MEMORANDUM FOR: Angelina LaRose
                          Assistant Administrator for Office of Energy Analysis

FROM: Jim Diefenderfer
                          Director for Office of Long-Term Energy Modeling

Subject: Summary of Oil and Gas Supply, Liquid Fuels Market, International
                          Energy, and Natural Gas Market Modules Working Group Meeting held
                          on September 29, 2021

This memorandum summarizes the presentation given during the *Annual Energy Outlook* (AEO) 2022 Oil
and Gas Supply, Liquid Fuels Market, International Energy, and Natural Gas Market Modules Working
Group meeting and the resulting discussions that took place. The meeting had three parts that focused
on different modules:

- Oil and Gas Supply Module (OGSM)
- Liquid Fuels Market Module (LFMM) and International Energy Model (IEM)
- Natural Gas Market Module (NGMM)

The presentation slides are available in a separate document on our website. All slides, charts, and
discussions for AEO2022 were preliminary and, therefore, should not be quoted or cited. We will release
final AEO2022 materials in early 2022.

OGSM

Will Sommer gave the first presentation, and he discussed two principal topics: data updates for
AEO2022 and recent laws and regulations that affect oil and natural gas. He highlighted the following
points:

Model and data updates
- Updated assumptions for tight and shale estimated ultimate recovery (EUR) of crude and natural
  gas per well resulting in an increase of crude oil resource estimates relative to AEO2021
- Updated the Lower 48 states offshore and Alaska announced discoveries
- Updated historical production through 2020 and estimated production for 2021
- Updated the natural gas plant liquids (NGPL) factors used for plays in the Denver-Julesburg Basin
- Updated Canada's natural gas supply (legacy declines and EURs)
- Started modifying code to handle revised oil and natural gas permitting rules in Colorado

Preliminary results
- We project West Texas Intermediate (WTI) crude oil prices to be lower than AEO2021
  projections after 2027.

- We project U.S. crude oil production to be generally lower than AEO2021 projections.
- We project growth in U.S. crude oil production primarily as a result of tight oil from the Permian Basin.
- We project U.S. dry natural gas production to be less than in AEO2021 after 2025.
- We project Marcellus, Hayesville, and tight oil plays to be the primary drivers of growth in shale gas production.
- We project NGPL production to be generally higher than in AEO2021.

Discussion
Attendees had no questions specifically for OGSM modelers.

LFMM and IEM
Peter Colletti and Estella Shi gave the next presentation. Peter covered key data updates for AEO2022 about Brent crude oil prices, crude oil supply and exports, domestic petroleum consumption, gross product exports, and diesel price spreads. Estella covered biofuels supply and renewable diesel. They highlighted the following:

Model and data updates

- Updated international crude oil and petroleum product curves
- Updated crude oil price differentials
- Updated pipeline capacity and transportation costs
- Updated state and federal fuel taxes
- Updated historical and *Short-Term Energy Outlook* (STEO) liquid fuels data
- Updated capacities for refinery, biofuels, and cogeneration
- Updated Renewable Fuels Standard (RFS) mandate levels

Preliminary results
- We project Brent crude oil prices to be higher early in the projection period and then be lower compared with AEO2021.
- We project the Brent-WTI price spread to remain similar to the AEO2021 projection.
- We project crude oil exports to decline slightly over the projection period.
- We project the total crude oil supply to be slightly lower than in AEO2021, but we project refinery utilization to remain the same.
- We project consumption of domestic petroleum products to be slightly higher than in AEO2021 through projection period.
- We project gross product exports to be lower than in AEO2021 to meet higher domestic product consumption.
- We project price spreads between gasoline and diesel to be narrower, compared with AEO2021.
- We project the diesel-jet fuel spread to narrow throughout projection period.
- We project biofuels supply to rise quickly to pre-pandemic levels and rise slightly above AEO2021 levels after 2040.
- We project renewable diesel supply to be higher than biodiesel supply throughout projection period.

Discussion

One attendee asked about 2021 and 2022 renewable volume obligations (RVOs) in the AEO. We explained that we will most likely not include RVOs in the AEO2022 because we only apply existing laws and regulations and the U.S. Environmental Protection Agency (EPA) will likely not makes its final rulemaking until after we freeze the Reference case. Another attendee asked about RFS assumptions for beyond 2022. We stated that because EPA has not yet released a rulemaking beyond 2022, current 2022 mandates are held constant throughout the projection period. An attendee asked about the separation of renewable diesel from other biomass-derived liquids in the AEO tables. We explained that we do not report renewable diesel separately from other biomass-derived liquids; however, most other biomass-derived liquids consist of renewable diesel.

An attendee asked about constraints on blend rates of biomass-based diesel. We stated that blend rates may be a constraint in the future but not at the moment. An attendee asked about volume thresholds for considering new fuels, specifically sustainable aviation fuel (SAF). We explained no specific volume thresholds currently exist and that we are investigating the introduction of SAF for future AEOs.

An attendee asked about the rapid recovery in liquid fuels demand and the recent Traffic Volume Trends data by the Federal Highway Administration (FHWA). We explained the near-term recovery in liquid fuels demand primarily reflects the most recent STEO forecast, which takes into consideration a number of different sources of consumption and demand data. LFMM does not explicitly use FHWA traffic volume trends data in its modeling.

An attendee asked about CO_2 taxes in the projection. Carbon taxes are added onto product prices produced by the model.

NGMM

Stephen York presented updates for AEO2022 that were related to natural gas production and consumption, spot prices, trade with Canada, exports to Mexico, and liquefied natural gas (LNG) exports and facilities. He highlighted the following:

Model and data updates

- Incorporated data from the *Natural Gas Annual*, released November 2020 (2019 annual data)
- Incorporated data from the *Natural Gas Monthly* through April 2021 (complete 2020 history)
- Updated pipeline capacity data, natural gas price data, and historical data for Mexico and Canada
- Updated in-service dates of LNG export facility projects
- Updated the natural gas spot price data
- Updated world oil price assumptions, economic recovery and related consumption changes, and STEO calibration

Preliminary results

- We project U.S natural gas consumption and production to be higher in the short term and slightly lower in the long-term projections compared with AEO2021.
- We project Henry Hub natural gas spot prices to be higher in the near term compared with AEO2021 but long-term prices approach $3.40/MMBtu by 2050.

- We project imports from Canada to decline, but we expect overall imports to remain unchanged compared with AEO2021.
- We project exports to Mexico to be lower than in AEO2021. We expect projected growth in exports to Mexico to peak near 2035.
- We have found that some LNG facilities are being completed much earlier than originally expected. Additionally we are exploring some export assumptions updates.

Discussion

An attendee asked for our renewable natural gas (RNG) production projections. We stated that we do not separately account for RNG production in the NGMM because it is not accounted for separately in our *Natural Gas Annual* and *Natural Gas Monthly* data. We are exploring options to account for RNG production separately in the future.

Another attendee asked about current Henry Hub prices affecting our projections. We explained that short-term prices are forecast in the STEO and are used as exogenous inputs in the NGMM. Higher prices are likely to be reflected in the model after the NGMM is benchmarked to the October STEO.

An attendee asked if total natural gas disposition was visible on any charts. We replied that our chart shows consumption but does not include exports.

Attendees

Registered guests (Webex and phone)

Abbas Abubakar	Tafawa Balewa University Bauchi
Emil Attanasi	U.S. Geological Survey
Ray Boswell	U.S. Department of Energy
Robert Brooks	RBAC Inc.
Ramses Omar Cabrales	Federal Energy Regulatory Commission
Leonardo Delgado	U.S. Department of Energy
Katharine Ehly	Natural Gas Supply Association
Cory Forgrave	Office of Natural Resources Revenue
Michael Godec	Advanced Resources International
Kathy Gramp	Congressional Budget Office
David Greene	National Highway Traffic Safety Administration
Bryan Just	American Petroleum Institute
Ben King	Rhodium Group
Hannah Kolus	Rhodium Group
Daniel Lerch	Post Carbon Institute
Emily Newes	National Renewable Energy Laboratory
John Powell	U.S. Department of Energy
Gregory Powell	U.S. Department of Transportation
Tony Radich	U.S. Department of Agriculture
Aymeric Rousseau	Argonne National Laboratory
Isabella Ruble	U.S. Department of Energy
Benjamin Schlesinger	UMD Public Policy Center for Global Sustainability
Kristen Strellec	Bureau of Ocean Energy Management
Morgan Summers	National Energy Technology Laboratory

Amy Sweeney	U.S. Department of Energy
Wyatt Thompson	University of Missouri
Peri Ulrey	U.S. Department of Energy
Boddu Venkatesh	ICF
Ken Walsh	Leidos Inc.
Alan Weber	MARC-IV
Jamie Webster	Boston Consulting Group: Center for Energy Impact
Jarrett Whistance	University of Missouri: Food & Agriculture Policy Research Institute

EIA participants (Webex and phone)

Greg Adams
Erin Boedecker
Hannah Breul
Peter Colletti (presenter)
Troy Cook
Jim Diefenderfer
Michael Dwyer
Kathryn Dyl (presenter)
Joshua Eiermann
Mindi Farber-DeAnda (presenter)
David Fritsch
Adrian Geagla (presenter)
Peter Gross
Sean Hill
Thaddeus Huetteman
Mala Kline
Mary Lewis (presenter)
Elizabeth May (presenter)
Jim O'Sullivan
Albert Painter (presenter)
April Patel
James Preciado
Corrina Ricker
Estella Shi (presenter)
Nicholas Skarzynski
Andrew Smiddy
Will Sommer (presenter)
Courtney Sourmehi
John Staub
Manussawee Sukunta
Dana Van Wagener (presenter)
Neil Wagner
Stephen York (presenter)