AEO2025 First Macroeconomic and Industrial Working Group Meeting

Office of Integrated and International Energy Analysis
Office of Long-Term Energy Modeling
April 24, 2024 | Virtual

Key Concepts

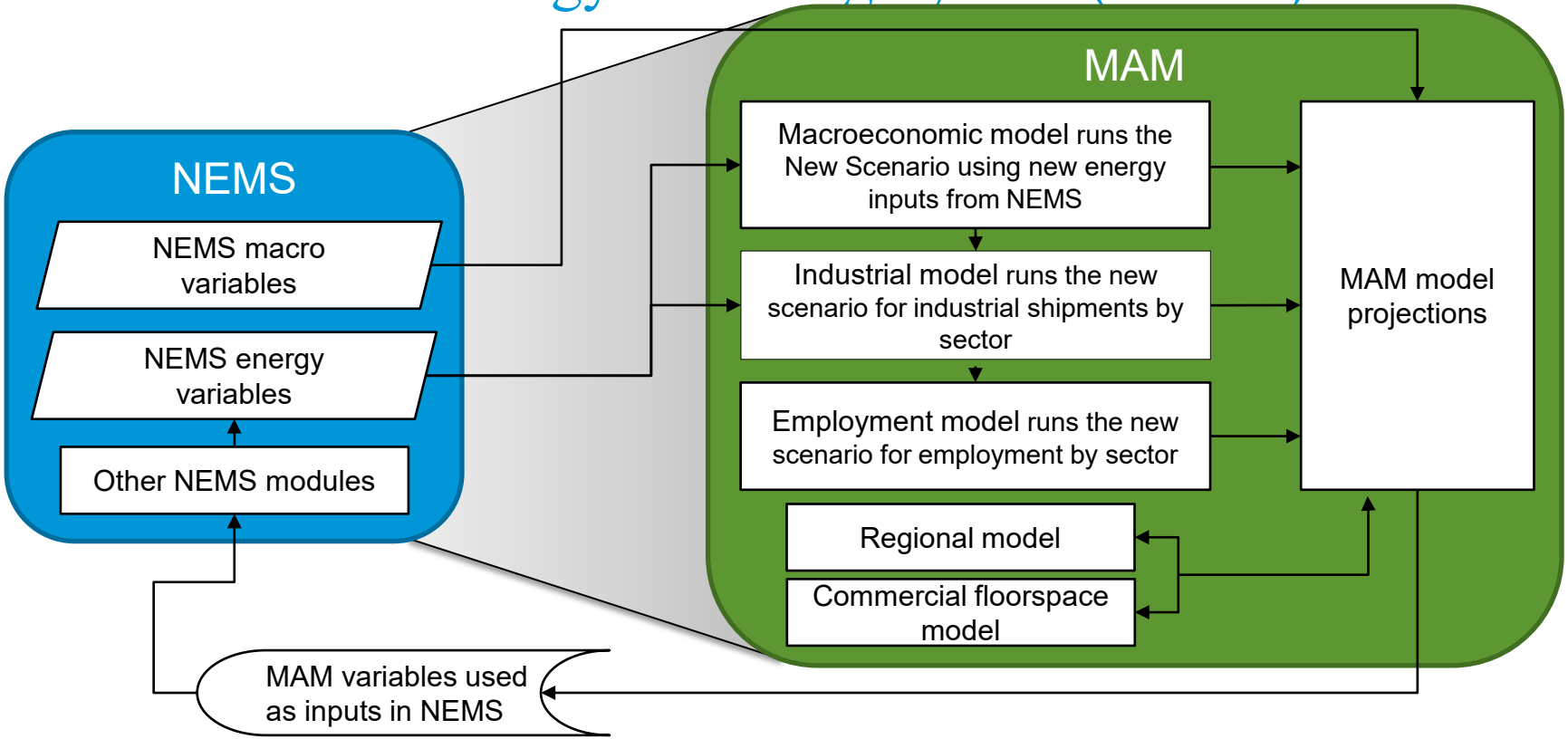
- Annual Energy Outlook (AEO) 2025 macroeconomic updates and preliminary results
- Review of AEO2023 industrial demand module (IDM) results
- AEO2025 planned industrial updates
- Discussion and questions

Review of preliminary AEO2025 macroeconomic results

Key preliminaryAEO2025 macro results

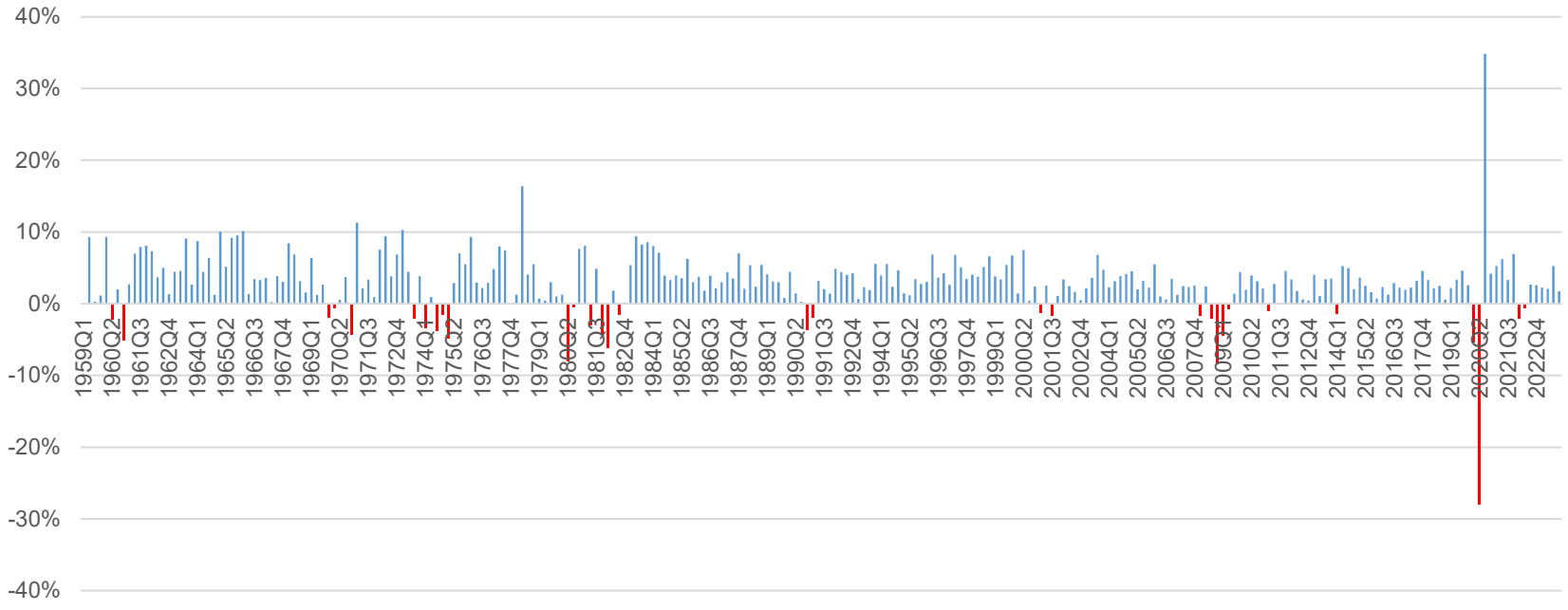
- AEO2025 real GDP grows an average of 1.7% per year from 2024 to 2050.
- Average growth of consumption is 2.1% over the projection period.
- Nonresidential fixed investment is projected to grow 2.2% per year from 2024 to 2050 in the AEO2025.
- Growth of nonfarm business productivity averages 1.6% over the projection period.

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



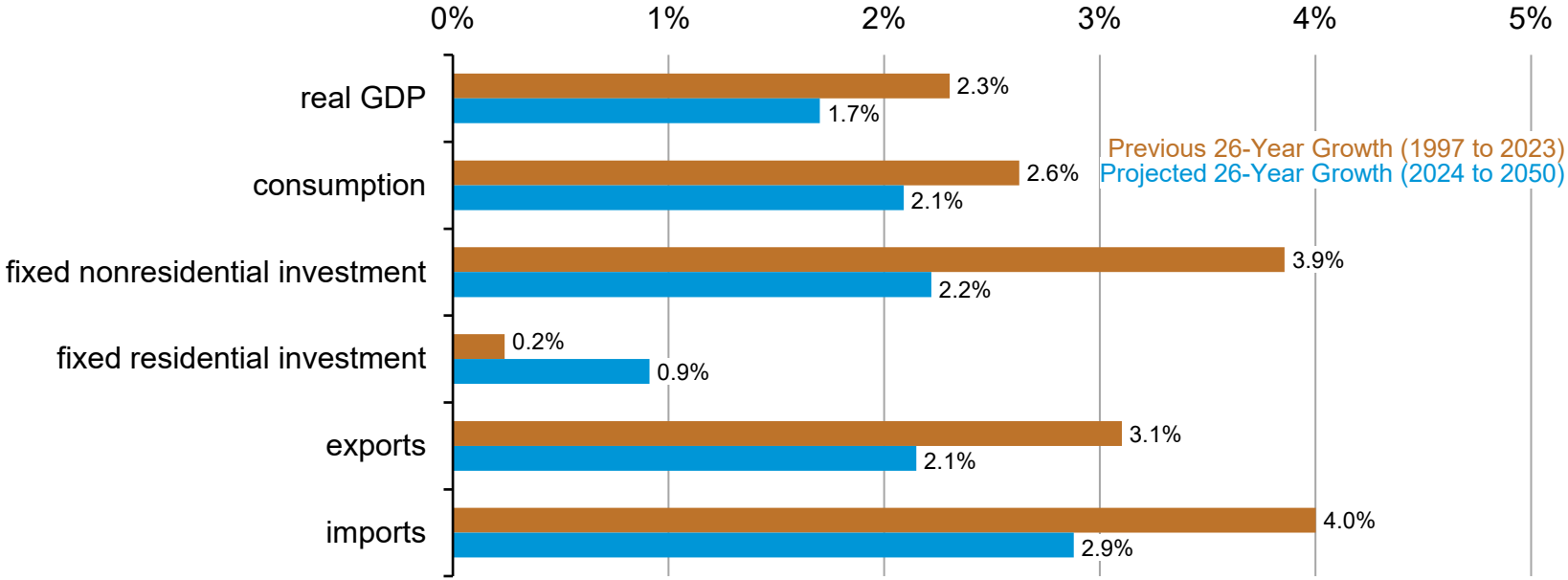
Robust growth in the third quarter increased 2023 annual growth of real GDP to 2.5% over the 2022 annual level

average annual percentage growth



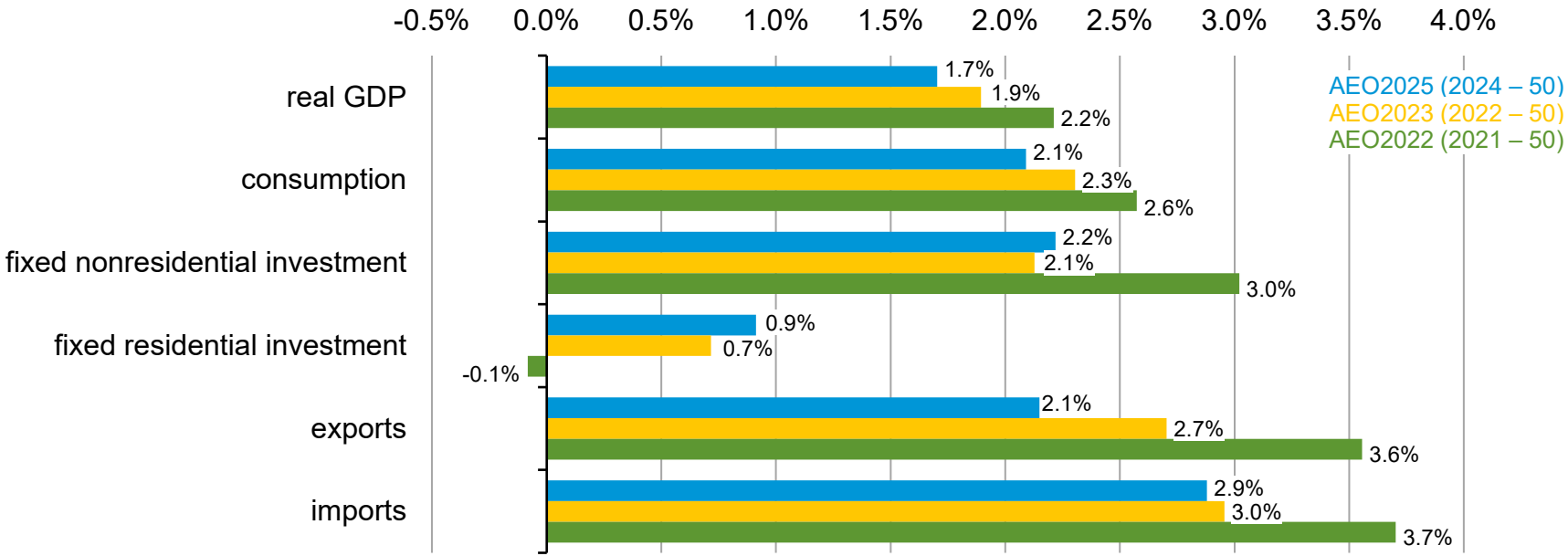
Growth of GDP and its components are slower in the AEO2025 projection than in recent history

average annual percentage growth

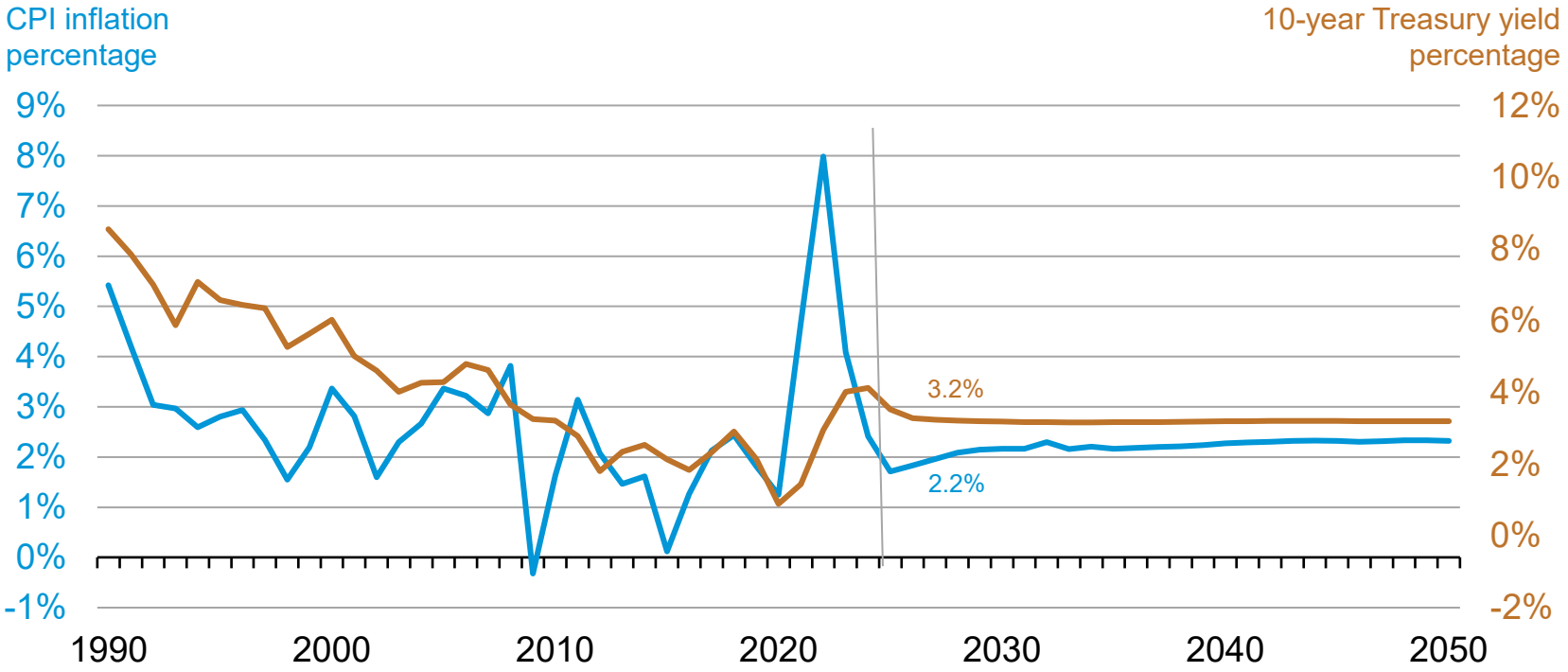


Preliminary AEO2025 projections are lower than past AEO projections

average annual percentage growth

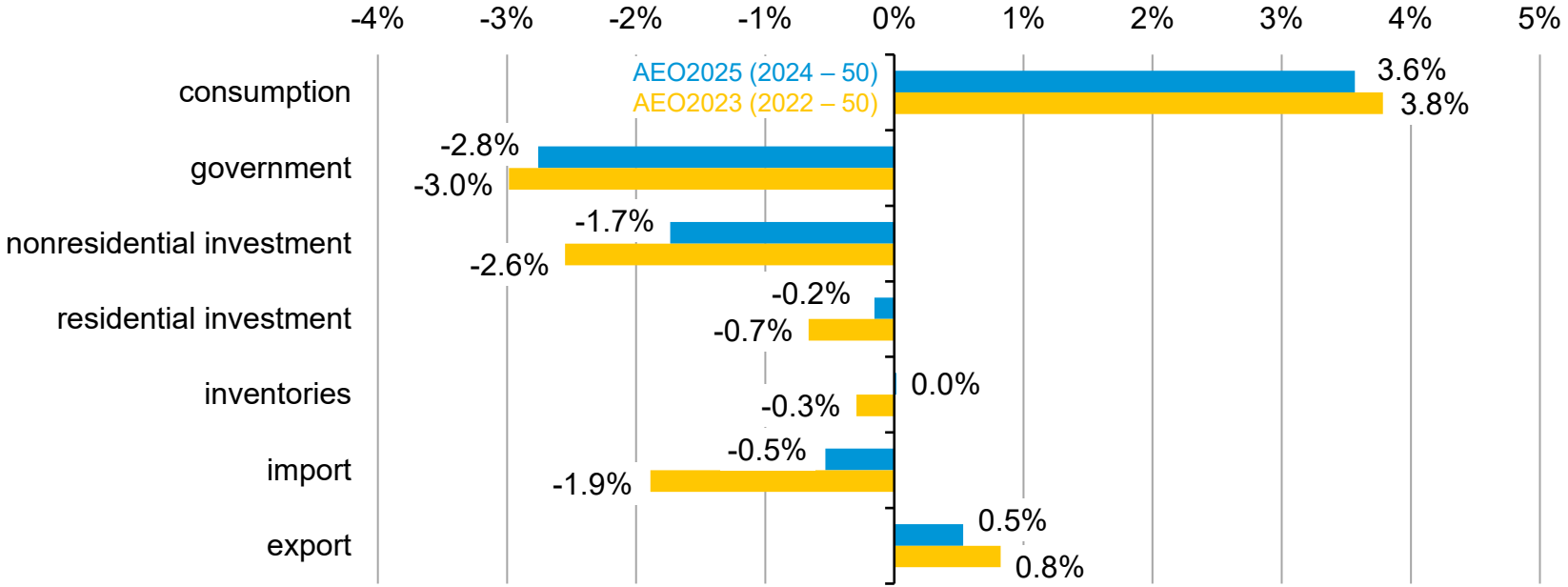


Modest rise in inflation over the projection.



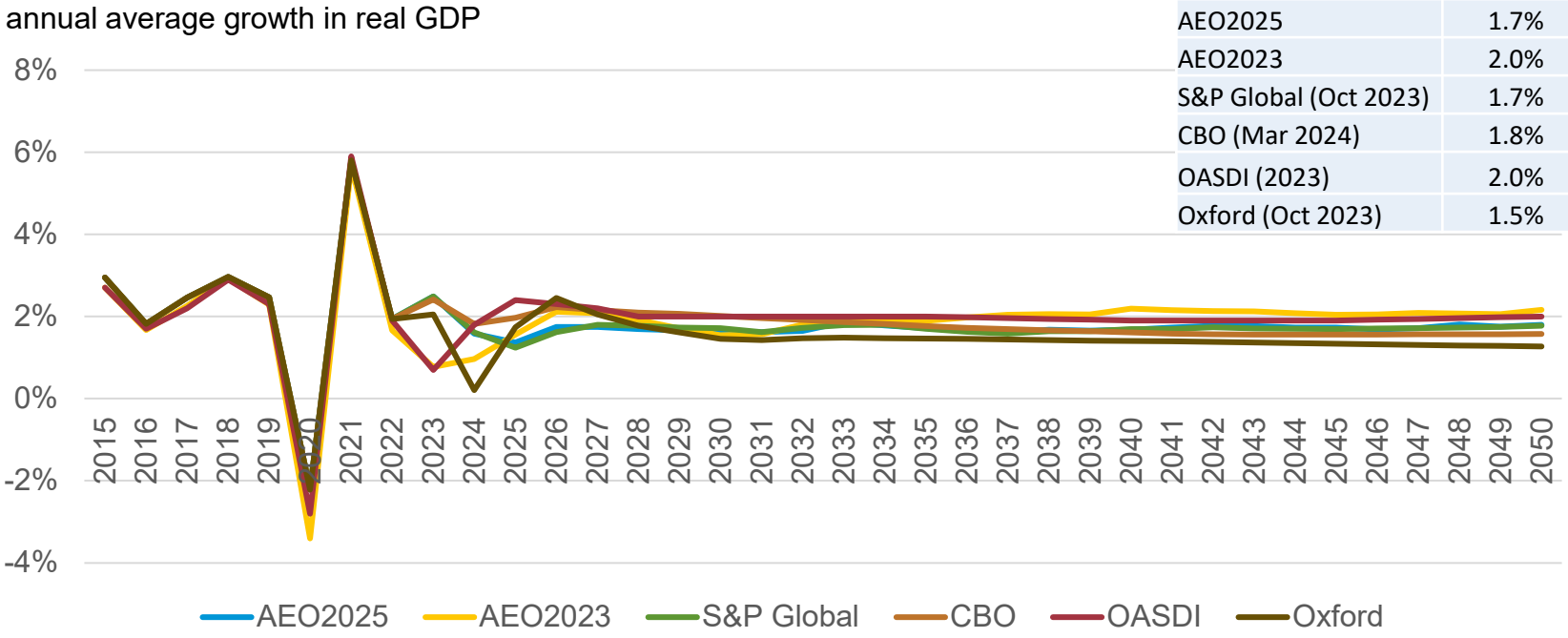
Small changes in the share for consumption and government relative to that for nonresidential investment and imports

change in GDP share over projection period
percentage points



AEO2025 real GDP growth is like other projections

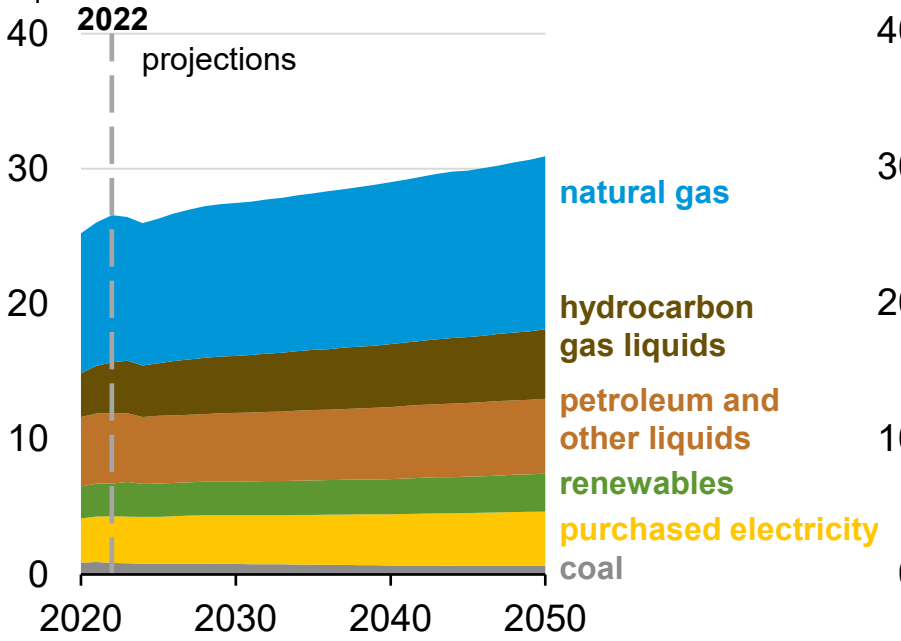
Projection	2024 – 50
AEO2025	1.7%
AEO2023	2.0%
S&P Global (Oct 2023)	1.7%
CBO (Mar 2024)	1.8%
OASDI (2023)	2.0%
Oxford (Oct 2023)	1.5%



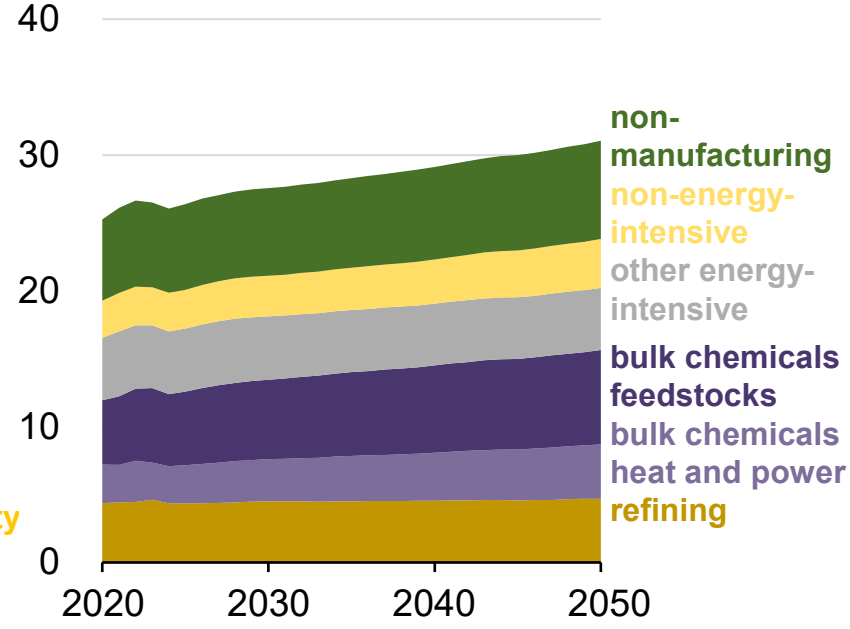
Review of AEO2023 industrial results

AEO2023 Reference case industrial sector energy consumption by fuel and sector

Industrial energy consumption by fuel
AEO2023 Reference case
quadrillion British thermal units



Industrial energy consumption by subsector
AEO2023 Reference case
quadrillion British thermal units



Industrial updates for AEO2025

Technology updates for energy-intensive industries

- Update cement and lime, glass, aluminum, steel, and paper industry parameters (costs, energy use), add new technologies, remove obsolete technologies
- Steel: H_2-based direct reduced iron (DRI) technology
- Cement: calcium-silicate-based clinker technology, retrofit carbon capture option
- Glass: electric furnace technology, recycling rate
- Paper: new drying and black liquor evaporator technologies
- Bulk chemicals: recycling mechanism, H_2 production moved to new NEMS module

NEMS hydrogen modeling

- Through AEO2023, H_2 production and consumption in IDM was *implicitly* modeled in the bulk chemicals industry (for example, nitrogenous fertilizers).

- Starting in AEO2025, H_2 production will be moved out of industrial to its own module, and H_2 demand will be modeled explicitly by demand sectors.

- The new Hydrogen Market Module (HMM) will model multiple H_2 supply technologies and solve for regional production and price of H_2 (their working group is scheduled for June 12).

- Industrial H_2 demand is only for feedstock in AEO2025.

Industrial hydrogen modeling

- Most of our efforts in the IDM are focused on moving H_2 production out of the module and modeling existing sources of H_2 feedstock demand.
  - New model structure allows different sources of H_2 to meet existing demand.
  - Agricultural chemicals is the largest source of H_2 feedstock demand.

- Baseline (historical) H_2 feedstock demand in bulk chemicals is inferred from the 2018 *Manufacturing Energy Consumption Survey* (MECS) and other public sources; it grows with chemicals shipments in the projections.
  - Sectors that produce syngas from natural gas (methanol) will not demand H_2 feedstock.

- H_2-based DRI in steel is the only potential new technology with H_2 demand.
  - Future AEOs might include other H_2 demand sources (e-methanol, H_2 heating).

Estimated 2018 hydrogen feedstock supply and demand

Sector	HMM on-purpose supply (trillion British thermal units H_2)	End-use demand (trillion British thermal units H_2)
Agricultural chemicals	362	385
Inorganic chemicals	192	43
Organic chemicals	69	69
Resins, synthetic rubber, and fibers	37	37
Refining	189	508
Total	849	1,042

- Base-year H_2 feedstock on-purpose supply and demand estimated based on MECS, *Petroleum Supply Annual*, U.S. Geological Survey fertilizer data
- Difference between total supply and demand (193 TBtu) assumed to be byproduct H_2; the rest of supply is assumed to be from steam methane reformers (natural gas)

CO_2 emissions and capture updates

- Process emissions modeling for glass, steel, and chemicals
- Mechanism to model carbon capture retrofits for cement
  - For now, cement CCS is only retrofit, with no traditional CCS option for new-built capacity.
  - Is being developed in tandem with the new Carbon Capture, Allocation, Transportation, and Sequestration Module (CCATS) in NEMS (working group June 5)
- Hydrogen module will have options for H_2 production with carbon capture

Modeling additional electrification

- More flexibility and price responsiveness in the steel industry
  - Further leaning toward electric arc furnaces, supplemented by direct reduced iron
- Electric boilers
- Industrial heat pumps
  - Low-temperature industries such as food, wood products, light chemicals, and metal-based durables

Other updates

- Benchmark purchased electricity by industry to the Census Bureau's *Annual Survey of Manufactures*
- Incorporate new *Short-Term Energy Outlook* value for industrial petroleum coke into benchmarking
- Break the Balance of Manufacturing industry into other primary metals, other non-metallic minerals, light chemicals, and miscellaneous finished goods
- Use new macro series: petrochemicals (subset of organic chemicals) and industrial gases (subset of inorganic chemicals)
  - Allow for better modeling of hydrocarbon gas liquid feedstocks and merchant H_2 production, respectively

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

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