

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

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

Subject: Summary of Petroleum and Natural Gas Long-Term Modeling Team
Working Group Meeting held on July 17, 2024

This memorandum summarizes the presentation given during the *Annual Energy Outlook 2025* (AEO2025) Petroleum and Natural Gas Long-Term Modeling Team Working Group meeting and the resulting discussions that took place.

The presentation slides are available in a [separate document](#) on our website. All slides, charts, and discussions for AEO2025 were preliminary and, therefore, should not be quoted or cited. We will release final AEO2025 materials in early 2025.

Katie Dyl introduced the presentation and the team of modelers who worked on five of the modules over the past year and a half since the AEO2023 was released.

Liquid Fuels Market Module (LFMM) and International Energy Module (IEM)

Peter Colletti covered the key data updates for AEO2025 on:

- Domestic refinery capacity
- Petroleum infrastructure
- Brent crude oil price
- Changes to refinery hydrogen representation

Estella Shi presented the planned updates to biofuel supply and federal and state regulations. They highlighted several points, as outlined below.

Model and data updates

- Incorporate data from the *Short-Term Energy Outlook* forecast (2023–2025 data)
- Remove xTLs (natural gas-, coal-, and biomass-to-liquids) from AEO report tables
- Update international import and export curves for crude oil and petroleum products
- Update crude oil price differentials
- Update capacity for refineries and cogeneration facilities

- Incorporate new pipeline capacity and transportation costs
- Consider announced projects from our U.S. Liquids Pipeline Projects Database
- Develop new World Oil Price (WOP) path, not significantly different from Brent crude oil projection in AEO2023
- Separate hydrogen production in steam methane reformers (SMRs) and work with Hydrogen Market Module (HMM) modelers to shift production to the new model
- Update capacity for all biofuels—ethanol, biodiesel, renewable diesel, and sustainable aviation fuel
- Plan to update biofuel feedstock costs and E15 penetration rate
- Update Renewable Fuel Standard (RFS) targets for 2023–2025
- Preserve RFS targets for 2026–2028 because the Environmental Protection Agency (EPA) delayed the final rulemaking until December 2025
- Add representation of Washington State Clean Fuel Standard
- Clean up representation of carbon capture and sequestration in LFMM, improving the modeling for carbon capture retrofits for ethanol plants
- Work with modelers from new Carbon Capture, Allocation, Transportation, and Sequestration (CCATS) module to properly integrate carbon capture

Peter concluded the presentation by announcing that our modelers have been developing a new model, the Fuel Liquids EXchange module, that incorporates a redesigned LFMM and IEM for AEO2026.

Natural Gas Market Module (NGMM)

Stephen York covered key data and model updates for AEO2025:

Model and data updates

- Incorporate data from the *Natural Gas Annual* (2022 annual data) and *Short-Term Energy Outlook* forecast (2023–2025 data)
- Incorporate historical data for Mexico and Canada through 2023
- Update pipeline capacity and new pipeline capacity focused on transporting Permian Basin natural gas to liquefied natural gas (LNG) export terminals and other U.S. Gulf Coast consumers
- Incorporate nearly 10 billion cubic feet per day of LNG export capacity under construction in the United States
- Incorporate LNG projects under construction in Mexico that will be supplied from U.S. natural gas pipelines
- Update natural gas spot price historical data and world oil price assumption
- Add representation of renewable natural gas (RNG) (We are using Argonne National Lab’s database for historical RNG capacity. We are projecting future RNG from landfills and livestock, taking into account credits from EPA’s RFS and California’s Low Carbon Fuel Standard to determine economics.)

New AEO2025 Modules

Katie Dyl summarized the key takeaways of two new models—Hydrogen Market Module (HMM) and Hydrocarbon Supply Module (HSM). Both modules were introduced to AEO2025 stakeholders in separate working group meetings on June 12 and July 11, respectively.

Both new modules allow us to analyze Inflation Reduction Act impacts.

- HMM represents hydrogen production from SMRs and electrolyzers and supplies hydrogen to the electric power and end-use sectors.
- HSM replaces our legacy Oil and Gas Supply Module, streamlines and enhances features, and shifts carbon capture and sequestration code to the new CCATS module.

Discussion

The first question from stakeholders asked if we could provide a confidence interval around the WOP rather than a flat line at around \$80 per barrel. Peter explained that the WOP is an assumption, not modeled results. The WOP is part of the assumptions that serve as a baseline for LFMM so we can model Brent crude oil price.

One attendee asked us to reiterate the E15 assumptions for the AEO2025. Estella explained that E15 consumption is rare in the United States. We use state-level data from Iowa, which has some of the highest penetration. States are divided into high, medium, or low penetration classes with distinct E15 trajectories. We do not expect to see much E15 consumption in the projection.

One attendee asked if incremental LNG capacity in Mexico is modeled endogenously in addition to announced capacity under construction. Stephen explained that we do not model Mexico's LNG endogenously and only consider capacity that is under construction and has a high likelihood of entering service.

One attendee asked if the models have access to CME West Texas Intermediate (WTI) and Henry Hub prices to use in our analysis, and if not, what do we use as an alternative. Peter explained that we do not use CME Group data in LFMM, and we endogenously calculate WTI. Stephen explained that we use Natural Gas Intelligence for historical natural gas prices, but NGMM projects Henry Hub prices endogenously and is a result of shadow prices from the Linear Programming optimization. Katie then added that for our natural gas spot price history, we use Natural Gas Intelligence for Henry Hub and myriad other spot prices that are assumptions in the model.

An attendee asked about the cost of making hydrogen from electrolysis because it seems expensive relative to producing hydrogen from SMRs. Katie explained that we do not have hydrogen production costs yet because we are still integrating the new HMM into National Energy Modeling System and do not have preliminary outcomes. Stephen added that hydrogen production costs from electrolyzers are difficult to summarize because they heavily depend on the cost of electricity, when the electrolyzers are running, and whether they receive the Section [45V credit](#). However, Stephen noted that without Section 45V credits, producing hydrogen from electrolyzers is generally less economical compared with producing hydrogen from SMRs.

Another attendee had very specific questions about the type of electrolyzers and the relevant learning rates considered for green hydrogen. We requested that he review the presentation and summary memo from the HMM working group meeting. If his specific question was not addressed there, he should contact us.

Attendees

Guests (Webex)

	Affiliation
David Shin	American Petroleum Institute
Elena Giyenko	California Energy Commission
Anthony Dixon	California Energy Commission
Michael Lynch	EnergySeer
Charles Sheppard	EOG Resources
Matthew Ives	GTI Energy
Ram Dharmarajan	GTI Energy
Harry Vidas	ICF
Ed Merrow	Independent Project Analysis
Marshall Carolus	Intek, Inc.
Doug Hengel	LNG Allies
Luciane Cunha	National Energy Technology Laboratory (NETL)
David Morgan	NETL
Rob Sweeney	nXSolutions
Cory Forgrave	Office of Natural Resources Revenue
Banafsheh Jabarivelisdeh	OnLocation, Inc.
Jefferson Riera	OnLocation, Inc.
Brian Prest	Resources for the Future
Richard Fullenbaum	RFF Consulting LLC
Ben King	Rhodium Group
Tomy Granzier-Nakajima	U.S. Department of Energy (DOE)
Brandon McMurtry	DOE
Brian Lavoie	DOE
Katie Spreitzer	DOE
Natalie Lefton	DOE
Andrew Paterson	U.S. NIC
Fazal Malakhail	University of Missouri
Jonathan Nylander	Vinnova
Alex Sun	Wood Mackenzie

EIA participants (Webex)

Monica Abboud	Jim Diefenderfer	Mike Kopalek
Greg Adams	Kathryn Dyl (presenter)	Angelina LaRose
Jeffrey Bennett	Mindi Farber-DeAnda	Trinity Manning-Pickett
Erin Boedecker	Adrian Geagla	John Maples
Zachary Chairez	Peter Gross	Jim O'Sullivan
Michael Cole	Inbal, Jonathan	Christopher Peterson
Peter Colletti (presenter)	Ari Kahan	Brittany Phalon
Matthew Corne	Mala Kline	Catherine Prendergast

Tess Prendergast
Corrina Ricker
Elizabeth Sendich
Estella Shi (presenter)

Sauleh Siddiqui
William Sommer
John Staub
Manussawee Sukunta

Neil Wagner
Mary Webber
Josh Whitlinger
Stephen York (presenter)