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As Executive Vice President of Operations for PJM Interconnection, along with my colleague Andy Ott, Executive Vice President of Markets for PJM, we appreciate this opportunity to participate in this Eastern Region Technical Conference on Environmental Regulations and Electric Reliability, Wholesale Electricity Markets and Energy Infrastructure. I previously submitted a statement and participated in the Commission's national conference on this topic held on February 19, 2015. I wish to submit this supplemental statement today to describe in broad terms an analysis of the Economic Impacts of the EPA Clean Power Plan that PJM recently completed.

Specifically, on March 2, 2015, PJM posted a paper entitled "PJM Economic Analysis of the EPA Clean Power Plan Proposal". I have attached the Executive Summary of that paper as well as a list of responses to Frequently Asked Questions that we posted on our website last week. I wish to use this statement to highlight and reinforce exactly what the study was intended to address and, equally important, what work is left for future analysis.

It is important to note that PJM takes no position on matters of environmental policy. Rather, we provide independent analysis of the potential impacts of pending environmental laws and regulations as they pertain to grid reliability. PJM undertook this particular analysis at the request of the Organization of PJM States (OPSI). Because the Clean Power Plan, as proposed by EPA, is focused on state actions and a range of resource options available to the states to meet compliance, the OPSI states provided PJM with the specific scenarios and assumptions they sought for us to test. PJM added several scenarios of our own to supplement those provided by OPSI and undertook an analysis of economic impacts under both regional (with the region corresponding to the PJM footprint) and individual state compliance approaches.

Second, it is important to emphasize the sequence of our work in response to OPSI's request and where this study fits within the ongoing analyses we are undertaking. This study is an economic analysis focused on how compliance with the Clean Power Plan might affect the economic dispatch of generation in PJM and the subsequent effect on real time energy prices. The analysis was conducted under a variety of assumptions regarding fuel prices, deployment of renewable resources and energy efficiency, availability of new entry combined cycle gas, and retention of existing nuclear resources.



The regional compliance approach PJM modeled results in calculating a price on CO₂ emissions, expressed in dollars per ton of CO₂ emissions (\$/ton) that applies across the entire PJM footprint to all resources in all states. The individual state compliance approach PJM modeled results in a price on CO₂ emissions for each state, for that portion of the state within the PJM region (11¹ prices in the state compliance approach). The CO₂ price is effectively the cost of reducing one ton of CO₂ derived from the difference in dispatch cost between lower-emitting resources, such as combined-cycle natural gas, and higher-emitting resources, such as coal, in order to facilitate a merit order of generation that results in an overall emission profile that meets the regional or state limits modeled.

PJM first ran the model to determine whether the assumptions in the scenario would result in exceeding the PJM-calculated regional or state-by-state emissions target without a CO₂ emissions price. If that target was exceeded, then PJM iteratively determined a CO₂ emissions price (or 11 prices in a state-by-state run) to be applied to each fossil fuel-fired generator that would cause lower-emitting or emission-free generation to replace the higher-emitting generation to achieve the regional or state-by-state mass or rate target. At the end of each iteration, PJM determined whether the emission target was met. If emissions still exceeded the target, the CO₂ price would increase in the next iteration, and conversely, if emissions were below the target, the CO₂ price would decrease in the next iteration. This iterative process continued until the emissions target was met within +/- 0.5 percent.

In short, our modeling approach *does not require* that either the states or EPA determine a price for CO₂ emissions on the front end. Rather, we have used the emission targets under the rule to derive a CO₂ emissions price included in the running costs just like fuel costs and variable O&M. The additional cost of CO₂ emissions alters the order in which generating units are dispatched for operations. Units are still dispatched based on cost. The addition of a price on CO₂ emissions ensures the least cost set of resources is dispatched to meet load, ensure transmission reliability, and meets the regional or state-specific emissions limit.

¹ The EPA did not include the District of Columbia in the Clean Power Plan as there is no existing fossil generation located in the District. Additionally, the portion of Tennessee in PJM does not include any existing fossil generation, so PJM did not model impacts to Tennessee.



There has been much public focus on our identification of units “at risk” for retirement under the various scenarios being tested. First, simply because a resource has been identified as “at risk” for retirement does not mean it will, in fact, retire. Second, and more importantly, I want to emphasize that the retirement of generating units does not automatically equate to a reliability concern. Planning for retirements is part of the process to ensure reliability. The PJM market has been able to offset previous retirements through new units, improvements to existing units, demand response, and energy efficiency. PJM’s recent experience with the EPA Mercury and Air Toxics Standards (MATS) has shown the market can replace retiring units, in fact, PJM has seen 33,000 MW of new or upgraded units developed in response to the latest retirements.

Under EPA’s Clean Power Plan, it is reasonable to assume that retirements will continue to occur over the initial 2020-2029 compliance period. The key to maintaining reliability is time and transparency. If the retirements are identified far enough in advance to allow needed transmission to be built and markets to respond to develop new generation and demand response, reliability can be maintained.

Because of the limited nature of the scenarios we studied—and the fact that the rule itself is not yet final, nor have state plans been developed—we are simply not in a position to make definitive conclusions as to the reliability impacts of the Clean Power Plan on the PJM footprint. However, that doesn’t end the inquiry. We are undertaking a reliability analysis using the results of this economic study (including the identified at risk units and units in the queue to replace them as inputs) to analyze the impact on both the installed reserve margin (difference between installed generation and expected requirements) and the transmission grid over this period.

Moreover, the question as to whether the Clean Power Plan will ensure reliability is not the kind of question capable of a clear yes/no response. Rather, the relevant question is, assuming the Rule remains as proposed (including its interim targets), is there enough time for new units to replace the retiring units without the state falling out of meeting its compliance requirements? Equally important, is there sufficient time to put in the transmission additions to meet any resulting reliability violations that may be identified as a result of the unit retirements? Preliminary analysis is presently underway at PJM and will be



available in the spring. But it is exactly because the answer to the question, “*is it reliable?*,” is not a “once-and-done” inquiry, that we and our other RTO/ISO colleagues have proposed a series of reliability reviews at key stages of the process as well as a “reliability safety valve” in the event of problems which arise during implementation of the rule. Those issues were addressed in the testimony presented on behalf of the ISO/RTO Council at the national conference on February 19, 2015.

I am attaching our summary of the results to date from our economic analysis. In a nutshell, the answer to the question of what will be the economic impacts of the Clean Power Plan on PJM is “*it depends.*” Determining a true cost of compliance with the Clean Power Plan as proposed is dependent on a host of factors including most prominently:

- The price of natural gas;
- The achievability of the energy efficiency goals set forth in the Proposed Rule;
- The ability of states to meet their RPS goals;
- Retention of existing nuclear resources;
- The final form of the EPA rule, including whether emission limits are calculated on a mass or rate-based target; and
- The state implementation plans themselves and whether regional or state solutions are adopted that can be efficiently implemented within the RTO security-constrained economic dispatch paradigm.

I am available to address this and other Commission questions at this Conference. Given the focus on our submittal since the national conference, I submit this statement to clarify the PJM Analysis in order to help inform the Commission, the EPA, other policymakers and the public at large. I look forward to your questions and comments.

Attachment

PJM Economic Analysis of the EPA
Clean Power Plan Proposal: Executive Summary

Frequently Asked Questions

PJM Interconnection Economic Analysis of the EPA Clean Power Plan Proposal

March 2, 2015

Executive Summary

At the request of the Organization of PJM States, Inc., PJM Interconnection has analyzed potential economic impacts on electric power generation in the PJM footprint resulting from the U.S. Environmental Protection Agency's Clean Power Plan. The plan, proposed by EPA in June 2014, seeks a 30-percent reduction in carbon dioxide emissions from the electricity sector by 2030 (compared to 2005 levels). PJM does not take positions for or against pending regulations but does provide independent expert analysis on the potential economic and reliability impacts of proposed regulatory rules and legislation.

The Organization of PJM States, which represents state utility regulators in the region served by PJM, requested analyses of several scenarios including a comparison of regional compliance versus state-by-state compliance. PJM included additional scenarios with different assumptions in the analysis to provide modeled results covering a wide range of possible outcomes. In total PJM analyzed 17 distinct scenarios – each was evaluated with and without the implementation of the Clean Power Plan. The scenarios covered varying combinations and levels of renewable resources, energy efficiency, natural gas prices, nuclear generation and new entry of natural gas combined-cycle resources.

This report is the first of two PJM evaluations of the proposed Clean Power Plan. It presents an analysis of the Clean Power Plan's potential economic impacts, including the identification of fossil-fueled steam generation capacity thought to be “at risk” for retirement based only upon energy market simulation results. PJM has not attempted to simulate capacity market outcomes in conjunction with the energy market simulations. PJM will use the results of the economic analysis to conduct a reliability analysis to determine transmission needs resulting from potential generator retirements.

The results of PJM's analyses are not predictions of future outcomes; rather, they are assessments of possible impacts based on specific assumptions and tempered by uncertainties. Those uncertainties include future market conditions, the form of the final EPA rule and the manner in which states choose to comply. PJM's analyses offer insights into the complex interactions between wholesale electricity prices, generation at risk for retirement, changes in natural gas prices, energy efficiency, renewable resources, nuclear generation and compliance costs associated with the Clean Power Plan. This analysis attempts only to quantify the change in production costs as a cost of compliance with the Clean Power Plan. PJM did not attempt to quantify the capital costs of renewable resources, energy efficiency, or new combined-cycle generation that may be associated with complying with the Clean Power Plan because such decisions may be due to existing state policies or to otherwise-economic decisions for new entry independent of the Clean Power Plan.

High-level insights from the economic analysis include:

- Fossil steam unit retirements (coal, oil and gas) probably will occur gradually. As the CO₂ emission limits decline over time, the financial positions of high-emitting resources should become increasingly less favorable, with lower-emitting resources displacing them more often in the competitive energy market.
- Electricity production costs are likely to increase with compliance because larger amounts of higher-cost, cleaner generation will be used to meet emissions targets.
- The price of natural gas likely will be a primary driver of the cost of reducing CO₂ emissions if natural gas combined-cycle units become a significant source of replacement generation for coal and other fossil steam units.
- Adding more energy efficiency and renewable energy and retaining more nuclear generation would likely lead to lower CO₂ prices; this could result in fewer megawatts of fossil steam resources at risk of retirement because lower CO₂ prices may reduce the financial stress on fossil steam resources under this scenario.
- State-by-state compliance options, compared to regional compliance options, likely would result in higher compliance costs for most PJM states. This is because there are fewer low-cost options available within state boundaries than across the entire region. However, results will vary by state given differing state targets and generation mixes. PJM modeled regional versus individual state compliance only under a mass-based approach.
- State-by-state compliance options would increase the amount of capacity at risk for retirement because some states likely would face higher CO₂ prices in an individual compliance approach.

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Frequently Asked Questions about the PJM Economic Analysis of the EPA Clean Power Plan Proposal

Version: March 6, 2015

Q Are the numerical results of the PJM economic analysis a forecast of future prices and costs under the Clean Power Plan?

A No. PJM's analysis should be used to see directional changes in prices, costs and generation outcomes resulting from various state-chosen implementation scenarios under the EPA's proposed rule, rather than specific numerical results. The PJM numerical modeling results depend heavily upon input assumptions regarding fuel costs, levels of energy efficiency and renewable resources, retention of existing nuclear resources and available new entry combined-cycle natural gas. Moreover, the final form of the rule and how states determine to comply both will influence the actual effects of the Clean Power Plan. As PJM evaluated 17 potential future scenarios at three different points during the 10-year compliance period, PJM assessed trends, resulting in a range of possible outcomes from the Clean Power Plan.

Q Can any reliability conclusions be derived from PJM's economic analysis?

A Not at this time. Because it is an economic analysis, no reliability conclusions can be drawn with respect to resource adequacy or the need for transmission upgrades. The economic results look at price and cost impacts using energy market modeling alone. Moreover, assessment of existing fossil-steam generation net revenues was performed to determine the amount of capacity that potentially could be at risk to retire to use as an input into reliability analyses currently underway. The results of this analysis should be available in the spring of 2015. In the interim, any conclusions about reliability are premature.

Q Does this analysis or the reliability analysis that is underway mean that the reliability of service to consumers will be affected?

A No. PJM's mission is to ensure the reliability of the grid. We have a number of tools ranging from our forward capacity market to our ability to order transmission upgrades as well as a host of operational tools to ensure that reliable service can be maintained. To the extent that the proposed EPA rule may make it harder to meet those goals, PJM, working with other grid operators, has proposed to EPA a reliability safety valve to ensure adequate, upfront reliability reviews and tools to seek targeted delays in implementation of state plans if specific reliability violations are identified during plan development or implementation. The reliability safety valve proposal is embodied in the comments filed by the [ISO/RTO Council](#) as well as [PJM](#).



Q Does the report's identification of generating units at risk for retirement mean there is a reliability problem for PJM?

A No. One needs to look at the cumulative impact both of resource additions and generator retirements as well as load levels to make any conclusions. Looking at plant retirements alone is only half of the story. Since 2007, PJM's capacity markets have helped to attract about 35,000 MW of additional generation. Although approximately 26,000 MW of generation will have retired between 2009 and 2016, the PJM Capacity Market has procured sufficient resources to maintain reliability.

Q What analyses currently are being completed to look at the reliability implications resulting from the proposed Clean Power Plan?

A With respect to transmission reliability, PJM is using the Energy Market results from the economic analysis, which determined a range of generation capacity at risk for retirement, to examine the transmission reliability implications using a standard transmission planning analysis approach. The PJM economic analysis is an input into the transmission reliability study; PJM also will look at the projected capacity adequacy when assessing reliability.

Q Does identifying an amount of capacity at risk for retirement mean that the generating units actually will retire?

A No. The PJM economic analysis only examines energy market outcomes and identifies units that may not fully recover their on-going costs in the Energy Market. Individual owners would look at many factors, including expected future market conditions and potential capacity revenues, in making a decision to retire a generator.

Q Does PJM's economic analysis show significant generation retirements and increases in wholesale energy market prices at the beginning of the interim 2020-2029 compliance period?

A The level of capacity at risk for retirement and wholesale price increases in the early part of the initial compliance period depends upon the deployment of energy efficiency and renewable resources and the retention of existing nuclear capacity. The scenarios show a wide range of possible outcomes regarding potential retirements and increase/decreases in wholesale energy prices during the interim period.

Q What are the impacts of (1) renewable resource development that are considerably below renewable portfolio goals in the PJM states, (2) energy efficiency at levels well below those assumed by the EPA in its goal computation and (3) retirements of some portion of the existing nuclear resources?

A The level of capacity at risk for retirement would be at the higher end of PJM modeling results and wholesale energy prices would increase relative to the PJM transmission planning case. Scenarios with the lowest level of zero-emitting sources suggest significant opportunities for new resources.



Q What are the effects of resource retirements that occur between the 2012 baseline year and 2020?

A PJM's analysis shows the mass-based targets in 2020, using the EPA's Nov. 6, 2014, guidance, would be slightly below the 2012 baseline emissions when units in the baseline scheduled for retirement are accounted for. The 2012 baseline emissions, 442 million short tons, falls to 392 million short tons after removing the contribution from the retiring generation, compared to the 2020 mass-target of 387 million tons. The load previously served by resources scheduled to retire will be served by a mixture of resources that are covered by the policy and that are not covered by the policy.

Q What are the assumptions behind the so-called “worst-case” scenario for the 49,000 MW of capacity at risk for retirement?

A The worst-case scenario assumes much lower energy efficiency than the EPA assumptions used in the goal computation, significantly lower renewable resource development than suggested by renewable portfolio standard goals in PJM states, loss of 50 percent of existing PJM nuclear capability, and/or 50 percent higher natural gas prices.

Q What is the lowest level of capacity at risk in PJM modeled scenarios, and what are the assumptions behind this value?

A PJM modeling estimates the low end of capacity at risk for retirement is 6,200 MW based on resources that are categorized as at risk in all PJM modeled scenarios. The 6,200 MW are categorized as at risk for retirement based on the resources' additional revenue requirements relative to the net cost of new entry. These 6,200 MW of resources possibly could be at risk for retirement even in the absence of the Clean Power Plan.

Q In the State-Level Detail analysis accompanying the PJM economic analysis, wholesale energy prices are lower under many of the Clean Power Plan OPSI-requested scenarios than in the PJM transmission planning case. What drives this result?

A PJM analyzed the potential economic impacts of the Clean Power Plan proposal at the request of the Organization of PJM States, Inc., which provided many of the assumptions modeled. This result is driven by the differences in assumed energy efficiency and renewable resources in the OPSI-requested scenarios versus the current PJM transmission case. The PJM transmission planning case has much lower levels of energy efficiency and renewables. Load reductions due to energy efficiency or adding more renewable resources into the Energy Market, effectively at a zero variable energy cost, results in lower wholesale energy prices.

Q Why are wholesale energy prices generally lower under regional compliance compared to state-by-state compliance?

A As some states are more limited by their mass-based carbon dioxide targets, less expensive generation in those states are not dispatched in order to achieve the state-level mass targets, forcing more expensive resources in



PJM to be dispatched. Under regional compliance modeling, a lower-cost set of resources can be dispatched, and states whose emissions are below the state-level mass targets offset emissions from other states in which the state-level mass targets are exceeded.

Q Why is the level of capacity at risk for retirement lower under regional compliance compared to state-by-state compliance?

A Under the state-level compliance modeling approach, coal resources in states that face a price on carbon dioxide emissions are financially worse off with lower output and higher running costs than similar units in states that are not limited by their emission targets and, hence, are more at risk to retire. Under regional compliance modeling, all resources face the same carbon dioxide price, and states under their mass targets help offset those states exceeding their mass targets, allowing coal resources to operate more and at lower cost.

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Document Content(s)

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