



November 30, 2018

MEMORANDUM FOR: Ian Mead
Assistant Administrator for Energy Analysis

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

SUBJECT: Summary of AEO2019 Preliminary Results of the Electricity Working Group Meeting held on September 20, 2018

This memorandum summarizes the presentation at the second AEO2019 Electricity Working Group meeting, which included preliminary results from AEO2019 and the resulting discussion. The presentation materials are available in a separate document on EIA's website.

Background: Policy developments

EIA began by outlining key policy-related developments for the AEO2019 cycle, including the EPA's proposed Affordable Clean Energy (ACE) rule that replaces the original Clean Power Plan (CPP.) EIA stated that our Reference case would exclude the CPP and retain the current New Source Performance Standard for greenhouse gas emissions for electric generating units (consistent with AEO2018). AEO2019 also includes coverage of new state programs in New Jersey (SB 2314) and California (SB 100) to support carbon-free generation, as well as state RPS programs to reflect tighter standards (in Massachusetts).

Model enhancements (AEO2019)

For new generation, EIA implemented revised assumptions for the costs of new combined-cycle generating units, which were based on a report conducted in support of the PJM basic generation service (capacity) auction. The report recommended a change in the assumed *cost of new entrant* based on the continued decline in the cost of new natural gas-fired combined-cycle generating units-- converging on simple cycle combustion turbine costs-- which was generally confirmed by EIA in the evaluation of data for new builds filed on the Form EIA-860. For renewable generation, EIA updated the costs of new solar PV to reflect policy and market considerations. Finally, EIA updated coal supply curve cost parameters.

For existing units, in AEO2019 EIA updated the generator operating and maintenance cost assumptions based on recommendations from a study conducted by engineering firm Sargent & Lundy (S&L). The S&L study also evaluated EIA's treatment of plant aging. In its current approach, EIA assumes plants incur an increase in annual capital expenditures to account for plant life extension when a unit reaches a certain age (generally 30 years). S&L's analysis could not verify that approach, instead finding that aging

was a significant factor for only a limited number of generating technology types. Further, where it was significant, the effect of aging was consistent over time rather than a one-time increase in cost.

In addition, the AEO2019 shifts from performing a risk analysis of individual nuclear plants (used in AEO2018) to evaluating generation-at-risk using the method applied to other types of generation. In AEO2018, EIA evaluated the potential for retiring individual nuclear plants based on an assessment of local market conditions (e.g., including, among others, local market prices, fixed costs, deregulated market exposure, load growth, and aging costs.) AEO2019 no longer includes retirements based on this separate risk factor analysis; instead the model retires units that meet two conditions: the plants are projected to have three or more years of negative operating margins and they are not needed for a least-cost solution to satisfy reserve margin requirements (as is the case for fossil generating units).

Preliminary Results

The next segment of EIA staff's presentation focused on comparing the AEO2018 results with the AEO2019 preliminary projections. Preliminary results show lower natural gas prices in the short term, stabilizing at about 7-8% lower than in the AEO2018, which results in a generation mix similar to AEO2018 with slightly less coal generation and higher mid-term natural gas generation. Also similar to AEO2018, after the year 2025, capacity additions consist mainly of natural gas and solar facilities. However, total solar PV capacity (utility and end-use) is lower as a result of lower natural gas and electricity prices and re-specification of the end-use PV model.

Coal production in AEO2019 is projected to decrease slightly in the short term with small increases in later years. Overall, coal production is lower than the AEO2018 levels throughout the forecast period with the western United States accounting for most of the decline in overall coal production. U.S. coal exports are expected to recover only gradually through 2050. In addition, overall electricity sales growth is expected to remain largely unchanged from AEO2018 projection levels.

Discussion

The discussion following the presentation of preliminary results focused on policy changes, additional modeling enhancements, and projections for coal, natural gas, and renewables generation.

Policy changes

At the state level, California's legislation (SB 100) commitment to 60% renewable electricity generation by 2030, phasing into 100% "carbon-free" generation by 2045 is still open to interpretation, given that qualifying *clean energy* resources and additional specifications related to the California RPS await final regulatory definition. One participant noted that such a program could result in significant cost increases. Under EIA's assumption that the program includes large-scale hydro, fossil with carbon sequestration, and nuclear, significant new costs as a result of SB 100 are unlikely given that approximately 90%-95% of RPS compliance will be met with in-state qualifying generation by 2050 (including large-scale hydro), even without new targets. Sufficient qualifying resources are available from bordering regions (such as hydro and wind in the Northwest or nuclear and solar in the Southwest) to allow for the residual target to be met without significant impact on the baseline generation projection.

Another participant asked if EIA would revise the costs for coal plants without carbon capture and sequestration given EPA's proposal to revise the NSPS for coal plants. The same participant also asked whether the experience with the Kemper integrated gasification combined-cycle (IGCC) plant would be considered given that Kemper did not end up operating as a coal plant. EIA noted that because the current status of NSPS revision as a proposed rule, the existing NSPS would be reflected in the AEO2019 Reference case. In addition, no further analysis has been conducted on the cost of IGCC, so EIA has no basis for revising the assumptions.

Additional modeling enhancements

One participant noted that EIA had previously discussed improvements to projections of transmission and distribution (T&D) costs and asked if EIA had done anything in that area for AEO2019. EIA acknowledged that, as a basis for a better representation of the potential to capture long-term cycles in T&D spending, a project to digitize historic financial reports for utility capital expenditures was underway and expected to be concluded in the next quarter, but it would not be completed in time for inclusion in AEO2019.

Another participant asked a follow-up question about the status of the monthly instead of seasonal electricity demand representation. EIA replied that load shapes are applied to annual demands from the end-use models to generate demand curves for the Electricity Market Model. The load shapes are based on monthly and hourly profiles and have 864 data points (24 hours x 12 months x 3 day types.) The new REStore model dispatches storage and intermittent generating technologies using this detailed level of demand information. The larger electricity dispatch and planning models use aggregated time slices, with three load slices for each of three seasons, due to processing time limitations.

Coal

One participant asked how much coal generation is projected to decline. They also asked how much additional coal will be exported from the Appalachian region.

EIA indicated that total coal production in AEO2019 was projected to drop to slightly less than 700 million tons per year between 2030 through 2050, a decline of about 50 million tons compared with AEO2018. In AEO2019, Appalachia exports are projected to rise by 2 million tons in 2018 and 5 million tons in 2019 compared with 2017 export levels, and the growth is split between metallurgical coal and steam coal. EIA's Reference case does not project a high level (more than 100 million) of coal exports after 2020.

Another participant asked what EIA assumed for the marginal cost of a flue gas desulfurization (FGD) unit. EIA assumes that FGD units are always on if installed, so no provision for variable operation of FGD at individual coal units is necessary.

Renewables

One participant asked for additional detail on the decline in the overnight capital costs of solar photovoltaic (PV) panels. EIA indicated that it re-evaluates solar and wind costs for each AEO cycle because they have both shown significant movement from year to year. For solar in AEO2019, EIA also had to consider the potential near- and long-term impacts of factors affecting solar costs such as PV tariffs and excess supply of panels on the international market resulting from changes to solar policy in China. EIA determined that these two factors more or less cancelled each other, and that adjusting the 2018 cost for PV panels to account for the learning effects of recent market builds was sufficient to keep modeled cost of PV panels in line with cost declines observed in both EIA and Lawrence Berkeley National Laboratories (LBNL) data, as well as with general price trends from the National Renewable Energy Laboratory (NREL).

Another participant asked if EIA planned to evaluate wind cost revisions. EIA found that adjusting the 2018 capital cost for wind generators to account for the learning effects of recent market builds was sufficient to keep modeled wind generator costs in line with cost declines observed in both EIA and LBNL data.

Another participant asked if EIA's projections of capacity additions (slide 22 in the presentation) the segment for solar PV panel additions includes both utility scale and distributed generation. EIA confirmed that the slide shown includes capacity from all sectors for PV panels.

Natural gas

One participant asked what contributed to the projections of a lower natural gas price in AEO2019 than AEO2018. EIA noted that the natural gas production projections have increased largely as a result of increasing the size of the estimated potential resource as well as technological improvements in industry production practices.

Attendees

Guests (in person)

Name	Affiliation
Rachel Goldstein	Solar Energy Industries Association
Adam Stern	AWEA
Celeste Wanner	AWEA
Skyler Drennen	Energy Ventures Analysis
Jordan Kislear	U.S. Department of Energy
Tina Kaarsberg	U.S. Department of Energy

Guests (WebEx/phone)

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Nana Ayensu	General Electric
Justin Baca	Solar Energy Industries Association
Youngsun Baek	Union of Concerned Scientists
Frank Benavides	Alliance Resource Partners
Jose Benitez	Energy Ventures Analysis
Kikelomo Buari	Southern Company
Jason Burwen	Energy Storage Association
Wesley Cole	National Renewable Energy Laboratory
Leslie Coleman	National Mining Association
Tyler Cromeey	Southern Company
Ryan Dougherty	Geothermal Exchange Organization
Erich Eschman	Environmental Protection Agency
Neva Espinosa	Electric Power Research Institute
Sarah Forbes	U.S. Department of Energy
Steve Frauenheim	Edison Electric Institute
Jamie Heller	Hellerworx
Michael Leitman	National Rural Electric Cooperative Association
Yanghe Liu	Entergy
Jay Lucey	Coalition of Northeastern Governors
Carl Lundgren	U.S. Department of Labor
Greg Marmon	Wood Mackenzie
Jim Moore	Spire
Aditya Jayam Prabhakar	MISO
Jay Ratafia-Brown	Leidos
Ricky Roberts	Electric Power Research Institute
Joshua Rockwell	Office of Surface Mining Reclamation and Enforcement
Sandra Sattler	Union of Concerned Scientists
Serpil Kayin	Environmental Protection Agency

Daniel Shields	Office of Ohio Consumer's Counsel
David Shin	American Petroleum Institute
Sharon Showalter	OnLocation
Cynthia Simpson	U.S. Department of Labor
Michael Stansky	First Energy
Mark Strohfus	GR Energy Services
Chen-Hao Tsai	Midcontinent Independent System Operator
Kenneth Walsh	Leidos
David White	Synapse
John Wilson	Southern Alliance for Clean Energy
Thomas Wilson	Electric Power Research Institute
Frances Wood	OnLocation
Thomas Wos	Tri-State Generation & Transmission
Evelyn Wright	Sustainable Energy Economics
Song Zhao	Leidos
Paul Zummo	American Public Power Association

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