Macro-Industrial Working Group Meeting

Updates and preliminary results

May 20, 2021 | Washington, DC

By

Office of Integrated and International Energy Analysis
Office of Long-Term Energy Modeling
AEO2022 Macro-Industrial Working Group: Overview

- Review of the *Annual Energy Outlook 2021* (AEO2021)
- AEO2022 planned macroeconomic updates
- AEO2022 planned industrial updates
- Longer-term plans for industrial modeling
- Questions and comments
Review of AEO2021 industrial results
Consumption in the industrial sector increases fastest for natural gas and hydrocarbon gas liquids in AEO2021; bulk chemical energy consumption grows the fastest of any industry.

**Industrial energy consumption by energy source and subsector (AEO2021 Reference case)**
quadrillion British thermal units

Source: U.S. Energy Information Administration, Annual Energy Outlook 2021
Energy intensities decline in most heavy industries, reflecting industrial capital stock turnover and adoption of new, more energy-efficient technologies.

### Energy intensity by subsector
(AEO2021 Reference case)
trillion British thermal units per billion 2012 dollar shipments

- **total industry**
- **manufacturing**
  - energy-intensive manufacturing
  - non-energy intensive manufacturing
- **non-manufacturing**

### Energy-intensive manufacturing
(AEO2021 Reference case)
trillion British thermal units per billion 2012 dollar shipments

- cement and lime
- iron and steel
- paper
- glass
- bulk chemical feedstocks
- bulk chemical heat and power
- aluminum
- food

Source: U.S. Energy Information Administration, Annual Energy Outlook 2021
Growth in electricity from combined heat and power (CHP) is primarily in the bulk chemical industry

Source: U.S. Energy Information Administration, Annual Energy Outlook 2021
Review of AEO2021 macroeconomic results
Key AEO2021 macro results

• AEO2021 real GDP grows an average of 2.1% per year from 2020 to 2050.

• Average growth of consumption is 2.4% over the projection period.

• Nonresidential fixed investment is projected to grow 3.0% per year from 2020 to 2050 in the AEO2021.

• Growth of nonfarm business productivity averages 1.7% over the projection period.

Source: U.S. Energy Information Administration, Annual Energy Outlook 2021
Summary of the Macroeconomic Activity Module (MAM) in the National Energy Modeling System (NEMS)

NEMS macro baseline variables

NEMS energy variables

Other NEMS modules

MAM variables used as inputs in NEMS

MAM

Macroeconomic submodule runs the New Scenario using new Energy Inputs from NEMS

Industrial submodule runs the New Scenario of values of shipments by industry sectors

Employment submodule runs the New Scenario of employment by sector

Regional submodule

Commercial floorspace submodule

MAM applies the ratios of the New Scenario values more than the Baseline values onto the Macro Baseline variables to obtain solution

WORKING GROUP PRESENTATION FOR DISCUSSION PURPOSES. DO NOT QUOTE OR CITE BECAUSE RESULTS ARE SUBJECT TO CHANGE
U.S. economy has yet to fully recover from 31.4% contraction in real GDP in the 2\textsuperscript{nd} quarter of 2020

\begin{figure}
\centering
\includegraphics[width=\textwidth]{chart.png}
\caption{Average annual percent growth}
\end{figure}

Source: IHS Markit February 2021 Long-Term U.S. Macroeconomic Model
Growth in GDP and most of its components is slower in the AEO2021 projection than history.

Source: U.S. Energy Information Administration, Annual Energy Outlook 2021
The AEO2021 projection for GDP and most of its components are quicker than recent projections.

Average annual percent growth:

- Real GDP: 1.9% (AEO2021), 2.0% (AEO2020), 2.5% (AEO2019)
- Consumption: 2.0% (AEO2021), 2.0% (AEO2020), 2.5% (AEO2019)
- Fixed Nonresidential Investment: 1.0% (AEO2021), 1.1% (AEO2020), 2.5% (AEO2019)
- Fixed Residential Investment: 1.2% (AEO2021), 2.5% (AEO2020), 3.0% (AEO2019)
- Exports: 3.2% (AEO2021), 3.6% (AEO2020), 3.8% (AEO2019)
- Imports: 2.8% (AEO2021), 3.0% (AEO2020), 3.8% (AEO2019)

Source: U.S. Energy Information Administration, Annual Energy Outlook 2021
Inflation remains moderate throughout the projection and bond yields gradually rise from historic lows.
Consumption, nonresidential investment and imports increase in share of demand mix while government fades

change in GDP share over projection period
percentage points

<table>
<thead>
<tr>
<th>Category</th>
<th>AEO2021 (2020-50)</th>
<th>AEO2020 (2019-50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption</td>
<td>-5.2%</td>
<td>-3.7%</td>
</tr>
<tr>
<td>Government</td>
<td>-5.2%</td>
<td>-3.7%</td>
</tr>
<tr>
<td>Nonresidential Investment</td>
<td>-0.7%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Residential Investment</td>
<td>-0.3%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Inventories</td>
<td>-0.3%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Import</td>
<td>-0.3%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Export</td>
<td>-0.3%</td>
<td>1.1%</td>
</tr>
</tbody>
</table>

Source: U.S. Energy Information Administration, Annual Energy Outlook 2021

WORKING GROUP PRESENTATION FOR DISCUSSION PURPOSES. DO NOT QUOTE OR CITE BECAUSE RESULTS ARE SUBJECT TO CHANGE
AEO2021 real GDP growth is similar to other projections

Source: U.S. Energy Information Administration, Annual Energy Outlook 2021
Updates for AEO2022 and beyond
Planned Macroeconomic Module changes for AEO2022

• Update of IHS Markit US macroeconomic model.

• Update of Industrial Output model historical data.

• Update of Employment by Industry model historical data.

• Update of Regional Economic Activity historical data.

• Update of Commercial Floor Space historical data.
AEO2022 and COVID-19

• AEO2022 will reflect updated macroeconomic projections (GDP and industrial shipments) that underlie industrial energy consumption.

• The forecast in our *Short-Term Energy Outlook* (STEO) incorporates short-term impacts of responses to the COVID-19 pandemic on broad industrial energy consumption.
AEO2022 planned industrial sector modeling and data updates

• Incorporate 2018 *Manufacturing Energy Consumption Survey* results

• Improve combined heat and power calculations
  – Improve iron and steel, paper combined heat and power code, including by allowing the paper industry to sell electricity to the grid
  – Implement new technology parameters from 2020 study

• Allow ethane/naphtha feedstock-switching in bulk chemical subroutine

• Integrate more effective fuel price sensitivity in process flow models
MECS 2018 update details

• Update unit energy consumptions (UECs) based on MECS 2018 results

• Work in Python instead of using 20+ page spreadsheet to update files
  – Streamlines updates and easily allows more frequent updates of non-MECS data
    • Macroeconomic data, the denominator of UECs
    • State Energy Data System (SEDS) revisions (nonmanufacturing industrial consumption equals SEDS minus MECS)
  – Uses other information in unified ways that benefit estimates
    • Annual Survey of Manufactures (ASM)
    • Greenhouse Gas Reporting Program (GHGRP) from EPA
    • Economic Censuses (2017)
    • Energy-efficient frontier and other research
Longer-term industrial modeling and data enhancements

- Enhance sensitivity of industrial energy intensity to changes in capacity utilization
- Investigate the source of the extra natural gas left for the non-manufacturing sectors
- Broader restructuring of the industrial module: convert some parts into Python, allow for more systematic data importation from annual data sources
## Regular industrial data updates and frequency

<table>
<thead>
<tr>
<th>Data</th>
<th>Update frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing Energy Consumption Survey</td>
<td>Every four years</td>
</tr>
<tr>
<td>State Energy Data System</td>
<td>Annual</td>
</tr>
<tr>
<td>Short-Term Energy Outlook</td>
<td>Annual</td>
</tr>
<tr>
<td>Combined-heat-and-power data</td>
<td>Annual</td>
</tr>
<tr>
<td>Feedstock history and short-term projections</td>
<td>Annual</td>
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Questions or comments?
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AEO economic activity and STEO macroeconomic projections

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