

March 10, 2016

## MEMORANDUM

TO: John Conti  
Assistant Administrator for Energy Analysis

Jim Diefenderfer  
Director, Office of Electricity, Coal, Nuclear, and Renewables Analysis

FROM: Coal and Uranium Analysis Team

SUBJECT: Notes from the **Second AEO2016 Coal Working Group Meeting** workshop held on February 9, 2016

### Attendees (30)

Name	Affiliation
Adams, Greg	U.S. DOE: EIA
Coleman, Leslie	National Mining Association
Diefenderfer, Jim	U.S. DOE: EIA
DiGiantomaso, Jennifer	U.S. Department of Labor
Fisher, Brian	Environmental Protection Agency
Herndon, Whitney	RHG Group, Inc.
Hodge, Tyler	U.S. DOE: EIA
Huetteman, Thad	U.S. DOE: EIA
Jell, Scott	U.S. DOE: EIA
Johnson, Elias	U.S. DOE: EIA
Jones, Ayaka	U.S. DOE: EIA
Jones, Jeff	U.S. DOE: EIA
Kayin, Serpil	Environmental Protection Agency
Kearney, Diane	U.S. DOE: EIA
Kislear, Jordan	U.S. DOE
Kwon, Augustine	U.S. DOE: EIA
Martin, Laura	U.S. DOE: EIA
Meroney, Bill	Environmental Protection Agency
Nandy, Samir	U.S. DOE: EIA
Nichols, Chris	U.S. DOE: National Energy Technology Laboratory
Park, Brian	U.S. DOE: EIA
Peters, Jamie	Union Pacific Railroad
Pierce, Paul	U.S. Geological Survey
Rosner, David	U.S. DOE
Rosner, David	U.S. DOE
Santsangi, Ann	U.S. DOE
Simpson, Cynthia	U.S. Department of Labor
Summers, Morgan	U.S. DOE: National Energy Technology Laboratory
Vermeer, Grace	M.J. Bradley & Associates
Wood, Frances	On Location, Inc.

In an effort to solicit feedback each year, the Coal and Uranium Analysis Team (CUAT) invites stakeholders to participate in coal working group meetings discussing EIA's coal modeling methodology as well as a general discussion of issues facing coal supply and use. On February 9th, Greg Adams, CUAT Team Leader, presented the attached slides. While the slides provide the information presented, discussion and commentary were also encouraged. The highlights of the meeting are provided here as well as additional comments (with EIA responses) provided after the meeting. Additional information is also provided below as 'supplemental clarification' where EIA staff felt they needed to provide follow-up on particular topics. Participants and other stakeholders are encouraged to direct comments on proposed modeling methods and plans to Greg Adams ([Greg.Adams@eia.gov](mailto:Greg.Adams@eia.gov)).

### **Preliminary Result Highlights**

- For the preliminary AEO2016 Reference case (displayed in the accompanying slides), the mass-based compliance option is assumed for implementation of the Clean Power Plan rather than the rate-based option. This differs from the proposed Clean Power Plan (CPP) analysis conducted by EIA this past summer, which assumed a rate-based compliance option.
- The AEO2016 Reference case differs from the earlier proposed Clean Power Plan analysis in four distinct ways: (1) mass-based compliance, (2) lower natural gas prices, (3) lower capital costs for renewable technologies, and (4) lower coal exports. A combination of these four factors contributes to a lack of rebound for coal in the later years of the projection in contrast to EIA's earlier analysis of the *proposed* Clean Power Plan.
- One participant asked about the differences in retirements between the proposed CPP analysis and the preliminary AEO2016 results. EIA staff responded that the proposed CPP analysis indicated about 90 gigawatts of retirements compared to 109 gigawatts in the preliminary AEO2016 Reference case. In response to a follow-up question, EIA staff stated that the differences in retirements are due to the assumption of the mass-based implementation in conjunction with lower natural gas prices and lower renewable technology capital costs. A participant also asked about the base level of coal capacity assumed in AEO2016. EIA staff indicated that 294 gigawatts of coal is assumed in 2014.

### **Coal Plant Technology and Capital Cost Updates**

- The carbon capture plant configuration available in the AEO2016 will be based upon an ultra-supercritical plant capable of 30% carbon capture. EIA provided a clarification (in response to a question) regarding the other coal plant technologies included in the model. The AEO2016 will not include the coal plant technology with 90% capture. Currently, the model does not have the structure to represent two carbon capture technologies simultaneously. Under the Clean Power Plan, when the 90% capture technology is available, EIA's tests have indicated that this technology is not chosen. One participant asked if there would be any side cases without the 30% capture technology to which EIA responded that there would not be.
- NETL staff mentioned that their research has identified that an IGCC plant without carbon capture could meet the Clean Power Plan emissions requirements. EIA staff indicated that they would like NETL to share more details about this plant with EIA.

- One participant asked how the costs of the 30% capture plant compare to the 90% capture plant. EIA staff responded that while the base plant costs are a little lower for the 30% capture plant, the capture portion of the plant is more expensive on a \$/kW basis.

Supplemental clarification: A supercritical plant with 90% capture was last modeled in AEO2013 with an assumed overnight cost of \$5400/kW (2014 dollars). An IGCC with 90% carbon capture technology was modeled in AEO2015 with an assumed overnight cost of \$6600/kW (2014 dollars). For the AEO2016, an ultra-supercritical plant with 30% capture is assumed to cost about \$5000/kW (2014 dollars). However, these costs (which also have been adjusted with optimism and contingency factors) cannot be directly compared against one another primarily because the base cost estimates were made at different points in time under different sets of underlying cost assumptions.

- One participant asked when the Leidos capital cost study would be publicly available.

Supplemental clarification: The Leidos study will most likely be posted on the web in the summer after the release of the AEO2016.

- EIA presented capital costs currently assumed for the Reference case for an ultra-supercritical coal plant with 30% carbon removal. These most recent cost estimates are much higher as represented on Slide 6 than previously assumed cost estimates primarily because the prior coal technology costs were reflective of a supercritical pulverized coal plant without carbon capture.

- EIA staff specified that the coal plant modeled (30% capture) has about a 1,380 lbs of CO<sub>2</sub>/MWh emission rate on a net generation basis. A participant commented that this technology over-complies with the Clean Power Plan. The participant stated that EPA specifies the emission rate based upon gross generation rather than net generation. Another commented that EPA stated that a 17% capture rate would meet the CPP requirements.

Supplemental clarification: EIA's electricity modelers are aware that their assumed technology specification means that generators will over-comply. EIA assumes that generators will want to ensure that they are in compliance for all time periods and would not want to risk occasionally being out of compliance especially after making expensive capital investments. The emission rate for a plant depends on many variable factors. Among them is the level of generation. If a plant dips below a certain generation level, for instance, the effective CO<sub>2</sub> removal rate could be affected.

- The ultra-supercritical plant technology in the AEO2016 is assumed to have a heat rate of 8800 Btu/kWh. One participant believed that this heat rate was too high. EIA staff stated that they expressed a similar concern to Leidos, but Leidos asserted its accuracy.

- In response to a question, EIA staff indicated that nuclear costs will be included in the second round of capital cost updates from Leidos Corporation but will not be received in time to incorporate them in the AEO2016.

### **Other Regulations Affecting Coal**

- The 316(b) rule (Cooling Water Intake Structures), the Coal Combustion Residual rule, and the Effluent Guidelines will not be modeled in AEO2016. EPA has estimated that the costs of these rules are relatively low for the power industry, and EIA staff did not expect the regulations to have a notable impact on the

AEO2016 projections. Additional follow-up with EPA is necessary to properly implement the rules for the next AEO.

### **Clean Power Plan (CPP)**

- As of the meeting date and time, EIA presented the Clean Power Plan (CPP) as part of its Reference case. The AEO2016 will have a side case where the CPP is excluded.

Supplemental clarification: After the coal working group meeting, the Supreme Court stayed the CPP. Because the Court did not throw out the regulation but instead left it in place, EIA will continue to include the CPP in its Reference case. As a result, the side cases will continue to be based upon and compared to this case.

### **Cost of Capital Adder for Coal**

- EIA will continue to use an incremental 3% cost of capital adder for the ultra-super critical coal plant with 30% removal. As a general rule of thumb, EIA plans to use the 3% cost of capital adder for any coal plant that captures less than 90% of its carbon dioxide emissions. Several meeting participants objected to the use of this cost of capital adder.

Supplemental clarification: EIA staff confirmed that for the AEO2016, the 3% cost of capital adder will continue to be included. Because there is substantial uncertainty in the market over future carbon regulation (i.e. the potential for restrictions that are more stringent than the CPP), the financial community continues to be cautious in its lending practices to relatively high-carbon emitting technologies. Even though the 30% CCS technology complies with the CPP, it is still substantially more carbon-intensive than the natural gas combined cycle technologies modeled, and EIA expects that financing for this type of coal plant would still be affected by uncertainty over future regulation. In addition, due to the limited number of side cases, the side case where the 3% adder is removed will not be part of the AEO2016 suite of side cases.

### **Mine price questions**

- One participant inquired about the how coal prices are modeled. EIA staff stated that labor productivity assumptions are the main driver for prices, and the AEO2016 assumptions largely are the same as for AEO2015. Labor productivity is expected to decline by 0.9%/year on average through 2040 in the AEO2016. In particular, the participant posited that lower demand for coal could mean that mine companies may not need to resort to geologically deep or lower quality resources to keep pace with demand. EIA staff agreed that this could be a possibility, and that time constraints and human capital limitations limited staff's ability to study labor productivity more extensively for AEO2016. EIA staff also mentioned other issues of concern for the coal mining industry including its aging workforce.
- Some additional comments related to mining costs were received after the meeting. Specifically, the commenter asked if EIA has looked at declining mining costs. The individual cited the reduction in benefit packages for labor and changes in work rules as the result of bankruptcies as well as falling costs for diesel and explosives. EIA staff responded that this has not been an area of focus yet, but we will look into these issues for the next AEO. EIA staff indicated that the outlook for diesel is derived directly from model results, and wages currently are assumed to rise at about 0.9% per year; both are factors that influence the coal pricing equation.