# Second Macro-Industrial Working Group Meeting

*Updates and preliminary results*

*September 30, 2021 | Washington, DC*

*By*
*Office of Integrated and International Energy Analysis*
*Office of Long-Term Energy Modeling*

# *Annual Energy Outlook 2022* (AEO2022) Macro-Industrial Working Group: Overview

- AEO2022 macroeconomic updates and preliminary results
- AEO2022 industrial updates and preliminary results
- Longer-term plans for industrial modeling
- Discussion and questions


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# Review of preliminary AEO2022 macroeconomic results



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# Key preliminary AEO2022 macro results

- AEO2022 real GDP grows an average of 2.1% per year from 2021 to 2050
- Average growth of consumption is 2.5% over the projection period
- Nonresidential fixed investment is projected to grow 2.9% per year from 2021 to 2050 in the AEO2022
- Growth of nonfarm business productivity averages 1.9% over the projection period

Source: U.S. Energy Information Administration, *Annual Energy Outlook 2022* preliminary run


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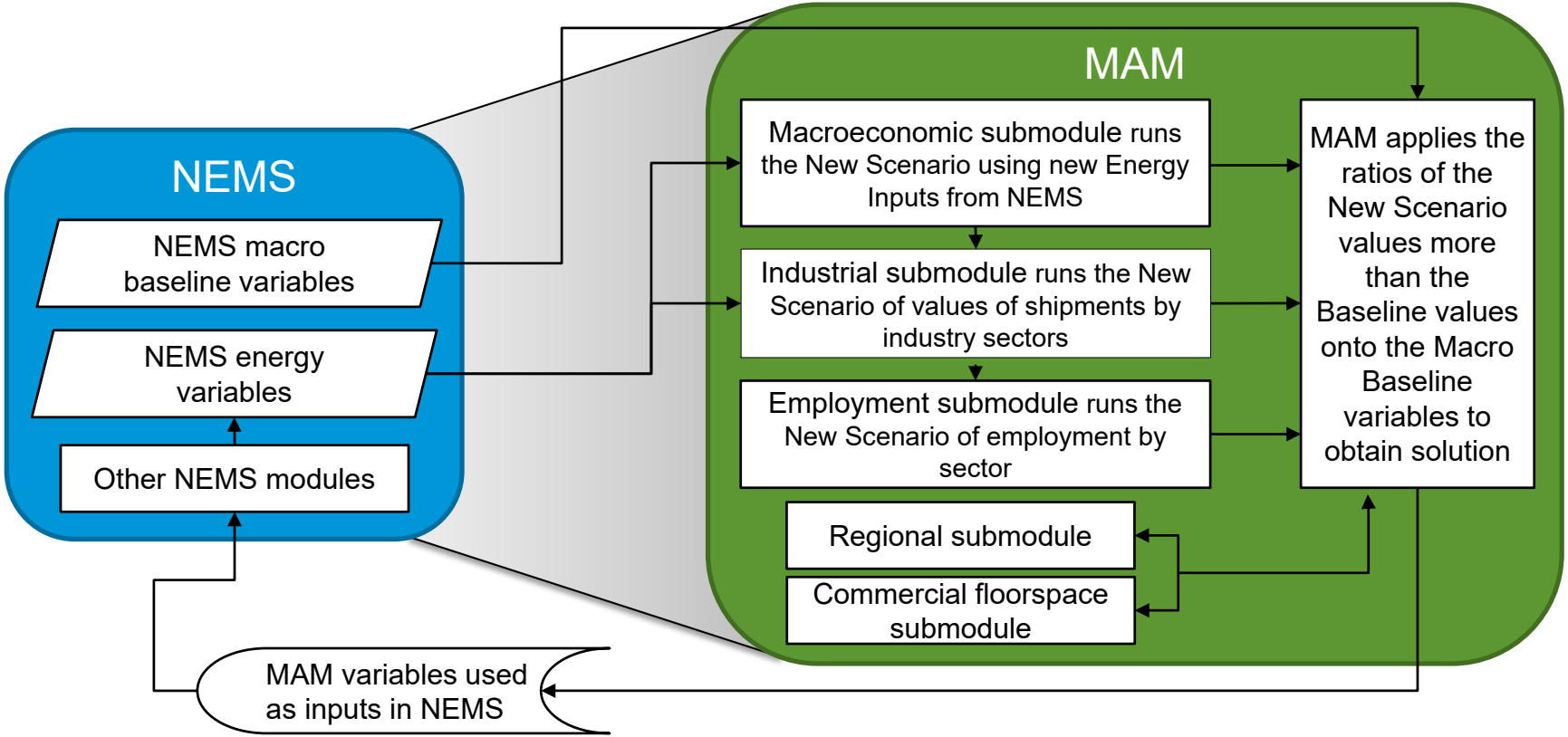
# Summary of the Macroeconomic Activity Module (MAM) in the National Energy Modeling System (NEMS)



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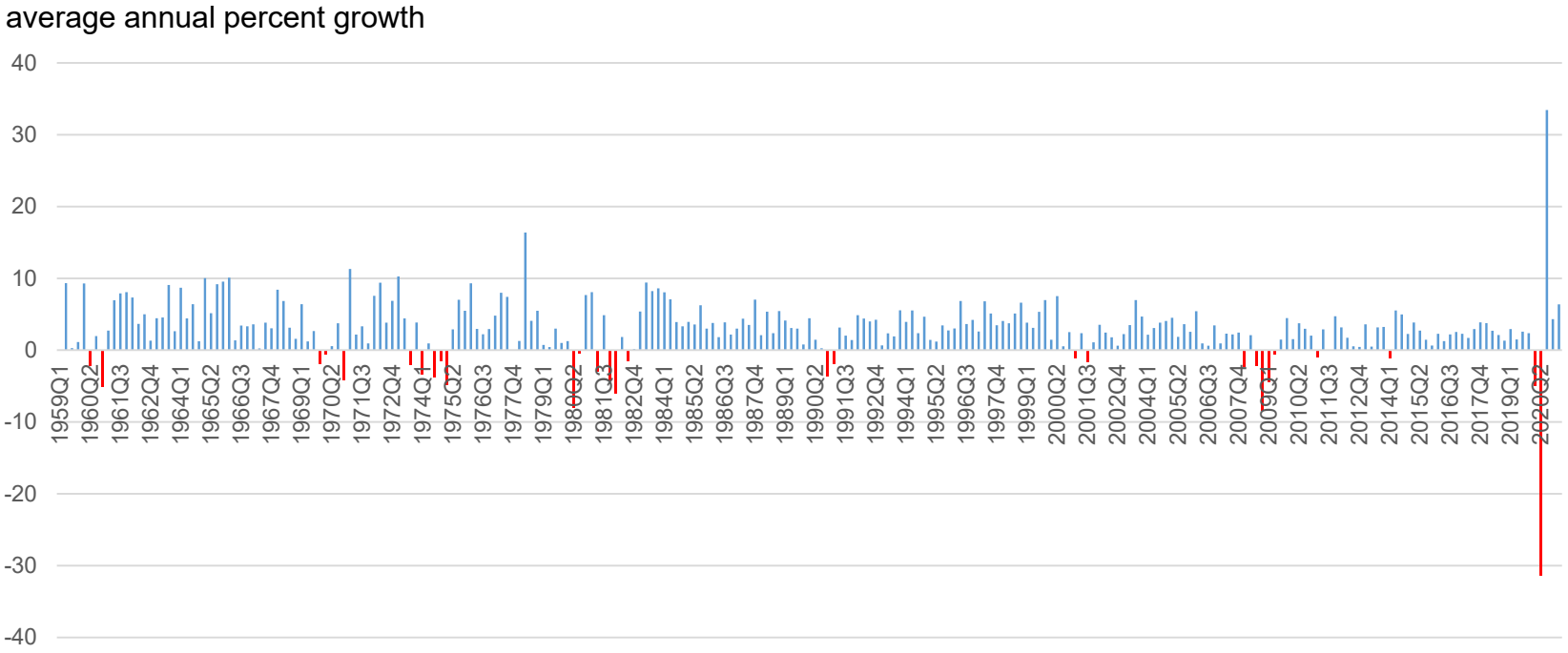
# U.S. economy recovered in second quarter of 2021 from 31.4% real GDP contraction in the second quarter of 2020




Source: IHS Markit May 2021 Long-Term U.S. Macroeconomic Model



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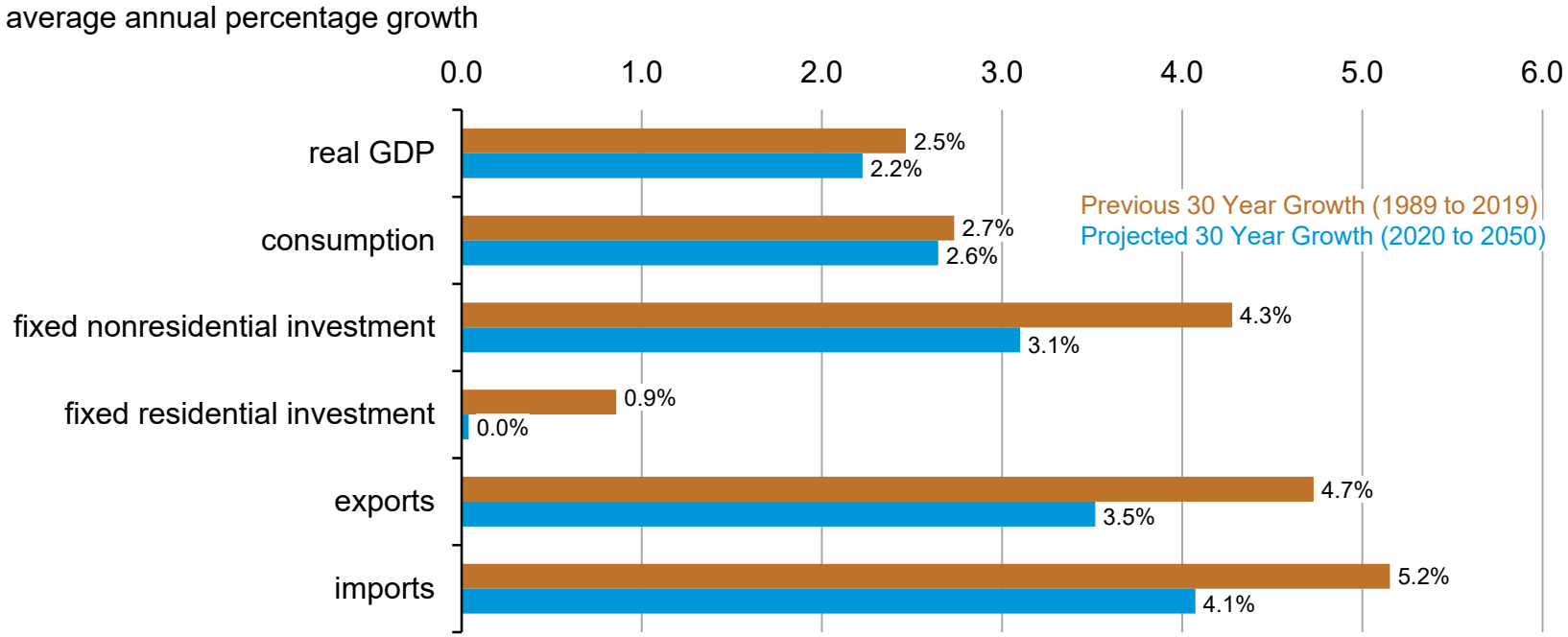
# Growth in GDP and its components are slower in the AEO2022 projection than historically




Source: U.S. Energy Information Administration, *Annual Energy Outlook 2022* preliminary run



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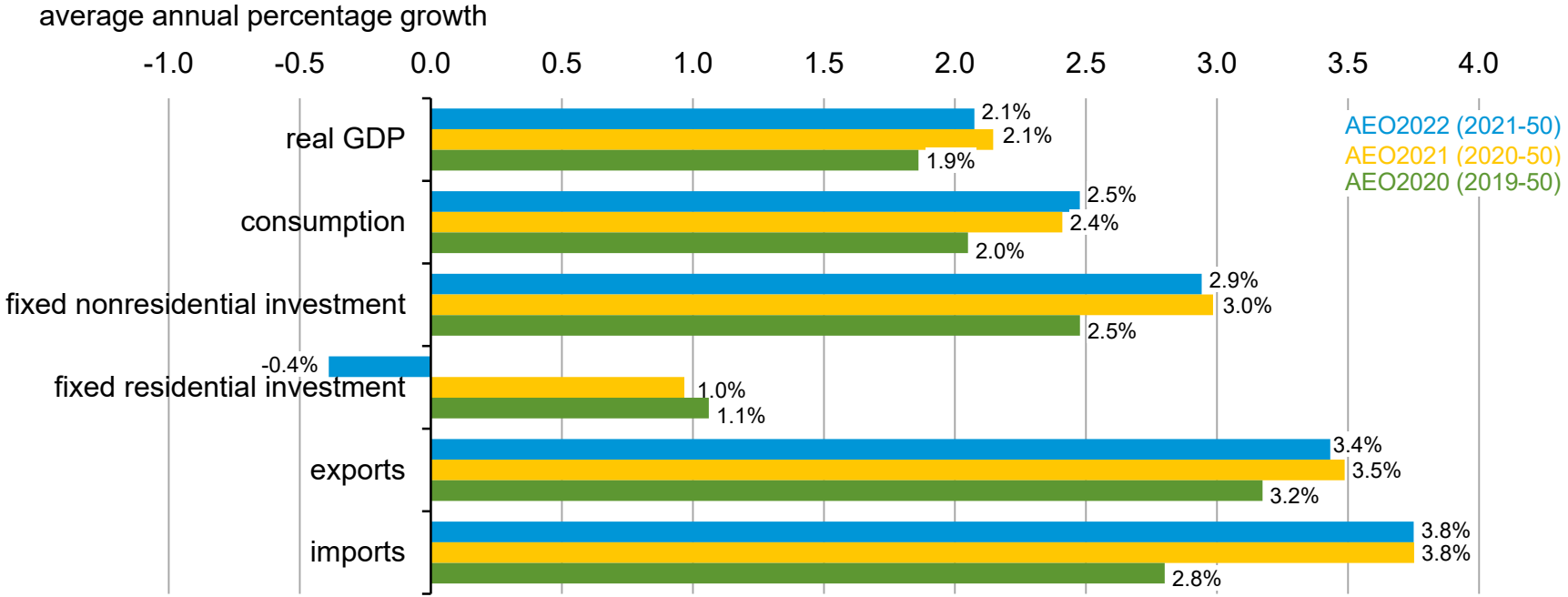
# Impact of the pandemic makes comparison of preliminary AEO2022 projections to past AEOs difficult




Source: U.S. Energy Information Administration, *Annual Energy Outlook 2022* preliminary run



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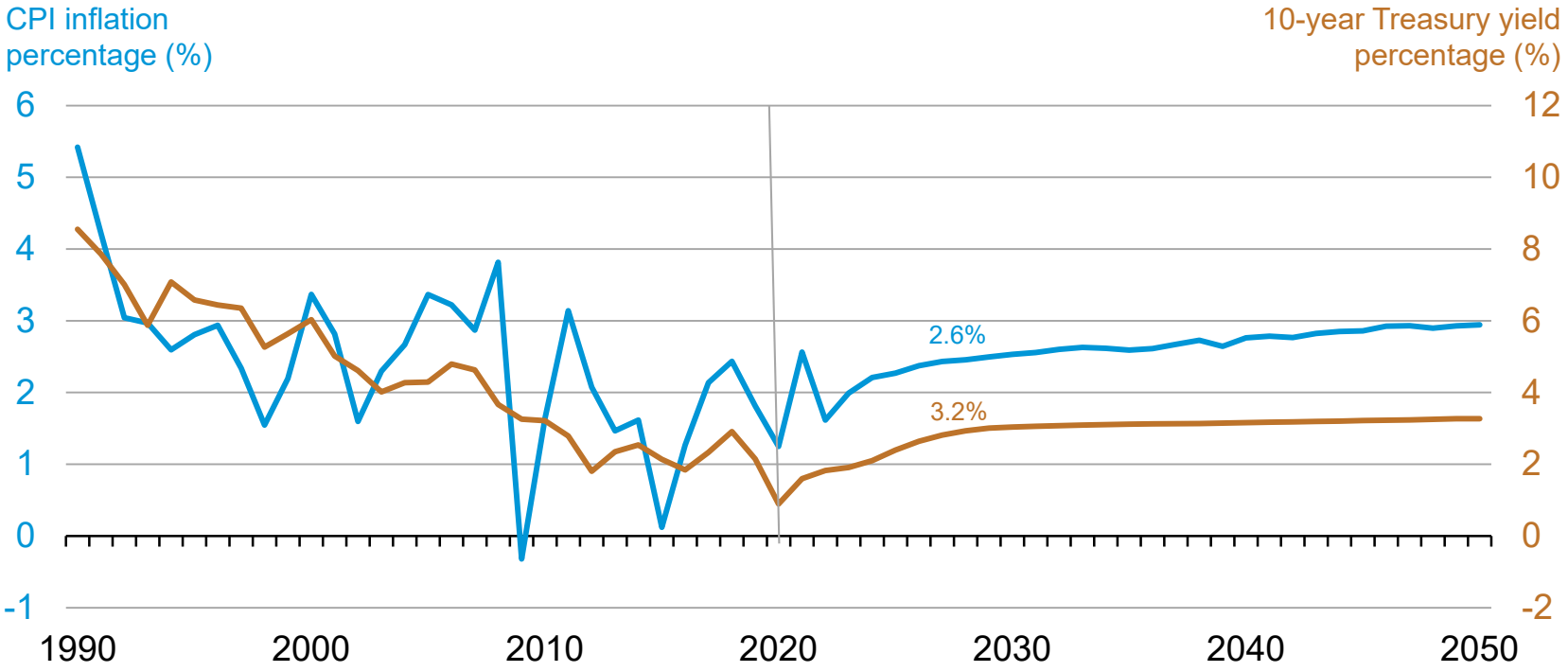
# Inflation remains moderate throughout the projection and bond yields gradually rise from historic lows




Source: U.S. Energy Information Administration, *Annual Energy Outlook 2022* preliminary run



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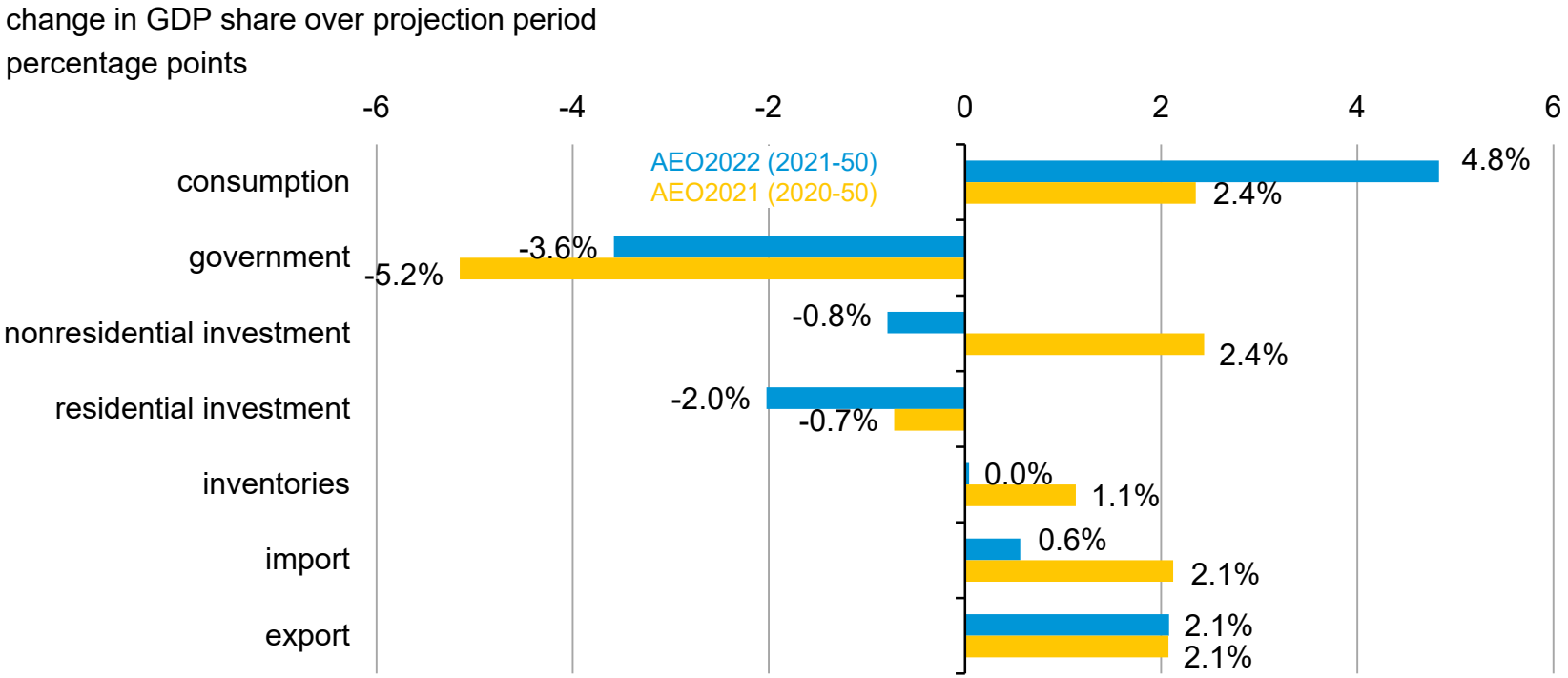
# Consumption gains in share of the demand mix




Source: U.S. Energy Information Administration, *Annual Energy Outlook 2022* preliminary run



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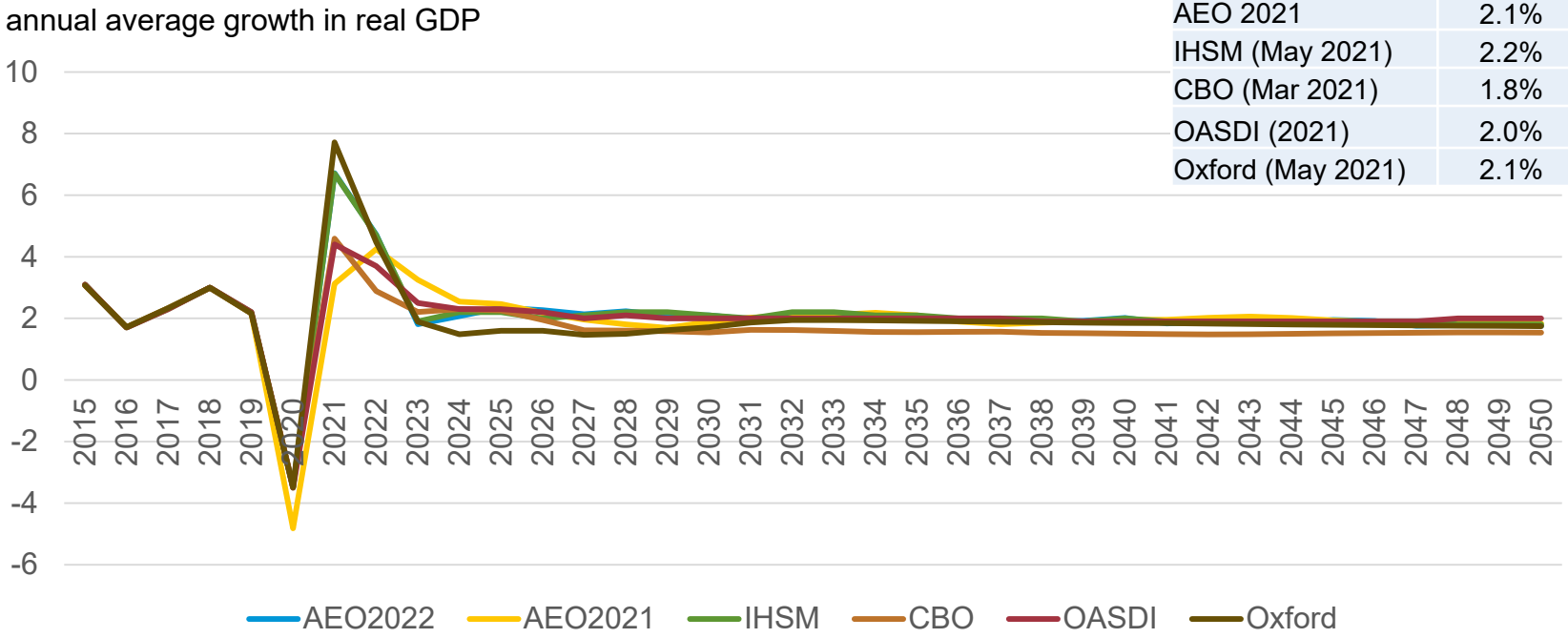
# AEO2022 real GDP growth is similar to other projections

| Projection | 2020-50 |
|---|---|
| AEO 2022 | 2.2% |
| AEO 2021 | 2.1% |
| IHSM (May 2021) | 2.2% |
| CBO (Mar 2021) | 1.8% |
| OASDI (2021) | 2.0% |
| Oxford (May 2021) | 2.1% |




Source: U.S. Energy Information Administration, *Annual Energy Outlook 2022* preliminary run



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# Macroeconomic Module changes for AEO2022

- Update of IHS Markit U.S. macroeconomic model
- Update of Industrial Output model historical data
- Update of Employment by Industry model historical data


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# Review of preliminary AEO2022 industrial results


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# AEO2022 major updates for industrial—current status

- Incorporate 2018 *Manufacturing Energy Consumption Survey* results to establish updated historical baseline (in progress)
- Improve combined-heat-and-power calculations (completed)
- Allow ethane and naphtha feedstock switching in bulk chemical subroutine (completed)
- Update ethane and propane price methodology (in progress)
- Integrate more effective fuel price sensitivity in process flow models (pushed to AEO2023)


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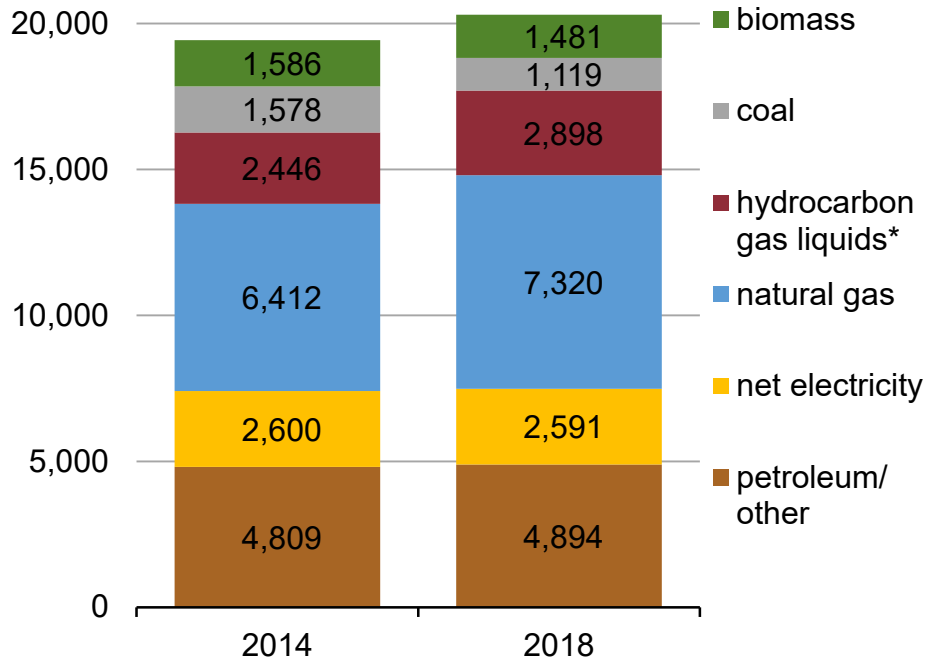
# *Manufacturing Energy Consumption Survey* (MECS) 2018

- Updating unit energy consumptions for manufacturing industries based on MECS 2018 results
  - The amount of energy needed to produce one unit of output for a given industry
- Updating non-manufacturing industries using other data sources
  - Sources:
    - *Economic Census 2017* (U.S. Census Bureau)
    - *National Agriculture Statistics Survey* (U.S. Department of Agriculture)
    - *Fuel Oil and Kerosene Sales* report (EIA)
  - Most significant changes are in construction (more natural gas) and agriculture (less overall fuel use)
- Changing the base year for the Industrial Demand Module to 2018

# MECS energy consumption changes 2014–2018

- We conduct the survey every four years, and we released 2018 data this year.
- MECS supplies baseline energy consumption by manufacturing industry and fuel.
- MECS 2018 versus MECS 2014
  - Higher natural gas, hydrocarbon gas liquid consumption
  - Lower coal consumption
  - Similar electricity purchases

**MECS first use of fuel and feedstock**
trillion British thermal units




Sources: U.S. Energy Information Administration, MECS 2014, MECS 2018

*excluding natural gasoline



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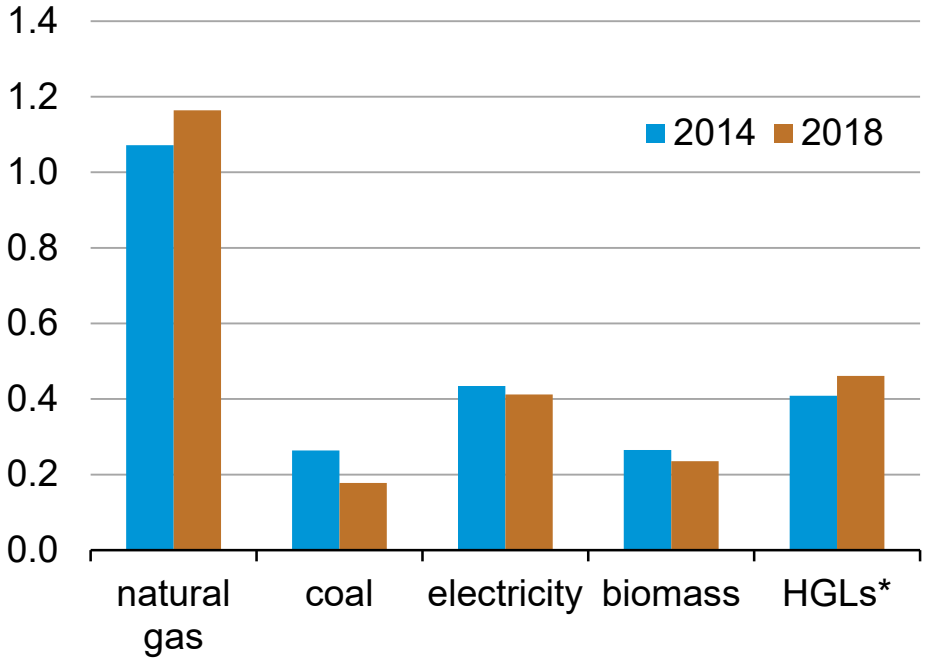
# Energy intensity increased for natural gas and HGLs

- Comparing 2018 to 2014, manufacturing industries as a whole use more natural gas and less coal per unit of output.
- The decrease in coal consumption is most significant in paper and chemicals.
- Hydrocarbon gas liquid (HGL) intensity increases.
  - More use as chemical feedstock

**Manufacturing industries fuel intensities**
thousand British thermal units per 2012 dollar of shipments




Sources: U.S. Energy Information Administration, MECS 2014, MECS 2018, *Annual Energy Outlook 2022* preliminary run

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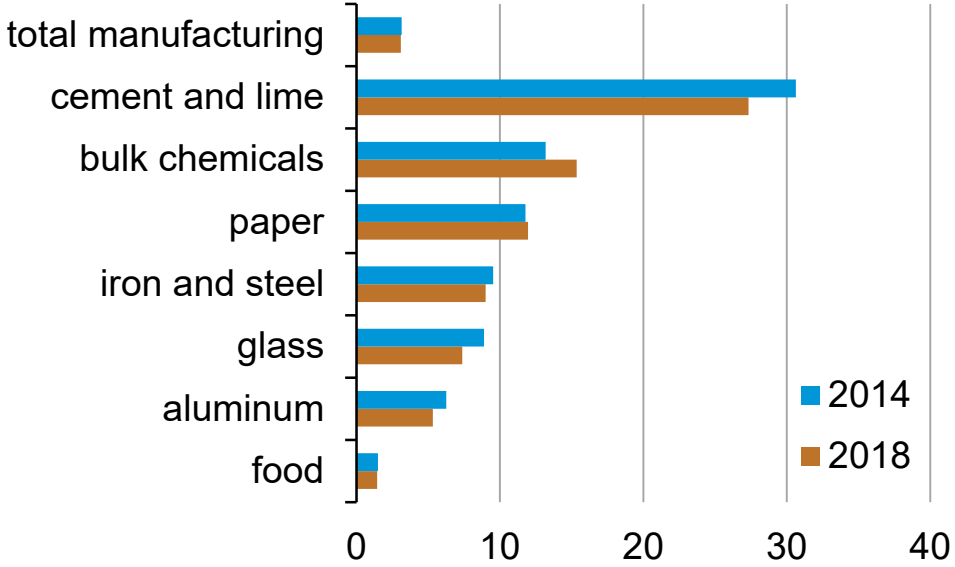
# Energy intensity declined in most heavy industries

- Retirement of less-efficient equipment, replacement with newer, more-efficient equipment decreased energy intensity for many industries.
- The bulk chemicals industry built many new, energy-intensive facilities (like ethylene crackers)
  - Feedstock has been a major source of demand growth, but doesn't become more efficient

**Energy intensities of selected manufacturing industries**
thousand British thermal units per 2012 dollar of shipments

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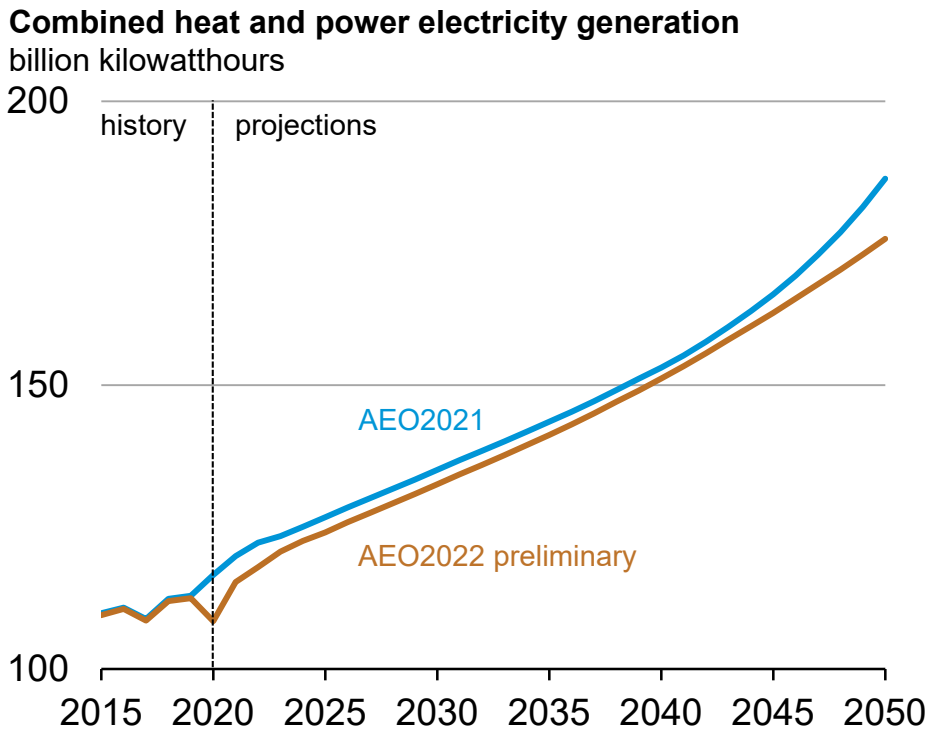
# Combined heat and power (CHP)

- Improved iron and steel, paper calculations
  - CHP in specific technologies is now counted.
  - The paper industry can now sell electricity to the grid.
- Implemented new technology parameters from 2020 study, adjusted weighting parameters in code
  - Results vary by industry, but generation is lower overall.




Sources: U.S. Energy Information Administration, *Annual Energy Outlook 2021*, *Annual Energy Outlook 2022* preliminary run



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# Chemical submodule changes

- The chemicals industry is the largest industrial energy consumer, and has recently been growing significantly.
  - Energy-intensive, with limited efficiency opportunities
- Changes allow switching between ethane and naphtha as feedstock for ethylene production, based on cost of feedstock and values of co-products.
  - Naphtha substitution is not expected to occur in the Reference case, but it could happen in some side cases (such as Low Oil Price).
- Substitute propane and normal butane for ethane when model reaches U.S. ethane production limit
- Update ethane and propane pricing model to reflect supply and demand dynamics between projected domestic feedstock production


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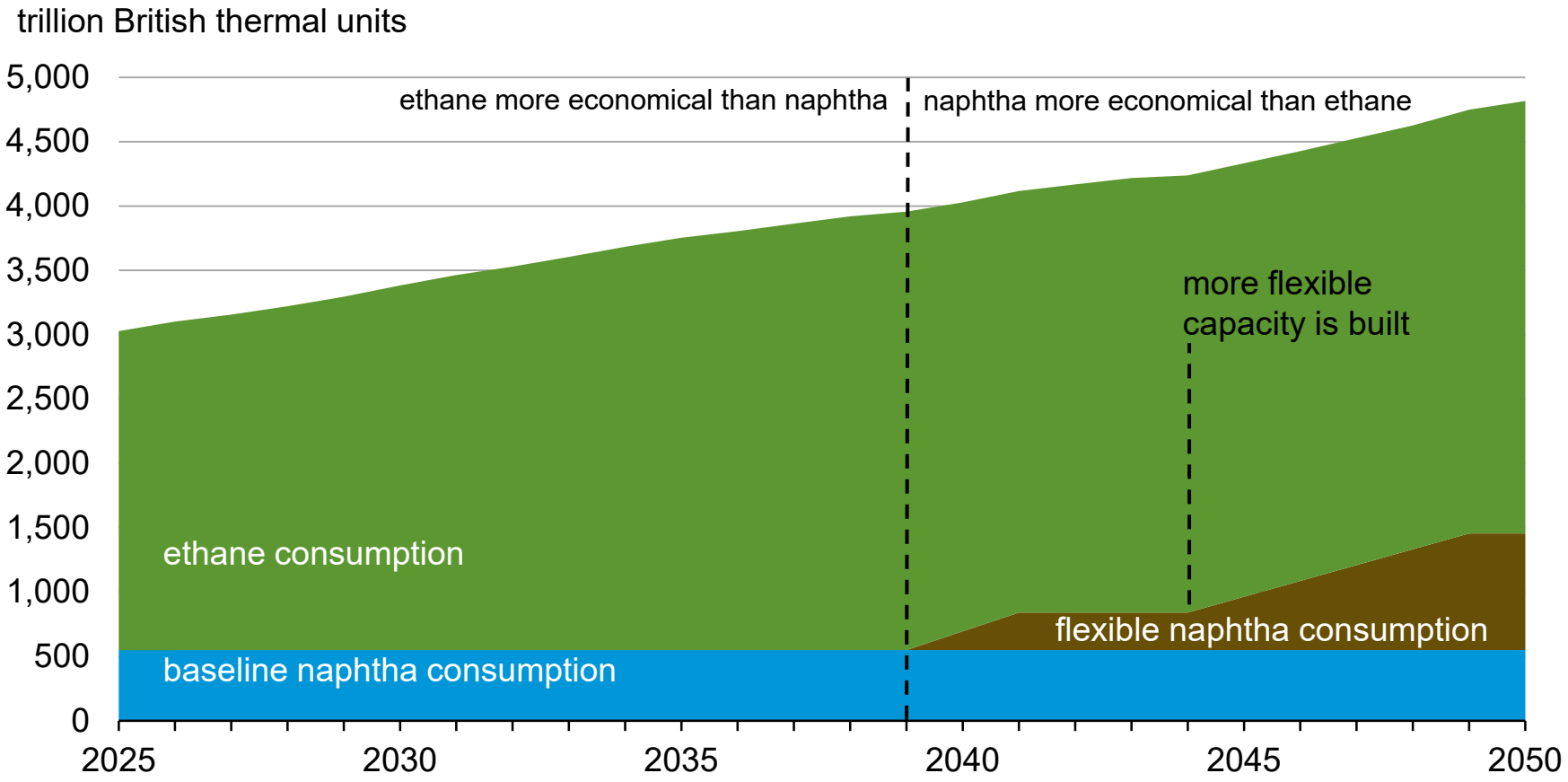
# Example ethane and naphtha capacity switching



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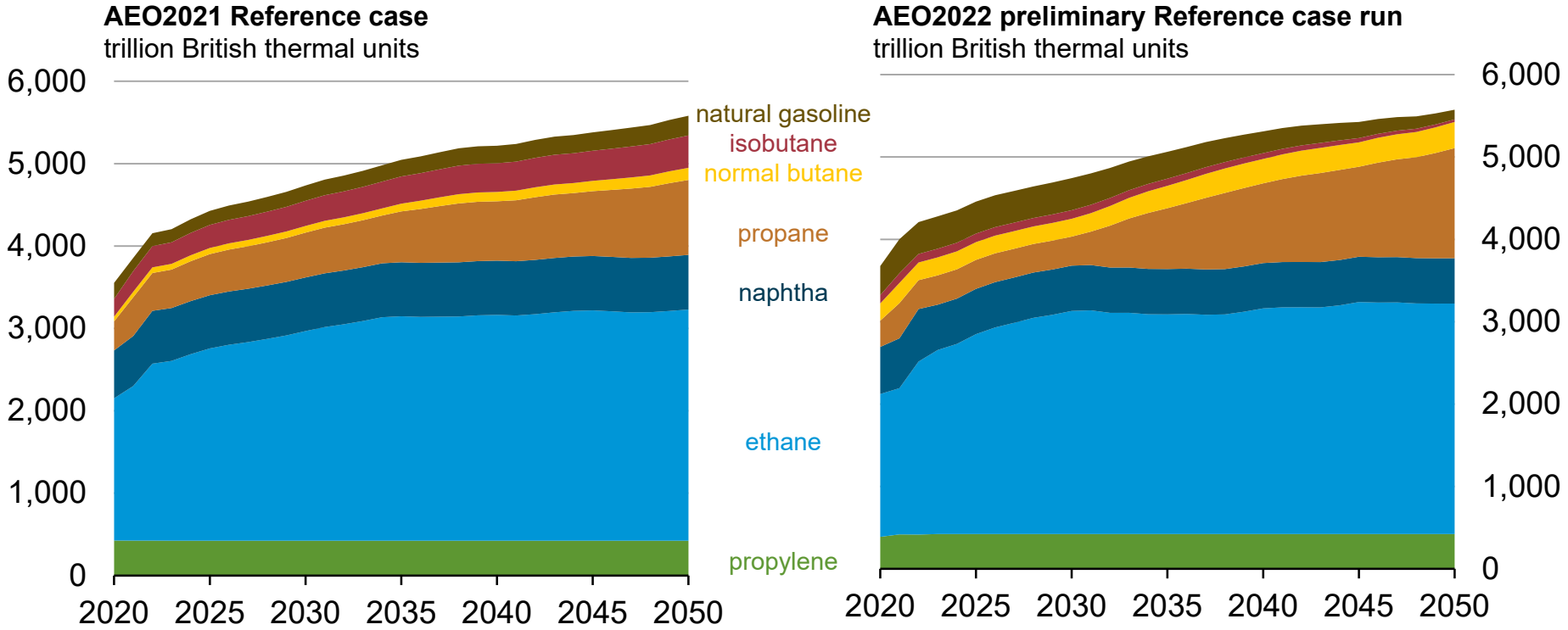
# New chemical model changes the feedstock makeup

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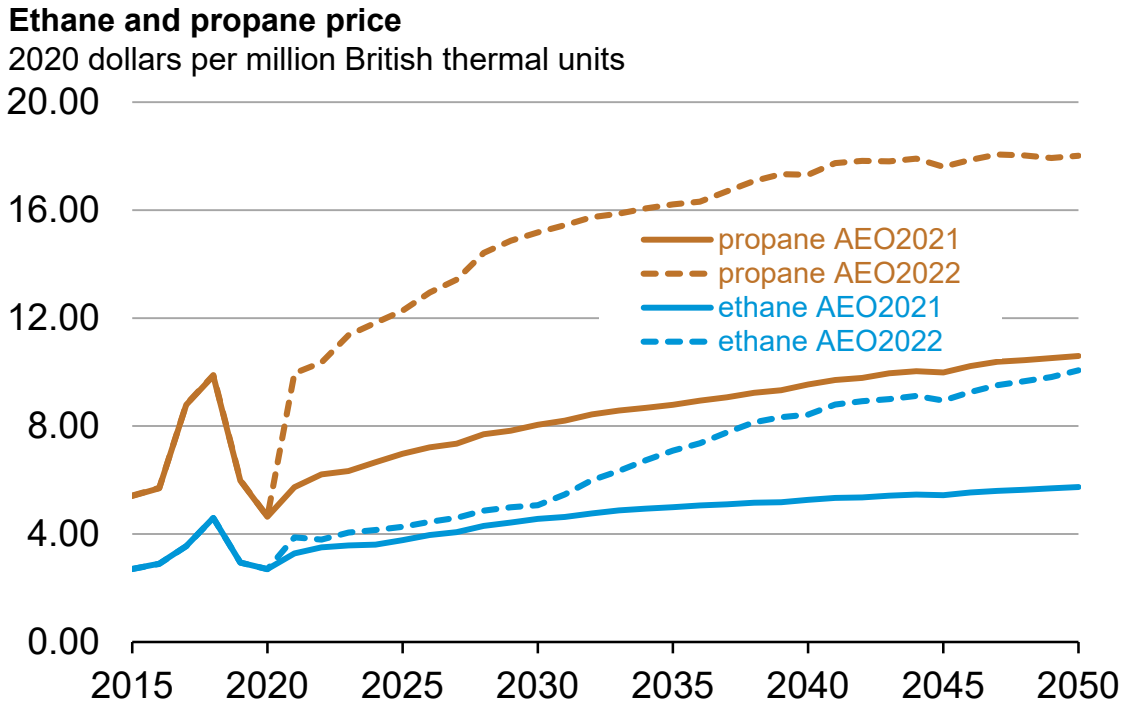
# Updated ethane and propane price projection methodology

- Considers constrained ethane supply
- Explicitly includes ethane and propane feedstock consumption drivers
- 2021 is a “historical” data point

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# Longer-term modeling and data enhancements

- Incorporate electric boilers
- Integrate more effective fuel price sensitivity in process flow industries
- Enhance sensitivity of industrial energy intensity to changes in capacity utilization
- Consider more carbon functionality (hydrogen, electrification, carbon capture)
- Continue to investigate the source of the extra natural gas left for the non-manufacturing sectors
- Restructure the industrial module more broadly: convert some parts into Python, allow for more systematic data importation from annual data sources

# Questions or comments?



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