

October 5, 2017

MEMORANDUM FOR: Ian Mead
Assistant Administrator for Energy Analysis

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

SUBJECT: Summary of AEO2018 2nd Joint Electricity, Coal, and Renewables Working Group held on September 19, 2017

The working group presentation provided a discussion of the significant data and modeling updates expected for the AEO2018 Reference case, and presented preliminary AEO2018 projections. Participants were also encouraged to forward any follow up questions or comments to AnnualEnergyOutlook@eia.gov, or any of the staff listed at the end of the presentation materials, which are available in a separate document.

Model Enhancements

Electric Sector, including Nuclear

EIA staff began the meeting with a discussion of the significant electric sector model development activities, focusing on review and revision of existing air regulations for electric generators, including the status of EPA's Clean Power Plan (CPP) and related regulations, and an overview of cases that EIA expects to include in the AEO2018 release. Although EIA has yet to determine whether the Reference case will include the CPP, cases based on Reference Case assumptions with and without the CPP will be published. In addition, several side cases will also be published to show the effects with and without the CPP.

Another development for AEO2018 includes the capability to model the economic risk for nuclear units to more accurately reflect unit operating costs and revenues to gauge the impact of state Zero Emission Credit programs.

Renewables

The discussion of renewable electricity model updates highlighted the more detailed representation of state Renewable Portfolio Standards, changing utility rate structures, the addition of capital costs and performance assumptions for new energy storage, solar (tracking), and wind (tall tower) technologies, increasing the limits on the share of intermittent generation, renewable curtailments, and updated capital structures.

Preliminary Results

The second portion of EIA staff's presentation focused on a comparison of the AEO2017 results with the AEO2018 preliminary projections which included the CPP (to allow for a more direct comparison). Preliminary results show lower natural gas prices, stabilizing at around 20-25% lower than AEO2017, which results in less coal and higher natural gas generation in the projected generation mix through 2035. Capacity additions consist mainly of natural gas and solar after 2025. Coal production is lower in

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response to the reduced coal generation demand, and coal exports appear slightly lower overall in AEO2018, with the Western U.S. accounting for most of the decline in overall coal production. The overall electricity sales growth rate through 2050 is expected to remain quite low, at under 1%, similar to AEO2017.

Discussion

Questions and comments on the presentation from participants mainly revolved around the CPP, modeling nuclear economic risk, and renewables.

Clean Power Plan

The Clean Power Plan was the focus of much of the discussion. In particular, participants were concerned with the potential effects on the projections and their relative validity if the CPP is repealed. EIA noted that while it does look unlikely that the CPP will be implemented in its current form, there will likely be some form of a rule, particularly with the EPA v. Massachusetts endangerment finding remaining in place, which would require some form of carbon regulation. As EIA does not make explicit policy assumptions, current laws are incorporated and cases with and without the CPP will still be run so as to include the possibility of repeal and provide projections addressing both scenarios.

One participant asked if we allowed for coal units without carbon capture and sequestration (CCS) to be built. EIA staff indicated that this option is not available since all cases in the AEO2018 currently include EPA's New Source Performance Standard, which requires at least 30% CCS for coal units. In addition, the assumption of a 3% adder on the cost of capital for all coal-related investments with less than 90% CCS continues to be included to account for the riskiness of these investments in the absence of a defined carbon policy. EIA staff also referred one participant to the AEO2017 Electric Assumptions document for information on the technology options for new combined cycle units with CCS.

Some participants inquired as to whether EIA would, in the case of overwhelming public opinion in favor of carbon reduction, revise AEO cases. EIA reiterated that it does not develop policy, preventing us from formulating cases based on policy that was not proposed or in effect. Another participant expressed interest in revised CO₂ emissions side cases. EIA staff indicated that CO₂ cases may be considered, but no decision has been made regarding the full complement of side cases for AEO2018.

Modeling Nuclear Economic Risk

One participant inquired about the update procedures for the plant-level nuclear generator data. EIA staff responded that multiple sources of information are in place, and updates are expected to occur regularly. Another participant asked if there would be a specific assumption about retirements associated with subsequent license renewal (SLR). EIA staff indicated that according to a recent study, rather than being a significant source of uncertainty, the costs of SLR are another routine and foreseeable cost consideration for nuclear operators and would be considered as such in the evaluation of economic risks. For that reason, EIA is developing a plant-level risk analysis in lieu of the approach used for AEO2017 where approximately 25% of the fleet was retired after 60 years of commercial operations.

One participant inquired whether EIA would select one of the nuclear fixed O&M assumptions mentioned on slide 7, or include multiple cases. EIA staff indicated that the testing of a range of fixed O&M is intended to test the sensitivity of the model to competition with natural gas at current gas prices, and that only one assumption would be made across all cases published in the AEO2018.

Regarding the discussion of economic risks for nuclear units on slide 8, a participant inquired whether the model includes a reward for baseload reliability or generation portfolio diversification. EIA staff stated that the model does not model portfolio diversity directly, but instead requires that power be provided in every hour with sufficient capacity reserve margin.

Another participant asked about the assessment of nodal and zonal prices. EIA replied that nodal prices were reviewed at the plant level, but that EMM regional prices apply within the NEMS-EMM, and EIA is looking at plant-level market information to adjust risk factors, accordingly.

Renewables

Regarding the revision of utility rate structures (slide 13), EIA staff clarified that the value of solar is passed through to end-users to ensure appropriate price signals are modeled to signal new solar builds. EIA also clarified that energy efficiency program costs for the Clean Power Plan are explicitly accounted for in developing retail electricity prices, as are incentives for California's SB32. Although the end-use models represent current utility efficiency programs using rebates, the costs of the modeled rebates for those programs are not passed to the power sector and are not explicitly considered when developing retail electricity prices.

Another participant asked if EIA assumes 100% achievement of RPS and whether transmission expansion projects are explicitly modelled. EIA staff stated that RPS targets are assumed to be met, with Alternate Compliance Payments incorporated as appropriate, and that although transmission expansion projects are not modelled in detail, inter-regional transmission costs and constraints are included between EMM regions. EIA also added that contractor efforts are underway to determine if more transmission detail is needed to ensure adequate representation of the potential for new transmission links to mitigate the impact of intermittent generation on regional grid operations.

Regarding the costs for new technologies discussed on slide 14, EIA staff clarified that the capital cost estimate for battery storage developed by [Leidos](#) is not being used, and provided a discussion of the learning trajectory for storage in response to questions from participants. EIA staff further explained that its learning curve methodology is assumed to start off learning at a 'revolutionary' technology rate of 20% per doubling during a technology's early development phase, and slowing to a 10% rate of 'evolutionary' learning as the scale of development increases (the technology is not assumed to reach a 'mature' state of learning by 2050).

Regarding the increasing maximum intermittent share of total generation discussed on slide 15, some participants asked what level of caps for solar generation and diverse portfolio requirements are built into the model. EIA responded that non-dispatchable generation is currently capped at 40%, though testing is being done for values as high as 70%. EIA staff clarified that the cap applies at the regional annual level and is not a cap on the instantaneous or hourly level.

A participant asked whether EIA made any assumptions regarding the cost of renewable life extension. EIA staff stated that fixed and variable O&M costs represent the cost of maintaining capacity indefinitely, but that EIA may pursue a study to look at useful life and aging costs past the first 30-40 years of commercial operations.

Attendees

<u>Guests (in person)</u>	<u>Affiliation</u>
Courtney Grosvenor	DOE Office of Energy Policy and Systems Analysis
Elke Hodson	DOE Office of Energy Policy and Systems Analysis
Nathaniel Horner	DOE Office of Energy Policy and Systems Analysis
Sophia Mahmood	Energy Ventures Analysis
Ann Satsangi	DOE Office of Fossil Energy
Bob Schmitt	DOE Office of Energy Policy and Systems Analysis
Seth Swartz	Energy Ventures Analysis

<u>Guests (WebEx/phone)</u>	<u>Affiliation</u>
Chad Augustine	National Renewable Energy Laboratory
Justin Baca	Solar Energy Industries Association
Youngsun Baek	Union of Concerned Scientists
Delma Bratvold	Leidos
Glenn Carlson	Union Pacific
Wesley Cole	National Renewable Energy Laboratory
Leslie Coleman	National Mining Association (NMA)
Erich Eschmann	Environmental Protection Agency
Carolyn Evans	Norfolk Southern
Jerry Eyster	GE Energy Financial Services
Rachel Fakhry	Natural Resources Defense Council
Mark Gehlhar	Office of Surface Mining
Don Hanson	Argonne
Whitney Herndon	Rhodium Group
Riley Hollis	Office of Surface Mining
Emily Hunter	Department of Labor
Hari Kadavath	Department of Labor
Serpil Kayin	Environmental Protection Agency
John Larsen	Rhodium Group
Michael Leitman	National Rural Electric Cooperative Association (NRECA)
Osmond Lindo	Department of Labor
Carl Lundgren	Department of Labor
Grant Marciniak	Norfolk Southern
Gregory Marmon	Wood Mac
Emily Medine	Energy Ventures Analysis
Jim Moore	Spire
Greg Moxness	Department of Labor
Caitlin Murphy	Department of Energy
Andrew Nicholls	Pacific NW National Laboratory
Chris Nichols	National Energy Technology Laboratory (NETL)

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Karen	Obenshain	Edison Electric Institute
Ron	Oster	Peabody Energy
Paul	Pierce	U.S. Geological Survey (USGS)
Jay	Ratafia-Brown	Leidos
Shawn	Rumery	Solar Energy Industries Association
Sandra	Sattler	Union of Concerned Scientists
Dan	Shields	Office of the Ohio Consumers' Counsel
Cynthia	Simpson	Department of Labor
Michele	Somerday	FirstEnergy
Kevin	Steinberger	National Resources Defense Council (NRDC)
William	Stevens	Independent Consultant
Mark	Strohfus	Great River Energy
Chen-Hao	Tsai	Center for Energy Economics
James	VandePutte	Department of Energy
Boddu	Venkatesh	ICF
Brian	Walker	Office of Energy Efficiency & Renewable Energy (EERE)
Ken	Walsh	Leidos
David	White	Synapse Energy
Frances	Wood	OnLocation, Inc.
Thomas	Wos	Tri-State G&T
Evelyn	Wright	Sustainable Energy Economics
Garry	Young	Energy
Chuck	Zelek	National Energy Technology Laboratory (NETL)
Song	Zhao	Leidos

EIA attendees (in person)

Greg Adams	EIA
Lori Aniti	EIA
Rosalyn Berry	EIA
Erin Boedecker	EIA
Richard Bowers	EIA
Michelle Bowman	EIA
Michael Cole	EIA
Jim Diefenderfer	EIA
Kenneth Dubin	EIA
David Fritsch	EIA
Thaddeus Huetteman	EIA
Kevin Jarzomski	EIA
Scott Jell	EIA
Augustine Kwon	EIA
Angelia LaRose	EIA
Cara Marcy	EIA

Laura Martin	EIA
Chris Namovicz	EIA
Michael Scott	EIA
Manussawee Sukunta	EIA
Bonnie West	EIA
Carol White	EIA

EIA attendees (WebEx/Phone)

Marta Gospodarczyk	EIA
Tyler Hodge	EIA
Jeff Jones	EIA
Nilay Manzagol	EIA