



AEO2025 Second Macroeconomic and Industrial Working Group Meeting

Office of Integrated and International Energy Analysis

Office of Long-Term Energy Modeling

October 31, 2024 | Virtual

Overview

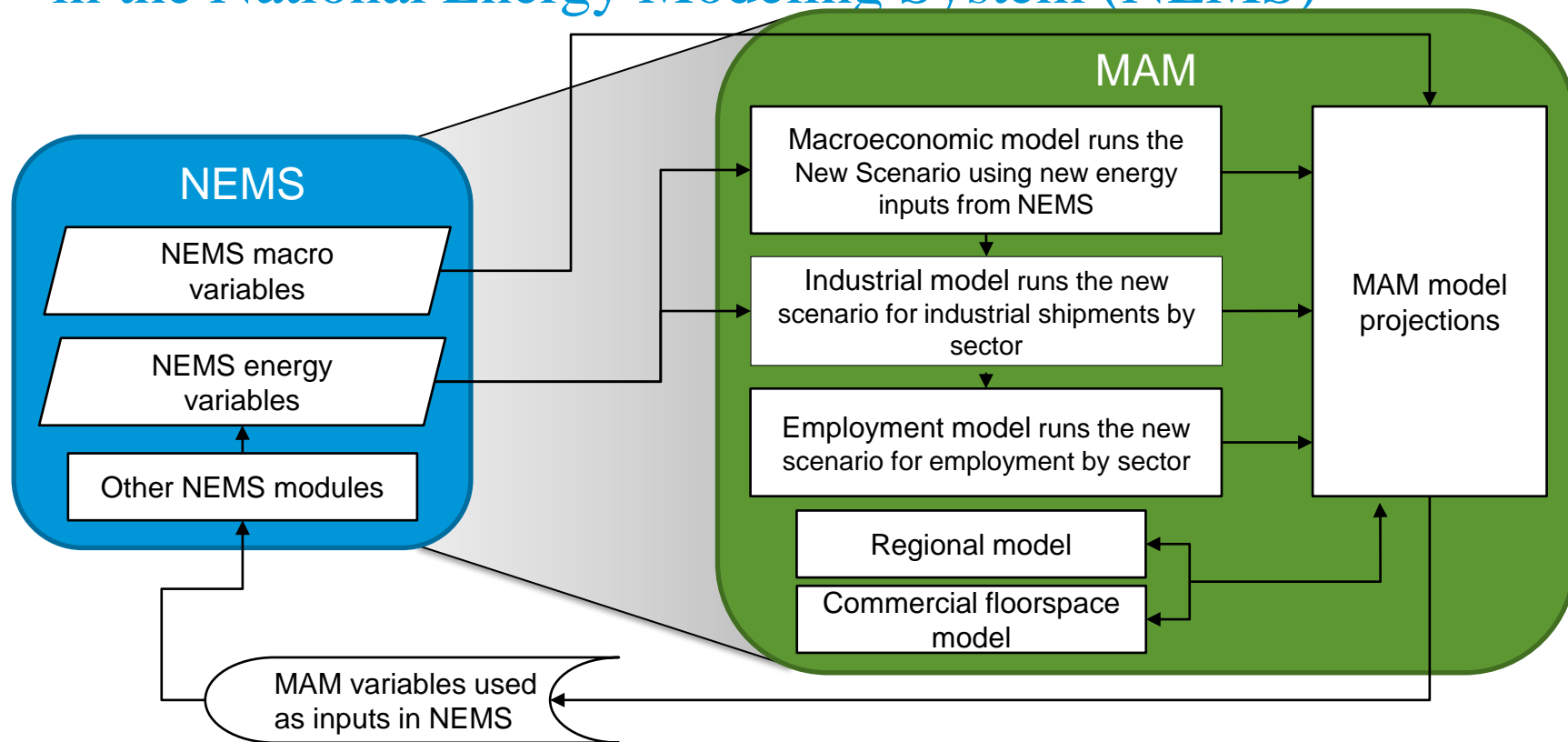
- Annual Energy Outlook (AEO) 2025 macroeconomic updates and preliminary results
- AEO2025 industrial updates and selected preliminary results
- Potential industrial updates for future AEOs
- Discussion and questions

Review of preliminary AEO2025 macroeconomic results

Key preliminary AEO2025 macro results

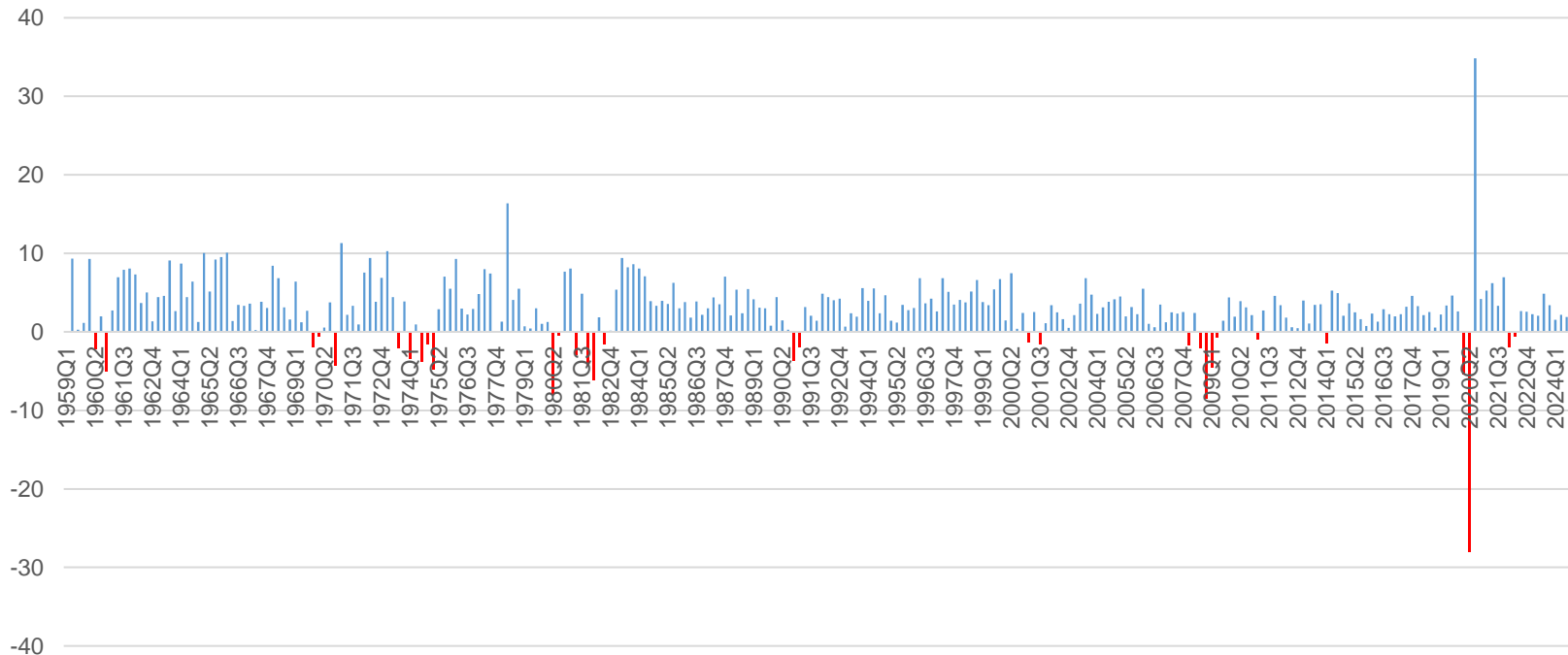
- AEO2025 real GDP grows an average of 1.7% per year from 2024 to 2050.
- Average growth of consumption is 2.0% over the projection period.
- Nonresidential fixed investment is projected to grow 2.2% per year from 2024 to 2050 in the AEO2025.
- Growth of nonfarm business productivity averages 1.9% over the projection period.

Summary of the Macroeconomic Activity Module (MAM) in the National Energy Modeling System (NEMS)



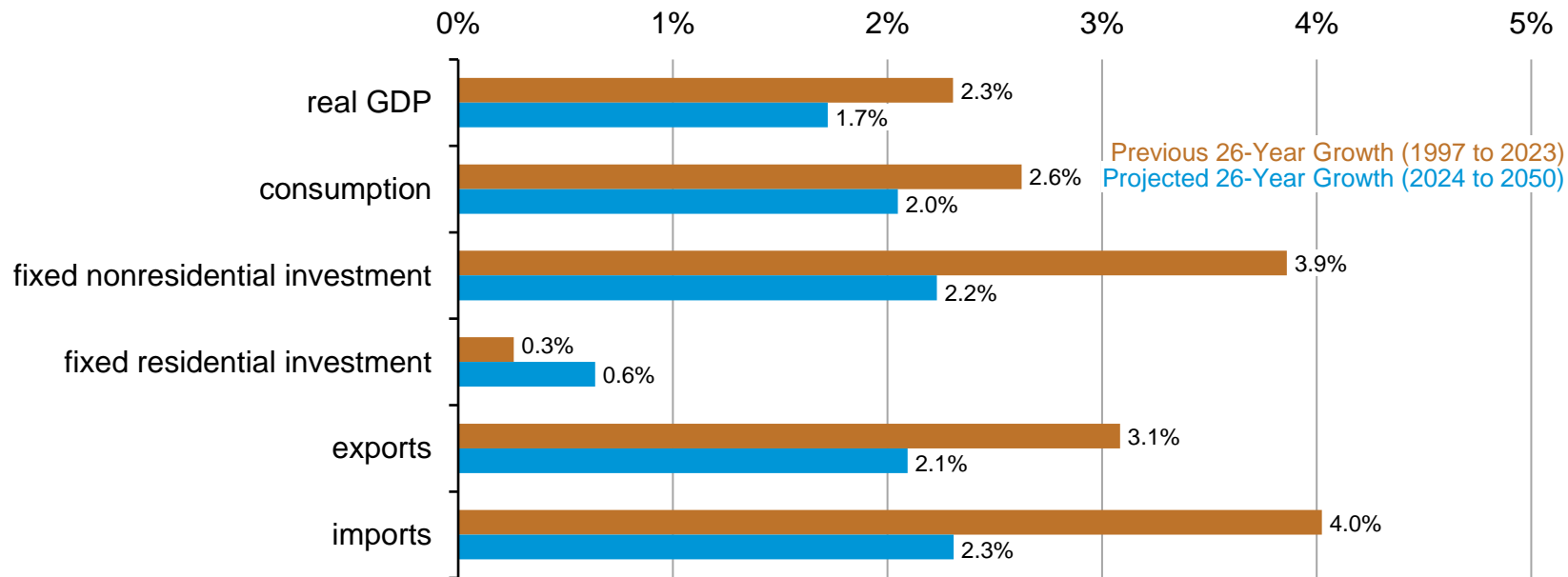
Solid growth is projected for 2024 with another year of real GDP growing at least 2.5%

average annual percentage growth



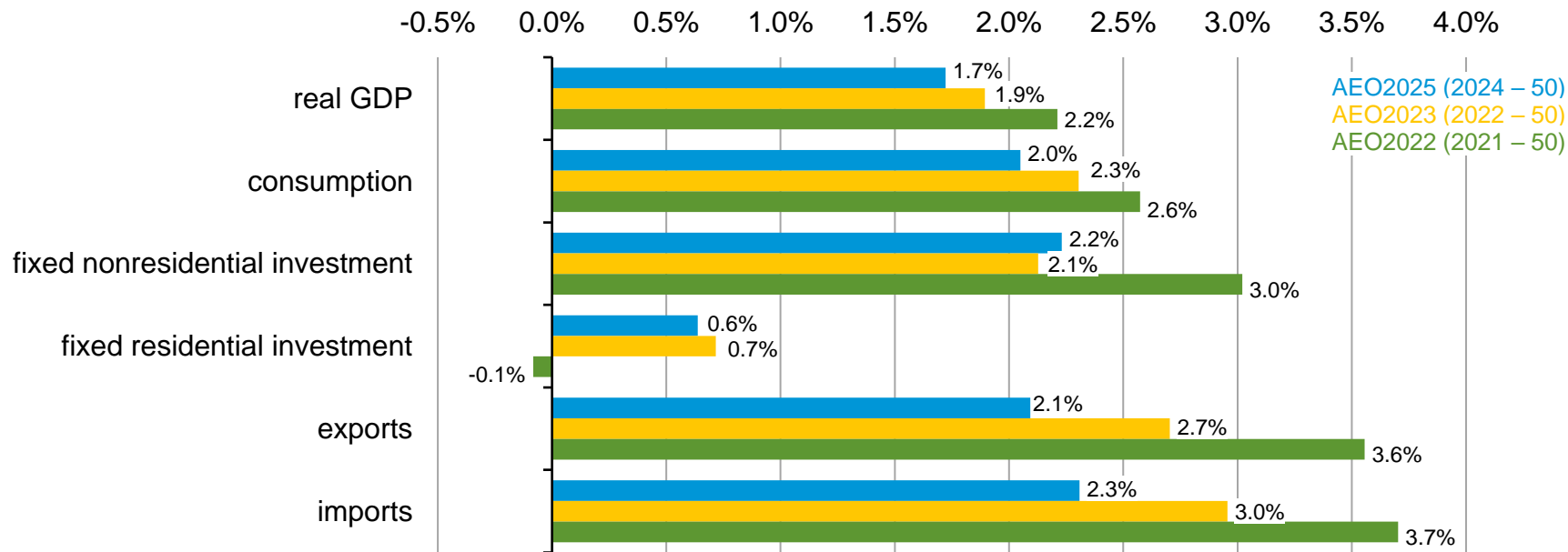
Growth of GDP and its components are slower in the AEO2025 projection than in recent history

average annual percentage growth

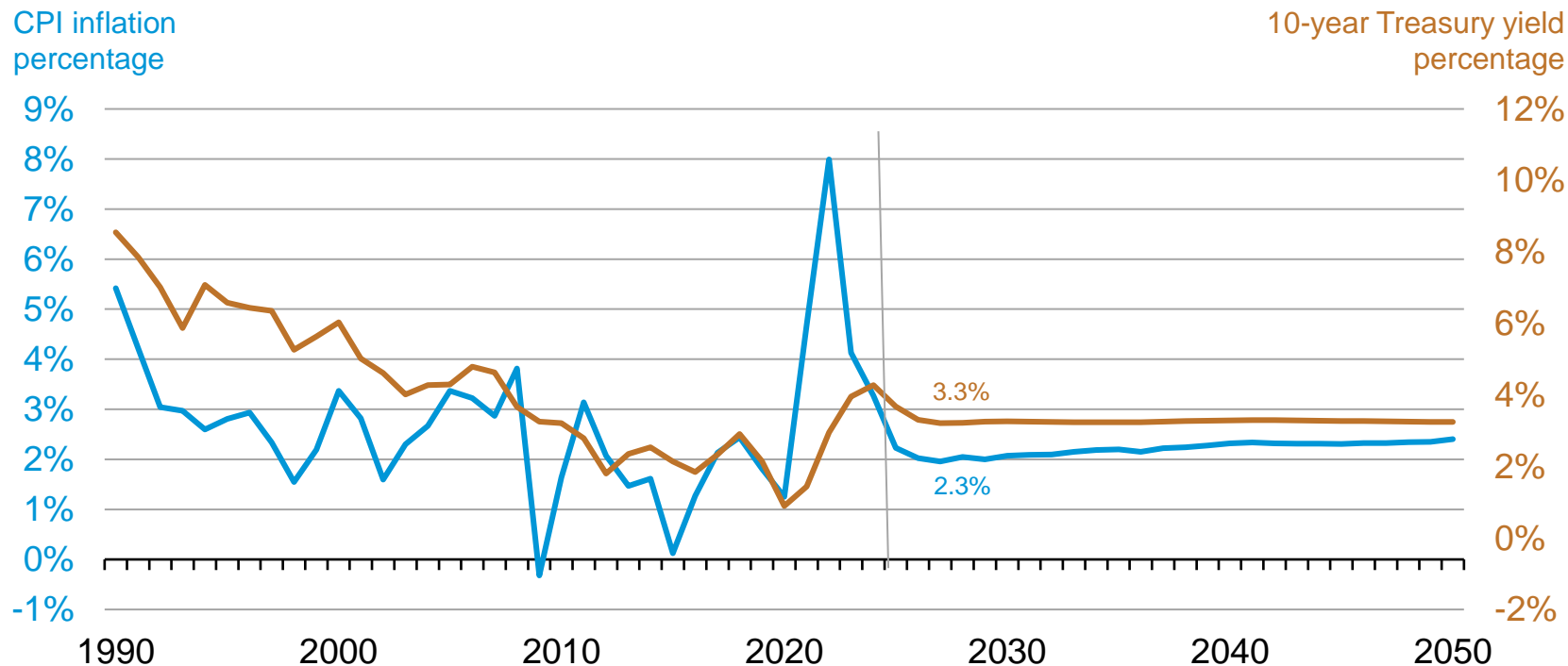


Preliminary AEO2025 projections are lower than past AEO projections

average annual percentage growth



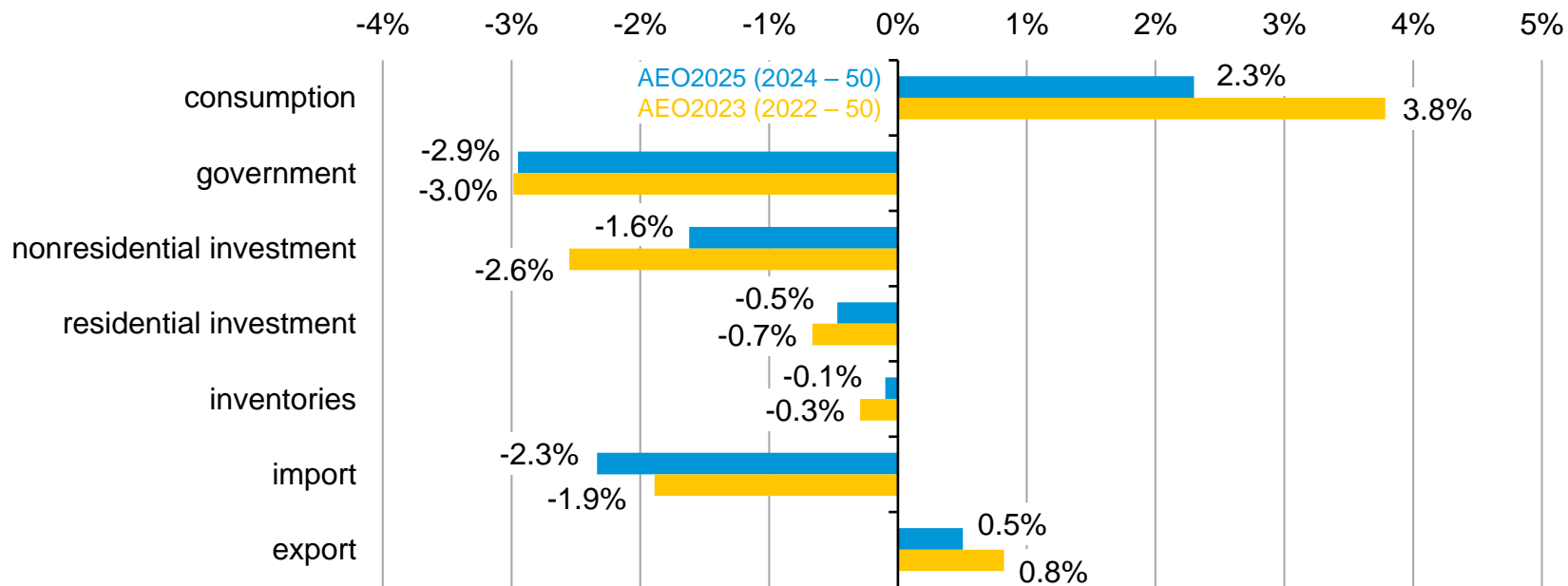
Modest rise in inflation over the projection.



Small changes in the share for trade and government relative to that for consumption and investment

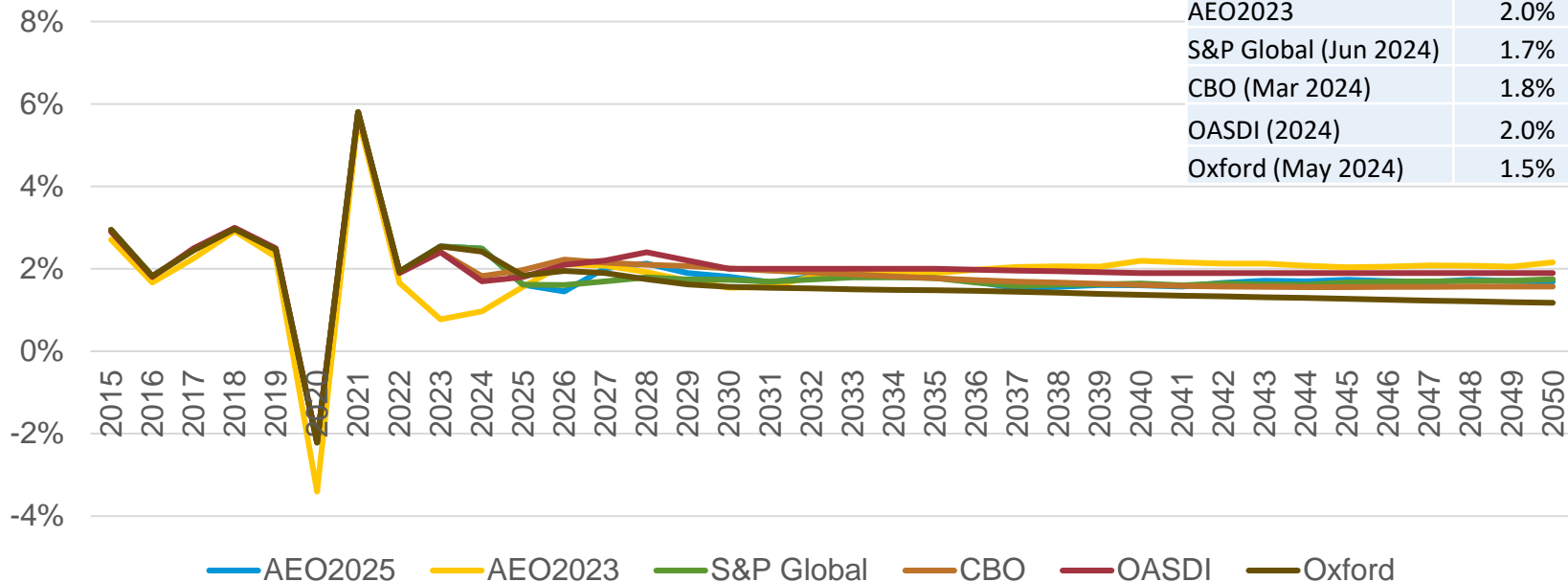
change in GDP share over projection period

percentage points



AEO2025 real GDP growth is like other projections

annual average growth in real GDP



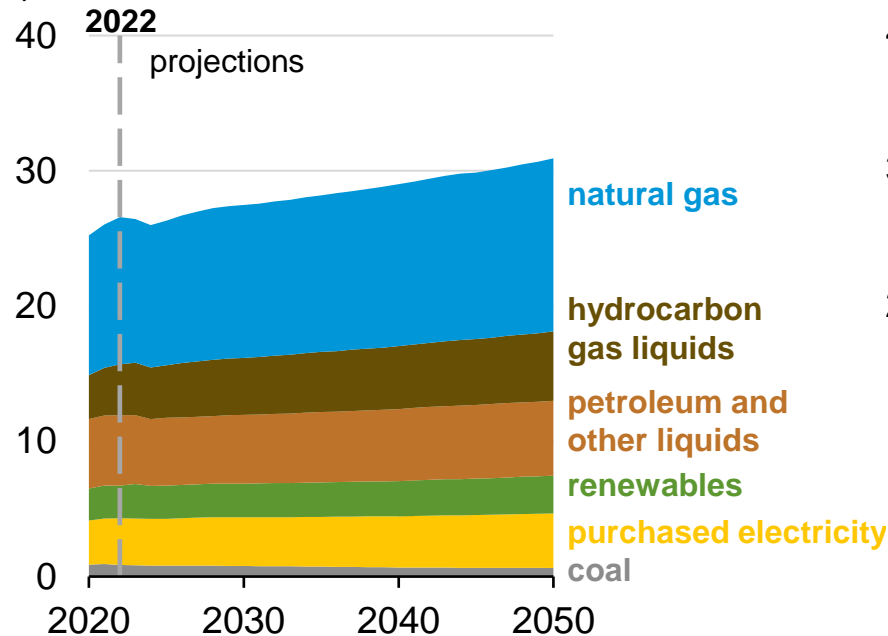
Industrial updates for AEO2025

AE02023 Reference case industrial sector energy consumption by fuel and sector

Industrial energy consumption by fuel

AE02023 Reference case

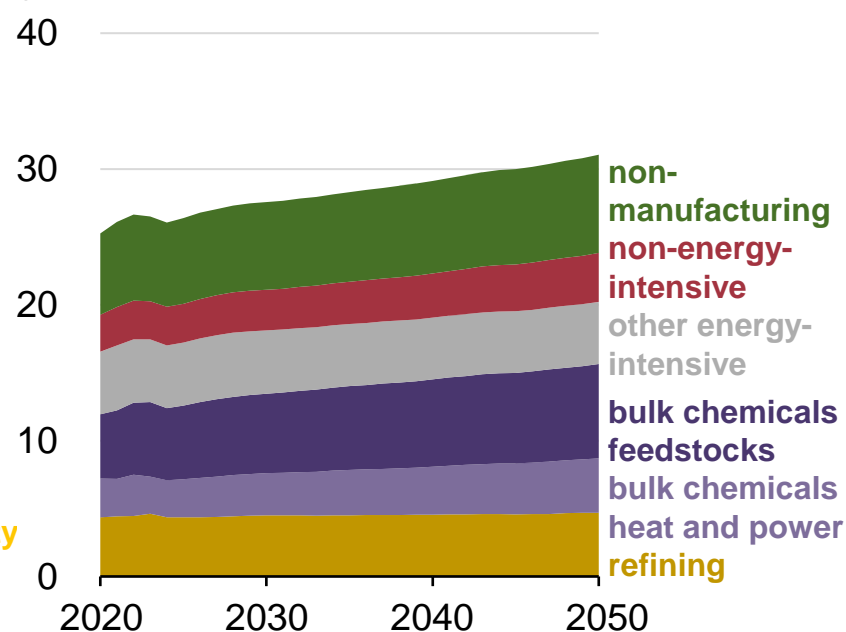
quadrillion British thermal units



Industrial energy consumption by subsector

AE02023 Reference case

quadrillion British thermal units



Technology updates for energy-intensive industries

- Updated cement and lime, glass, aluminum, steel, and paper industry parameters (costs, energy use), added new technologies, removed obsolete technologies
- Key additions
 - Cement: retrofit carbon capture option, calcium-silicate-based clinker technology
 - Glass: more detailed macroeconomic input, container glass recycling
 - Steel: H₂-based direct reduced iron (DRI) technology, greater price responsiveness for electric arc furnace (EAF) deployment
 - Bulk chemicals: explicit H₂ feedstock demand, recycling mechanism

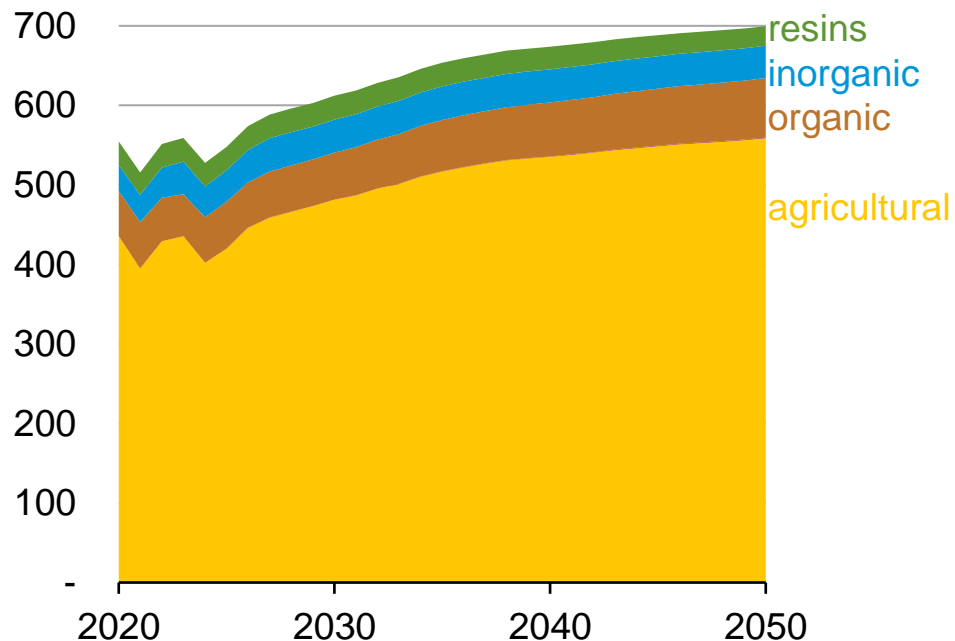
NEMS hydrogen modeling

- Previously, H₂ production and consumption in IDM was *implicitly* modeled in the bulk chemicals industry (for example, nitrogenous fertilizers).
 - The Liquid Fuels Market Module (LFMM) also modeled refinery natural gas consumed to produce H₂.
- Now, H₂ production has been moved out of IDM and LFMM to its own module, and H₂ demand is modeled by demand sectors.
 - IDM is still responsible for byproduct H₂ production, which is tied to petrochemical cracking.
- Industrial H₂ demand is only for feedstock in AEO2025.
- You can find out more about the new Hydrogen Market Module (HMM) at the Petroleum and Natural Gas Working Group on November 4.

Industrial hydrogen modeling

- IDM now explicitly models sources of H₂ feedstock demand.
 - We infer baseline (historical) H₂ feedstock demand in bulk chemicals from EIA data and other sources.
- IDM still demand some natural gas feedstock for methanol production.
- H₂-based DRI in steel is the only potential new technology with H₂ demand.
 - Negligible deployment in Reference case

Hydrogen feedstock demand by chemical subsector, AEO2025 preliminary results
quadrillion British thermal units

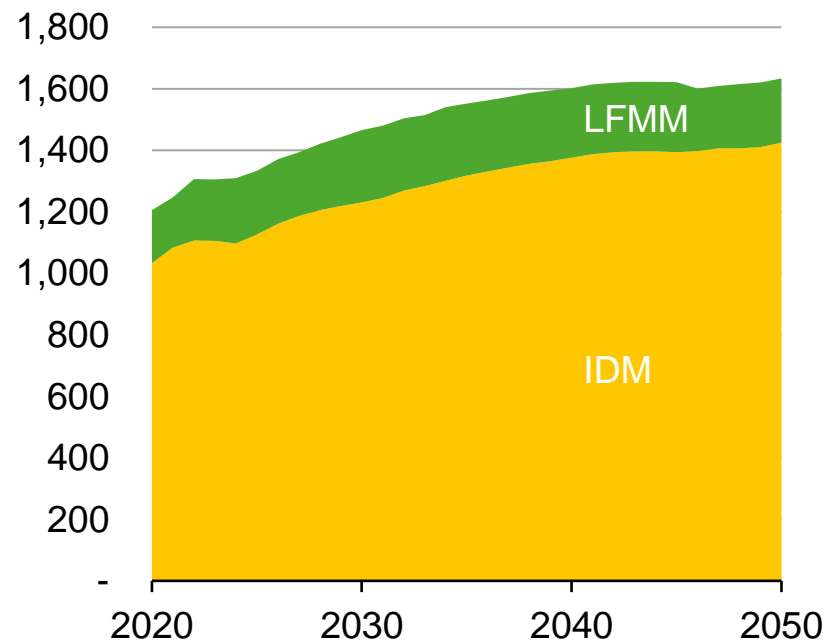


Natural gas feedstock consumption in NEMS shifts from IDM and LFMM to HMM

Natural gas feedstock consumption

AEO2023 Reference case

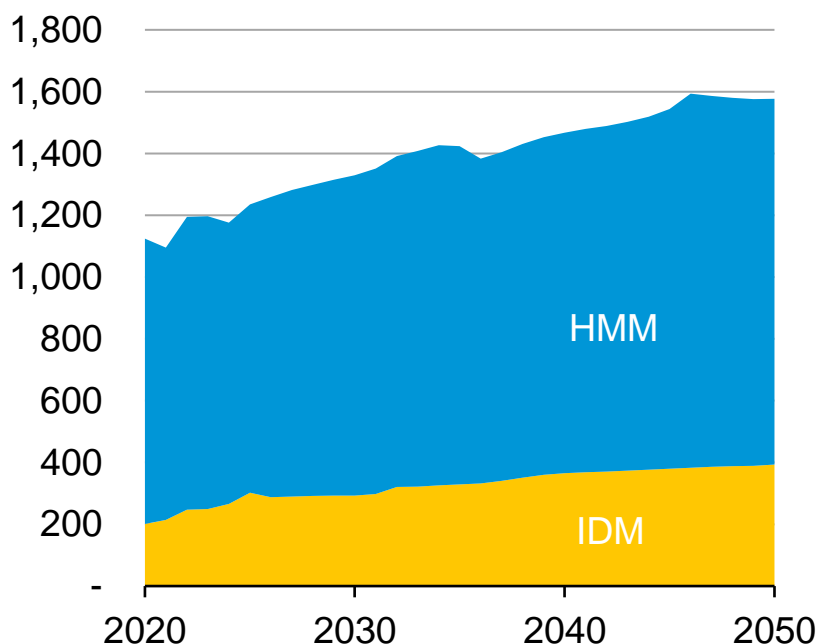
quadrillion British thermal units



Natural gas feedstock consumption

AEO2025 preliminary results

quadrillion British thermal units



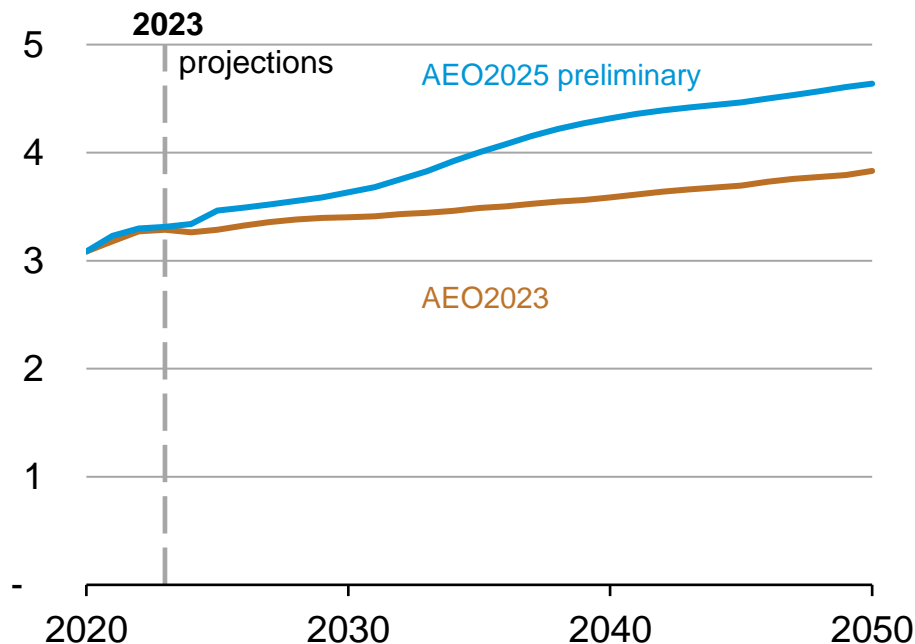
CO₂ capture and emissions updates

- IDM now models carbon capture retrofits for cement.
 - For now, cement CO₂ capture is only retrofitted, with no traditional capture option for newly-built cement capacity.
 - IDM gets a CO₂ price from the new Carbon Capture, Allocation, Transportation, and Sequestration Module (CCATS).
 - Cement CO₂ capture retrofit model uses parameters from the National Energy Technology Lab's Carbon Capture Retrofit Database.
- New Brimstone technology uses alternative to clinker that avoids process emissions.
 - A cement project using the Brimstone technology is one of those selected under the Industrial Demonstrations Program (funding still pending as “Award Under Negotiation”).
- We now model process emissions from glass production.

Electrification updates

- Electric boilers
- Industrial heat pumps
- More flexibility and price responsiveness in the steel industry
 - Further favoring electric arc furnaces, supplemented by direct reduced iron

Electricity consumption
quadrillion British thermal units

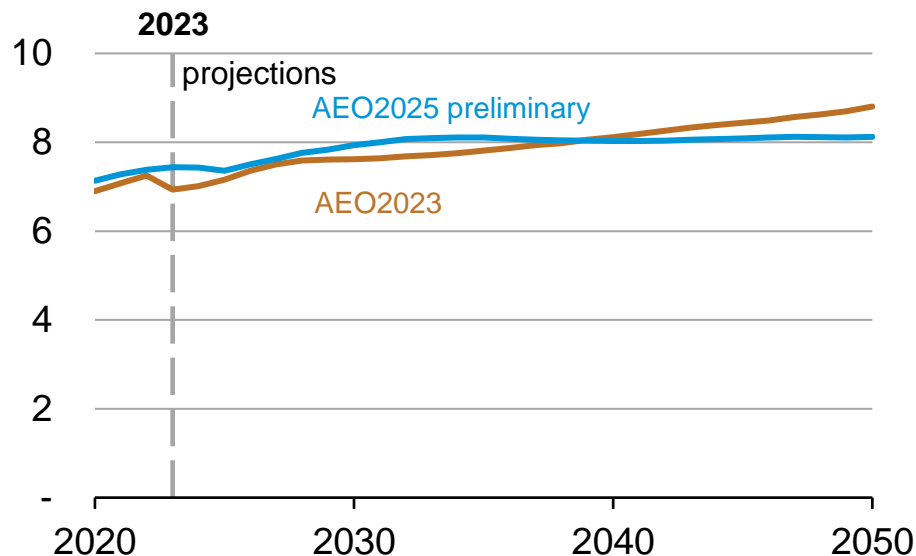


Note: Excludes refining

Changes to natural gas consumption

- Lower consumption because of chemical macroeconomic changes
- Lower consumption as a result of electrification of boilers, addition of heat pumps
- Higher consumption from new chemical recycling mechanism (less aggressive recycling growth)
- Final results likely lower than those shown

**Industrial natural gas consumption,
AEO2025 preliminary**
quadrillion British thermal units



Note: Excludes refining

Other updates

- Split the Balance of Manufacturing industry into other primary metals, other non-metallic minerals, light chemicals, and miscellaneous finished goods
- Benchmarked historical purchased electricity by industry to the Census Bureau's *Annual Survey of Manufactures*
- Removed motor model
- Incorporated new *Short-Term Energy Outlook* value for industrial petroleum coke into benchmarking

Potential updates for AEO2026 and beyond

- Better represent methanol technologies, including e-methanol (methanol from captured CO₂ and purchased H₂)
- Add more H₂ technologies (for process heat, boiler fuel)
- Increase CO₂ capture options (steel, new cement plant capacity)
- Consider more technologies incentivized by funding from Industrial Demonstration Program grants
- Expand electrification options (thermal batteries for high temperature heating needs)

AEO economic activity and STEO macroeconomic projections

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U.S. Energy Information Administration home page | www.eia.gov

Annual Energy Outlook | www.eia.gov/aeo

Short-Term Energy Outlook | www.eia.gov/steo

International Energy Outlook | www.eia.gov/ieo

Monthly Energy Review | www.eia.gov/mer

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