



# Petroleum and Natural Gas (PNGM)

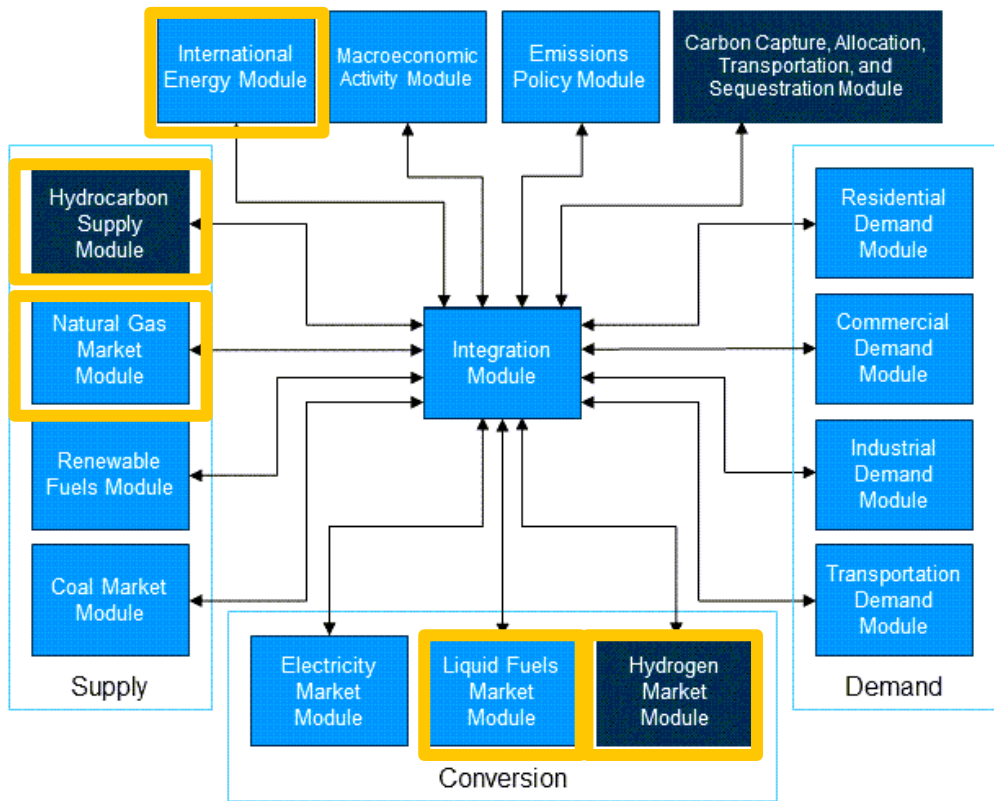
## AEO2025 Working Group

*Internal and external stakeholders*

*Katie Dyl, Peter Colletti, Estella Shi, and Stephen York*

*July 17, 2024 | Virtual*

# PNGM long-term modelers are responsible for five NEMS modules, including two new for AEO2025



# Since AEO2023, PNGM staff have worked across modules to make the necessary model changes for AEO2025

NEMS Module	NEMS Acronym	Lead Modeler	Modelers	AEO2025 Modifications
Liquid Fuels Market Module	LFMM	Peter Colletti	Estella Shi, Brittany Phalon	Data updates + modifications for new CO <sub>2</sub> , H <sub>2</sub> modules
International Energy Module	IEM	Adrian Geagla	Zach Chairez, Andrew Smiddy	Establish AEO2025 Brent crude oil price path + data updates
Natural Gas Market Module	NGMM	Stephen York	Jonathan Inbal, Mary Webber	Renewable natural gas + Mexico LNG + data updates
Hydrocarbon Supply Module	HSM	Will Sommer*, Andrew Smiddy	Matt Corne	Replaces Oil & Gas Supply Module (OGSM), 7/11/24 working group
Hydrogen Market Module	HMM	Stephen York	Neil Wagner, Katie Dyl	New module, 6/12/24 working group

\*Will Sommer was Lead Modeler through June 2024 and is transitioning responsibilities to Andrew Smiddy for HSM

# Outline

- Liquid Fuels Market Module and International Energy Module (LFMM and IEM)
- Natural Gas Market Module (NGMM)
- Brief summaries of new NEMS modules that held individual working group meetings
  - Hydrocarbon Supply Module (HSM)
  - Hydrogen Market Module (HMM)

Liquid Fuels Market Module  
and  
International Energy Module

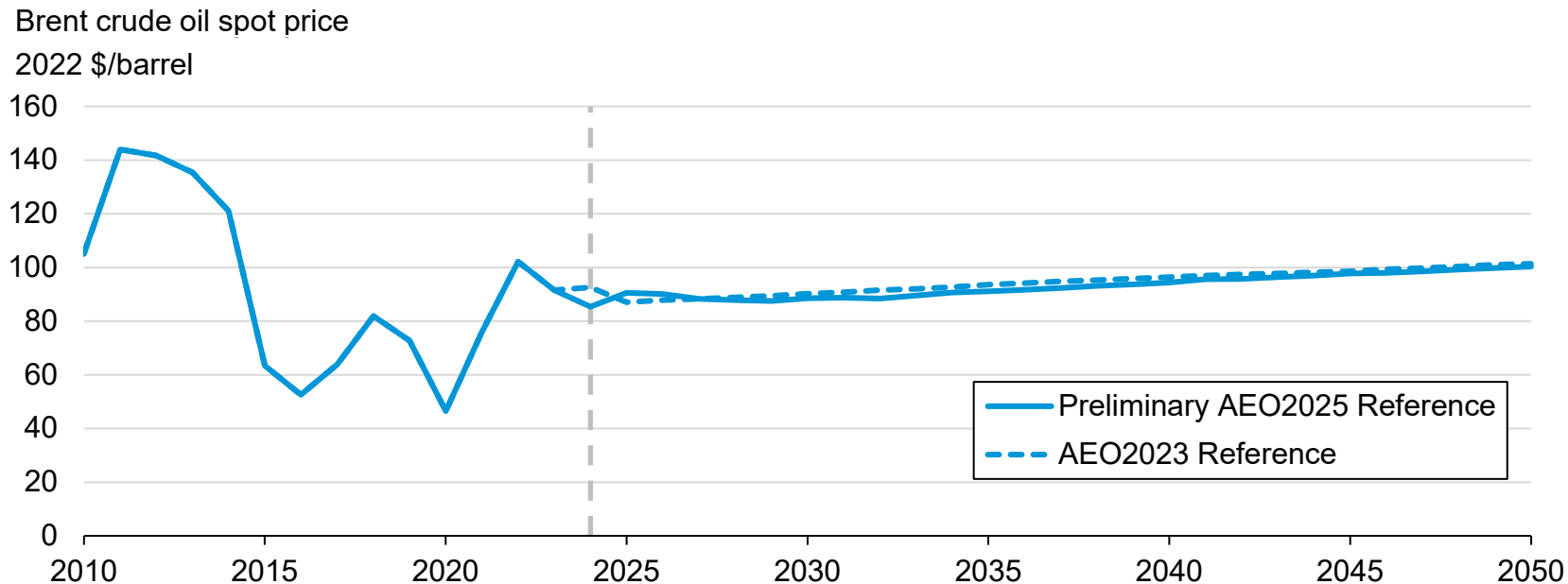
# AEO2025 LFMM and IEM Updates:

- LFMM: key updates planned
  - Historical and *Short-Term Energy Outlook* (STEO) liquid fuels data
  - State and federal fuel taxes
- Removal of xTLs (natural gas/biomass/coal-to-liquids) from AEO report tables
- IEM: key updates planned
  - International crude oil and petroleum product import and export curves
  - Crude oil price differentials by crude oil type

# Minimal petroleum infrastructure changes since AEO2023

- Capacity updates for refineries and cogeneration
  - Approximately 40,000 b/d of new/reactivated refinery capacity
- Pipeline capacity and transportation costs
  - One new interregional crude pipeline included – South Bend Pipeline
- Announced pipeline projects
  - One interregional product pipeline reversal
  - Three large crude oil pipelines to offshore terminals
- EIA's U.S. Liquids Pipeline Projects Database
  - <https://www.eia.gov/petroleum/data.php>

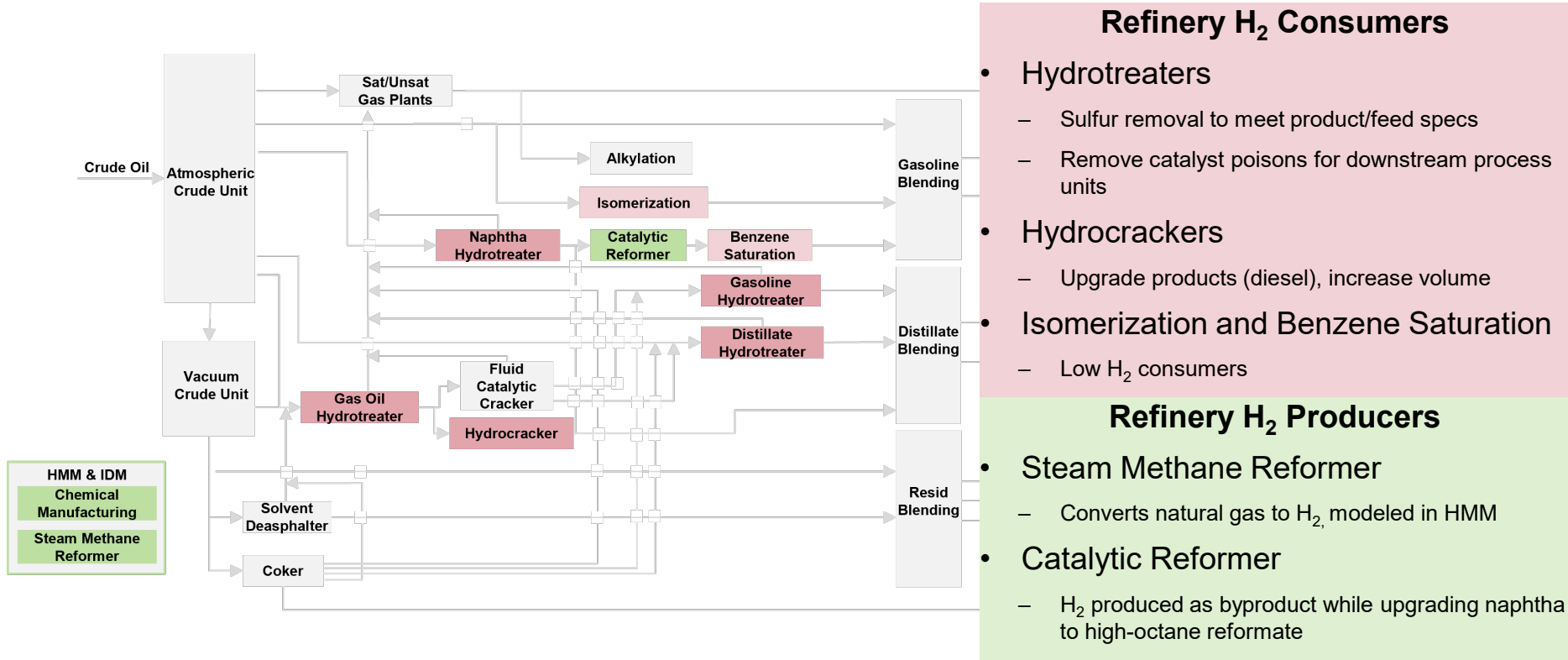
# Preliminary Brent crude oil prices are comparable over the projection period with AEO2023



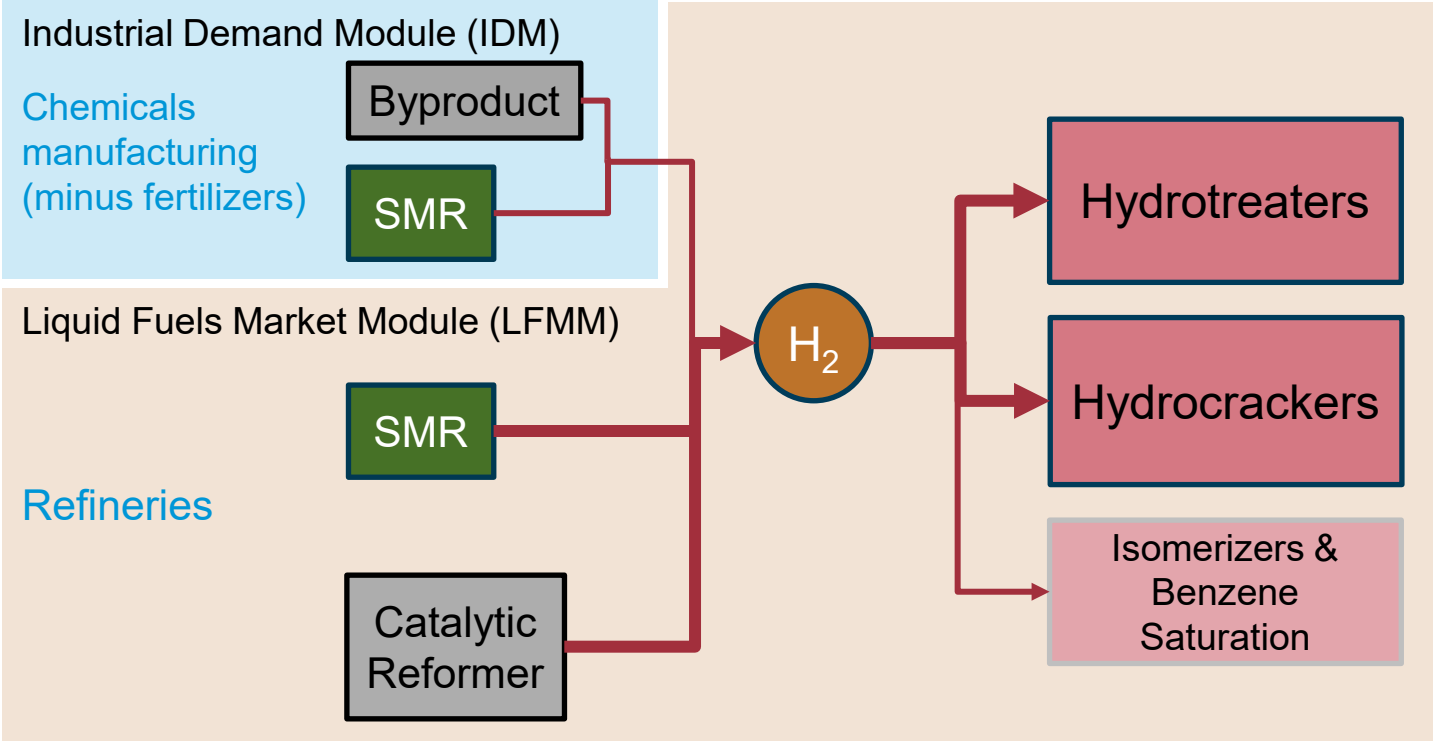
Data source: U.S. Energy Information Administration



# LFMM refinery primary H<sub>2</sub> production represented across NEMS modules for AEO2025

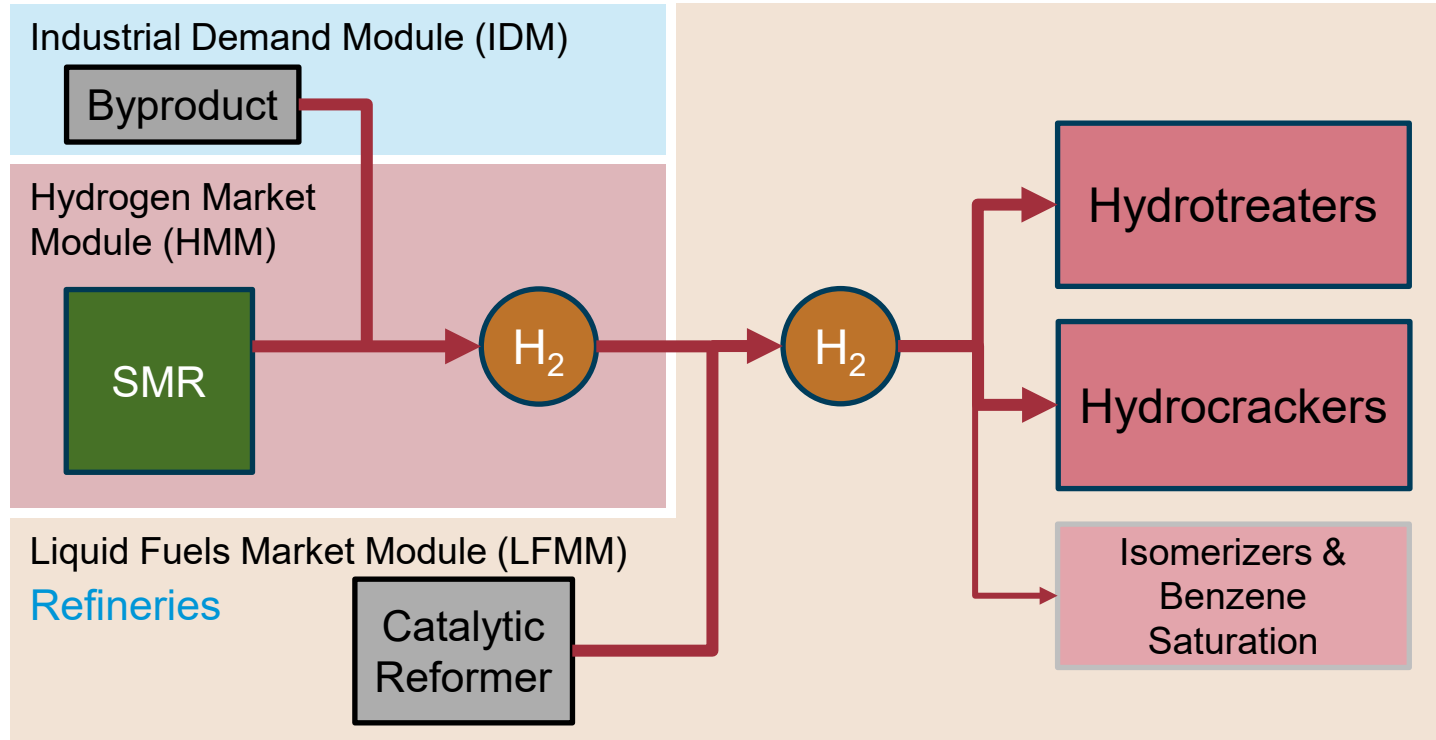


# LFMM H<sub>2</sub> representation (AEO2023 and prior) was largely internal to LFMM



SMR = Steam Methane Reformer

# LFMM in AEO2025 now represents H<sub>2</sub> as a quantity LFMM demands from the new HMM



SMR = Steam Methane Reformer

# AEO2025 Liquid Fuels Market Module Updates - Biofuels

- Capacity updates
  - Ethanol, biodiesel, renewable diesel, sustainable aviation fuel
- LFMM biofuels: other key updates planned
  - Feedstock costs
  - E15 penetration rate
  - Renewable Fuel Standards (RFS) for 2023–2025 based on June 2023 EPA rulemaking
  - EPA announced delay of final RFS rulemaking for 2026–2028 until December 2025
- Addition of Washington Clean Fuel Standard representation

# LFMM in AEO2025 now provides CO<sub>2</sub> quantities from ethanol plants for the new CCATS module

- The Carbon Capture, Allocation, Transportation, and Sequestration (CCATS) module is under development for AEO2025.
- Previously, limited representation of carbon capture and sequestration
  - Coal-to-liquids
  - Coal-and-biomass-to-liquids
- For LFMM, we will model carbon capture retrofits for ethanol plants
  - CO<sub>2</sub> from ethanol fermentation
  - Underlying capture cost data from National Energy Technology Laboratory database

## Upcoming Project – LFMM/IEM Redesign

- Ongoing effort to redesign and combine LFMM and IEM into one NEMS module
- New name – Fuel Liquids EXchange module (FLEX)
- Will debut as part of AEO2026
- Design documents available later this year
  - <https://www.eia.gov/outlooks/documentation/workshops/>

# Natural Gas Market Module

# Planned data updates and changes for AEO2025

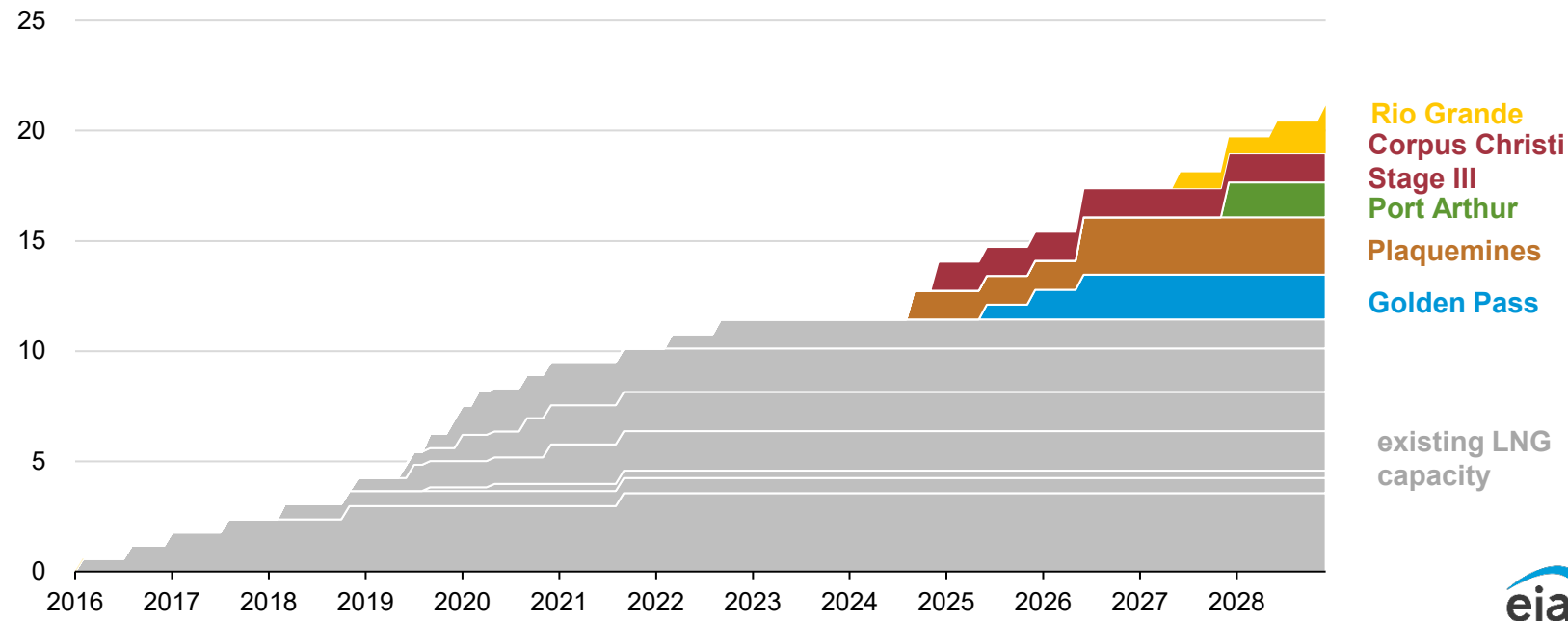
- *Natural Gas Annual* data through 2022
- Historical data for Mexico and Canada through 2023
- Pipeline capacity and upcoming pipeline and LNG projects
- Natural gas spot price data
- Additional changes that can drive projections include:
  - World oil price assumption
  - *Short-Term Energy Outlook* forecast (2023–2025 data)



# Nearly 10 Bcf/d of U.S. LNG export capacity currently under construction

## Existing and under construction LNG export capacity (baseload)

billion cubic feet per day



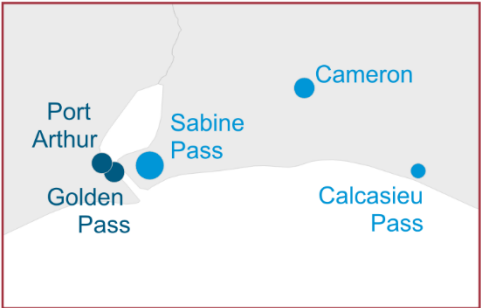
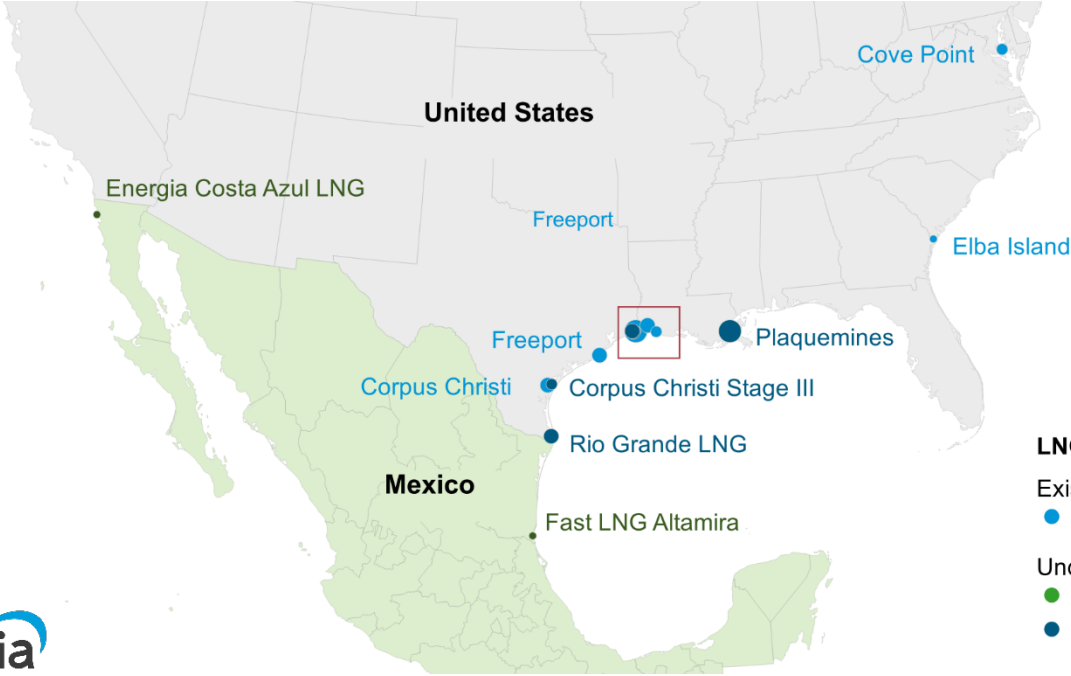
Data source: [EIA Liquefaction Capacity Tracker \(Q1 2024\)](#)



# Beginning in AEO2025, NGMM will represent LNG exports from Mexico

- Fast LNG Altamira's three units (200 MMcf/d each) expected to come online gradually from summer 2024 to fall 2025
- Energia Costa Azul (ECA) LNG under construction and estimated to come online in early 2026 with 428 MMcf/d of export capacity
- LNG exports from Mexico will generally be supplied from natural gas piped in from the United States

# Map of current and under construction LNG export terminals



LNG terminals	Production capacity (Bcf/d)
Existing	● lower than 0.6
● United States	● 0.6 – 1.5
Under construction	● 1.6 – 2.5
● Mexico	● 2.6 or greater
● United States	



## Natural gas pipeline projects for AEO2025 are dominated by new capacity to bring natural gas from the Permian Basin to Gulf Coast consumers, particularly LNG export terminals

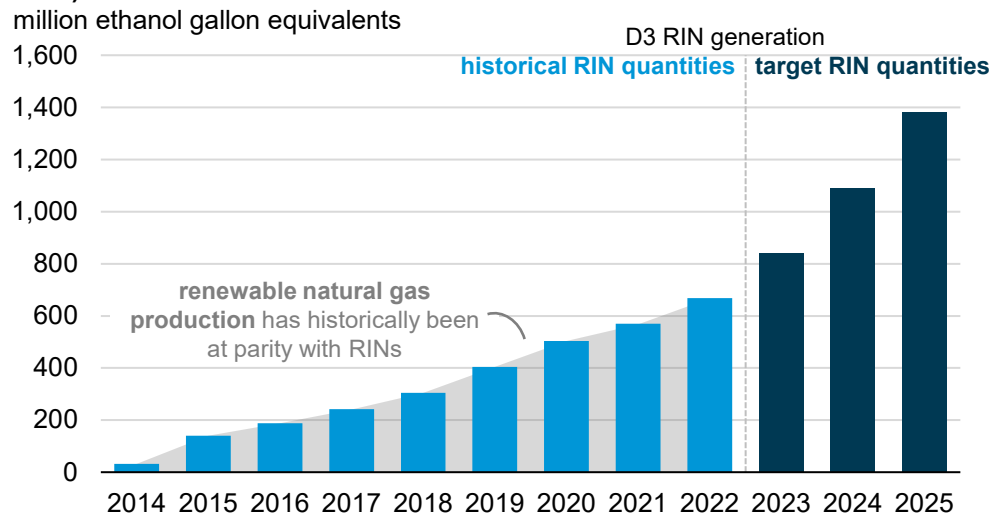
Project	Capacity (MMcf/d)	Status	In-Service Date
North Baja Xpress	495	Complete	5/20/2023
Whistler Pipeline Expansion	500	Complete	9/30/2023
Permian Highway Expansion	550	Complete	12/1/2023
Mountain Valley Pipeline	2,000	Complete	6/11/2024
Matterhorn Express	2,500	Construction	2024 (est.)
Golden Pass LNG Bidirectional Pipeline	2,500	Construction	2024 (est.)
Trunkline Pipeline Modifications Project	3,100	Construction	2025 (est.)

Data source: [EIA Natural Gas Pipeline Project Tracker \(April 2024\)](#)

# NGMM will represent renewable natural gas (RNG) production in AEO2025

- Existing food waste, landfill, livestock, and wastewater RNG capacity from [Argonne National Lab's RNG Database](#), with future landfill and dairy farm production modeled by NGMM
- Considers the Renewable Fuel Standard (RFS) and California's Low Carbon Fuel Standard (LCFS) credits to determine project build economics
  - Short-term RNG production driven by RFS mandates
  - LCFS credits generally make RNG production economical, but production faces long-term constraints from transportation demand in California

Annual D3 RIN generation and new volume targets under the RFS (2014–2025)



Data Source: Environmental Protection Agency

New AEO2025 modules:

Hydrocarbon Supply Module  
and  
Hydrogen Market Module

## Hydrocarbon Supply Module: key takeaways

- EIA developed and tested the Hydrocarbon Supply Module (HSM) to replace the Oil and Gas Supply Module (OGSM).
- Representation of upstream petroleum and natural gas production allows insight into the impacts of policy and model assumptions.
- HSM functions much like OGSM, but changes include:
  - Written in Python
  - New modeling features (incl. federal/non-federal land, methane venting/flaring)
  - Streamlined representations
- Changes make HSM simpler to maintain and improve transparency of results.

# Key differences between HSM and OGSM

Key difference	OGSM	HSM
<b>Programming language</b>	Fortran	Python
<b>Model runs/cycle</b>	First iteration and reporting iteration	Every iteration
<b>Federal/non-federal land</b>	Not represented	Represented
<b>Methane venting/flaring</b>	Not represented	Represented
<b>CO<sub>2</sub> capture</b>	2014 NETL static estimate for industrial sources	Carbon capture retrofit decision for natural gas processing plants (NGPP)
<b>CO<sub>2</sub> sequestration</b>	All sources of captured CO <sub>2</sub> matched 1-1 with enhanced oil recovery (EOR) sites	Represented in CCATS
<b>Split decline curves</b>	Not represented	Represented



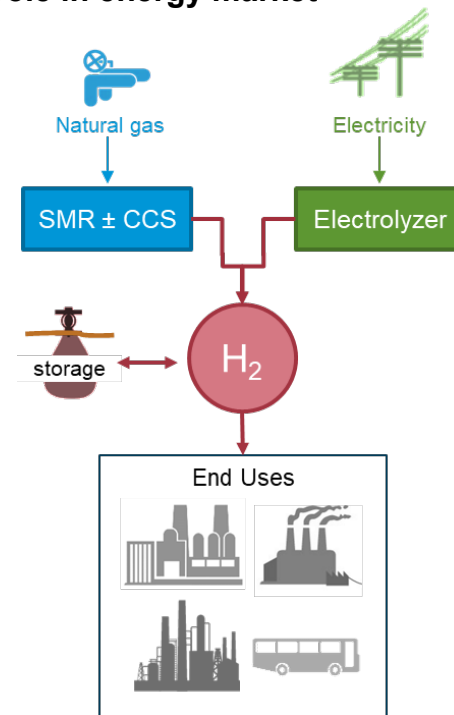
## Hydrogen Market Module: key takeaways

- The representation of hydrogen markets allows insight into key questions about the impacts of policy and model assumptions.
- We are running tests with other NEMS modules to verify interactions and input/output exchange.
- We published on our public website the Hydrogen Market Module (HMM) [Requirements Document](#) that defines our expectations for AEO2025.

# HMM will represent key production technologies and end uses of H<sub>2</sub>

- Three hydrogen production pathways represented:
  - Electrolysis (grid-based)
  - Steam Methane Reforming (SMR)
  - SMR with carbon capture and sequestration (CCS)
- Production technology options allow HMM to analyze the mid- to long-term impacts of current policies, laws, and regulations governing hydrogen markets, specifically the Inflation Reduction Act (IRA).
  - Section 45V hydrogen production tax credits
  - Section 45Q tax credits for capturing CO<sub>2</sub>
- Hydrogen consumption in the industrial, electric power, refining, and transportation sectors

**Simplified diagram of hydrogen's role in energy market**



# For more information

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