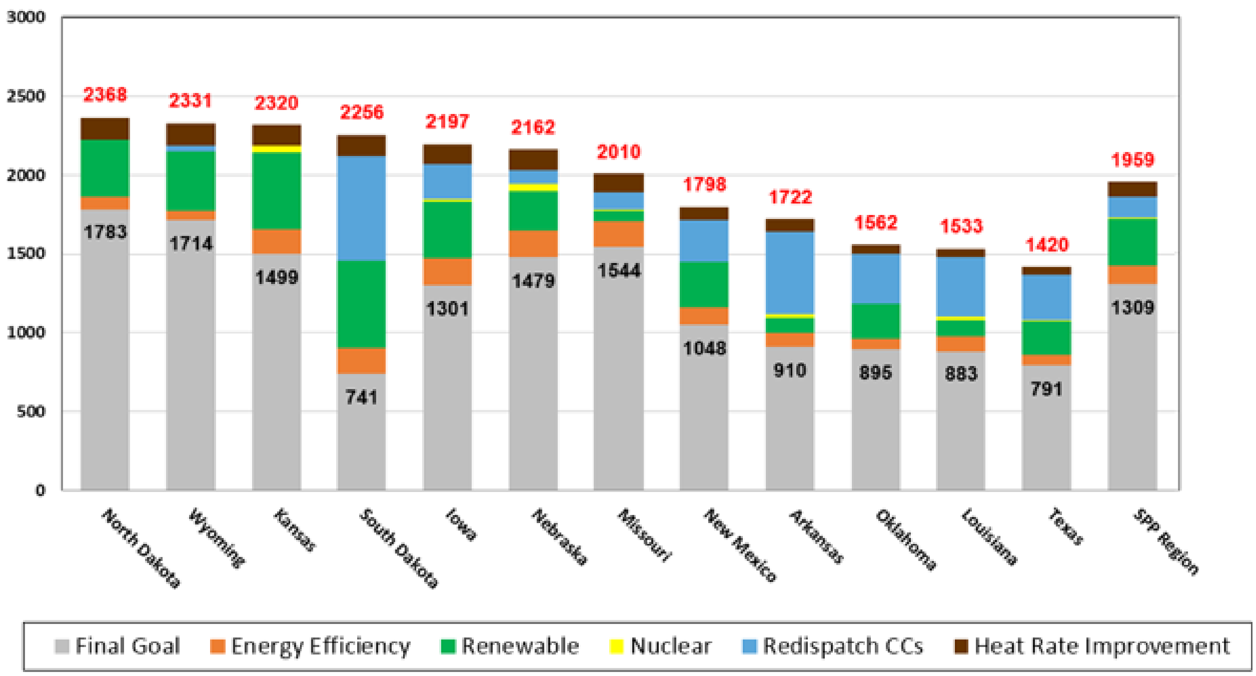

Figure 8: State and SPP Regional CO_2 Emission Rate Targets

Analysis

SPP used PROMOD version 11.1 to analyze the EPA's proposed CPP. PROMOD is a production cost-modeling software tool developed by Ventyx; it performs a security-constrained economic weekly unit commitment and hourly dispatch.

In assessing compliance impact on a regional basis, the SPP market was modeled to meet hourly system demand obligations by committing and dispatching the region's least-cost mix of available resources. Unlike the ITP process, the analysis did not consider economic interchange with other regions. This minimized the uncertainty associated with trying to determine how SPP's neighbors will operate under their own compliance with the CPP.

This analysis also assumed a "copper sheet" system in which PROMOD's security-constrained option was not used to commit and dispatch SPP's available generation. The commitment and dispatch did not consider transmission congestion to minimize the uncertainty of resource-expansion siting choices and to closely align with a capacity expansion software tool that will be used in actual implementation of an emissions rate-compliance resource plan. While this last assumption does not include the effects of transmission congestion costs in the analysis, the ultimate goal is a comparison of CPP regional implementation versus state implementation. The analysis did not compare compliance-plan implementation costs with SPP and members' planning under current regulations.

SPP's goal was not to analyze each of the EPA building blocks, but to implement reasonable carbon-abatement measures capable of meeting the regional emissions rate target.

Compliance Case Development

Using the BAU reference case, SPP first analyzed a series of carbon cost adders. A carbon cost adder is applied as a tax on the CO_2 emissions output of each fossil unit. This affects the dispatch of each fossil resource by increasing the cost of CO_2 output per MWh produced. In order to determine the SPP region's appropriate cost of carbon and the impact on the assumed SPP fleet, staff analyzed a range of $/ton of carbon emissions adders in $15 increments from $0-$75, with a $100 high end. As the carbon cost increases, a noticeable shift in the generating units' fuel mix is seen. Figure 9 shows the average capacity factor of certain fossil units by unit type over the range of carbon cost adders analyzed.

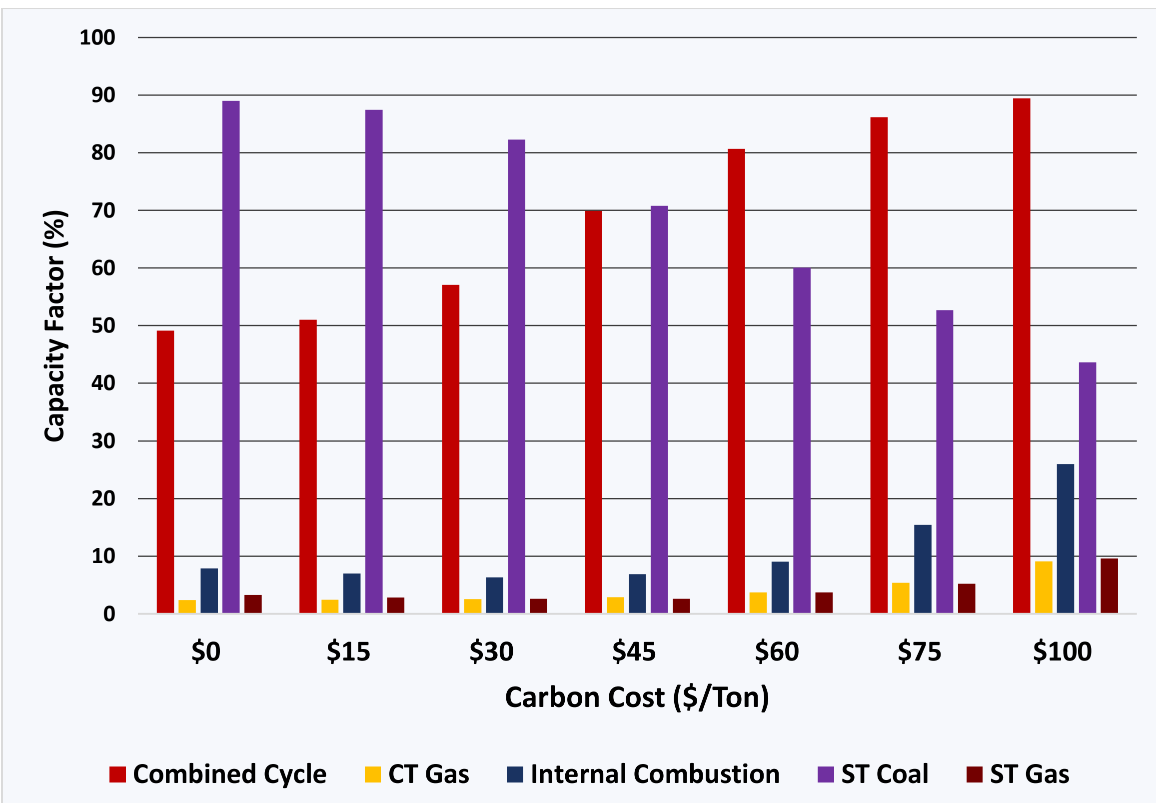

Figure 9: Average Capacity Factor by Unit Type

As the cost of carbon begins to create a shift in fuel usage from coal to gas, the amount of coal capacity that could likely be affected by the emission rate targets increases. Figure 10 shows that under a BAU reference case assumption, all SPP coal units are operating at a capacity factor of 60 percent or greater. As the $/ton of carbon emissions cost increases, the amount of units operating below a 60 percent capacity factor encompasses nearly 15 GW of the SPP coal fleet.

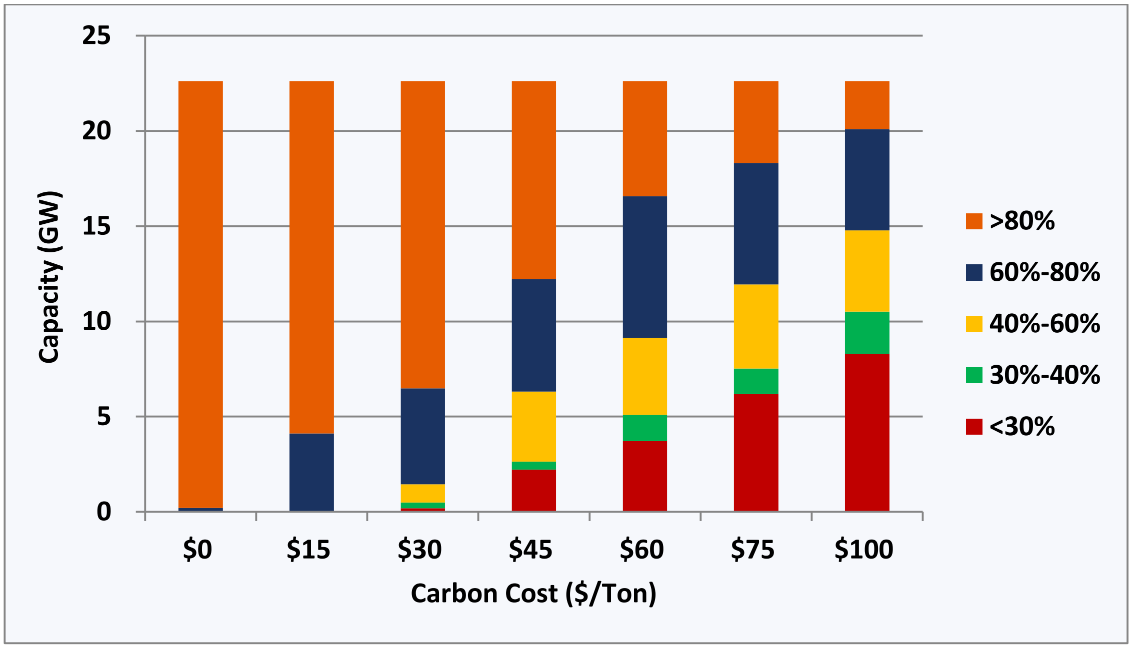

Figure 10: Coal Capacity by Average Capacity Factor

There was also a noticeable change in the point at which the carbon cost adder began to become less effective for each increase. Figure 11 shows the SPP region's emissions rate at each level of carbon cost adder analyzed. The dashed line represents the region's target rate.

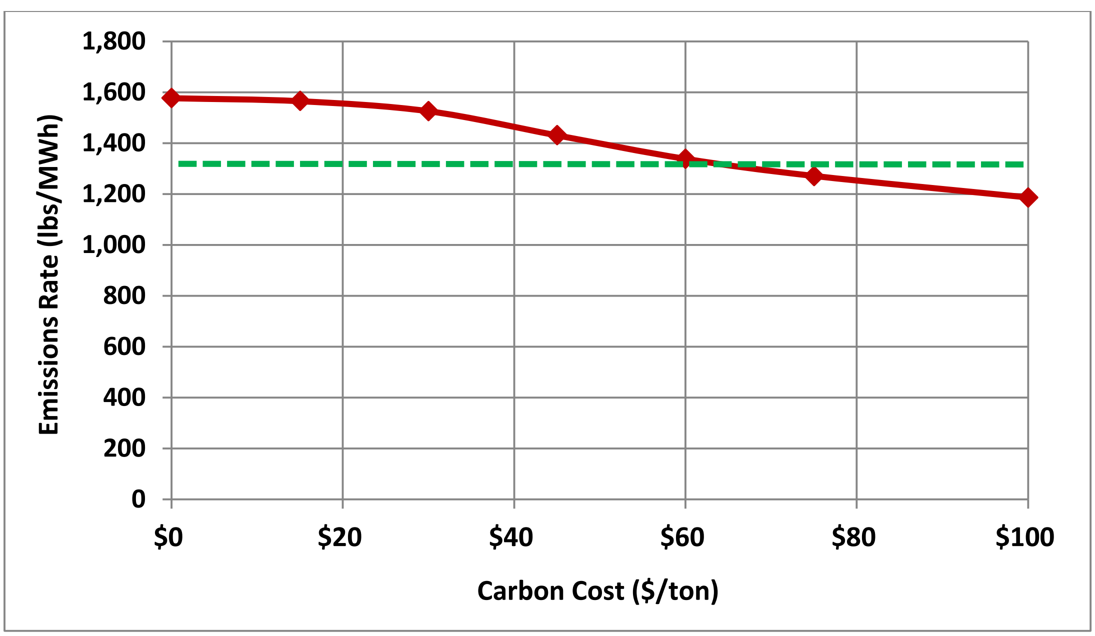

Figure 11: SPP Emissions Rate per Carbon Cost

The carbon emissions rate reduction increases dramatically from \$15/ton of CO_2 to \$45/ton, and clearly exhibits a drop-off after \$45/ton. A decrease in the rate of change is seen after \$60/ton, indicating a clear point of diminishing returns. This is shown in Figure 12.

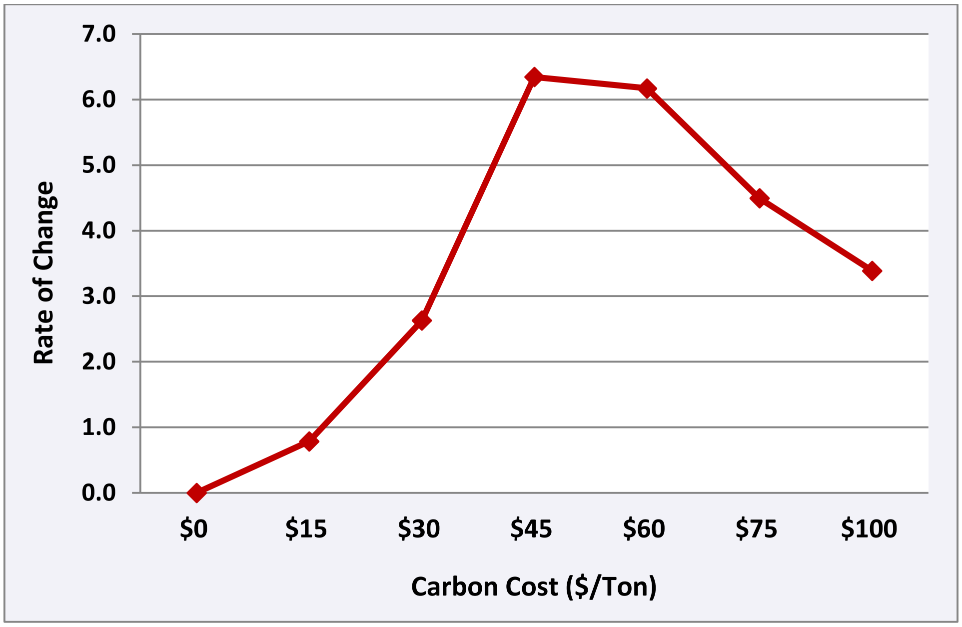

Figure 12: Rate of Change of SPP Emissions Rate per Carbon Cost

Based on these results, a \$45/ton carbon cost adder was selected as the first assumption in developing the compliance scenario. With a cost to carbon and the resulting reduced operation of coal units in the SPP region, a certain amount of coal capacity will be at risk. SPP does not know what decisions each member utility will make in such units' future operation, but it is assumed some utilities will make the business decision to retire a unit due to reduced operation. For this analysis, SPP chose to retire a group of units operating at less than 30 percent capacity factor, resulting in an additional 2,200 MW of coal retirements. Figure 13 shows the coal capacity by capacity factor percentage for the SPP region, assuming a \$45/ton carbon cost.

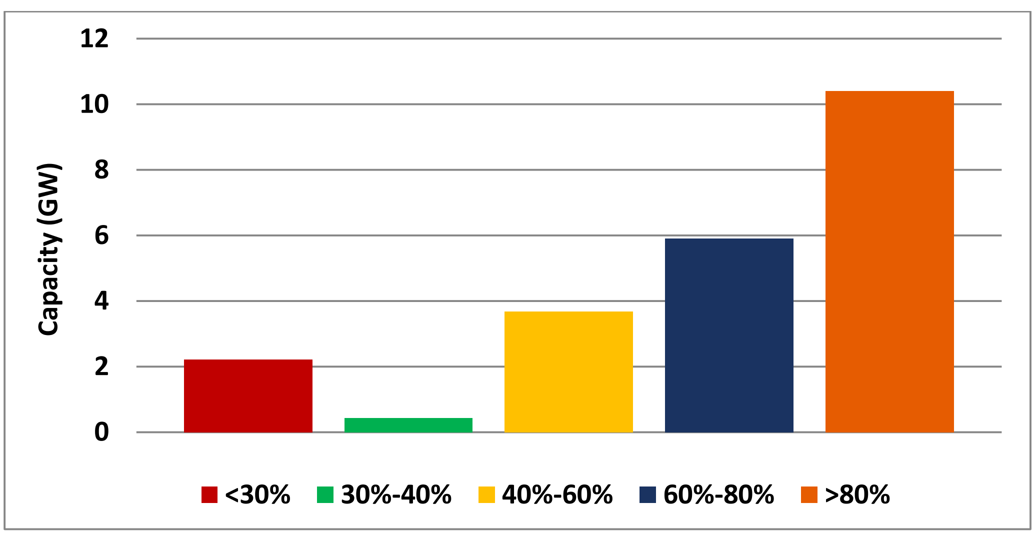

Figure 13: Coal Capacity by Capacity Factor at \$45/Ton Carbon Cost

Increasing the cost of carbon to a reasonable value reduced the carbon emissions rate from 1,577 lbs/MWh to 1,431 lbs/MWh, but did not meet the SPP regional goal of 1,309 lbs/MWh. Given the strong potential for wind energy in certain geographical areas of the SPP region, the next step to implement additional carbon abatement assumed a certain amount of wind energy availability.

Attachment J to the SPP Tariff details recovery of costs associated with new transmission facilities; it allows a transmission customer to designate wind resources up to 20 percent of its peak-load responsibility and still be eligible to receive base-plan funding for service-upgrade costs. Given the high capacity factor wind available in SPP, it was assumed the region would meet or exceed this amount of wind development under CPP compliance. An additional 5.6 GW of wind capacity was included in the compliance resource plan to meet 25 percent of the non-coincident peak-load obligations within the SPP region.

The retirement of potential at-risk coal capacity and the addition of 5.6 GW of wind capacity required an adjustment to the compliance scenario's resource plan to maintain a 12 percent capacity margin or greater. Taking technology advancements of new wind into account and its possible acceleration through CPP compliance, a 10 percent accreditation toward capacity-margin requirements was used for new wind generation; this was an increase to the 2015 ITP10's existing 5 percent accreditation assumption. Each load zone's shortfall was reevaluated and conventional generation was considered to meet capacity-margin requirements.

An initial compliance case resource plan using the same CC–to-CT capacity ratio was developed, but the ratio needed to be reassessed due to the amount of additional wind capacity. Wind generation is considered an energy-only resource because of its low capacity accreditation. On the other hand, CTs are considered to be a capacity-only resource because they are peaking units and seldom run, but have a 100 percent capacity accreditation. CCs are considered to be energy and capacity resources, aiding in both energy requirements and capacity margin requirements. Based on the energy gained by the wind additions, a portion of the CCs from the reference case resource plan were converted to CTs because of their cheaper capital cost.

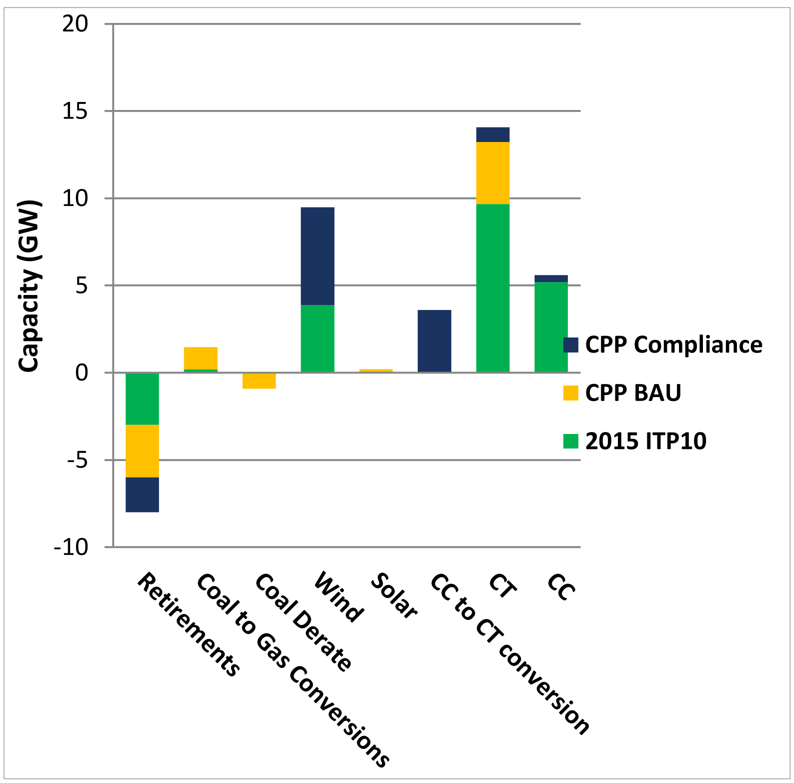

Figure 14: CPP Compliance Scenario Resource Plan

To determine the appropriate amount of capacity to convert, the energy gained by the wind additions was compared to the energy produced by the CCs. This calculation assumed a capacity factor of 70 percent for CCs and an average capacity factor of 47 percent for the new wind machines added for wind. This resulted in converting 3,600 MW of CC capacity to CT capacity for the compliance scenario. Figure 14 shows the compliance scenario resource plan.

Indicative Process Timeline

SPP developed an indicative timeline for infrastructure and market design activities needed to facilitate compliance with the CPP. The timeline in Figure 15 shows possible durations involved with each applicable process and activity. These timelines were developed based on available SPP data from transmission planning, development, and construction activities and data from members and other public sources. Extra high voltage facilities assigned from an 18-month, long-term ITP study could take up to eight and a half years to be placed in service.

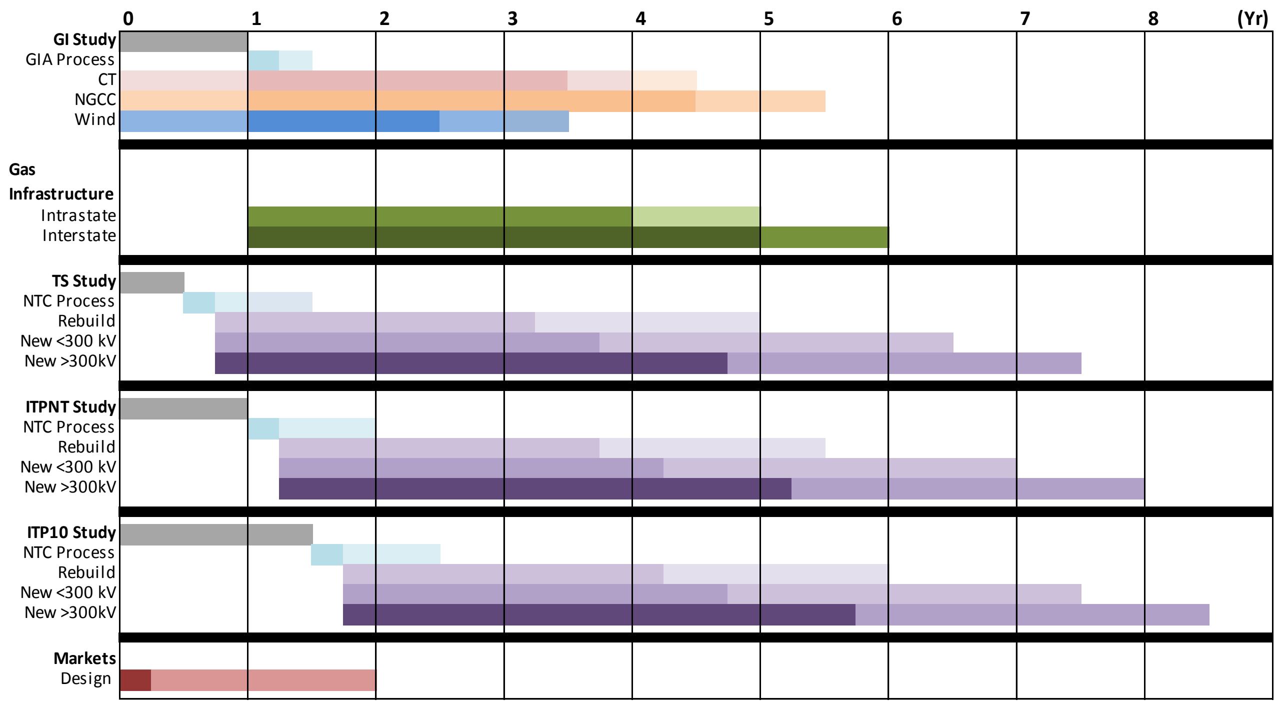

Figure 15: Timelines for Various Processes

Results

Regional Compliance Scenario

The final compliance scenario achieved an emissions rate of 1,285 lbs/MWh, 24 lbs/MWh below the SPP regional emission rate target of 1,309 lbs/MWh. Figure 16 shows the emission rates for the BAU reference case, the $45/ton carbon cost adder analysis, and the final compliance scenario. It is clear that although the applied carbon cost adder was effective at reducing the BAU emission rate, additional resource plan changes were needed to achieve the SPP regional emission rate goal.

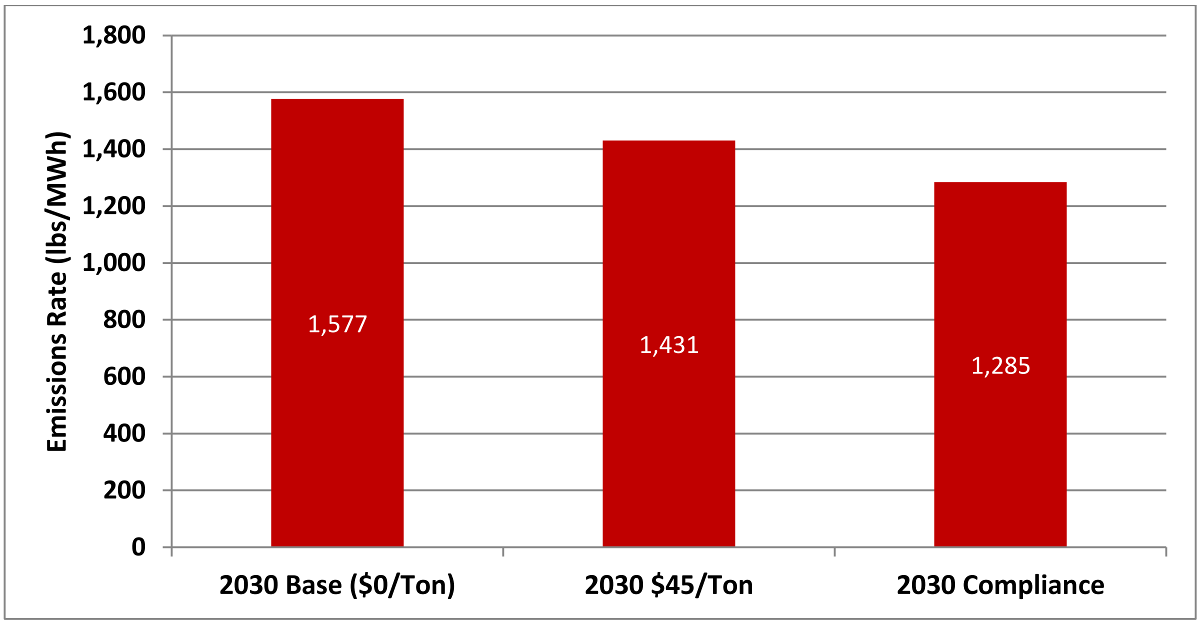

Figure 16: Comparison of SPP Regional Emission Rates

Comparisons of total emissions output, system production costs, and change in capital costs for each of the scenarios is summarized in Table 2. The change in production cost for the SPP region increases significantly when only including a carbon cost adder. With the additional wind energy, the compliance case helps to bring down the overall system production cost, but with an increase in required capital costs.

Scenario	CO2 Emissions (billion tons)	System Production Cost Delta (2015$B)	Carbon Cost Adder Price ($/ton)	Change in Capital Cost of Resource Plan (2015$B)	Incremental Capacity (GW)
Base Case - Current Resource Plan	407	-	$0	-	-
Carbon Price Case - Current Resource Plan	344	$1.4	$45	-	-
Compliance Resource Plan Case	336	$0.6	$45	$13.3	6.9

*2015 dollars

Table 2: Summary of Scenario Results

Even in the compliance scenario, nearly 16 GW of coal capacity is still operating above a 60 percent average capacity factor. With addition of the wind energy, only a small portion of coal generation is operating below the 30 percent average capacity factor criteria used to determine that scenario's incremental coal retirements. Figure 17 shows a comparison of each scenario's average coal generation capacity factor.

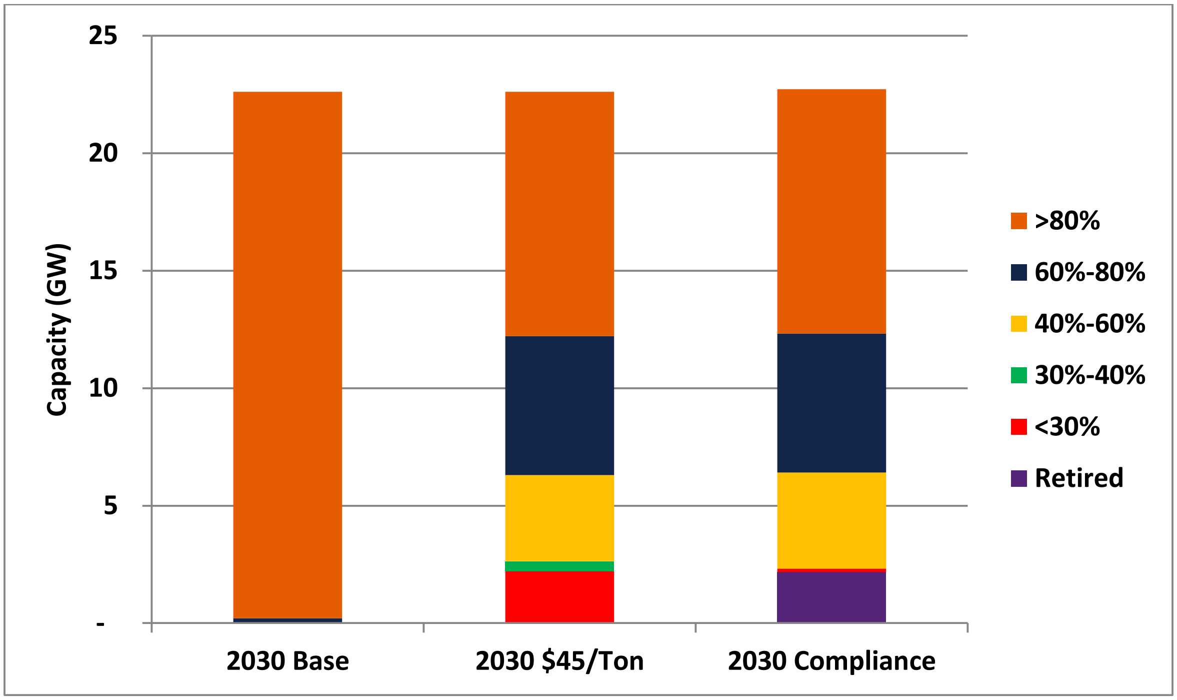

Figure 17: Coal Capacity by Capacity Factor

The compliance scenario's overall average capacity factor for coal units dropped to 75 percent from the reference scenario's nearly 90 percent capacity factor. At the same time, the CC units' average capacity factor increased from nearly 20 percent to just under 70 percent. Figure 18 shows the compliance scenario's average capacity factor of selected unit types.

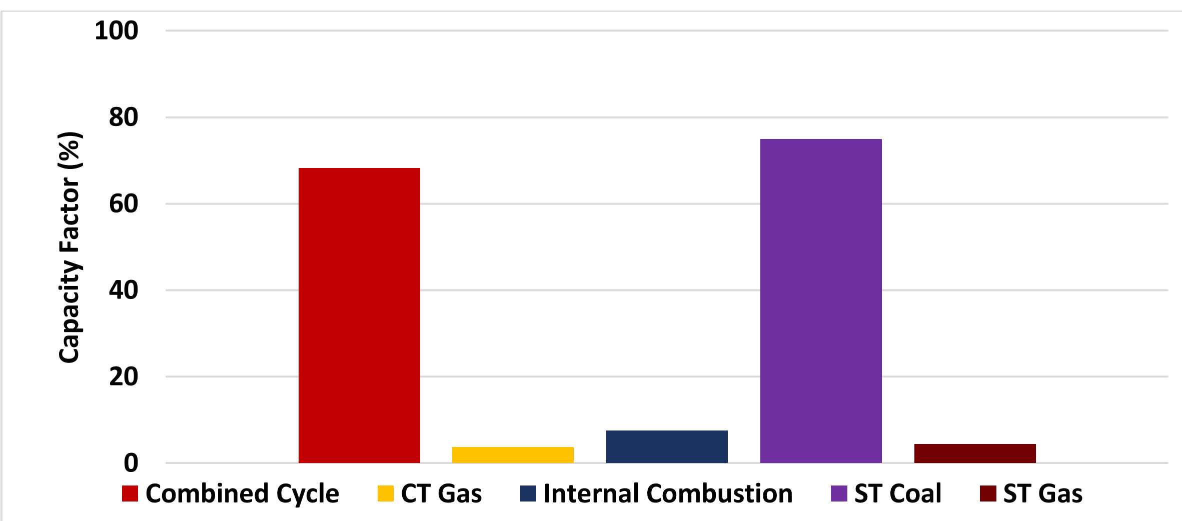

Figure 18: Compliance Scenario Capacity Factors by Unit Type

The BAU reference case contained a resource plan necessary to meet the SPP region's future demand obligations and statutory/regulatory mandates and goals. Included in this case was 26 GW of additional capacity by 2030 that is currently not committed. Table 3 details the capital costs of these uncommitted[7] BAU resources.

Type	Capacity (GW)	2015 $B (Total)	2015 $B (1-Year)
Wind	3.9	9.3	1.6
CC	8.8	9.8	1.7
CT	13.2	9.7	1.6
Solar	0.2	0.8	0.1
Total	**26.1**	**29.6**	**5.0**

Table 3: Cost of Uncommitted BAU Resources

Table 4 contains the capital costs used to price new resources as derived from the EIA's Annual Energy Outlook, shown in $M/MW values.

Generation Type	2015 $M/MW
New Wind	2.4
Advanced CC	1.1
Advanced CT	0.7
Solar	4.2

Table 4: EIA Annual Energy Outlook Prototype Capital Costs

Table 5 details the incremental costs of meeting compliance beyond the resources necessary to meet future demand absent the CPP. This includes the cost of additional resources necessary to reduce the regional emissions rate, offset potential retirements, and effectuate changes in the compliance scenario's mix of future resources. The increase in the system's total fuel and operations and maintenance production costs is also shown. This analysis assumed an additional 6.9 GW of capacity would be needed by 2030 at a total of $13.3 billion in capital costs incremental to a BAU resource plan. Including production cost, this equates to $2.9 billion per year in additional costs to comply with the CPP on a regional basis.

Type	Capacity (GW)	2015 $B (Total)	2015 $B (1-Year)
Wind	5.6	13.5	2.3
CC	0.4	0.4	0.1
CT	0.8	0.6	0.1
Solar	0.0	0.0	0.0
CC to CT Conversion	3.6	-1.2	-0.2
Production Cost	-	-	0.6
Total	**6.9**	**13.3**	**2.9**

Table 5: Incremental Compliance Scenario Costs

[7] "Uncommitted" represents resources that do not have SPP Generation Interconnection Agreements.

The production cost referenced in Table 5 does not include the costs directly resulting from the CO_2 emissions cost adder. The compliance scenario's overall cost of energy in terms of unit revenues is inflated due to the model's carbon tax effects on the system's locational marginal prices. The analysis' carbon adder was used as a modeling tool to achieve a desired result; it was not meant to be reflective of SPP's compliance expectations for the CPP.

The costs reported above are only reflective of one potential change in production costs and the SPP regional resource fleet's capital costs due to CPP compliance. The emissions targets can be met many ways. SPP is not suggesting this is the only path to compliance. Furthermore, the compliance scenario costs do not consider the additional cost of transmission expansion, transmission congestion, gas infrastructure expansion, and market enhancements that could be necessary to facilitate CPP compliance implementation.

Conclusion

By jointly applying an effective carbon cost adder and augmenting existing resource plans, compliance with the proposed CPP's carbon emission goals on a regional basis by 2030 is possible. A carbon cost adder between $30/ton and $45/ton is likely to be most cost effective for an SPP regional approach to CPP compliance. Compliance with the CPP on a regional basis within SPP could cost approximately $2.9 billion per year in resource capital investment costs and higher energy production costs[8], based on the approach developed and evaluated. Up to 13,900 MW of generation beyond that assumed in its most recent transmission planning models could be at risk for retirement under this approach.

The approach evaluated by SPP is indicative of what can be accomplished through regional compliance efforts. SPP is currently evaluating state-by-state compliance approaches using a similar methodology and will use those results to compare implications of state-by-state versus regional compliance.

Although this assessment did not evaluate transmission infrastructure needed to facilitate a regional compliance approach, the results do not alter SPP's conclusions from its 2014 reliability impact assessment that additional infrastructure is needed. Development of a stable, secure, efficient and effective bulk electric power system takes time. Disruptive changes such as retirements, retrofits, and/or changes in the operating characteristics of base load resources must be considered carefully and communicated clearly in a transparent, open process.

This assessment utilized a "copper sheet" approach that did not consider transmission constraints or interchange with adjacent pools. SPP will require more comprehensive planning efforts with stakeholders and new tools and metrics to fully identify the transmission and generation infrastructure required. In addition, broader system assessments of the bulk power system and natural gas pipeline and storage systems based on environmental constraints will be required.

Implementation of an approved regional compliance plan will take time, as will potential mitigation measures to address unacceptable system conditions to accommodate retirements and/or retrofits to existing plants.

[8] SPP's analysis did not evaluate infrastructure needs and does not include costs of transmission or gas pipeline infrastructure needed to facilitate generator interconnection or energy delivery.