

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 Oil and Gas Supply & Liquid Fuels Markets Working Group Meeting held on May 31, 2018

This memorandum provides an overview of the presentation given during the first Annual Energy Outlook (AEO) 2019 Oil and Gas Supply & Liquid Fuels Markets Working Group meeting and a summary of the resulting discussions that took place. The meeting was split into two halves. The first half covered the Liquid Fuels Market Module (LFMM) and International Energy Model (IEM). The second half covered the Oil and Natural Gas Supply Module (OGSM). The presentation slides are available in separate documents on EIA's website.

### **LFMM and IEM**

The presentation was given by James Preciado, who began the working group by describing the differences between this year's first AEO2019 working group and past ones. Most significantly, this first working group is being held before the start of AEO2019 modeling effort to allow more time for feedback on the AEO2018 results and incorporation of outside stakeholder suggestions.

Three main subjects were covered: an overview of LFMM and IEM; related results from AEO2018, and future model development plans. The presentation highlighted the following points:

- LFMM is a linear program that projects petroleum product prices and sources of liquid fuels supply for meeting petroleum product demand. The sources of supply include crude oil refined into petroleum products, imports of petroleum products, and non-petroleum liquids such as biofuels, coal-to-liquids, and gas-to-liquids.
- IEM is an economic model that simulates the interaction between U.S. and global petroleum markets. It uses assumptions of economic growth and expectations of future world crude oil and liquids production and consumption to compute Brent crude oil prices, provides a supply curve of world crude like liquids, and generates a worldwide oil supply/demand balance with regional detail.

### **Results (AEO2018)**

The following results were highlighted during the presentation:

- Oil prices continue to rise in the reference case projection.
- The United States becomes a net exporter of crude oil, petroleum products, and natural gas liquids in 2029.
- While total crude oil imports decline in the reference case, imports of heavy crude oil increase to balance the crude slate.
- Refinery utilization rises in 2020 in reaction to increased international demand for diesel, but returns to historical levels.

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- Volumes of imports and exports of petroleum products shift as a result of the 2020 International Maritime Organization (IMO) regulation on sulfur content of marine fuel.

#### Model updates (AEO2019)

The following updates were presented as being under consideration for AEO2019:

- Update transportation costs between regions as well as import and exports costs for crude oil and petroleum products.
- Assess the ability of the West Coast refineries to process additional volumes of Alaskan crude oil production.
- Further analyze the effects of IMO regulations on sulfur content for marine gasoil starting in 2020 on international crude oil and product markets.
- Some “under the hood” process improvements for benchmarking to the STEO forecast.

#### Discussion

The discussion focused on three topics: how the models being discussed operated, AEO2018 results, and future model development.

**LFM and IEM.** Several general questions were asked about the LFMM including how it handles changes in capacity, movement of products between regions, changing prices, and changes in technology. Staff explained that, in regards to downstream capacity, the model is flexible. Although there are no atmospheric distillation unit (ADU) retirements, utilization can decline. It was also explained that changes in technology can be captured by lowering or raising utilization rates, which can also account for retirement of capacity. Staff explained that information is aggregated at the regional level and that cost and capacity are accounted for when moving products between refining regions.

When EIA staff were asked about how crude oil prices are accounted for, it was explained that prices are exogenous. Staff also stated that crude oil pipelines cannot be built in the model, but that current market conditions are captured and some analyst judgement is applied to the projection.

Additional questions included how exports destinations are determined and if peak demand is included. EIA staff explained that exported volumes go to the global market, and it is assumed that global demand is sufficient to consume anything the U.S. exports. Staff also explained that EIA does not project peak petroleum product demand. In the IEO, both production and consumption increase out through 2050.

**Results (AEO2018).** There was a general question about if the U.S. is a net exporter of crude oil. EIA staff explained that the U.S. is not a net exporter of crude oil by itself, but that the U.S. is projected to be a net exporter in 2029 when petroleum products and NGLs are included along with crude oil.

**Model development.** There were three main categories of questions about future AEO development and assumptions: IMO regulation impacts, how LFMM adjusts to increasing share of U.S. light oil, and what future process improvements are planned.

EIA staff explained that investment ahead of IMO regulation is slow. Adoption of scrubbers is proceeding slowly and the capacity to add more to ships by 2020 is limited. Current thinking has not changed since AEO2018 and assumes the majority of ships will not have scrubbers by 2020. Similarly increased refining capacity to produce IMO compliant fuels is also progressing slowly. Some investment has been made,

but not much more is expected to come online before 2020. With respect to the ultra-low sulfur diesel fuel (ULSD) outlook, staff explained that U.S. imports of ULSD is expected to decrease, and internationally demand of ULSD is expected to increase and drive US exports of ULSD.

In regard to the increasing share of lighter oil production within the United States, LFMM has the ability to build downstream unit capacity to accommodate the domestic processing of lighter crude oil. It is already occurring in the model and there is an increase in light oil refining capacity. Staff explained that the IMO regulations limits the sulfur content of marine bunker fuel from currently 3.5% to 0.5% Sulphur in 2020.

In regards to process improvements, the current plan is to improve matching the AEO results to baseline STEO forecasts, especially in the side cases.

## **OGSM**

The presentation was given by Dana Van Wagener. Three main subjects were covered: the results from AEO2018, a review of changes to the Short-Term Energy Outlook (STEO); and plans beyond AEO2018. The following points were highlighted:

### Results (AEO2018)

The following AEO2018 results were highlighted during the presentation:

- U.S. crude oil and natural gas production continues to be driven by growth in tight oil and shale gas supply.
- The Southwest region leads growth in U.S. crude oil production and the East region leads growth in natural gas in the Reference case.
- Bakken and Wolfcamp lead growth in tight oil production.
- Marcellus and Utica lead production of shale gas.
- U.S. crude oil and natural gas production are sensitive to resource availability and technological improvements.
- Natural gas plant liquids production increases from 2017 levels in all AEO2018 cases.
- The East and Southwest regions lead the production of natural gas plant liquids in the Reference case.
- Crude oil price projections are sensitive to global conditions, while U.S. natural gas prices depend more on domestic resource assumptions.
- Key oil and natural gas supply assumptions including technically recoverable resources and annual average rate of technological improvement.

In addition, some comments were made that related to the latest forecasts in EIA's STEO:

- West Texas Intermediate oil prices are forecast to average over \$60/barrel in both 2018 and 2019 in the latest STEO.
- Higher prices drive crude oil production growth higher in the latest STEO than in the AEO2018 Reference case.
- Henry Hub natural gas prices are forecast to average \$3.01/MMBtu in 2018 and \$3.11/MMBtu in 2019 in the latest STEO.

- Marketed natural gas production is projected to grow by a record 7.4 Bcf/d on average in 2018 in the latest STEO.

#### Model updates (AEO2019)

The following items were mentioned as possible areas for improvement during future AEO cycles:

- Add Northern Great Plains region to AEO2019 published regional crude oil and natural gas supply tables
- Expand short-term supply curve options
- Include the coastal plain of the Arctic National Wildlife Refuge
- Update Tight oil and shale gas assumptions for
  - Estimated ultimate recovery
  - Lateral length
  - Well spacing
- Update NGPL assumptions for the DJ and Anadarko basins
- Update lower 48 offshore and Alaska field declines and announced discoveries
- Update according to current laws and regulations

#### **Discussion**

The ensuing discussion centered around the AEO2018 results and future model development.

#### Results (AEO2018)

There were several questions about both the AEO2018 natural gas projections and the technology and price assumptions used in the model. EIA staff explained that natural gas production increases throughout the projection — despite low natural gas prices — because both strong demand (including demand from LNG) and production derived from a large resource base. In response to questions about the percentage of associated gas in the projection, EIA staff explained that in 2017, associated gas production was 3.4 tcf of the 27 tcf total, and 6.5 tcf of the 43 tcf total in 2050.

In regard to technology improvement assumptions and how it relates to recently reduced drilling and leasing costs, EIA staff explained that long-term modeling of technological progress is difficult in terms of timing and significance. In addition to technological progress, costs are a function of price and drilling activity levels. The model reflects the significant decrease in costs in 2015-2016 when prices and activity levels fell, and the recent increase in costs as prices and activities levels have increased. EIA staff responded to a specific question about technology improvement, explaining that it takes 3-6 years to ramp up production for tier 2 EURs, depending on the size of the play and the price environment. EIA staff also clarified that tight oil estimates include shale oil and that drilling cost improvements are modeled on a per well basis.

An additional question was asked about global geopolitical events and how they are accounted for within the model. In response, staff explained the model relies on exogenous oil price paths which can be structured to represent different geopolitical scenarios, but that the model does not include the kind of macro level ideas mentioned in the question.

There was one question about how EIA estimates the amount of flared and vented gas from oil or gas wells. EIA staff explained that volumes of flared and vented gas are not tracked or estimated for the AEO.

#### Model development (AEO2019)

There were several specific questions concerning AEO2019 plans. There was an observation about natural gas plant liquids (NGPL) supply which does not appear to increase as much as natural gas production and it was asked if this will change in the next AEO. EIA staff explained that NGPL growth in the near term is from the more liquid rich portions of plays, and that the drier portions are developed later, resulting in relatively less NGPLs as time goes on.

Another participant asked if the WTI-Brent spread would change over time. Staff responded that the differential is generally flat at \$5.00 per barrel to \$5.50 per barrel and stays there throughout the projection. It was also asked which regulations and legislative changes would be updated. Staff responded that this has not been completed yet and would have to be reviewed first to identify what has changed since AEO2018. The two areas where changes have been identified so far include the lifting of drilling ban in the Arctic National Wildlife Refuge (ANWR) and Section 45Q tax changes for CO<sub>2</sub> enhanced oil recovery. Staff explained that NETL is updating the representation of Section 45Q for CO<sub>2</sub> EOR into their version of the NEMS model and EIA might do something similar or utilize their work if it is available in time for the AEO2019.

There was another question about if EIA used estimates of lateral length (on horizontal wells) at the county level. EIA staff explained that lateral length is estimated at the play and county level. Staff went on to explain that they know that lateral length has changed in the past, and that updates for lateral length are made as more information becomes available for how particular formations are being completed.

Further, there was a comment from the audience that depending on global macro economic issues (not in the AEO modeling), things peak and decline, and that they do not form smooth rollovers (a comment on general production profiles).

#### **Attendees**

##### Guests (in person)

John Powell	DOE
Amir Zaman	Rystad
Katherine Ehly	NGSA
Brett Murray	ARI
Joseph Kile	CBO
Jeffrey Eppink	Enegis LLC

##### Registered Guests (WebEx/phone)

Scott Greenip	State Department
Irene Chang	Exxon Mobil

Steven McCusker	Exxon Mobil
Paul Tanaka	Exxon Mobil
Whitney Herndon	RHG
Shree Vikas	ConocoPhillips
Greg Levelle	ConocoPhillips
Robert Kleinburg	Schlumberger
Celest Marshall	API
Geoffrey Brand	API
Svetlana Ikonnikova	Bureau of Economic Geology (BEG)
Bill Fairhurst	BEG
Gurcen Gulen	BEG
Victor del Caprio	BEG
Bill Fairhurst	BEG
Michael Schaal	Energy Ventures Analysis Inc.
Jose Benitez	Energy Ventures Analysis Inc.
Steven Kopitz	Princeton Energy
Paul Touradji	Touradji Capitol Management
Deborah Gordon	Carnegie
Jairam Gopal	Deloitte
Oliyanka Ogunsola	DOE
Brian Lavoie	DOE
Erica Folio	DOE
Jennifer Li	DOE
Donald Remson	NETL
Ray Boswell	NETL
Emily Newes	NREL
Yan Zhou	ANL
Andy Kydes	OnLocation
Ken Walsh	Leidos
Yelena Dandurova	Leidos
Greg Leveille	COP
John Highes	Twin Comm
Jerry Eyster	GE
Ben Salisbury	FBR
Dustin Pool	Hess
Greg Terzian	Hess
Jack Weixel	Point Logic Energy
Charles Nevle	Point Logic Energy
Ben Schlesinger	BSA Energy
Robert Schutz	Leenalabs
Michell DeRubis	FTI Consulting
Jarrett Whistance	University of Missouri

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Eder Garcia  
Anja Singh

Mexico Energy Department  
Hart Energy

EIA attendees (in person)

James Preciado (presenter)  
Dana Van Wagener (presenter via Webex)  
Meg Coleman  
John Staub  
John Conti  
Ian Mead  
Angelina LaRose  
Faouzi Aloulou  
Hannah Breuhl  
David Daniels

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