

May 31, 2018

MEMORANDUM FOR: Ian Mead
Assistant Administrator for Energy Analysis

FROM: John Staub
Director, Petroleum, Natural Gas, and Biofuels Analysis

Subject: Summary of Natural Gas Working Group Meeting held on
May 23, 2018

This memorandum provides an overview of the presentation given during the first Annual Energy Outlook 2019 (AEO2019) Natural Gas Working Group meeting and a summary of the resulting discussions that took place. The presentation slides are available in a separate document.

Background

Katie Dyl, EIA's lead natural gas markets modeler, led the working group.

She explained to participants that EIA was holding the first working group meeting earlier in the development cycle than in the past in to discuss the results in the recently released AEO2018 and solicit stakeholder feedback for consideration in future modeling efforts. Additionally, the first working group meeting provides an opportunity to identify issues or topics that might be better addressed through smaller, targeted working group discussions.

AEO2019 will be a short AEO cycle and will include the 6 core side cases (High/Low Macro, High/Low Oil Price, High/Low Oil and Gas Resource and Technology cases), along with the Reference case.

The meeting began with EIA staff presenting an overview of the updates that were included in AEO2018, including the new Natural Gas Markets Module (NGMM). Highlights includes specific results (*e.g.*, selected regional flows, regional supply price differentials), which may imply the NGMM may be underestimating natural gas flows from the Northeast down to the Gulf Coast, and where future modeling efforts should be focused.

Model updates (AEO2019)

The following updates are being considered for AEO2019:

- Improvements to the variable tariff curves (the unit cost as a function of capacity utilization) to align regional flows and supply prices with recent history
- Improvements with convergence between NGMM and EMM (in collaboration with the electricity modelers)
- Strengthening NGMM's benchmarking to new STEO forecasts
- The inclusion of historical calibration of NGMM results (a part of the post-AEO 2019 plan)

Not all of these update may be incorporated into AEO2019 because it is a short cycle, but a concerted effort is being made to improve this model based on what was learned when it was introduced during the last modeling cycle.

**WORKING GROUP PRESENTATION FOR DISCUSSION PURPOSES ONLY.
DO NOT QUOTE OR CITE AS RESULTS ARE SUBJECT TO CHANGE.**

Discussion

The first set of questions were related to how NGMM was structured and operated. Afterwards, the discussion focused on AEO2018 results and future modeling efforts. Finally, a few questions were asked about EIA's related publications.

NGMM

Staff clarified that the NGMM was written in AIMMS, not GAMS, and that all future new models will be using AIMMS because of its ease of use and ability for staff to learn the interface relatively quickly. It was also asked whether NGMM solves each month one at a time. Staff indicated that all months in a given year are solved simultaneously and independently of one another.

When asked to explain how storage is considered in the NGMM, staff explained that storage is endogenous in the model, fixed to the historical annual average. This assumption is well justified since NEMS is focused on producing long-term annual projections, not short-term, monthly results for publication. This means, as one stakeholder pointed out, that supply is the "balancing" quantity in the NGMM, not storage as often happens in the marketplace. Storage injections and withdrawals are each represented by their own nodes, and balance out to zero in any given year.

Regarding capacity expansion, staff explained that NGMM determines capacity expansion endogenously using the extension of the variable tariff curves (representing the additional cost required to build a pipeline) and consumption ~15% in excess of the historical average to represent a peak January and August month. If the utilization of existing capacity surpasses 100%, that additional volume is added into the total for a given year starting in November.

When asked if the NGMM can stop or not consider capacity expansion for a given transportation arc (i.e., into New England), EIA indicated that yes, the price associated with the utilization on the tariff curve can be adjusted to make the cost too high to ever be reasonably economic.

Modelers were then asked about the upper portion of the tariff curve. In particular, there was a concern that the variable tariff curve represents a variable cost below 100% utilization and a fixed capital cost above 100% utilization. EIA responded that this was not really a concern, especially as a first order approximation for the costs. There may be other ways to incorporate capacity expansion than this, but this way seems to work well. It was also pointed out that the curves should not be thought of as a variable cost, but as a basis differential representing a willingness to pay above the variable cost as capacity becomes constrained. The modelers were simply representing whether the demand is there for more capacity, not the capital costs associated with it.

Results (AEO2018)

Most of the questions during this discussion centered around natural gas trade. In response to a question related to where LNG export capacity was being built in the model endogenously after 2020, staff indicated that all additional LNG export capacity built beyond what is under construction is in the Gulf Coast. The only other option (by assumption) is to build capacity in Alaska. However this capacity does not come online since the project development lags behind others currently in advanced planning stages. Current constraints in the model do not allow for LNG exports out of the west coast (i.e., Jordan Cove in Oregon) as the prices seem too high for any likely expansion due, in part, to the additional

infrastructure required and its distance from low-cost U.S. supply. This choice can be amended, however, as the NGMM is flexible enough to include additional options for LNG export capacity sites. Any LNG out of Western Canada is exogenous as we use results from IEO 2017 to inform Canadian LNG export capacity.

As for where U.S. LNG exports ultimately go in the NGMM, these flows are not explicitly modeled. However, when determining the economic benefit of building additional capacity, two possible options are modeled: Atlantic basin (*i.e.*, Europe) and Pacific basin (*i.e.*, Japan, South Korea, China). In the NGMM, LNG exports go to the Pacific as prices are higher and therefore offer a greater profit. LNG going to Mexico or South America is not currently included in the model. However, an exogenous LNG import level into Mexico based off of results from IEO 2017 is assumed.

There was also a question on how NGMM models Canadian supply, specifically shale gas development in western Canada. Unlike in the prior natural gas model, this is now handled by the Oil and Gas Supply Module (OGSM), which bases their results on NEB projections. However, the NGMM does solve for the spot price in western Canada, which is sent to OGSM as an input for determining future production. NEB projections show that most of the growth in natural gas production does come from shale gas, specifically the Montney formation.

Model updates

This discussion centered on two themes: the incremental attempts to improve historical calibration and improved convergence with the electricity market module.

While stakeholders were informed that a thorough historical calibration effort would not be possible in AEO2019, EIA intends to work on this in the future. EIA also received a lot of good feedback about potential pitfalls and options. Stakeholders thought the improved regionality was a “great start,” and asked about any future plans to make certain states (*i.e.* Texas) even more granular. While increased regional granularity is something worth considering, it’s a difficult task because demand data is not available at that level, and it would require a significant effort to prepare the data to this level. Therefore, this is not a high priority improvement unless it becomes necessary for historical calibration.

One stakeholder asked about how EIA was dealing with the issue of pipelines that purchase electricity for processing, compression, etc., while dealing with the calibration of natural gas used as pipeline fuel because electricity is increasingly used in lieu of natural gas to run these facilities. The response was that EIA is aware of the issue, and the Natural Gas Markets Team is trying to make modifications to existing EIA surveys in an attempt to collect more information on this issue.

With respect to convergence with Electricity Market Module (EMM), one participant pointed out that it could be a sensitivity issue, and the EMM may be jumping on penny changes. Monthly storage might be impacting this because the NGMM is generating too much price sensitivity to months with peak electricity use. Additionally, the historic storage pattern might overstate the demand. EIA could try a separate run where interactions with EMM are at an annual, not seasonal, level, letting it underestimate the price volatility. It may not get as much of a price swing which may be more reflective of the electric markets. Another participant suggested the alternate approach, interacting at a monthly level, but EIA modelers were not sure about the feasibility of this; it could also add to run time.

Toward the end of the meeting, the discussion went back to storage, where the idea rose that instead of making storage a historical average, or part of the QP, the model could look at demand changes and adjust storage values accordingly (thereby potentially mitigating price spikes). However, while this could work with residential and commercial sectors, there was still skepticism that this could work given the price sensitivity of the electric power sector.

EIA confirmed that a historical average injection and withdrawal pattern was used for each individual state and that it is kept constant across the projection and scenarios. Therefore, no more storage is built, even in the high resource case.

One stakeholder pointed out that this fixed storage could be exaggerating price swings, for example, local distribution centers (LDCs) needing additional storage, and that it might benefit the NGMM to look at changing storage by demand type and change. However, the difficulty of this was acknowledged given that it could depend on a lot of different factors (i.e. weather). But it might be worthwhile to look at electric load changes. Finally, the discussion closed with a comment that the electric power sector is a lot more important to balancing gas markets than might be acknowledged.

Additional issues

There were some general questions related to publication:

- The AEO2018 Assumptions document is available for the Natural Gas Market Module.
- NGMM documentation is in review and will be out as soon as it gets through that process. Katie Dyl offered to provide an early copy of this document for those that have an interest when it is through the first stage of review and edits.
- The documentation process, including the development of a “User’s Handbook,” is being discussed within EIA and may be available in a few years.

Attendees

Guests (in person)

Brian D. Lavoie	DOE
Joe Benneche	Former EIA
Pete Whitman	FERC
Jose Benitez	Energy Ventures Analysis

Registered Guests (WebEx/phone)

Ben Schlesinger	BSA Energy
Amy Sweeney	DOE
Brian D. Lavoie	DOE
Yelena Dandurova	Leidos
Matthew Hansen	National Energy Board, Canada
Chris Doleman	National Energy Board, Canada
Bill Pepper	Consultant
Robert Schultz	Leena Labs, Inc.

Sauleh Siddiqui
Felipe Feijoo
Robert Gulliksen
Niko Kydes
John Myer
Henan Xu
Kevin Blaser

Johns Hopkins University
Johns Hopkins University
California Energy Commission
OnLocation, Inc.

Energy Ventures Analysis
Saginaw Chippewa Indian Tribe

EIA attendees (in person)

Katie Dyl (presenter)
Peter Gross
John Staub
Samantha Calkins
Ian Meade
Angelina LaRose
David Fritsch

EIA attendees (WebEx/phone)

Michael Cole
David Manowitz
Beth May
James Preciado
Dana Van Wagener