Assumptions to the Annual Energy Outlook 2023: Macroeconomic Activity Module

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Macroeconomic Activity Module

The Macroeconomic Activity Module (MAM) represents interactions between the U.S. economy and energy markets. How fast the economy grows, as measured by growth in real GDP, drives energy demand. Associated economic factors, such as interest rates and disposable income, also strongly influence supply and demand for energy. This module shows how energy markets can affect the aggregate economy. For example, a slowdown in economic growth can result from increasing energy prices. Our publication, *Model Documentation Report: Macroeconomic Activity Module (MAM) of the National Energy Modeling System*, describes the module.

Key assumptions

We expect the U.S. economy, measured by GDP, to increase by 2.2% per year from 2021 to 2050 in the Reference case. Specifically, real GDP grows by:

- 1.6% from 2022 to 2030
- 2.0% from 2031 to 2040
- 2.1% from 2041 to 2050

The growth rate of nonfarm employment and the productivity change rate associated with employment both help determine the GDP growth rate. Nonfarm employment shows 0.3% growth from 2022 to 2030 in the Reference case, and then it returns to its long-term growth trend of 0.4% from 2031 to 2050.

In the Reference case, productivity (output per hour in nonfarm business) grows by 1.9% from 2022 to 2050, compared with the 2.0% growth from 1989 to 2021. We anticipate steady growth in labor productivity to contribute to long-term GDP growth. Improvement in labor productivity reflects the positive effects of a growing capital stock and technological change over time. We expect annual growth for nonfarm labor productivity to remain between 1.1% and 2.0% throughout the projection period.

We expect nominal business-fixed investment as a share of nominal GDP to decline from 2022 to 2050. Additions to the capital stock and the technology base of that capital stock help sustain productivity growth of 1.9% from 2022 to 2050 in the Reference case.

The IHS Markit Population Model is the basis for population growth in AEO2023. The series projects that total U.S. population will grow by 0.4% per year from 2022 to 2050 in the Reference case. It also projects that during this period, the share of the population older than age 65 will increase over time and that this group's share of the labor force will also increase.

U.S. economic growth, as projected in the Reference case, is uncertain, so AEO2023 uses the High and Low Economic Growth cases to project how alternative economic growth assumptions may affect energy markets (Table 1). The High Economic Growth case incorporates higher population, labor force, investment, capital stock, and productivity growth rates than the Reference case. Higher productivity helps reduce production costs, which is passed on to consumers as lower prices. Lower prices, in turn, promote higher demand, greater output, and more employment. We project economic output in the High Economic Growth case to increase by 2.3% per year from 2022 to 2050. In this case, real GDP grows 0.4 percentage points per year faster than the Reference case from 2022 to 2050. Annual growth in

nonfarm employment in the High Economic Growth case is 0.2 percentage points more than in the Reference case, averaging 0.6% per year from 2022 to 2050.

The Low Economic Growth case assumes lower population, labor force, investment, capital stock, and productivity gains that result in higher production costs and consumer prices and lower output and employment. In the Low Economic Growth case, we expect economic output to increase by 1.4% per year during the projection period. In this case, real GDP grows 0.5 percentage points per year slower relative to the Reference case. In the Low Economic Growth case, nonfarm employment is less than in the Reference case by 0.2 percentage points, averaging 0.2% per year from 2022 to 2050.

Table 1. Average annual economic growth in GDP, nonfarm employment, and productivity

Assumptions	2022–2030	2031–2040	2041–2050	2022–2050
Real GDP (billion chain-weighted 2012$)				
High Economic Growth Case	2.1%	2.3%	2.4%	2.3%
Reference Case	1.6%	2.0%	2.1%	1.9%
Low Economic Growth Case	0.9%	1.5%	1.8%	1.4%
Nonfarm employment				
High Economic Growth Case	1.0%	0.4%	0.5%	0.6%
Reference Case	0.3%	0.4%	0.4%	0.4%
Low Economic Growth Case	-0.3%	0.4%	0.3%	0.2%
Productivity				
High Economic Growth Case	2.1%	2.4%	2.6%	2.4%
Reference Case	1.6%	1.9%	2.2%	1.9%
Low Economic Growth Case	0.6%	1.0%	1.4%	1.0%

Data source: U.S. Energy Information Administration, AEO2023 National Energy Modeling System, runs: ref2023.d020623a, highmacro.d020623a, and lowmacro.d020623a
Note: Minor discrepancies with published data are a result of independent rounding.