

# *Annual Energy Outlook 2023 Working Group*

## *Preliminary results for oil, natural gas, and liquid fuels*



*for*

*Oil and Gas Supply, Natural Gas Markets, & Liquid Fuels Markets Working Group*  
*September 29, 2022 | Washington, DC*

*By*

*Petroleum & Natural Gas Modeling Team*  
*Office of Long-Term Energy Modeling*

# Oil and Natural Gas Supply

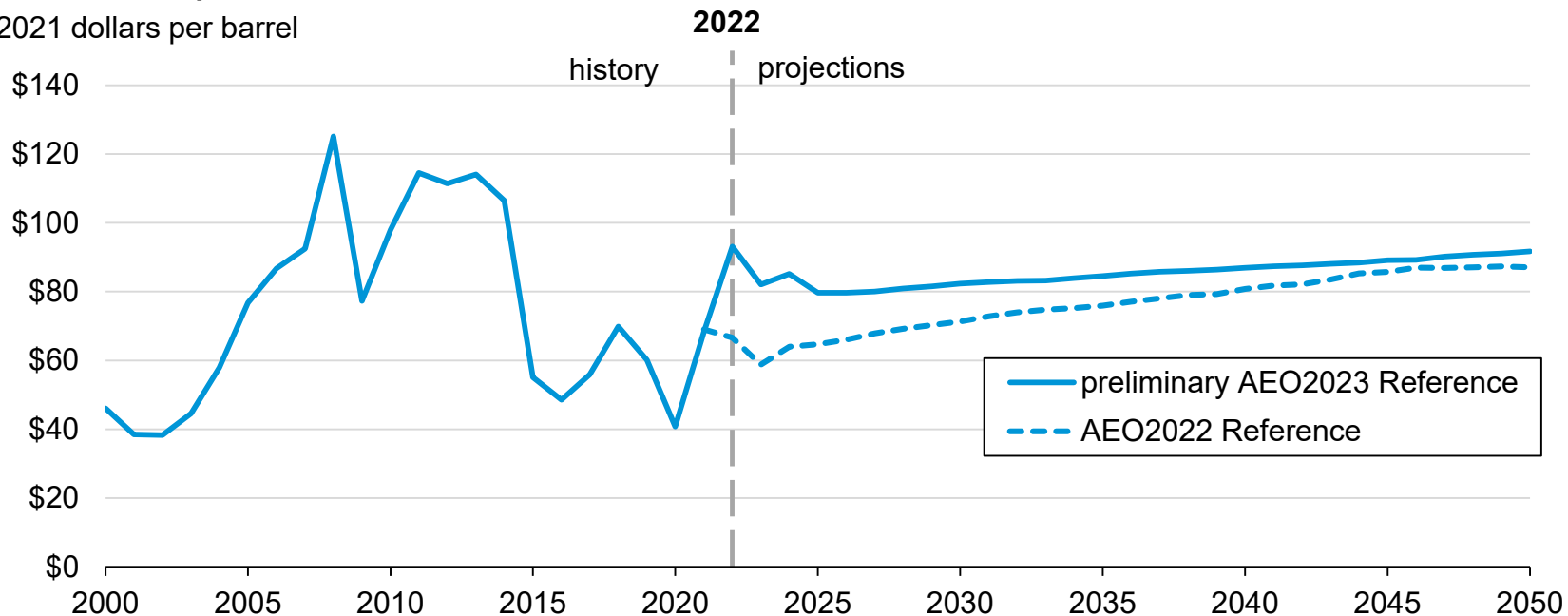
# AEO2023 Oil and Gas Supply Module Updates

- Data updates
  - Tight/shale estimated ultimate recovery per well (EUR)
  - Lower 48 offshore and Alaska announced discoveries
  - Historical production through 2021
  - Drilling responsiveness
- Inflation Reduction Act updates
  - Sec. 50261 Oil and Gas Royalty Rate (**AEO2023**)
  - Sec. 50264 2017 – 2022 OCS Leasing Program (**AEO2023**)
  - Sec. 50263 Royalties on all Extracted Methane (**AEO2024**)
  - Sec. 60113 Methane Emissions Reduction Program (**AEO2024**)
  - Sec. 50262 Mineral Leasing Act Modernization (**not applicable**)

# West Texas Intermediate crude (WTI) oil prices are higher than in last year's AEO

## WTI crude oil price

2021 dollars per barrel

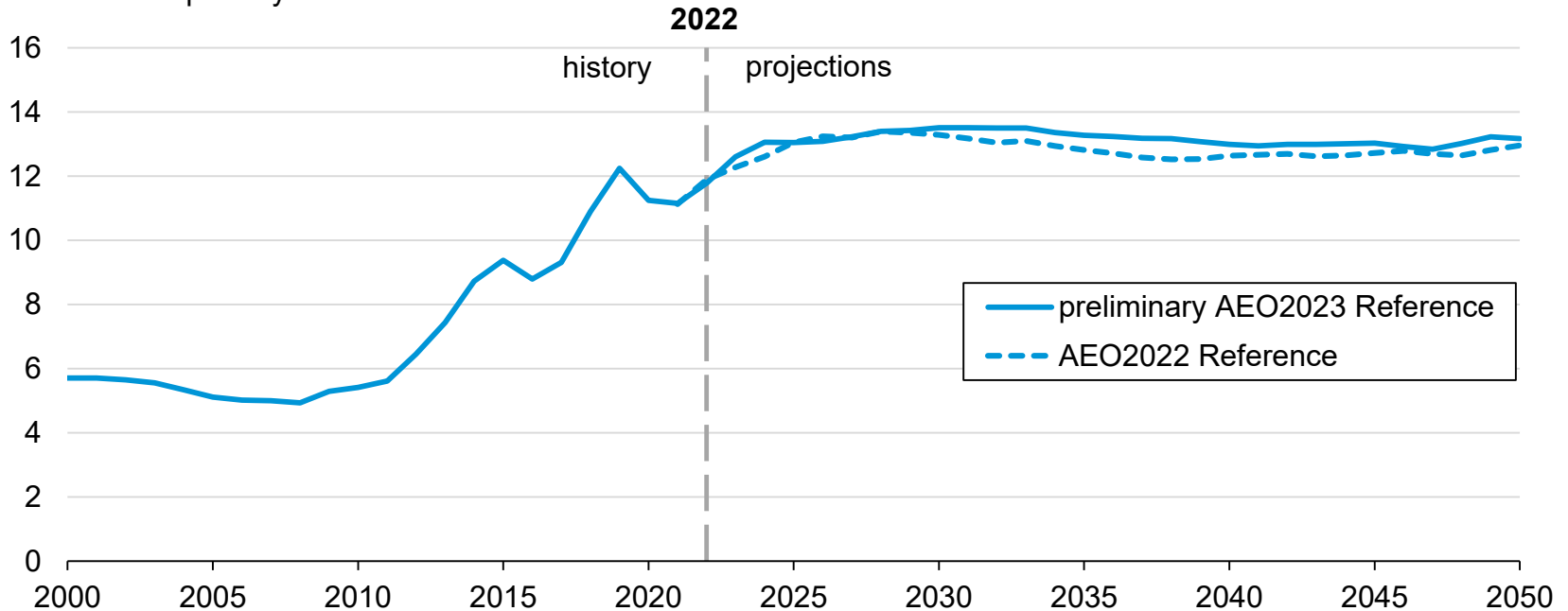


Data source: Preliminary AEO2023 runs, dated September 20, 2022

# U.S. crude oil production is slightly higher than in last year's AEO with higher oil prices

## U.S. crude oil production

million barrels per day

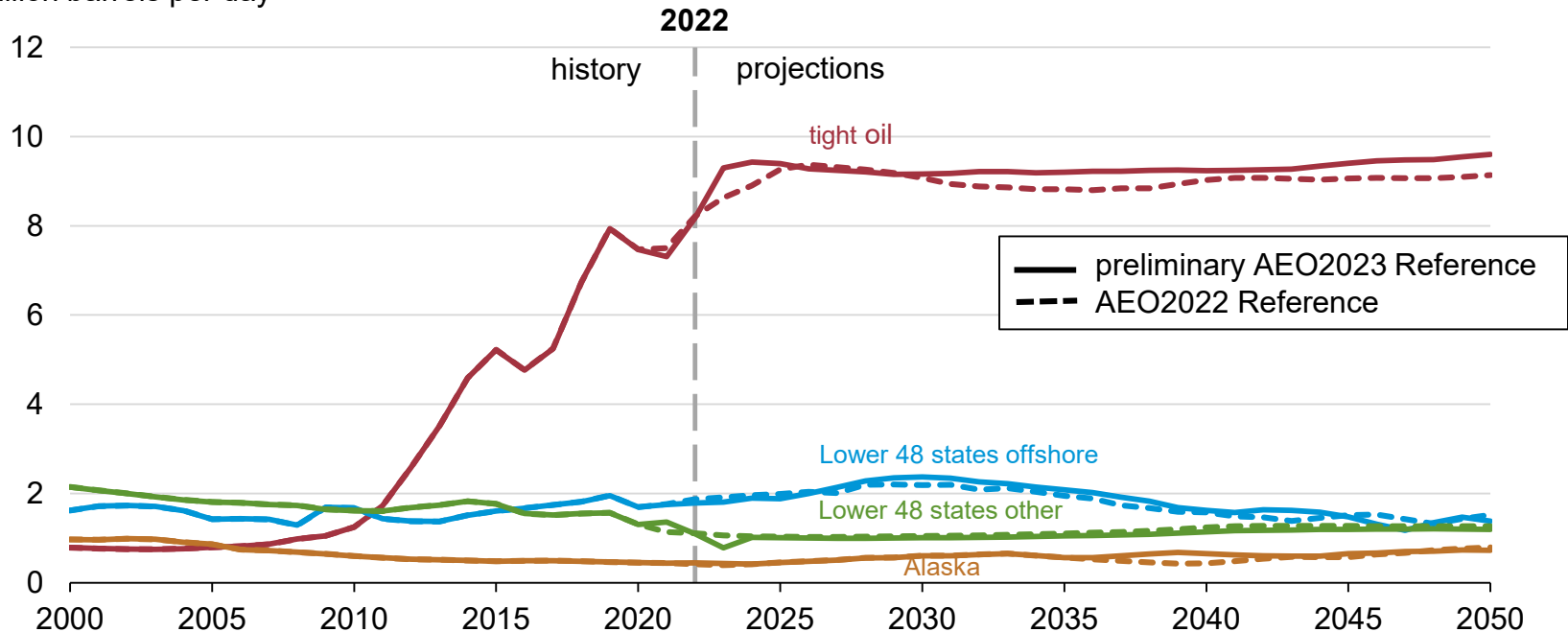


Data source: Preliminary AEO2023 runs, dated September 20, 2022

# Tight oil leads growth in U.S. crude oil production in AEO2023

## U.S. crude oil production by type

million barrels per day

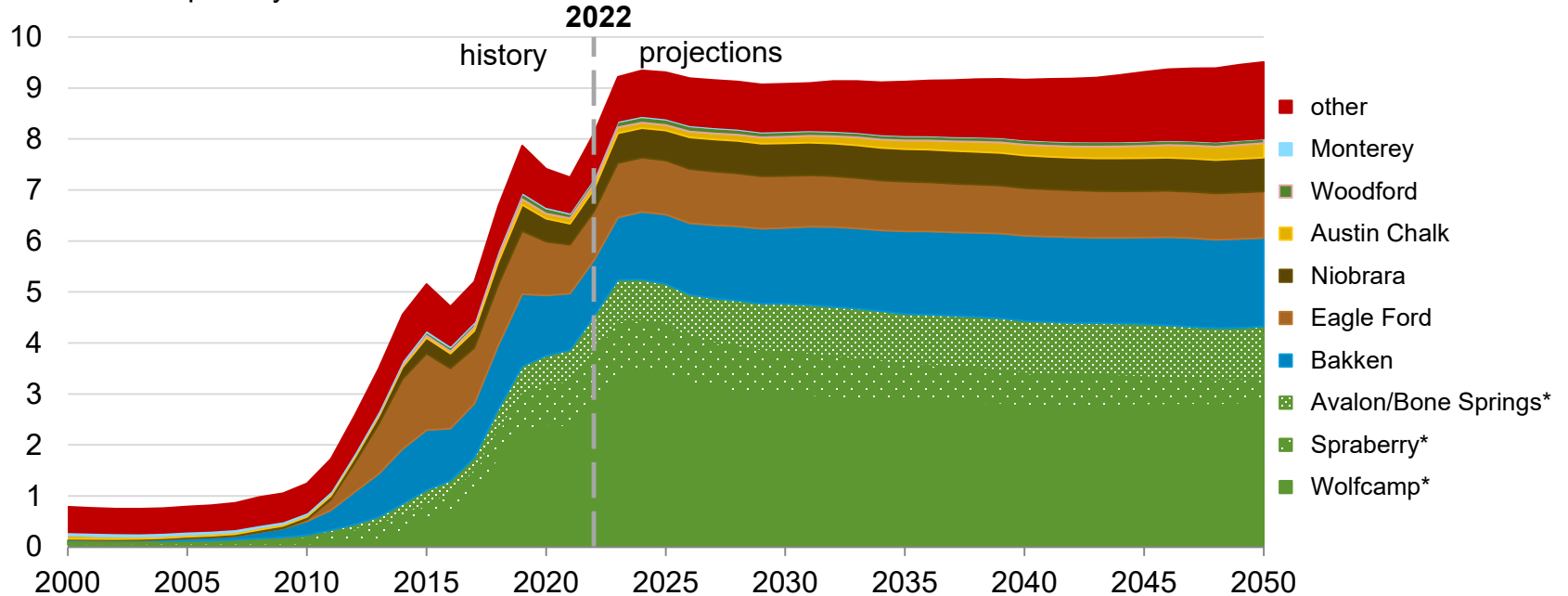


Data source: Preliminary AEO2023 runs, September 20, 2022

# Bakken and Wolfcamp lead production throughout projection period

## Crude oil production by selected tight oil plays

million barrels per day



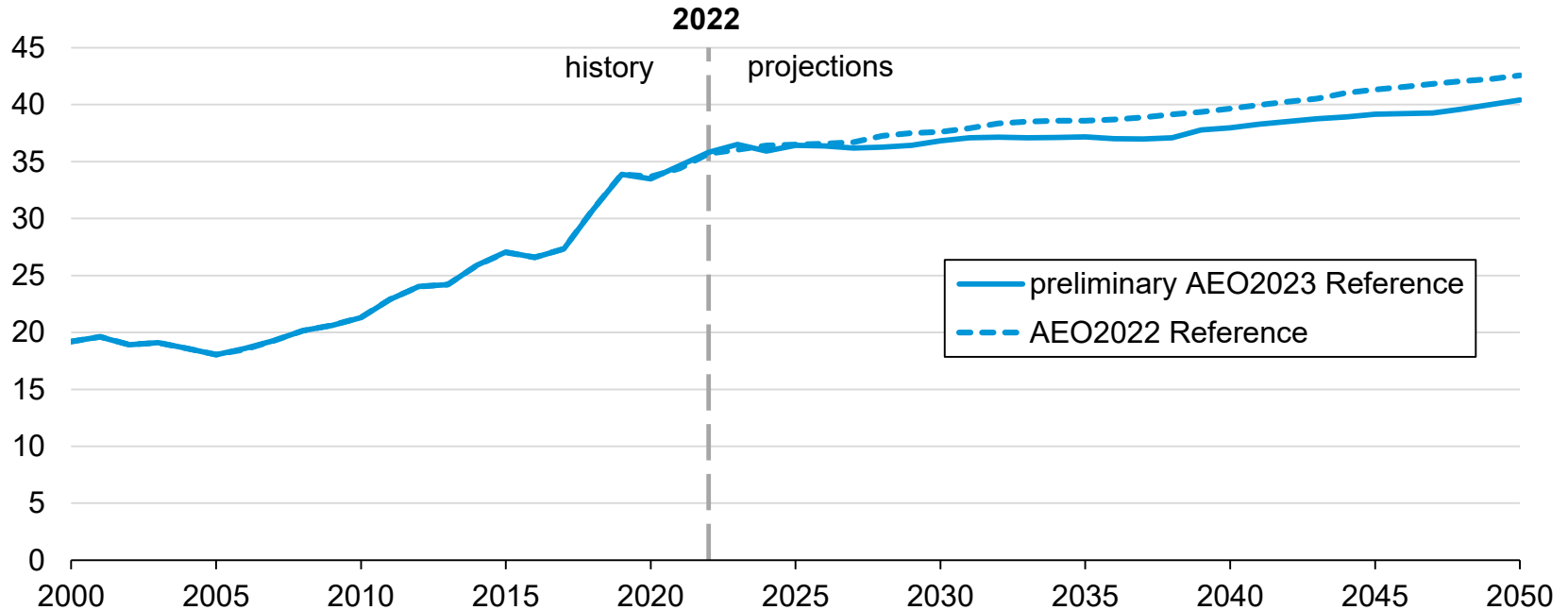
\*Permian Basin

Data source: Preliminary AEO2023 runs, dated September 20, 2022

# U.S. dry natural gas production after 2025 is lower than in AEO2022

## U.S. dry natural gas production

trillion cubic feet



Note: 1 trillion cubic feet = 2.74 billion cubic feet per day

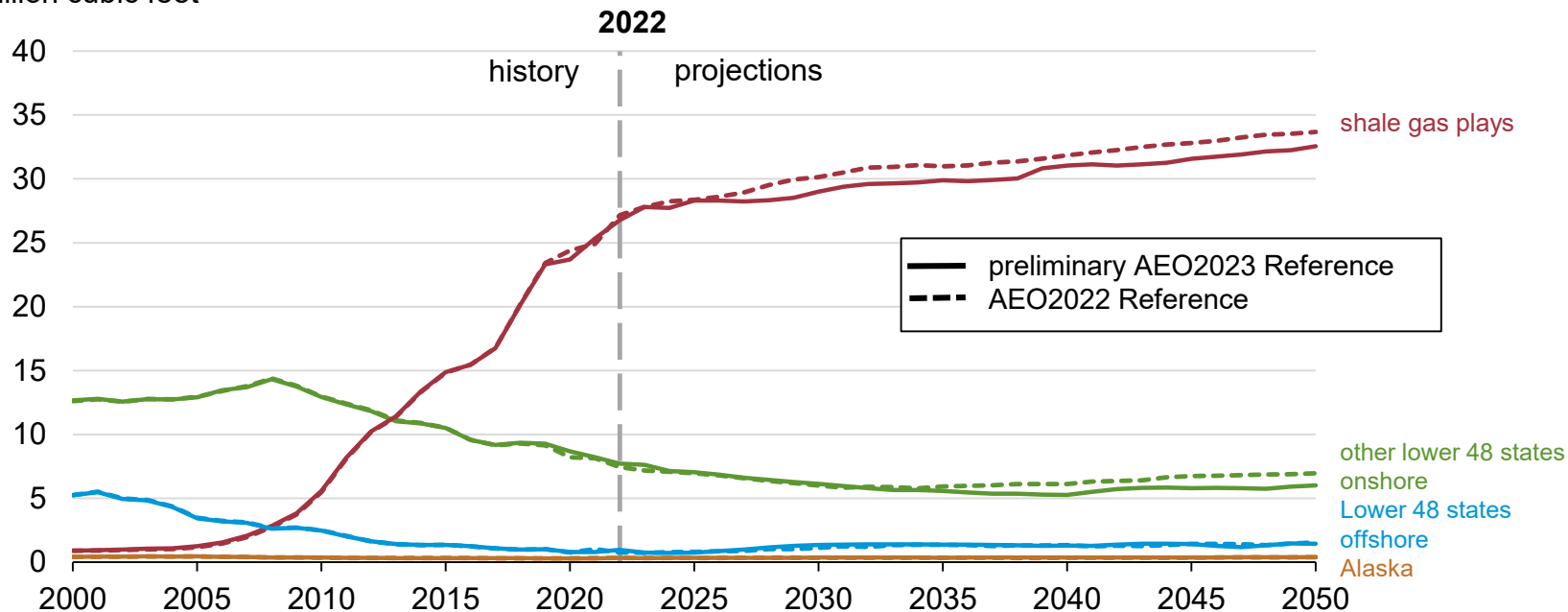
Data source: Preliminary AEO2023 runs, dated September 20, 2022



# Shale gas leads growth in U.S. dry natural gas production in AEO2023

## U.S. dry natural gas production by type

trillion cubic feet

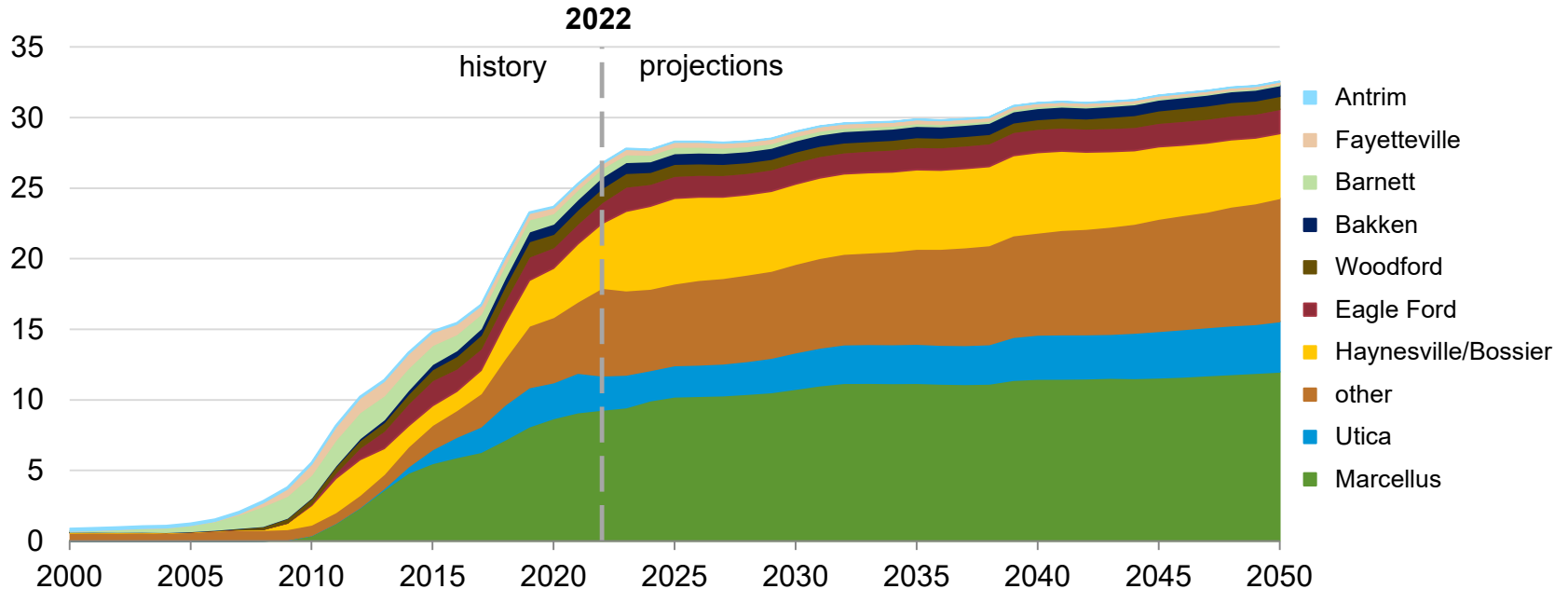


Data source: Preliminary AEO2023 runs, dated September 20, 2022

# Marcellus, Haynesville, Utica, and other tight oil plays ( such as the Permian) are the major contributors to U.S. shale gas production

## Dry natural gas production by selected shale play

trillion cubic feet



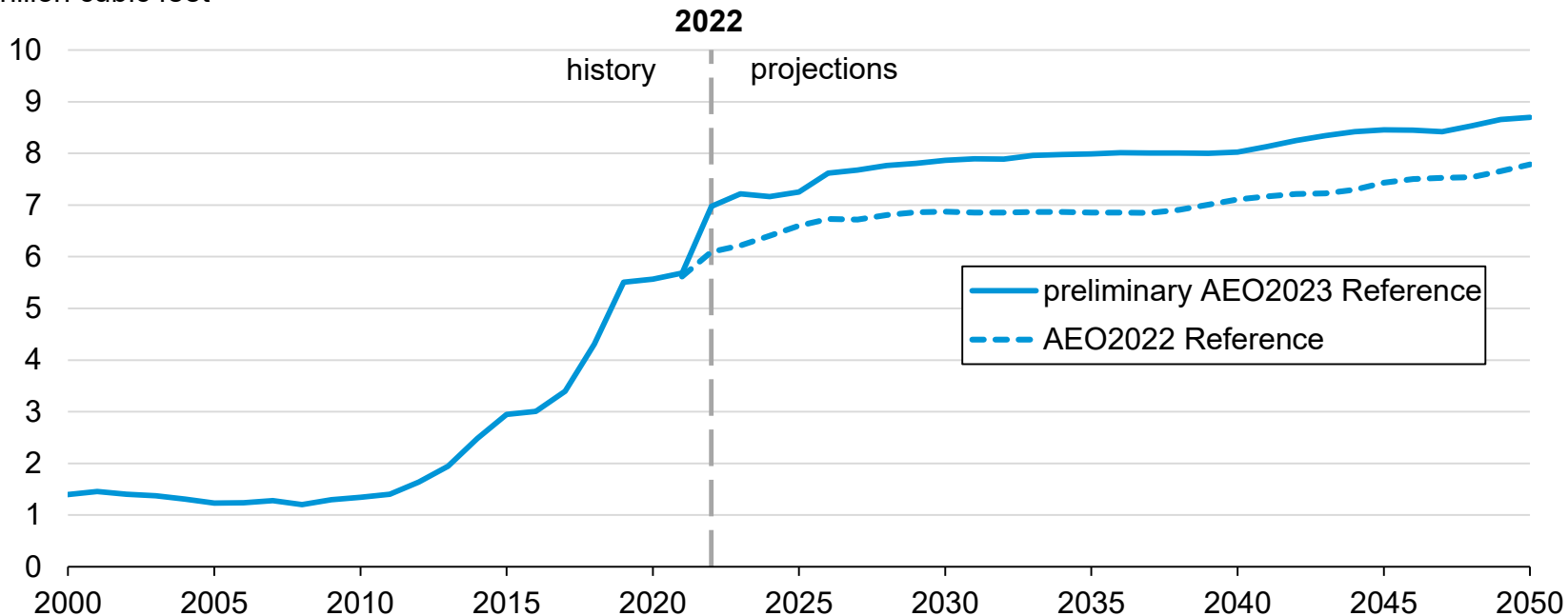
Note: Other includes natural gas production in tight oil plays.

Data source: Preliminary AEO2023 runs, dated September 20, 2022

# U.S. dry natural gas production from oil formations (that is, co-produced with oil) is higher than in AEO2022

## U.S. dry natural gas production

trillion cubic feet



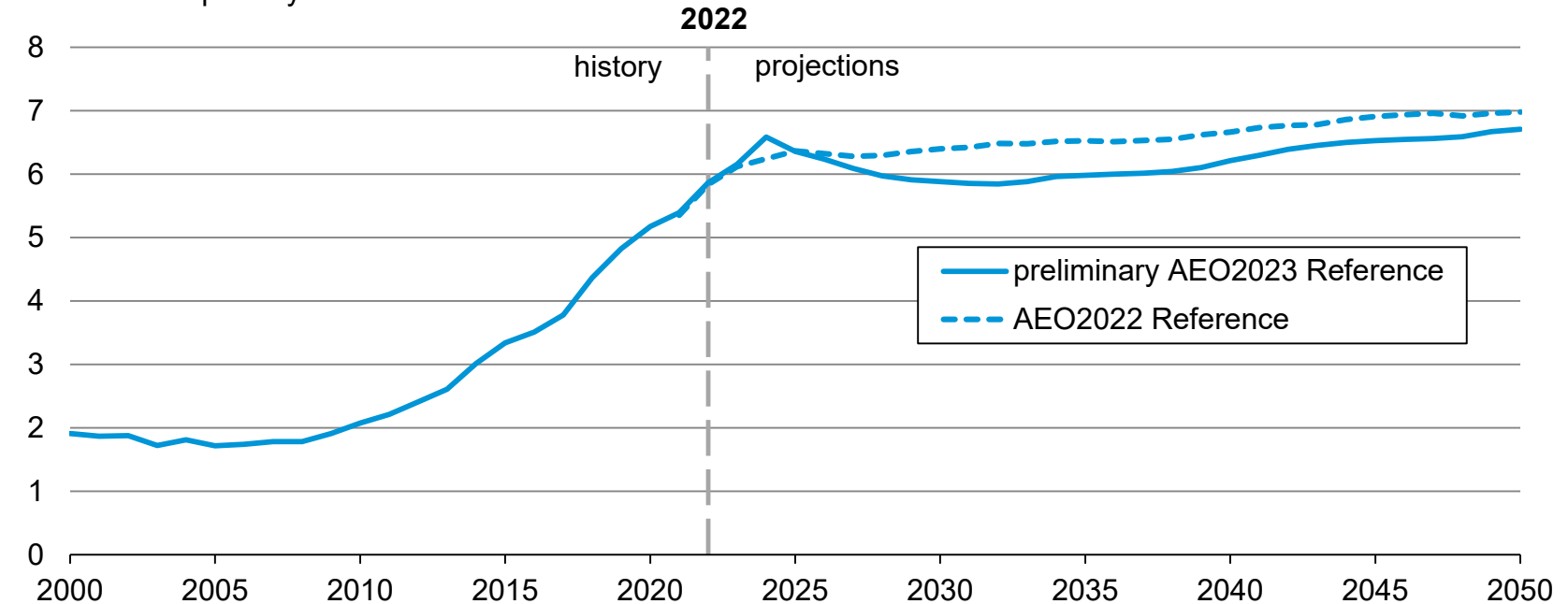
Note: 1 Tcf = 2.74 Bcf/d

Data source: Preliminary AEO2023 runs, dated September 20, 2022

# Natural gas plant liquids production is lower than in AEO2022 after 2025

## U.S. natural gas plant liquids production

million barrels per day



Data source: Preliminary AEO2023 runs, September 20, 2022.

# Liquid Fuels Markets

# AEO2023 Liquid Fuels Market Module and International Energy Module updates

- International crude oil and petroleum product import and export curves
- Crude oil price differentials by crude oil type
- Pipeline capacity and transport costs
- State and federal fuel taxes
- Historical and *Short-Term Energy Outlook* (STEO) liquid fuels data
- Capacity updates for refinery and cogeneration
  - Refinery capacity closures and planned capacity delays
- Unfinished oils imports from Russia substituted with imports from other countries

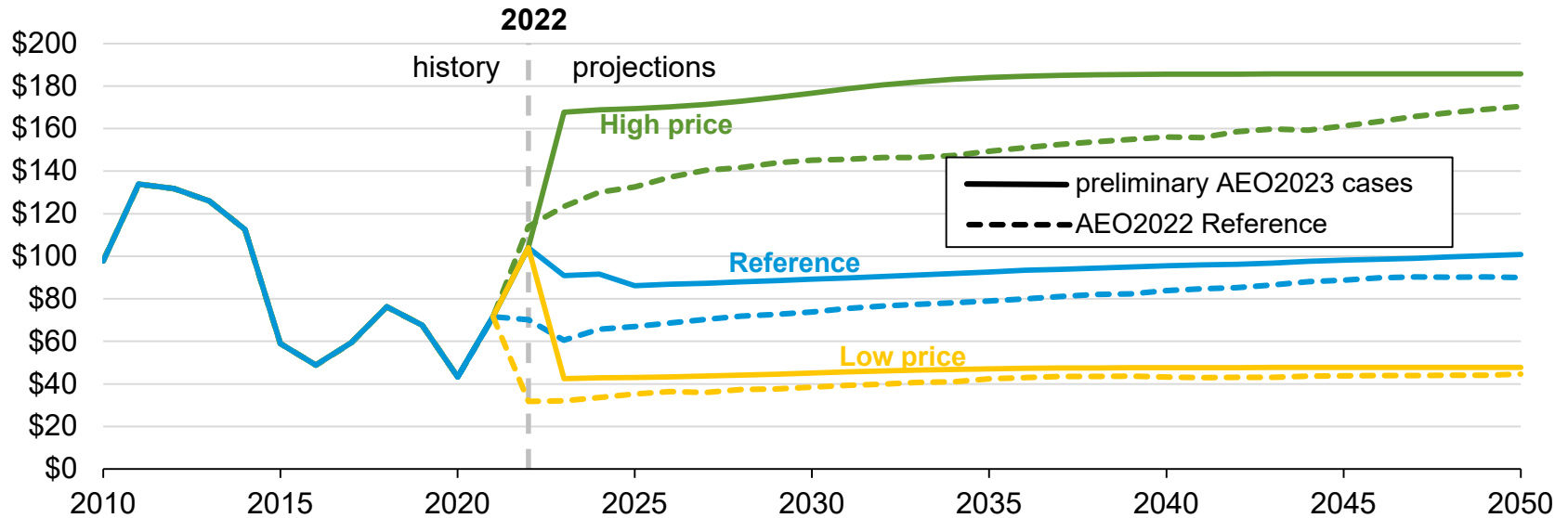
# AEO2023 Liquid Fuels Market Module biofuels updates

- Annual and bi-annual updates for biofuels
  - Increased planned renewable diesel capacity and decreased biodiesel capacity
  - Added some existing and planned sustainable aviation fuel capacity
  - Increased the E15 max penetration rate slightly
- Renewable Fuel Standard (RFS) mandate
  - Updated to reflect EPA's final rulemaking from June 2022
  - Flat-lined after 2022
- Sustainable aviation fuel (SAF)
  - Added to represent HEFA SAF as a process unit capable of producing renewable diesel and/or SAF from the same feedstock
- Oregon's Clean Fuels Program (CFP)
  - Added to represent Oregon's CFP based on existing representation of California's Low Carbon Fuel Standard
  - Had negligible impact on overall results

# Brent crude oil prices are higher over the projection period compared with AEO2022

## Brent crude oil spot price

2022 dollars per barrel



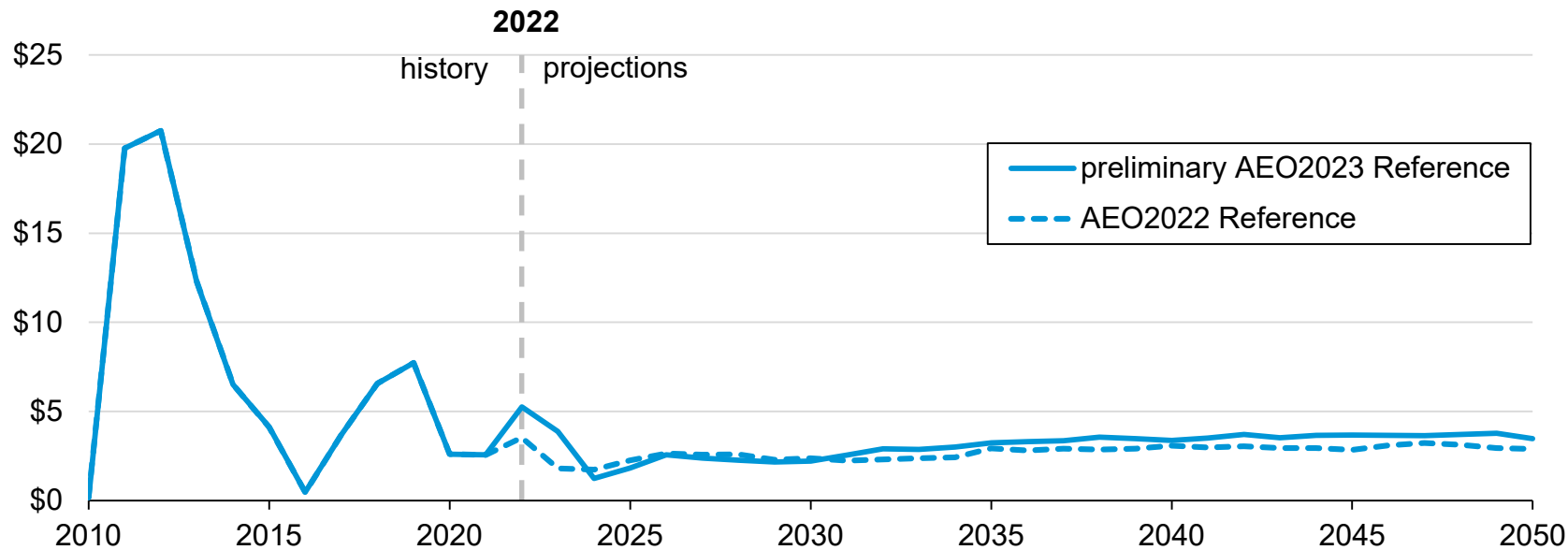
Data source: Preliminary AEO2023 runs, dated September 24, 2022



# The Brent-WTI price spread rises in the near term and then remains under \$4 per barrel in the projection period, similar to AEO2022

## Brent-WTI price spread

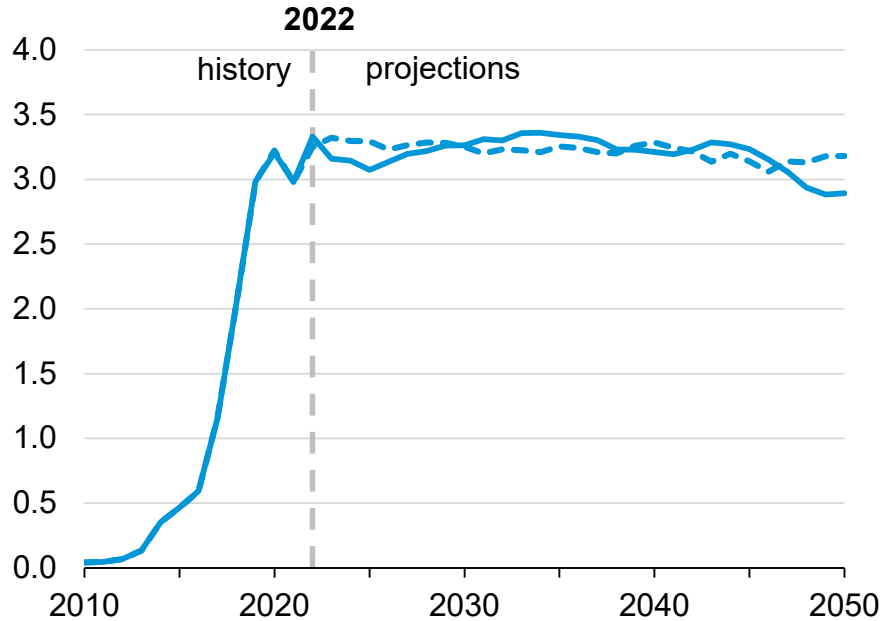
2022 dollars per barrel



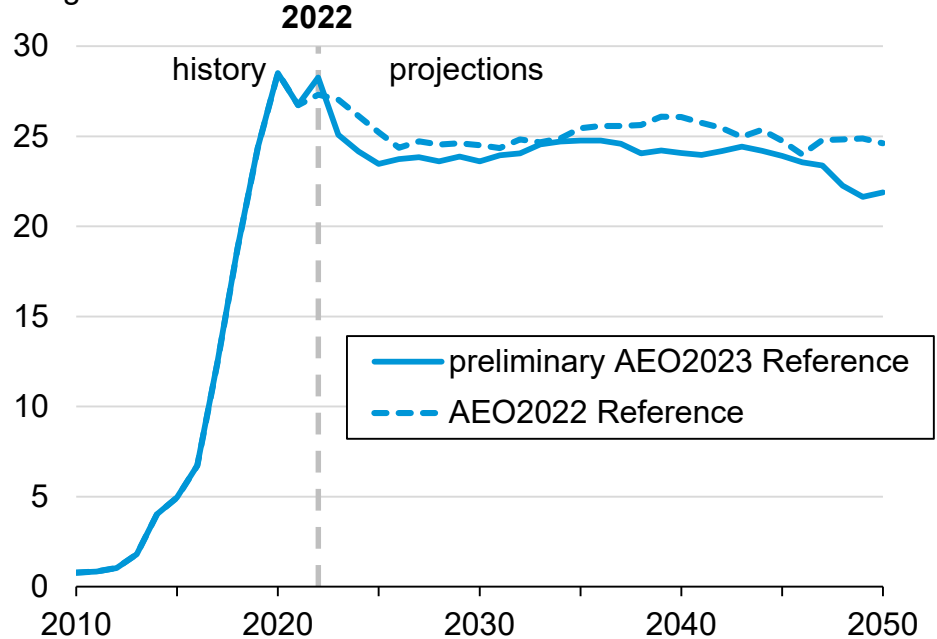
Data source: Preliminary AEO2023 runs, dated September 24, 2022

# Crude oil exports decline a little in the near term and are projected to remain under 25% of total crude oil production

**Gross crude oil exports**  
million barrels per day



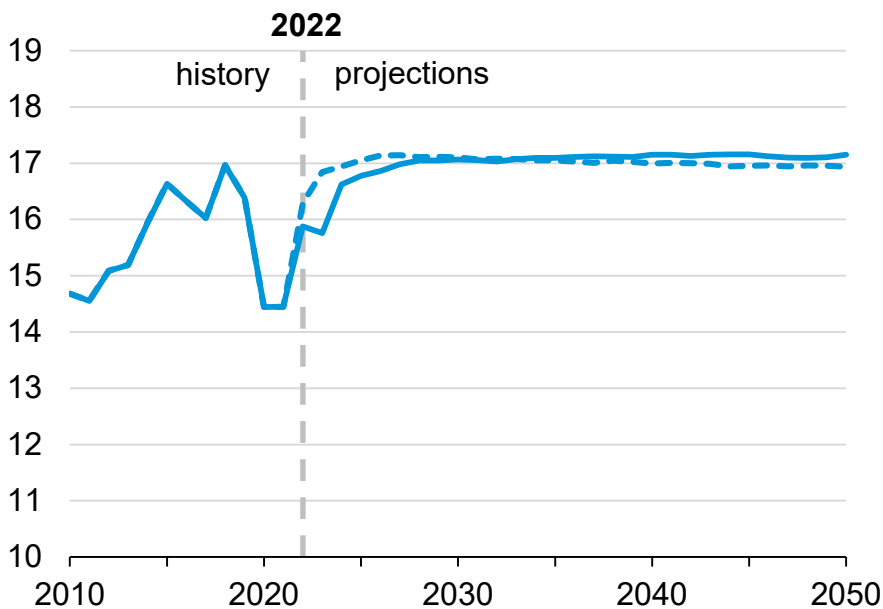
**Crude oil exports as a fraction of total domestic crude oil production**  
percentage



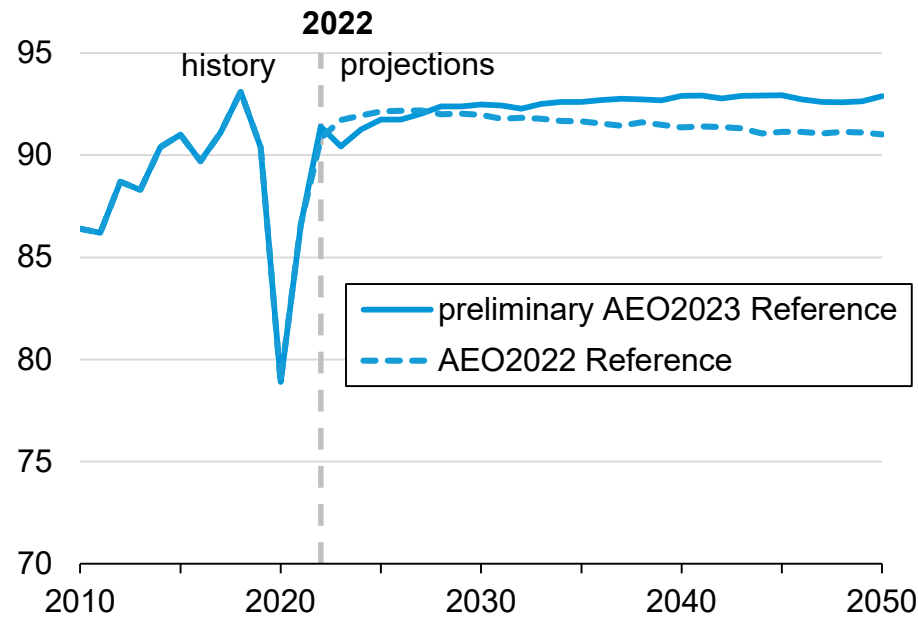
Data source: Preliminary AEO2023 runs, dated September 24, 2022

# Total crude oil supply to U.S. refineries reflects lower atmospheric distillation capacity in the near term due to lower refining capacity while maintaining strong utilization levels over the projection period

**Total crude oil supply to U.S. refineries**  
million barrels per day



**Average U.S. refinery utilization**  
percentage

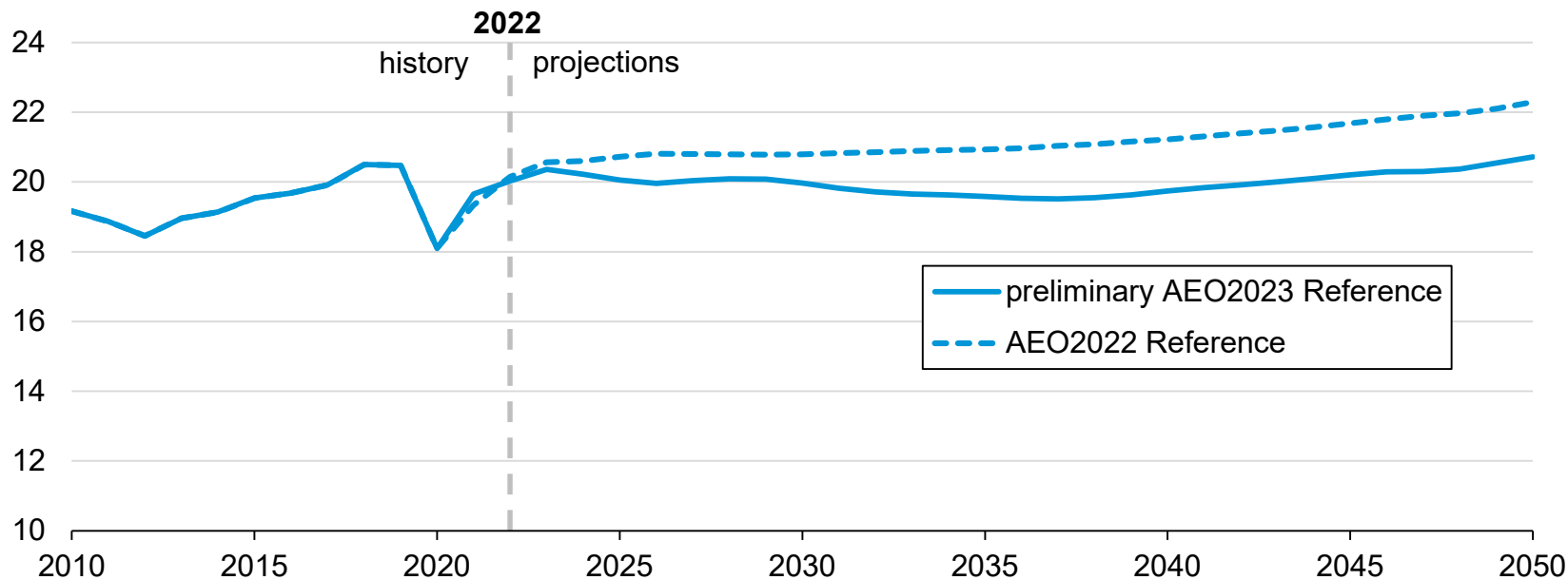


Data source: Preliminary AEO2023 runs, dated September 24, 2022

# Projected domestic petroleum product consumption is slightly lower in AEO2023, met by domestic production and net imports of crude oil-based and biofuels-based products

## U.S. domestic petroleum product consumption

million barrels per day

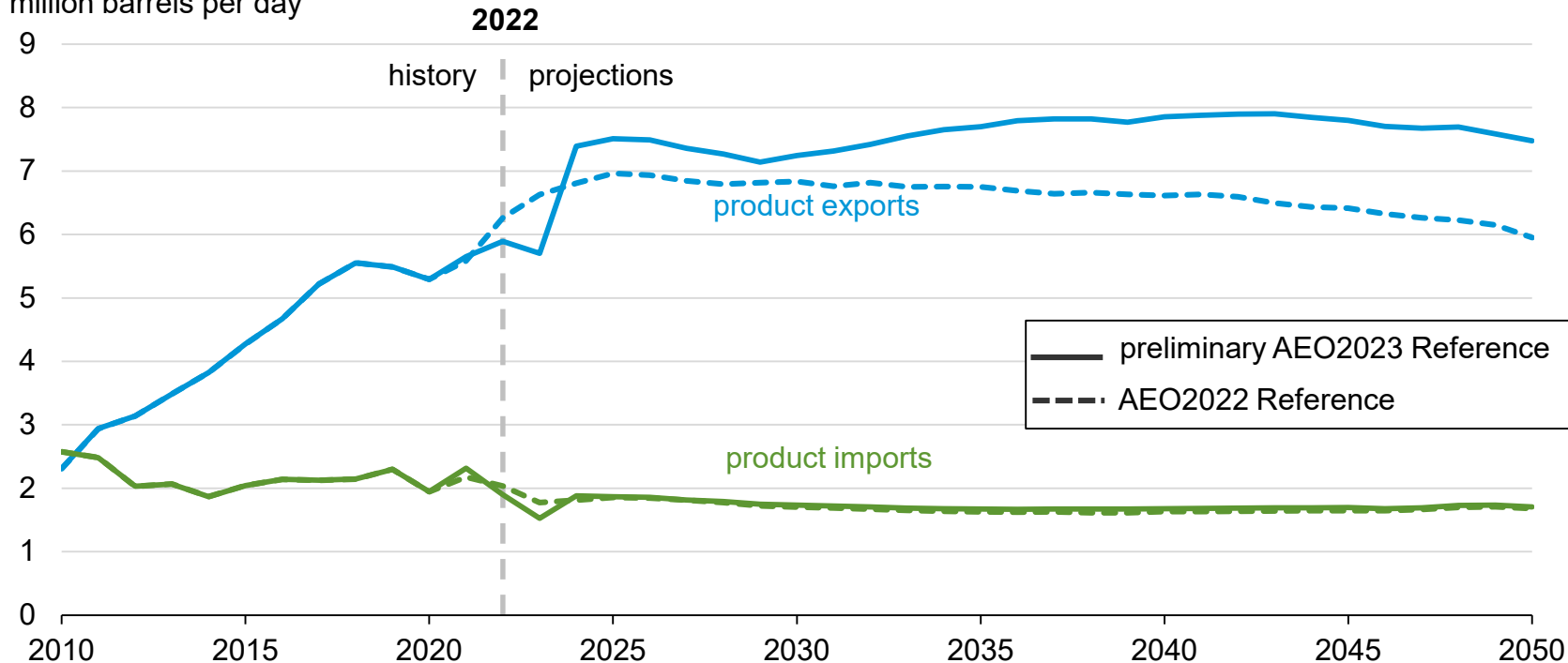


Data source: Preliminary AEO2023 runs, dated September 19, 2022

Gross product exports are projected to be higher compared with AEO2022 to compensate for lower domestic demand; gross product imports remain unchanged.

### Gross product imports and gross product exports

million barrels per day

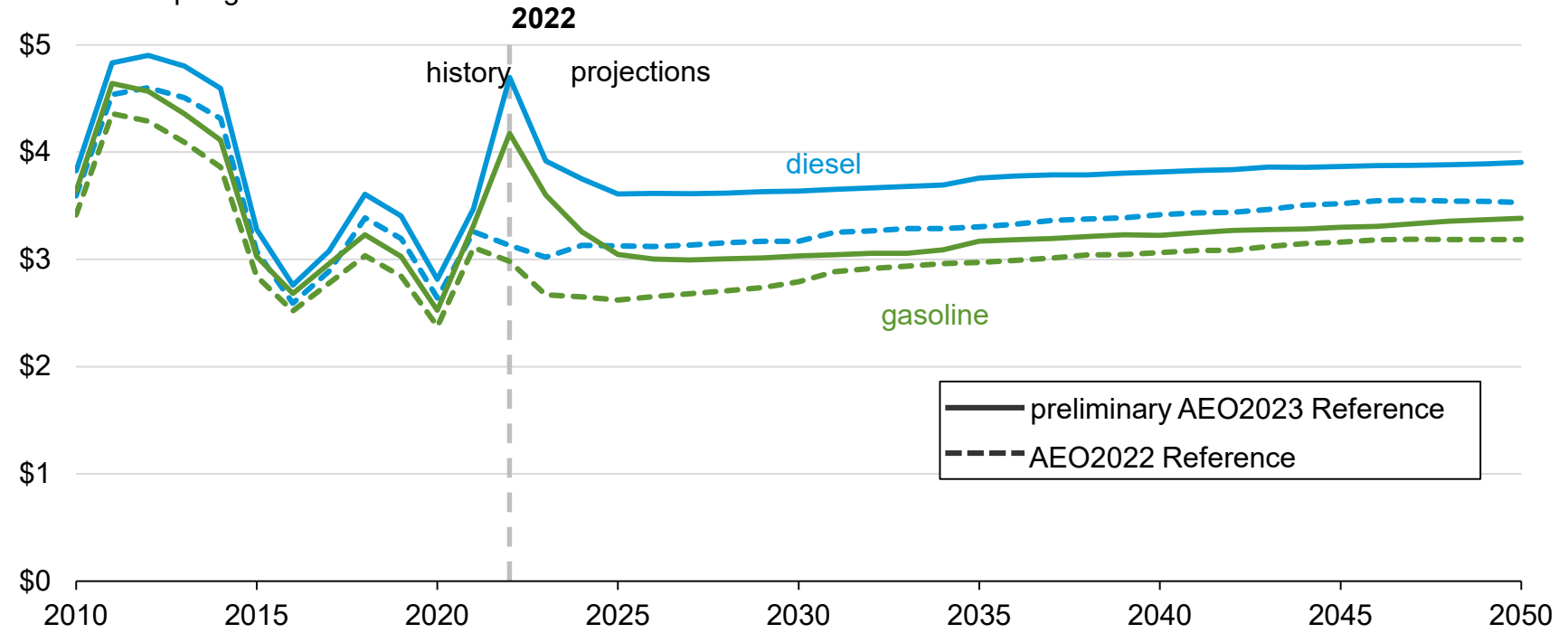


Data source: Preliminary AEO2023 runs, dated September 19, 2022

For AEO2023, the spread between gasoline and diesel prices will be narrow in the near term before evening out to a slightly wider price spread compared with AEO2022

### Diesel and gasoline end-use prices

2020 dollars per gallon

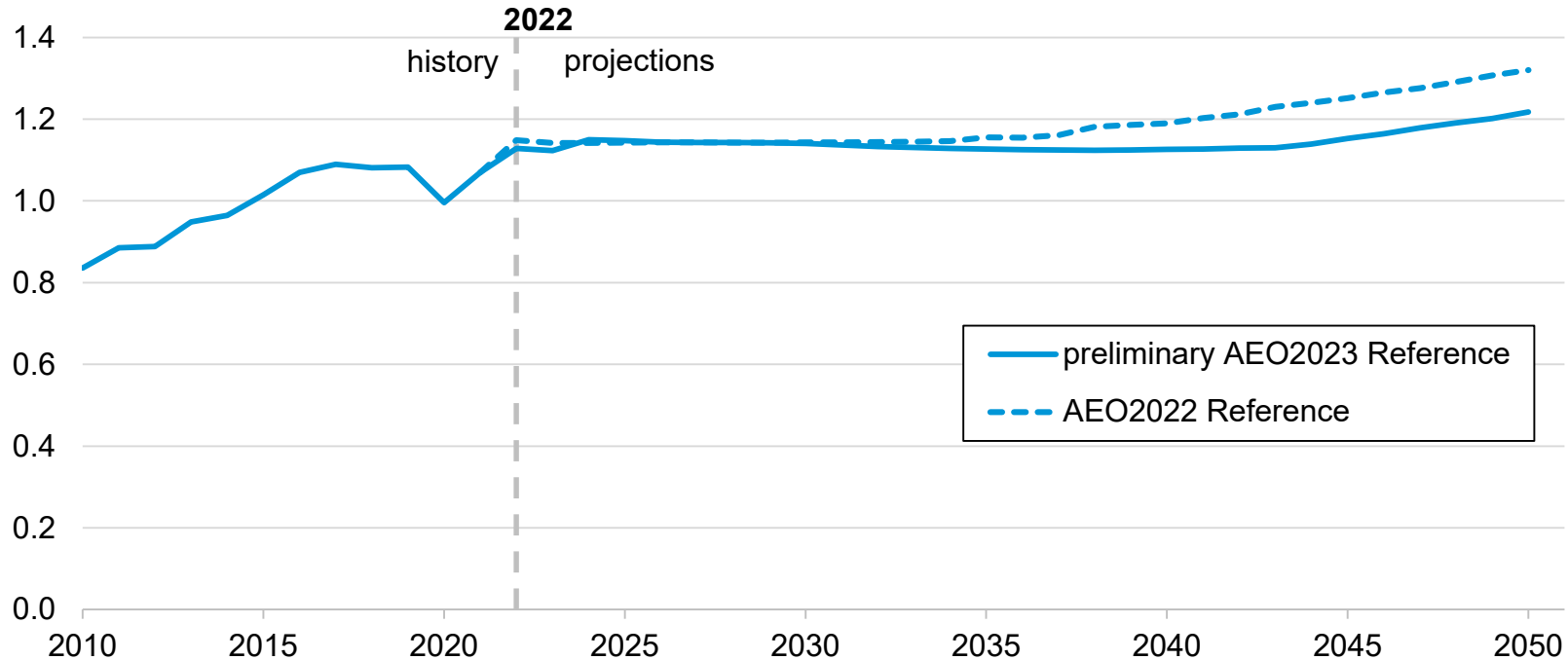


Data source: Preliminary AEO2023 runs, dated September 19, 2022

# Biofuels supply will be slightly lower than in AEO2022 due to lower motor gasoline demand, but will increase in 2023 and 2024 due to IRA biofuels subsidies

## Biofuels supply

million barrels per day



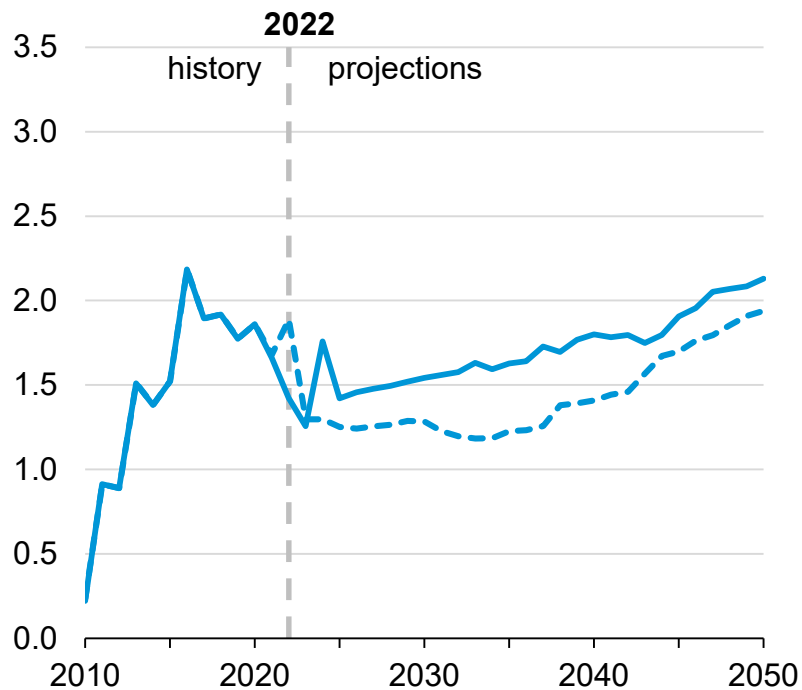
Data source: Preliminary AEO2023 runs, dated September 19, 2022

Note: Supply = domestic production plus net imports

# Renewable diesel supply outpaces biodiesel supply as a result of updated current and planned capacity

## Biodiesel supply

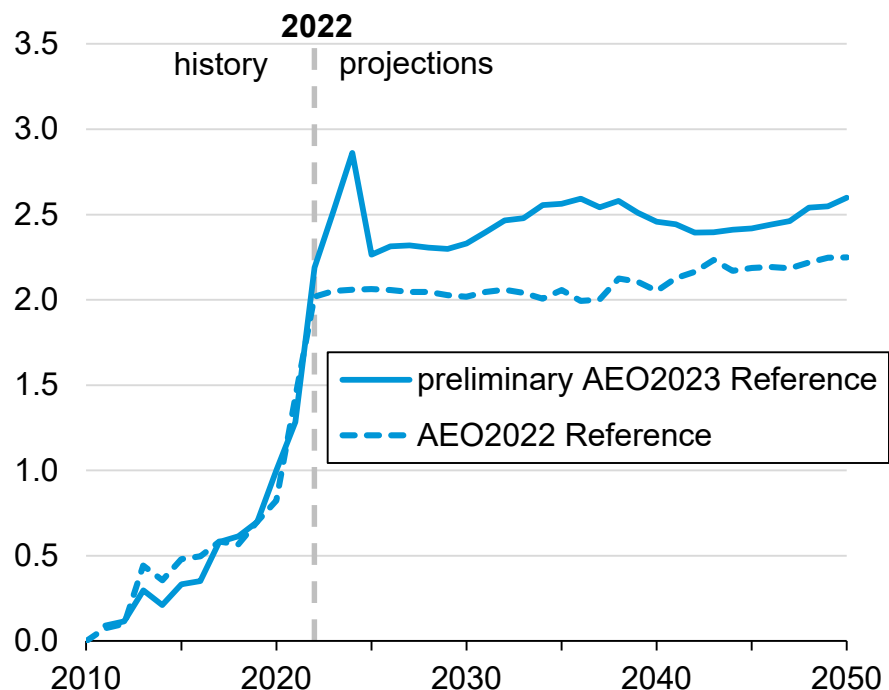
billion gallons



Data source: Preliminary AEO2023 runs, dated September 19, 2022

## Renewable diesel supply

billion gallons



Note: Supply = domestic production plus net imports

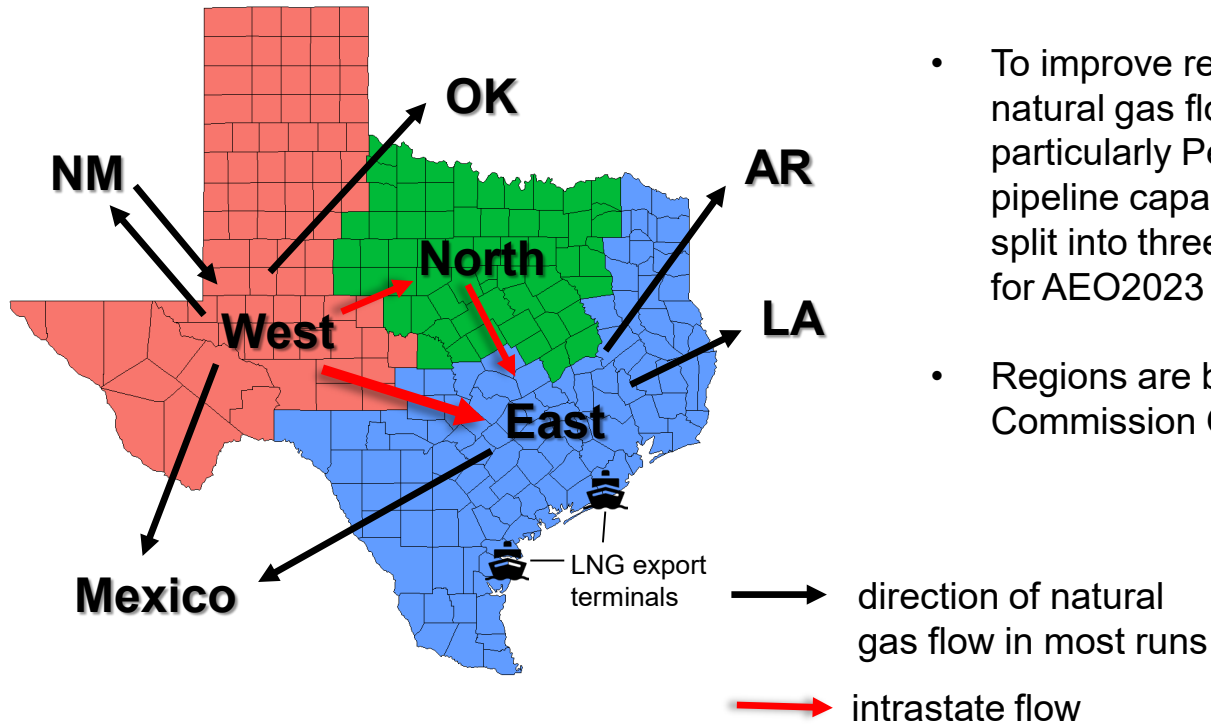


# Natural Gas Markets

# Data updates and changes for AEO2023

- *Natural Gas Annual* released September 2021 (2020 annual data)
- *Natural Gas Monthly* through April 2022 (complete 2021 history)
- Historical data for Mexico and Canada through 2021
- Pipeline capacity and pipeline projects tracked by EIA
- Updates to natural gas spot price data
- These changes between AEO2022 and preliminary AEO2023 projections are driven by external changes in assumptions:
  - World oil price assumptions
  - *Short-Term Energy Outlook* forecast
  - Impacts from the Inflation Reduction Act in the upstream and electric sectors

# Addition of sub-state demand nodes for Texas



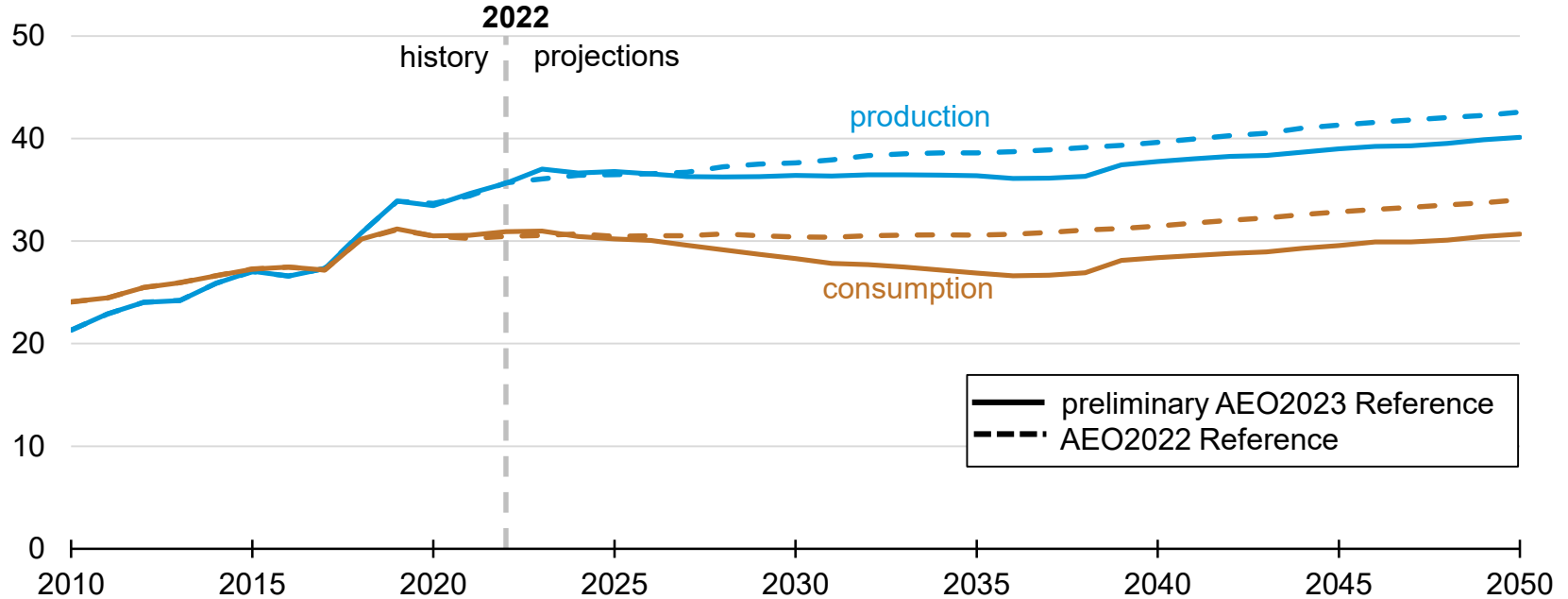
- To improve representation of projected natural gas flows within Texas, particularly Permian to Gulf of Mexico pipeline capacity constraints, Texas was split into three distinct demand nodes for AEO2023
- Regions are based on Texas Railroad Commission Oil and Gas Districts

*Note: NM = New Mexico, OK = Oklahoma, AR = Arkansas, and LA = Louisiana; LNG = liquefied natural gas*

# U.S. natural gas consumption and production are lower compared with AEO2022 as IRA provisions decrease natural gas production long term

## U.S. dry natural gas production and consumption in the Reference case

trillion cubic feet

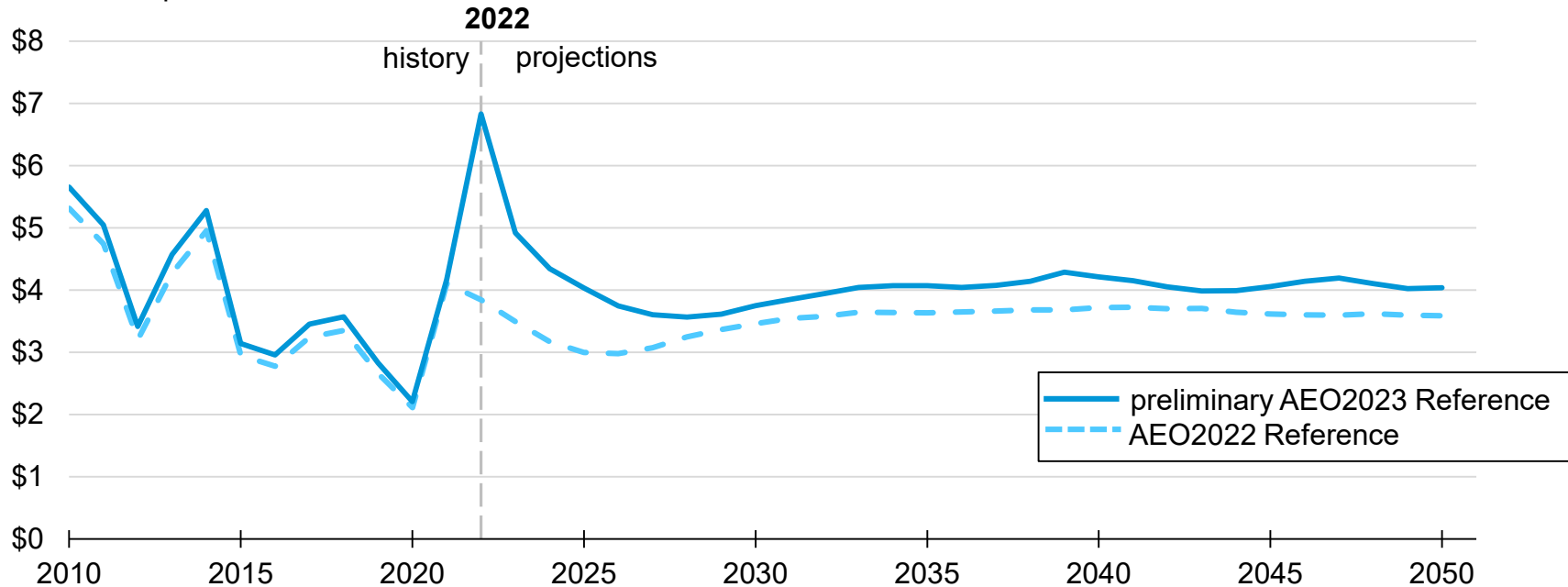


Data source: Preliminary AEO2023 run, dated September 20, 2022; U.S. Energy Information Administration *Annual Energy Outlook 2022*

In AEO2023, the U.S. Henry Hub natural gas spot price falls from its 2022 highs before settling into a price of slightly over \$4.00 per million British thermal units by 2035, which is higher than in AEO2022

### Henry Hub natural gas spot price in the Reference case

2022 dollars per million British thermal units

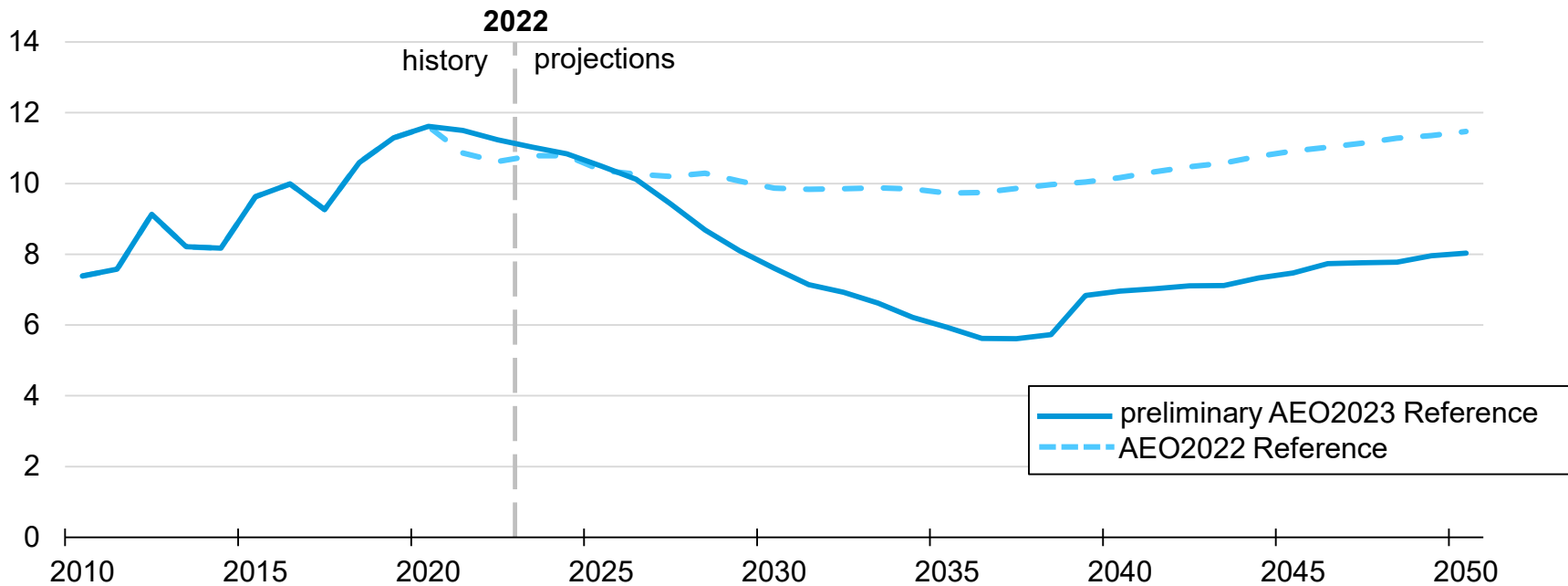


Data source: Preliminary AEO2023 run, dated September 20, 2022; U.S. Energy Information Administration *Annual Energy Outlook 2022*

# Early AEO2023 results suggest a large decline in natural gas consumption in the electric power sector relative to AEO2022, primarily due to impacts from the Inflation Reduction Act on the electric power sector

## U.S. natural gas consumption in the electric power sector

trillion cubic feet



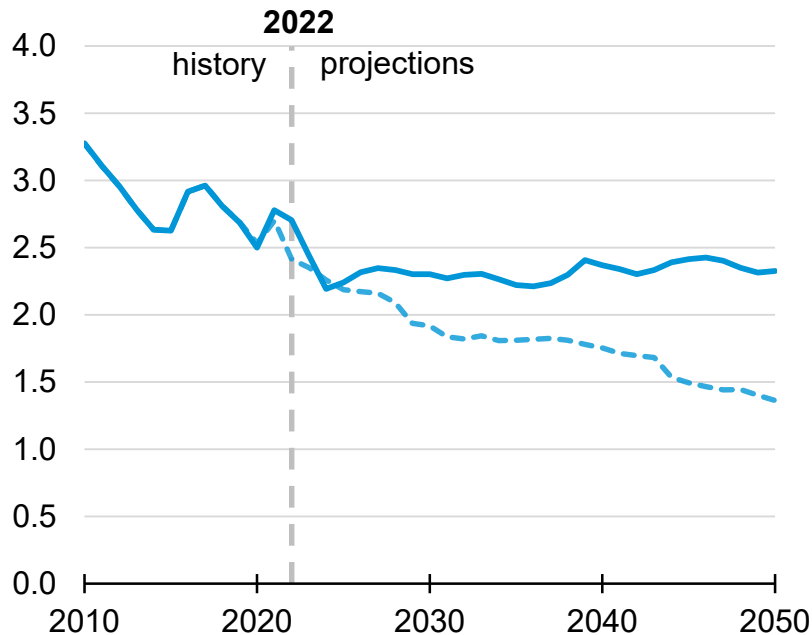
Data source: Preliminary AEO2023 run, dated September 20, 2022; U.S. Energy Information Administration *Annual Energy Outlook 2022*



# Imports from Canada are higher in AEO2023 compared with AEO2022; exports to Canada mostly unchanged

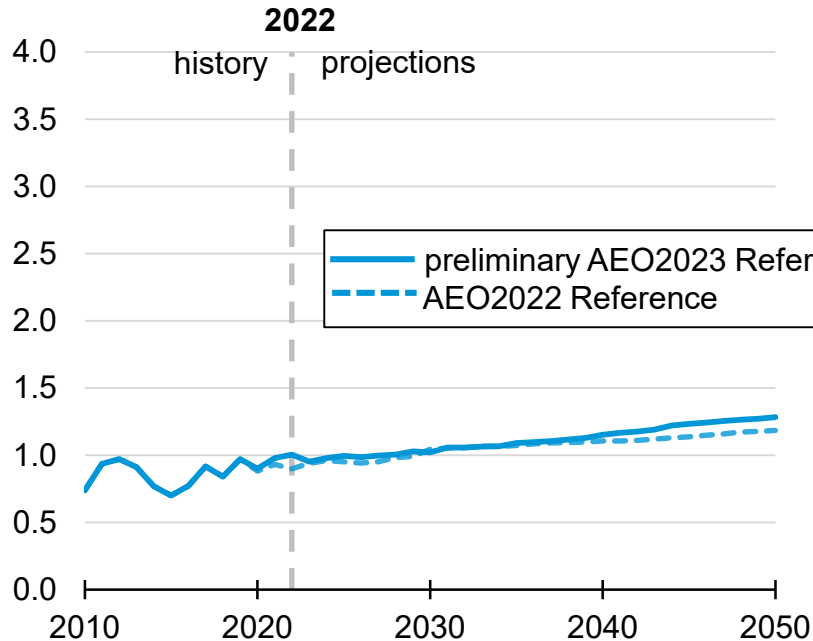
## U.S. natural gas imports from Canada

trillion cubic feet



## U.S. natural gas exports to Canada

trillion cubic feet

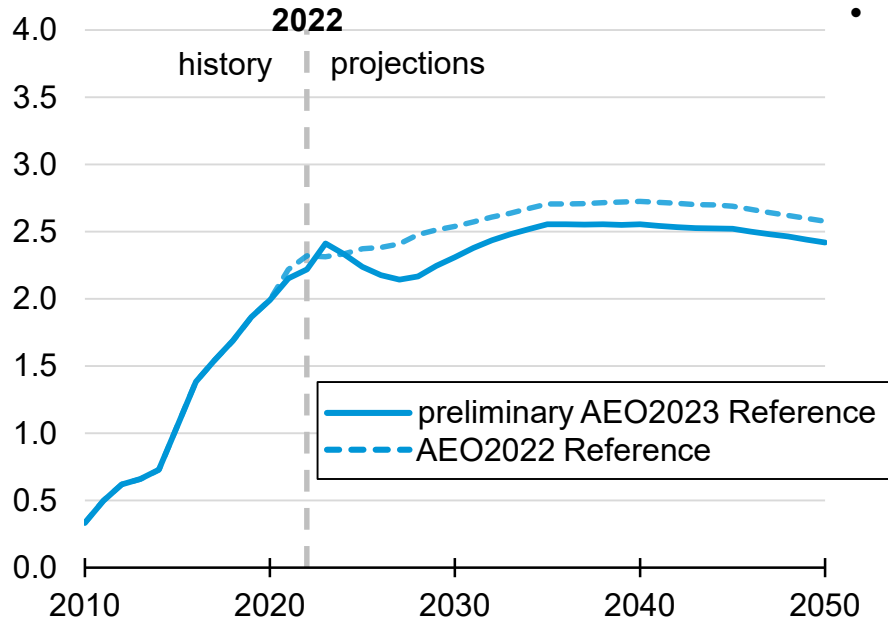


Data source: Preliminary AEO2023 run, dated September 20, 2022; U.S. Energy Information Administration *Annual Energy Outlook 2022*

# Pipeline exports to Mexico are lower than in AEO2022 and are projected to grow in the near term and ultimately peak near 2035

## U.S. pipeline exports to Mexico

trillion cubic feet



- Factors affecting projected exports to Mexico:
  - Lower domestic production relative to AEO2022
  - Decreases to Mexico’s natural gas generating capacity in the second half of the projection period (*International Energy Outlook 2021*)
  - Favorable LNG economics for Gulf Coast production increases regional demand and, as a result, prices for natural gas

Data source: Preliminary AEO2023 run, dated September 20, 2022; U.S. Energy Information Administration *Annual Energy Outlook 2022*



# Updated LNG export assumptions

- Dates of projects under construction in AEO2023:

| LNG project              | AEO2022 assumed in-service date | AEO2023 assumed in-service date | Baseload capacity |
|--------------------------|---------------------------------|---------------------------------|-------------------|
| Golden Pass Train 1      | January 2024                    | December 2023                   | 0.68 Bcf/d        |
| Golden Pass Train 2      | July 2024                       | July 2024                       | 0.68 Bcf/d        |
| Golden Pass Train 3      | January 2025                    | December 2024                   | 0.68 Bcf/d        |
| Plaquemines              | N/A                             | December 2024                   | 1.58 Bcf/d        |
| Corpus Christi Stage III | N/A                             | December 2025                   | 1.32 Bcf/d        |

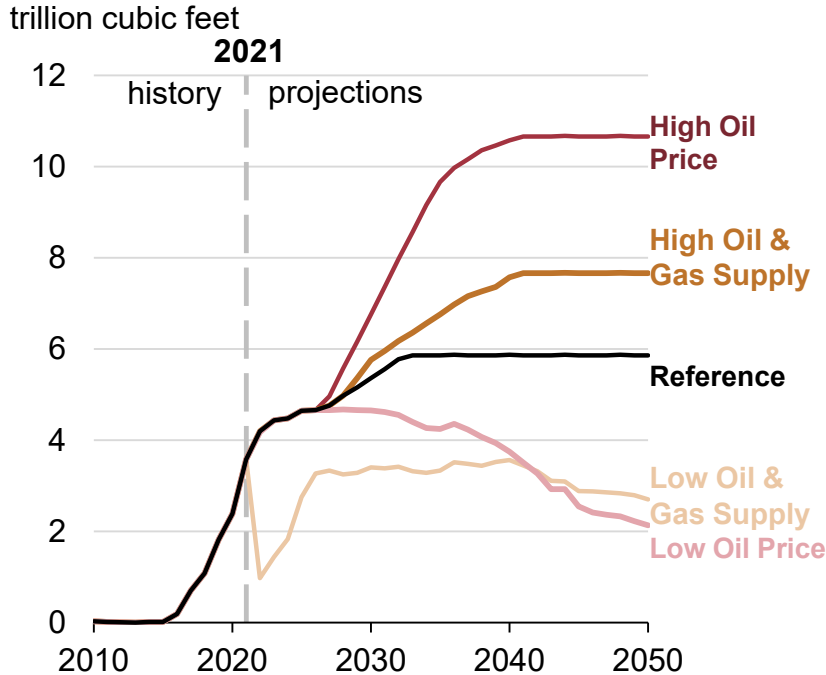
- Other updates:

- Shifted first year of allowed endogenous LNG builds from six years in the future (2028) to five years (2027)
- Considering changes to number of trains that can come online in a given year

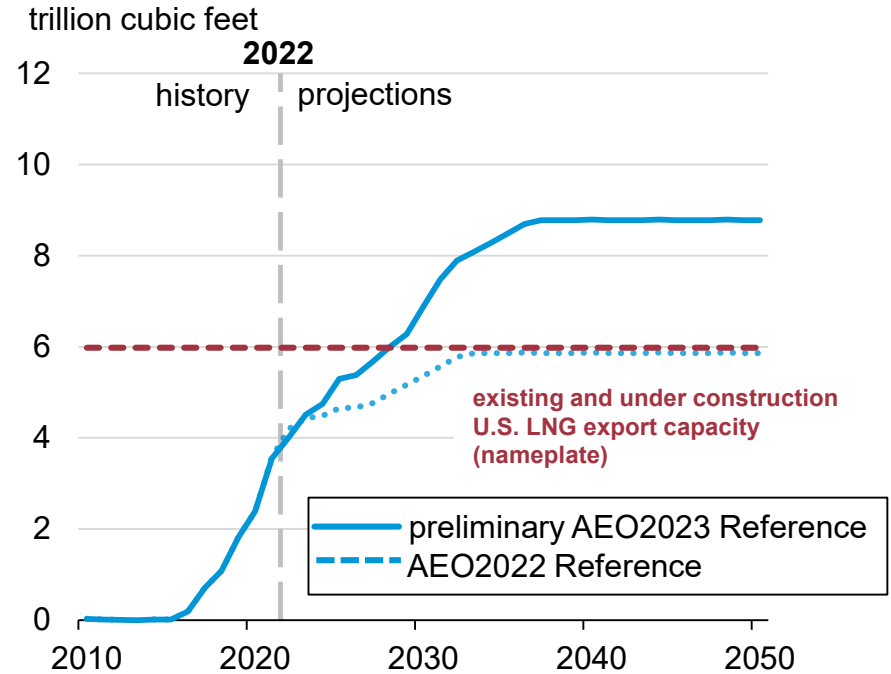
*Note: Bcf/d = billion cubic feet per day*

# LNG exports are higher in AEO2023 compared with AEO2022 because of more favorable LNG export economics

## AEO2022 U.S. LNG exports by side case



## U.S. LNG exports in Reference case



Data source: Preliminary AEO2023 run, dated September 20, 2022; U.S. Energy Information Administration, *Annual Energy Outlook 2022*

# Contacts

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# We welcome feedback on our assumptions and documentation

- Working group meetings <http://www.eia.gov/forecasts/aeo/workinggroup/>
- The AEO Assumptions report <http://www.eia.gov/forecasts/aeo/assumptions/>
- NEMS Model Documentation
  - Oil and gas supply (OGSM)  
[https://www.eia.gov/outlooks/aeo/nems/documentation/ogsm/pdf/m063\(2020\).pdf](https://www.eia.gov/outlooks/aeo/nems/documentation/ogsm/pdf/m063(2020).pdf)
  - Natural gas market (NGMM)  
[https://www.eia.gov/outlooks/aeo/nems/documentation/ngmm/pdf/ngmm\(2022\).pdf](https://www.eia.gov/outlooks/aeo/nems/documentation/ngmm/pdf/ngmm(2022).pdf)
  - Liquid fuels market (LFMM)  
<https://www.eia.gov/outlooks/aeo/nems/documentation/integrating/pdf/integrating-2022.pdf>
  - International energy (IEM)  
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- *Trends and Expectations Surrounding the Outlook for Energy Markets*  
[https://www.eia.gov/outlooks/aeo/trends\\_expectations.php/](https://www.eia.gov/outlooks/aeo/trends_expectations.php/)

# For more information

U.S. Energy Information Administration homepage | [www.eia.gov](http://www.eia.gov)

Short-Term Energy Outlook | [www.eia.gov/steo](http://www.eia.gov/steo)

Annual Energy Outlook | [www.eia.gov/aeo](http://www.eia.gov/aeo)

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