February 29, 2016

**MEMORANDUM FOR:** John Conti
Assistant Administrator for Energy Analysis

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

Paul Holtberg
Team Leader
Analysis Integration Team

**FROM:** Renewable Electricity Analysis Team

**SUBJECT:** Summary of AEO2015 Renewable Electricity Working Group Meeting held on February 9, 2016

**Presenter**: Chris Namovicz
*Topics included AEO2016 model and data updates and a summary of AEO2016 model results. Data updates included required modeling development efforts to include the final and proposed CPP rule, as well as capital cost updates, RPS developments, and new federal tax policies.*

**Participants Present:**
Bergman, Aaron (DOE)
Bowman, Michelle (EIA)
Boyd, Erin (DOE)
Brown , Austin (NREL)
Comstock, Owen (EIA)
Diefenderfer, Jim (EIA)
Donohoo-Vallett, Paul (DOE)
Goggin, Michael (AWEA)
Hodge, Tyler (EIA)
Hodson, Elke (DOE)
Jarzomski, Kevin (EIA)
Lindenberg, Steve (DOE)
Lindstrom, Perry (EIA)
Lowenthal-Savy, Danielle (EIA)
Luckow, Patrick (Synapse Energy)
Margolis, Robert (NREL)

Namovicz, Christopher (EIA)
Sukunta, Manussawee (EIA)
Vermeer, Grace (MJ Bradley)
White, Carol (EIA)

**Participants Via Webex:**

Augustine, Chad (NREL)
Baca, Justin (SEIA)
Dubin, Kenneth (On Location Inc)
Feldman, David (NREL)
Ho, Jonathan (NREL)
Hunt, Hannah (AWEA)
Jones, Jeff (EIA)
Kwon, Augustine (EIA)
Lee, April (EIA)
Mai, Trieu (NREL)
Marcy, Cara (EIA)
Martin, Laura (EIA)
Matek, Ben (Geothermal Energy Association)
Mayes, Fred (EIA)
Moses, Carolyn (EIA)
Peterson, David (EIA)
Richard, Christopher (EE)
Rosner, David (DOE)
Showalter, Sharon (OnLocation, Inc.)
Stanberry, Matt (AEE)
Tusing, Rich (DOE)
White, David (Synapse Energy)
Wilson, John D. (Southern Alliance for Clean Energy)
Wiser, Ryan (LBL)
Wood, Frances (OnLocation, Inc.)

**Issues Discussed**

**Renewable Portfolio Standards, Investment Tax Credit (ITC)/Production Tax Credit (PTC)**

- A participant asked how EIA handles the 'under construction' deadline for renewable tax credits.

*EIA assumes that the plant must be in-service based on the expiration date of the tax credit plus an assumed period that accounts for typical plant development and construction periods.*

- A participant asked how EIA treats interstate trading, and commented that ERC trading in EMM seems restrictive.

*EIA will conduct side cases to model interstate trading to the extent possible in the regional model, but there is still much uncertainty regarding the level to which trading might develop. EIA is also looking into nation-wide trading.*

**Performance Characteristics**

- A participant asked if the PV costs quoted in the presentation include the effect of learning.

*EIA confirmed that the estimated PV capital costs presented include the impact of learning. 30% of the PV costs are attributed to modules and 70% of the PV costs are attributed to the Balance of System. As more PV capacity is installed, the cost will decline.*

- The discussion of performance characteristics raised the issue of whether or not the CPP and ITC extension were causing costs to decrease.

*EIA confirmed that the CPP and ITC contribute to the decrease in capital costs. A third major factor is the lower initial cost for solar technology, which also helps to make it more competitive relative to other generating technologies.*

- The discussion on performance characteristics also addressed the change in slope of the learning curve. The participant wanted to know if the price of materials was the cause for the change in slope.

*EIA clarified that the change in the metals price index and segmented learning both contribute to the change in slope.*

- A participant wanted to know if EIA was modeling PV tracking or fixed tilt systems in the AEO2016.

*EIA is modeling fixed-tilt but requested both fixed and tracking cost and performance estimates to evaluate whether or not to model tracking systems in the future.*

- A participant wanted to know if the wind capacity is hitting any growth bounds, and if the wind growth bounds are specified at the EMM level.

*EIA uses an overall intermittent penetration limit of 40%, which is achieved in several steps. Current modeling results indicate that intermittent generation levels are reaching step limits (above 30%), at which point penetration levels begin to slow down. Current intermittent penetration growth limits for wind are specified in the EMM.*

- A question was raised as to whether growth limits applied only to utility scale or to both utility scale and distributed generation.

*EIA applies limits to both utility-scale and distributed generation. [Note: EIA's approach was modified subsequent to this meeting. As of this posting, the referenced limits only apply to utility-scale generation from wind and solar]*

- A participant wanted to know if there is a capacity factor difference occurring regarding the wind and solar balance.

*EIA confirmed that capacity factors are changing as new plants with higher capacity factors are built. Wind Capacity factors improve as additional capacity is installed. EIA has region-specific capacity factors. Solar capacity factors are static over time in the model.*

- The issue of regionality of wind costs was discussed. A participant wanted to know how the high-cost regions were calculated.

*EIA uses available data for the cost in specific regions or neighboring regions where necessary. In the highest cost region, the available data consists of only one plant, so that is what EIA used for the region's estimated cost.*

- A participant asked what other methodologies are used to estimate costs.

*EIA takes labor cost multipliers provided by Leidos and uses those multipliers to develop regional differentiation for all generating technologies (except for wind).*

- A participant wanted to know if the calculations to estimate costs are based on built plants.

*EIA confirmed that Leidos develops a cost-less cost estimate based on estimated labor and materials costs based on their experience with actual plants. They then use standard engineering models to estimate labor costs.*

- A participant wanted to know if EIA is using the regional cost estimates included to determine immutable costs.

*EIA confirmed that the regional cost multipliers are generally held constant in the model, although the underlying capital costs do change with time.*

- A participant raised additional concerns over costs, especially with small builds and basing cost estimates on a small sample size, which they believe to be the case.

*EIA stated that there are 2 options: 1) Wait for more projects to be built and adapt cost estimates; 2) Look at what are likely similarities/differences between regions, based on the Leidos study and other considerations. EIA noted that regions 9 and 5 have some similarities to the Southeast, and also have high costs. Tying together similar regions is probably a better approach than basing costs on one plant.*

- A participant noted that perhaps the EIA methodology is double penalizing with the single-point estimates for cost *and* capacity factor. Georgia Power did an RFI for wind projects in the Southeast (market offers only). Using this data from Georgia Power might help calibrate regional costs. This methodology might also provide a transitional component to cost to allow costs to come up or down to average over time.

*EIA recognizes the merits of the participant's suggestion, but is not following that methodology for this AEO cycle. Leidos did provide regional multipliers based on labor estimates but EIA used an observed distribution of actual project costs instead. [EIA subsequently followed-up with the Georgia RFI data and did not find suitable cost estimates to contribute to calibrating regional cost estimates.]*

- A participant wanted to know which technologies the Leidos regional cost multipliers being applied to.

EIA confirms that the multipliers are being applied to *all technologies, except for wind. The final regional cost multipliers will be specified in the final report from Leidos.*

- A participant asked if EIA will allow for capacity to increase if wind/solar are balanced, or if their capacity is capped.

EIA stated that *the 40% cap on intermittent generation is based on the sum of wind and solar generation, and is not a function of the relative contribution of each. The model is not readily adjustable to make capacity depend on the generation mix.*

**Clean Power Plan**

- A participant asked if EIA will apply an ERC for renewables in the rate-based approach to evaluating the Clean Power Plan.

*EIA confirms that it applies ERC's for trading. For the mass-based approach, renewables only reduce total carbon emissions. For the rate-based approach, renewables both lower the amount of carbon in the numerator of the rate, but in EPA's formula, also increase the base generation in the denominator, thus enhancing their overall value in reducing the emission rate. The mass based approach will be incorporated into the Reference Case. EIA is performing sensitivity analysis to evaluate the impact of the rate-based approach.*

- A participant asked if EIA is attributing the decrease in wind generation to the CPP and natural gas prices.

*Wind generation is influenced by a number of factors. EIA will run side cases with variations in natural gas prices and CPP implementation approaches that will help demonstrate the impact of these factors on wind and other renewable builds.*

- A participant asked how the EIA gas prices from AEO2016 compare to the gas prices in the High Oil/Gas case from AEO2015.

*Natural gas prices in the preliminary AEO2016 generally fall between the AEO2015 Reference case and the High Oil and Gas Resource case from the AEO2015.*

- A participant wanted to know if the CPP results in a decrease in biomass because the CPP is thought to penalize its use.

*EIA clarified that the CPP does not necessarily penalize biomass; whether or not biomass use is penalized depends on the biomass accounting that individual states choose to use. Current EPA guidance on biomass accounting leaves the biomass accounting interpretation dependent on a number of factors, and it is not easy to say if it penalizes biomass or not without case-specific knowledge. EIA assumes that biomass will count as a zero-carbon resource for CPP compliance. Biomass generation is less under the CPP as more coal-fired plants are retired so there are fewer opportunities for biomass cofiring.*

- A participant wanted to know if EIA will run an alternate scenario where the CPP is adjusted to meet COP21 targets.

*EIA is currently looking at cases based on various carbon fees. EIA will not be running an alternate COP21 specific side case. EIA does not propose or make energy or environmental policy and will not be exploring potential modifications of the CPP that would meet COP21 targets.*

- A participant wanted to know how states' targets are being allocated among CPP regions.

*EIA allocates emission targets based on current generation mix for each state. The methodology is based on shares of covered generation according to the CPP rule.*

**Other Topics**

- A participant wanted to know if EIA models energy storage.

*EIA currently models the operation of existing pumped hydro storage facilities, but does not model energy storage as a possible capacity expansion option. EIA is planning to assess energy storage for potential inclusion in future AEOs.*

- A participant wanted to know if EIA has made any changes to the way it models intermittency in AEO2016.

*EIA models dynamic capacity credits and a few other intermittency-related items such as surplus wind curtailment and time-of-day and seasonal match to load. One major change that was incorporated into the model this is year is the quantification of distributed PV. The average daily load had been net negative; now the model uses total generation, including end-use PV, which it treats as utility scale PV generation. This allows the distributed PV to be evaluated using existing intermittency algorithms, which are otherwise unchanged. [Note: EIA's approach was modified subsequent to this meeting. As of this posting, the referenced limits only apply to utility-scale generation from wind and solar]*

**Reporting Issues**

- A participant commented that wind builds seem to be low, especially compared to what's currently under construction.

*In combination with data reported to EIA on the Form EIA-860, EIA conducts independent research to assess projects in development. EIA encourages wind developers to report project construction status promptly to EIA. EIA currently picks up plants that are 'under construction' and 'planned'; capacity builds for 2016 and 2017, based on what is reported to EIA on the Form EIA-860.*