Annual Energy Outlook 2022

Presentation to Electricity Advisory Committee

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U.S. Energy Information Administration

About EIA

- An agency in the U.S. Department of Energy that collects, analyzes, and disseminates independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment.

- Policy-neutral: EIA does not develop, endorse, or implement policy

- Three primary energy outlooks for the Office of Energy Analysis:
  - Short-Term Energy Outlook (STEO): monthly domestic projections next 13 to 24 months
  - Annual Energy Outlook (AEO): annual domestic projections, to 2050 (current)
  - International Energy Outlook (IEO): annual international projections, to 2050 (current)

Annual Energy Outlook projections come from National Energy Modeling System (NEMS)

- Projections in the AEO2022 are not predictions of what will happen, but rather, they are modeled projections of what may happen given certain assumptions and methodologies.

- To illustrate the importance of key assumptions, AEO2022 includes a Reference case and side cases that systematically vary important underlying assumptions.

- The AEO is developed using the National Energy Modeling System (NEMS), an integrated model that captures interactions of economic changes and energy supply, demand, and prices.

AEO2022 projections were made before a number of significant recent events

- Shifting supply chain concerns
- Changes in the economy - slower growth, higher inflation
- Russian invasion of Ukraine
- U.S. Inflation Reduction Act

AEO2022 Highlights

- Petroleum and natural gas remain the most-consumed sources of energy in the United States through 2050, but renewable energy is the fastest growing
- Wind and solar incentives along with falling technology costs support robust competition with natural gas for electricity generation while the shares of coal and nuclear power decrease in the U.S. electricity mix
- U.S. crude oil production reaches record highs, while natural gas production is increasingly driven by natural gas exports

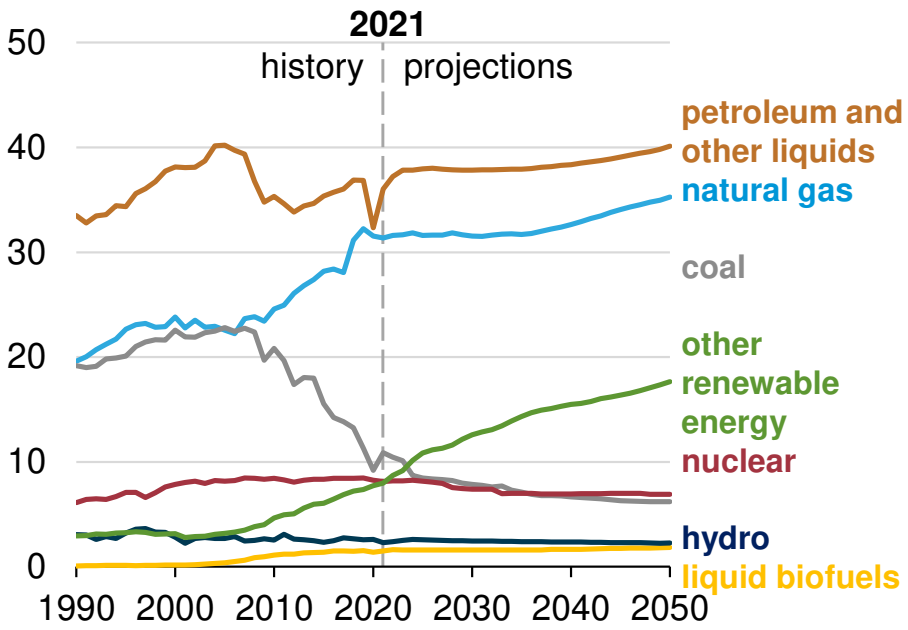
AEO2022 examines a range of conditions from 2021 to 2050

Assumptions

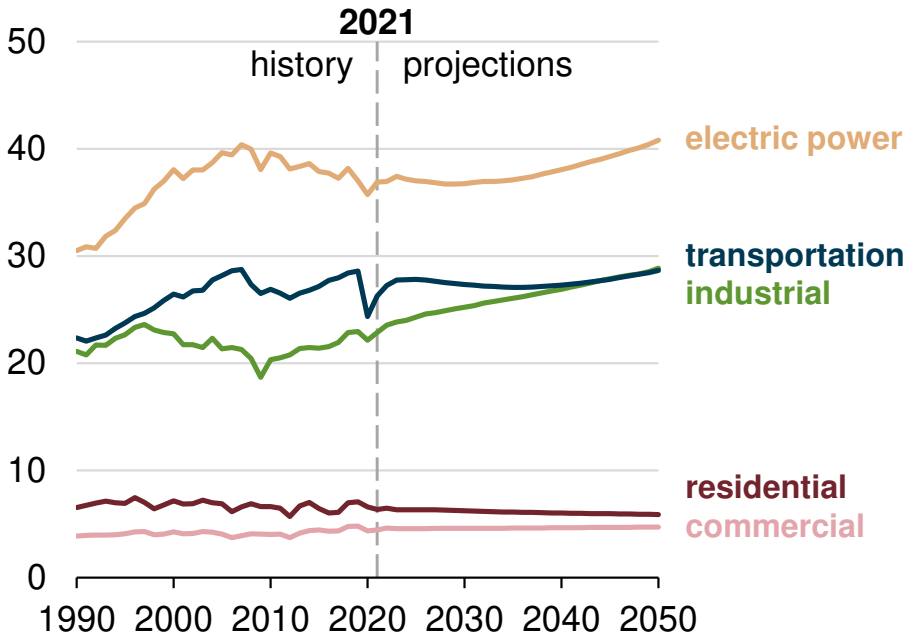
- Current laws and regulations as of November 2021
- Current views on economic and demographic trends, and technology improvements
- Compound annual growth rate for real U.S. gross domestic product (GDP) is 2.2% (Reference case)
  - High Economic Growth case (2.7%) and Low Economic Growth case (1.8%)
- The Brent crude oil price by 2050 is $90 per barrel (b) in constant 2021 dollars (Reference case)
  - High Oil Price case ($170/b) and Low Oil Price case ($45/b)
- Oil and natural gas supply cases
  - High: more accessible resources and lower extraction technology costs than the Reference case
  - Low: fewer accessible resources and higher extraction technology costs than the Reference case
- Renewables cost cases
  - High: no cost reductions in renewable technologies
  - Low: renewables achieve 40% lower overnight capital costs by 2050 compared to Reference case

Renewables consumption grows fastest but remains below petroleum and natural gas consumption in 2050

Energy consumption by fuel
AEO2022 Reference case
quadrillion British thermal units



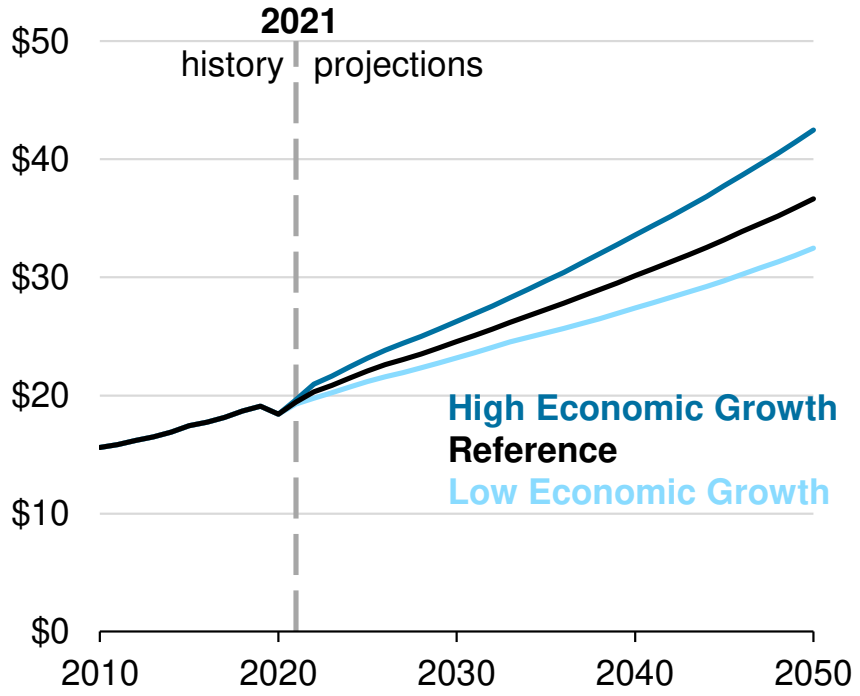
Energy consumption by sector
AEO2022 Reference case
quadrillion British thermal units



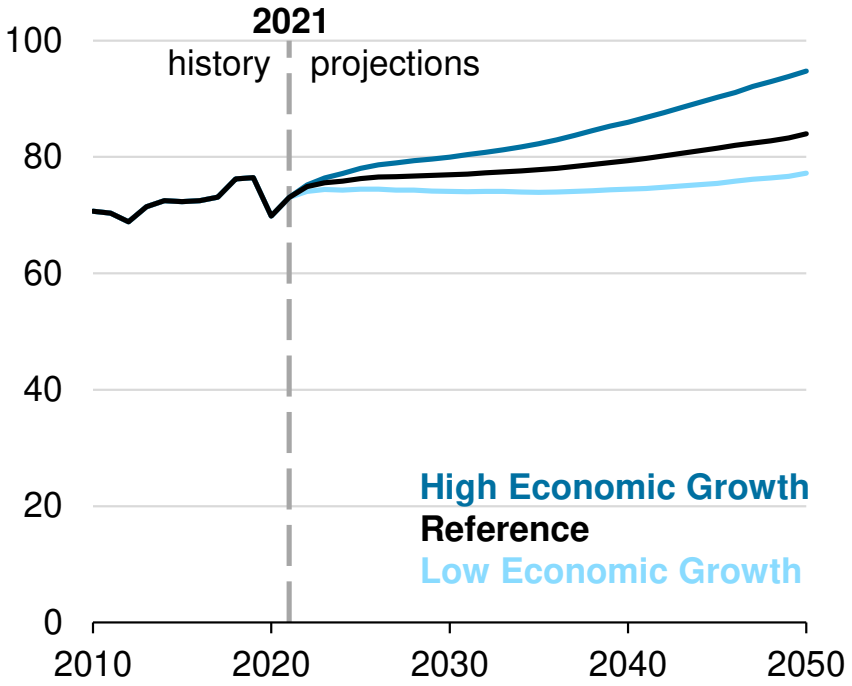
Note: Biofuels are shown separately and included in petroleum and other liquids.

GDP and energy consumption continue post-pandemic recovery

U.S. gross domestic product assumptions
AEO2022 economic growth cases
trillion 2012 dollars

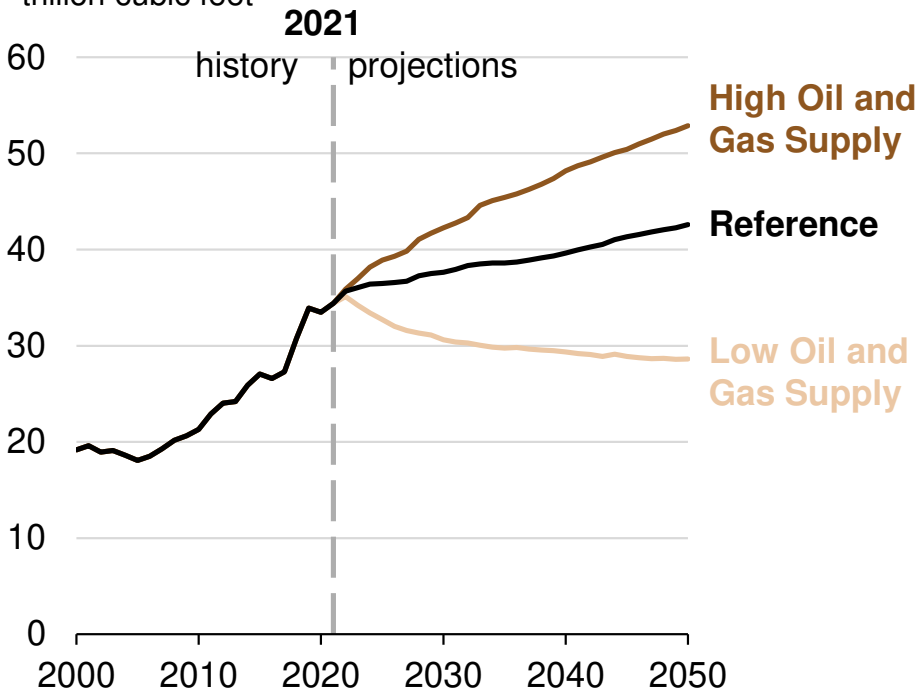


Delivered energy across end-use sectors
AEO2022 economic growth cases
quadrillion British thermal units

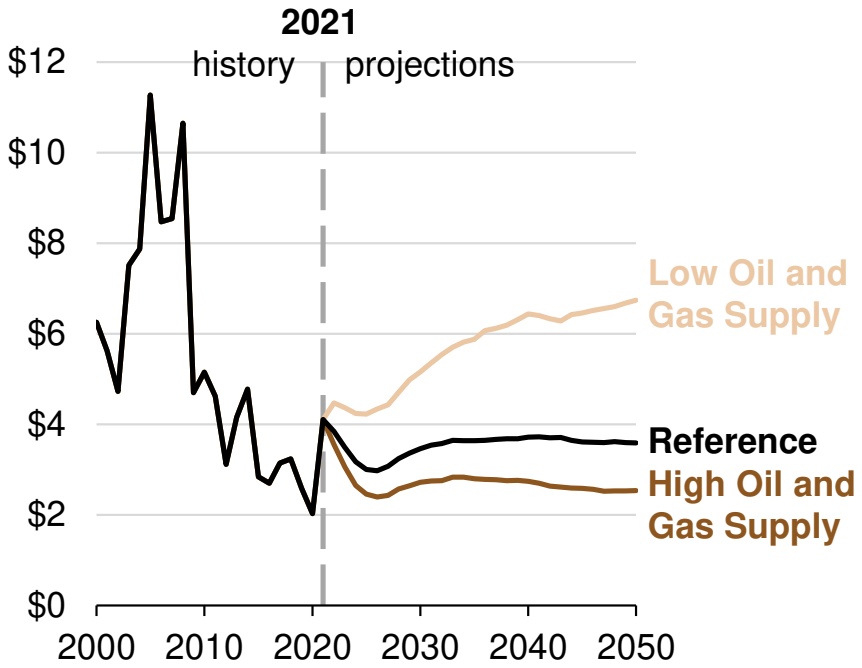


AEO2022 natural gas prices depend on resource and technology assumptions and Henry Hub prices in the Reference case remain lower than $4 per million Btu throughout the projection period

U.S. dry natural gas production
AEO202 oil and gas supply cases
trillion cubic feet

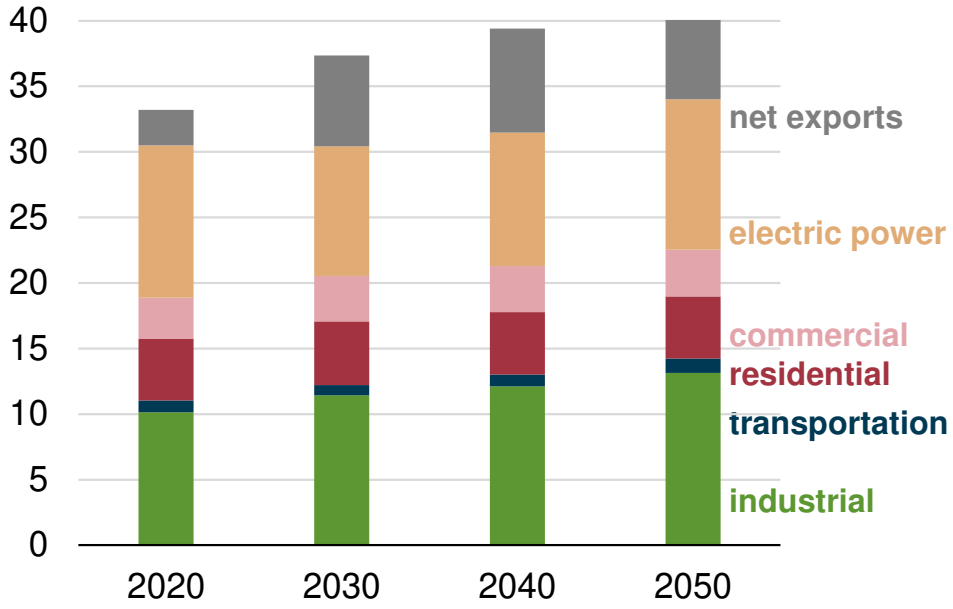


Natural gas spot price at Henry Hub
AEO2022 oil and gas supply cases
2021 dollars per million British thermal units

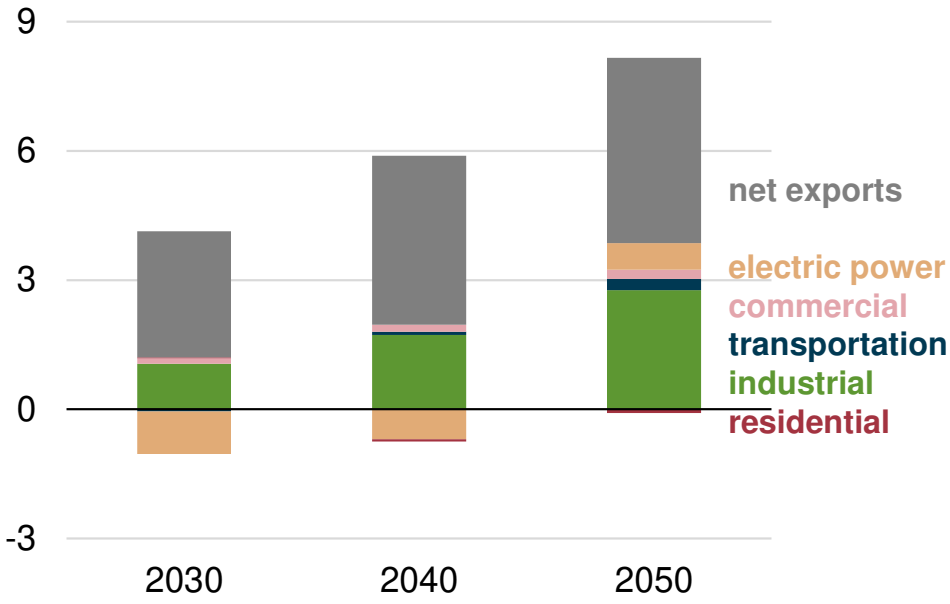


Natural gas use rises mostly because of industrial demand and exports

Natural gas disposition and net exports
AEO2022 Reference case
trillion cubic feet

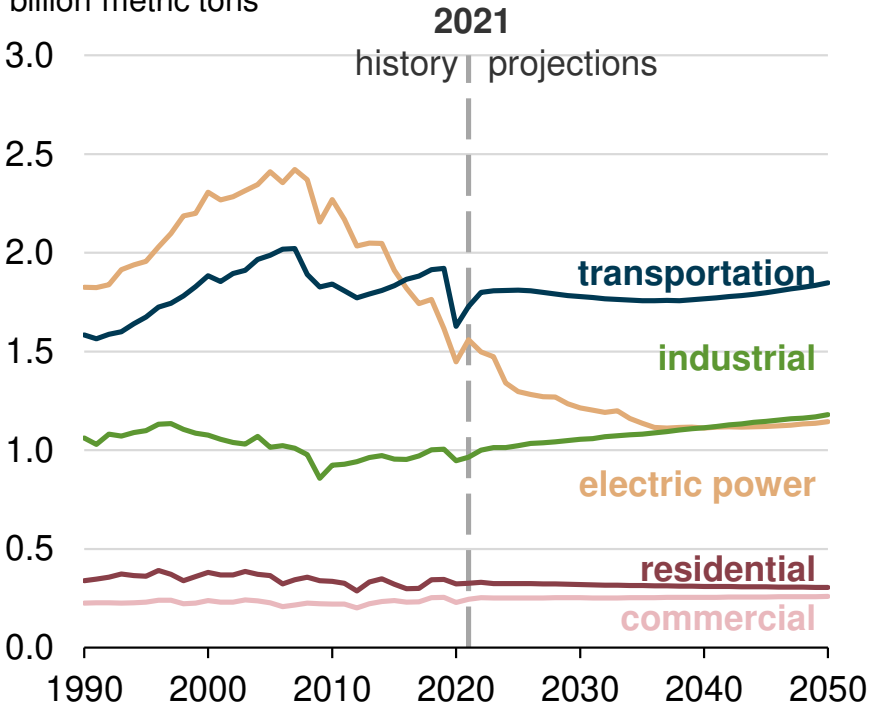


Change in natural gas disposition and net exports
AEO2022 Reference case
relative to 2021 in trillion cubic feet

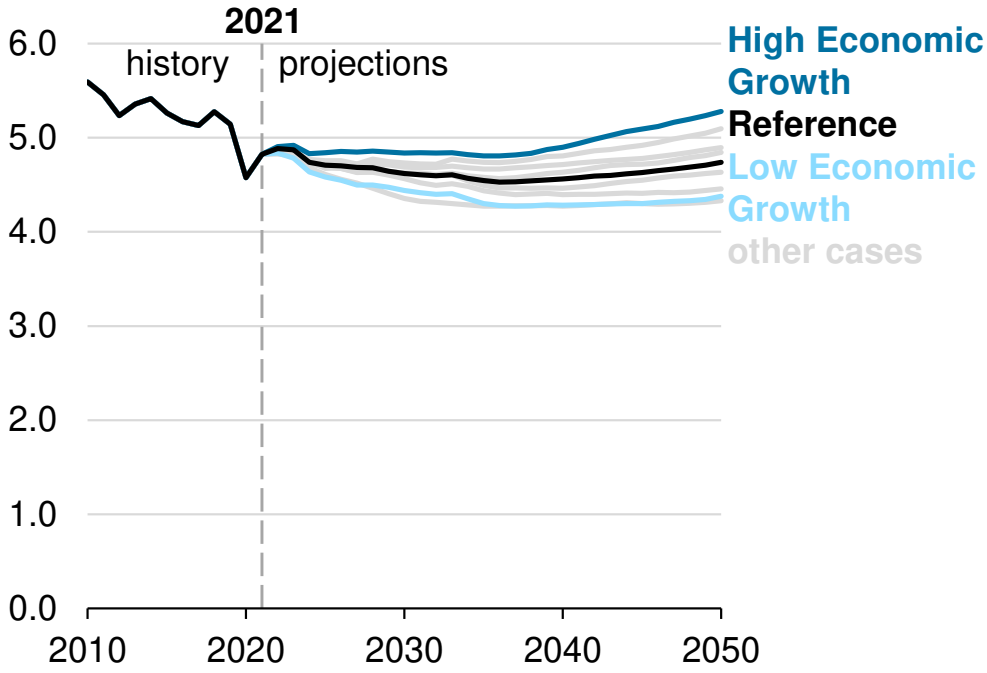


U.S. energy-related carbon dioxide emissions continue to decrease, but they start growing after 2035 in the Reference case

Energy-related carbon dioxide emissions by sector
AEO2022 Reference case
billion metric tons

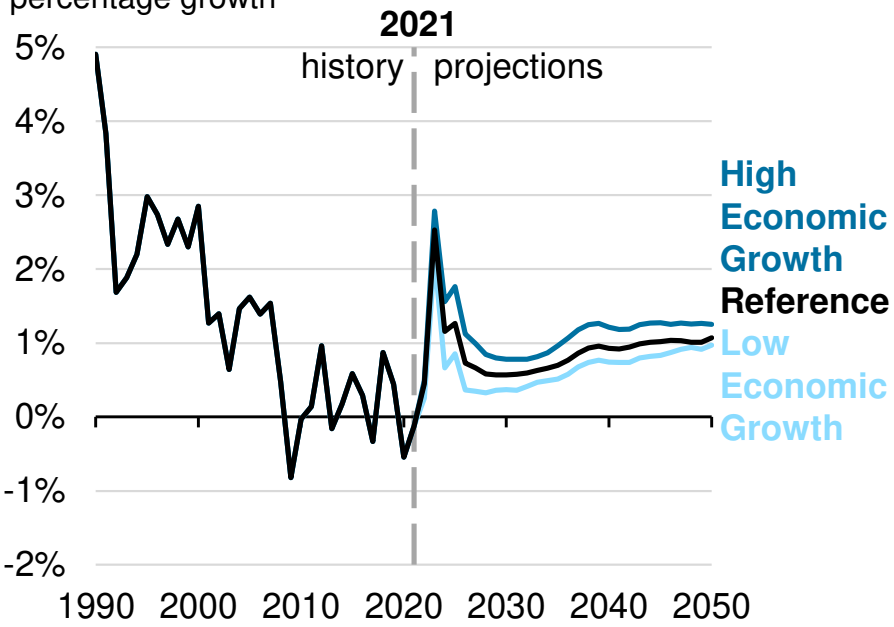


U.S. energy-related carbon dioxide emissions
AEO2022 economic growth cases
billion metric tons

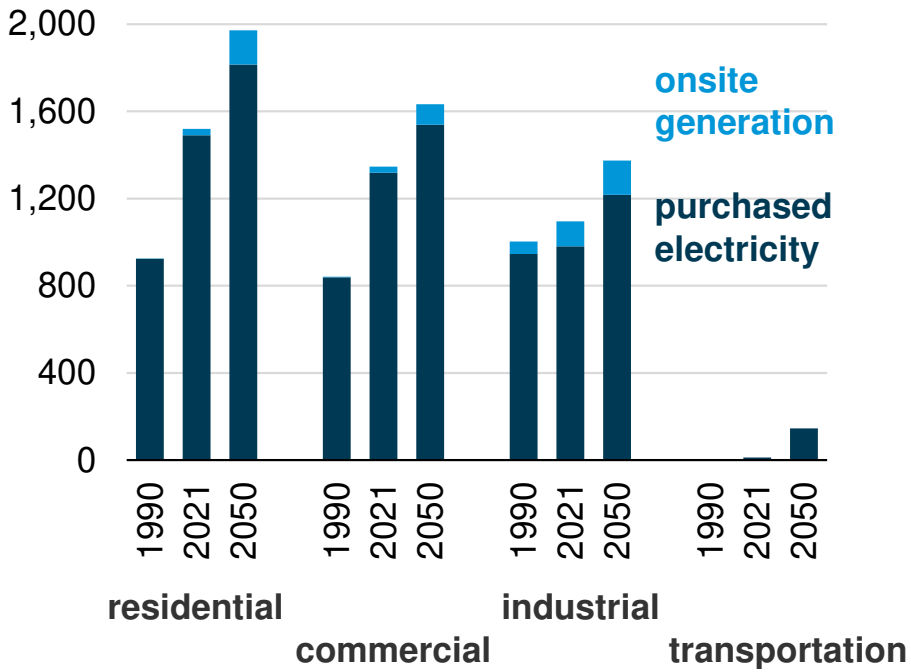


Electricity demand grows slowly through 2050 in the Reference case with increases occurring across all end-use sectors

U.S. electricity use growth rate, three-year rolling average
AEO2022 economic growth cases
percentage growth

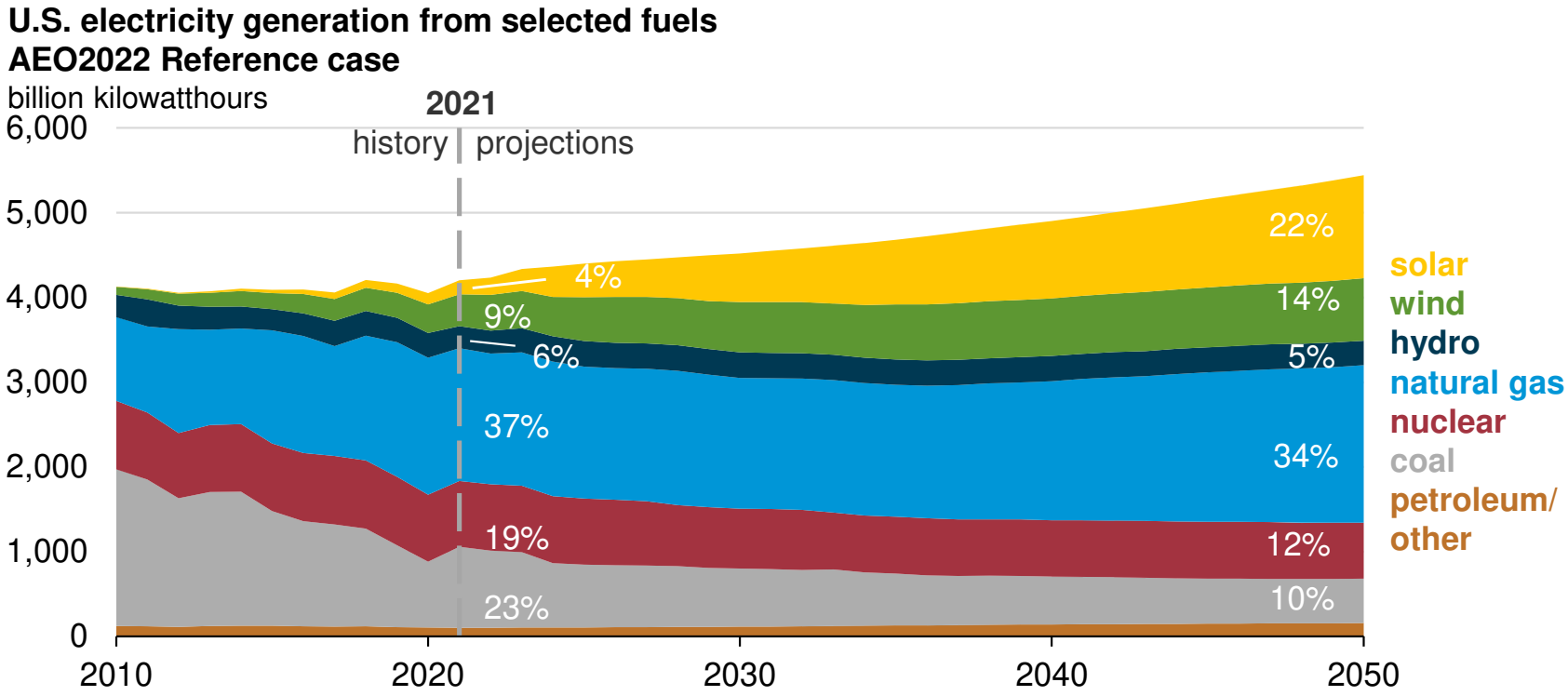


U.S. electricity use by end-use sector
AEO2022 Reference case
billion kilowatthours



Note: Onsite generation is electricity produced onsite for own use.

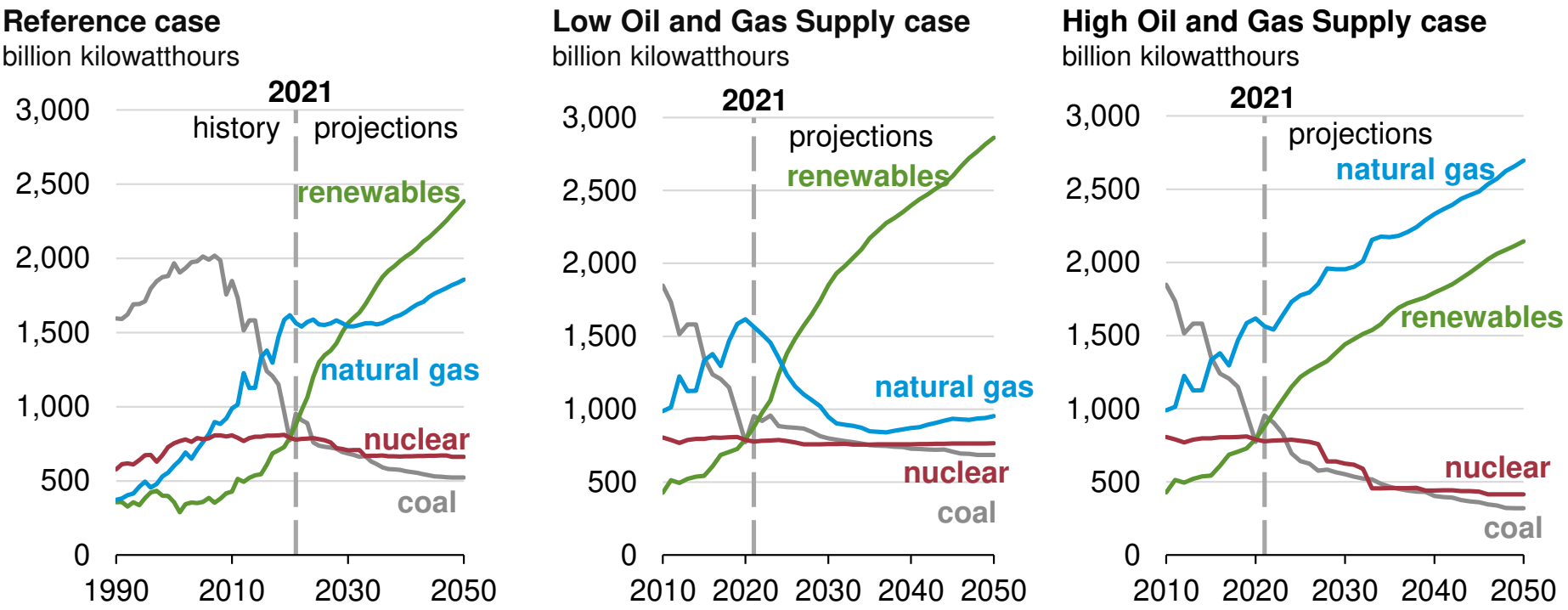
Renewable electricity generation increases more rapidly than overall electricity demand through 2050



Note: Solar includes both utility-scale and end-use photovoltaic electricity generation.

Renewable share of the generation mix grows across a wide range of assumptions, although sensitive to natural gas resource and price assumptions

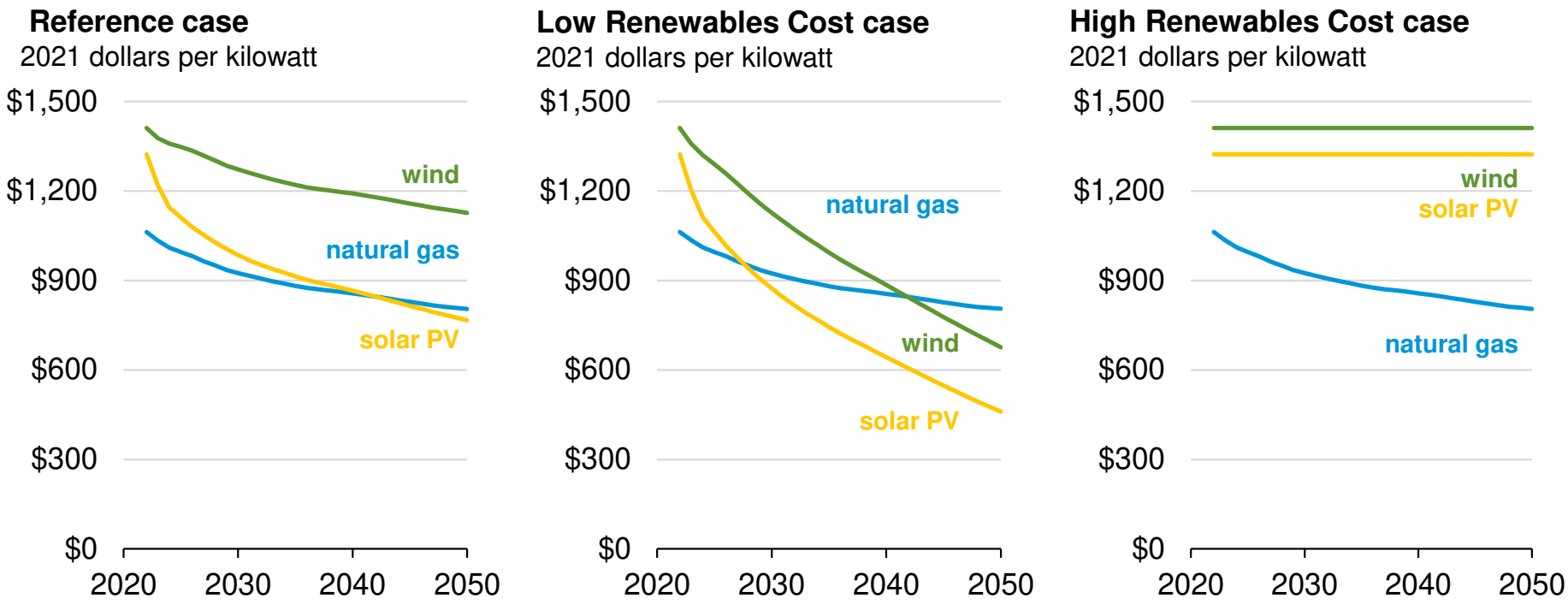
U.S. electricity generation, AEO2022 oil and gas supply cases



Note: Renewables category includes electricity generation from wind, solar, hydroelectric, geothermal, wood, and other biomass sources.

The High Renewables Cost and Low Renewables Cost cases assume different rates of cost reduction for renewable technologies compared with the Reference case; non-renewables assume the same rates

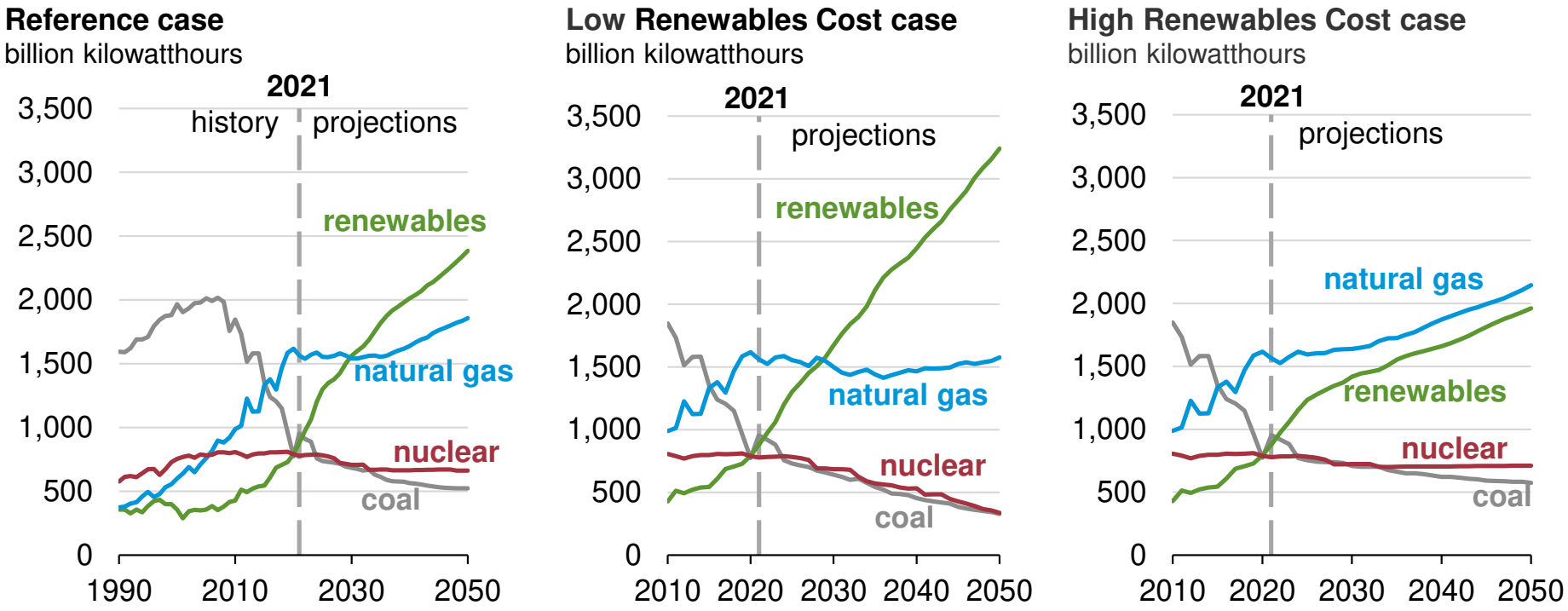
Overnight installation cost, AEO2022 renewables cost cases



Note: Series begin in 2022.

Changes in cost assumptions for new wind and solar projects result in significantly different projected fuel mixes for electricity generation

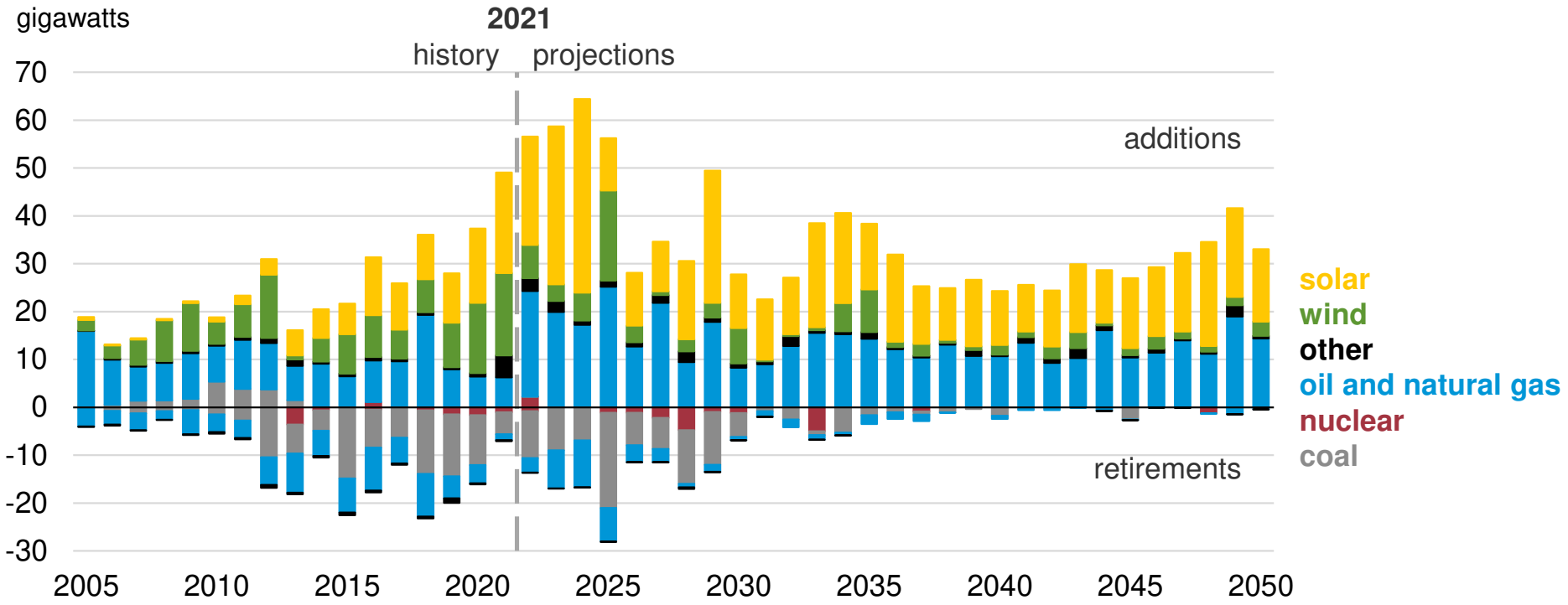
U.S. electricity generation, AEO2022 renewables cost cases



Note: Renewables category includes electricity generation from wind, solar, hydroelectric, geothermal, wood, and other biomass sources.

Requirements for new generating capacity met by renewables and natural gas due to declining costs and competiveness of natural gas

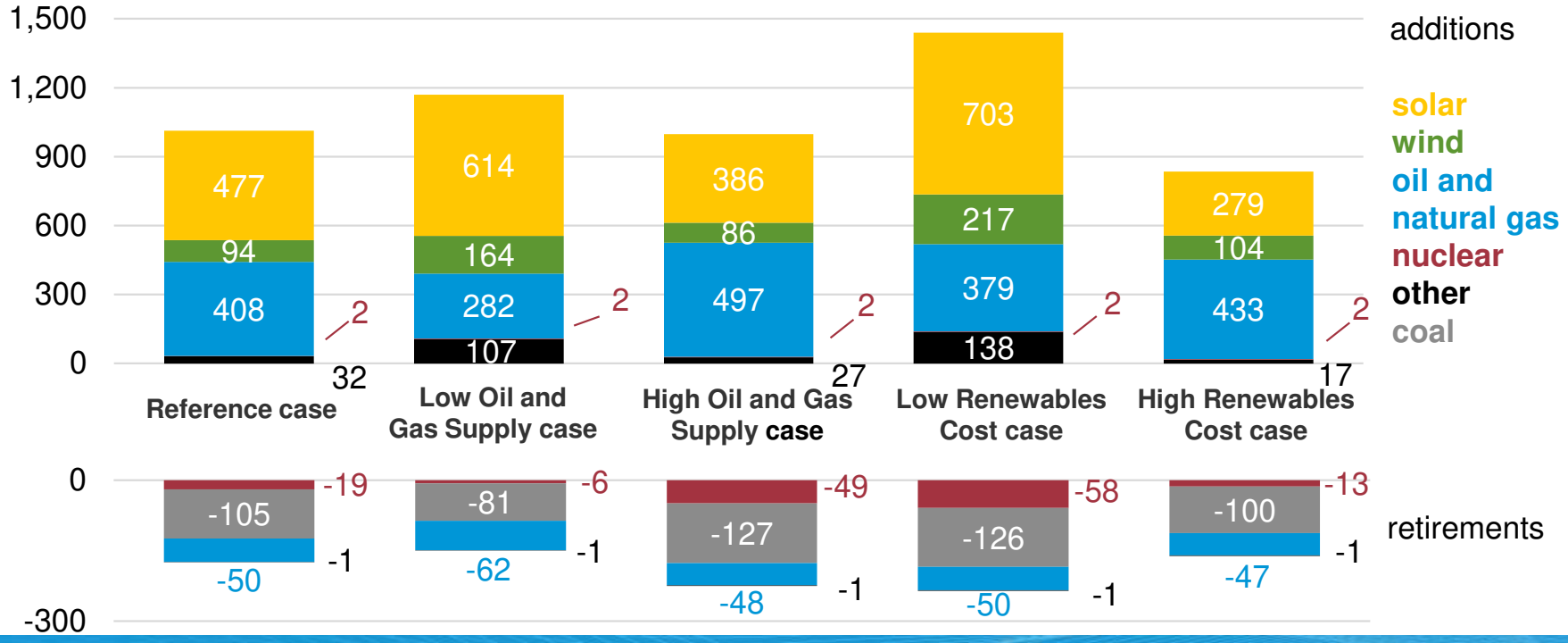
Annual electricity generating capacity additions and retirements
AEO2022 Reference case



Source: History: Form EIA-860M, Monthly Update to the Annual Electric Generator Report, August 2021; Projections: AEO2022 Reference case

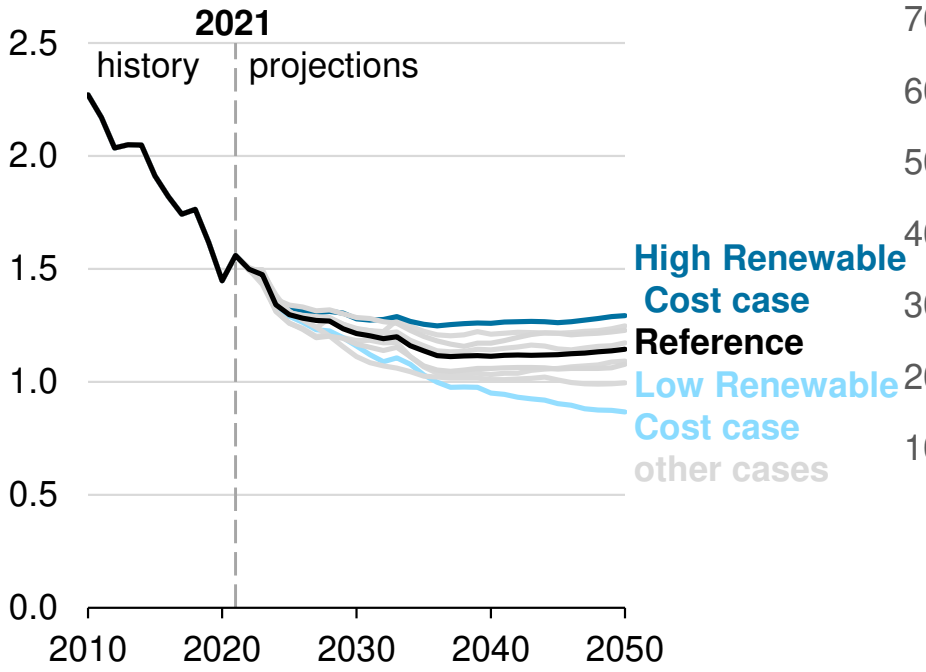
Electricity generating capacity increases 57% to 102% across AEO cases; additions come mostly from solar, wind, and natural gas

Cumulative electricity generating capacity additions and retirements (2022–2050)
AEO2022 selected cases
gigawatts

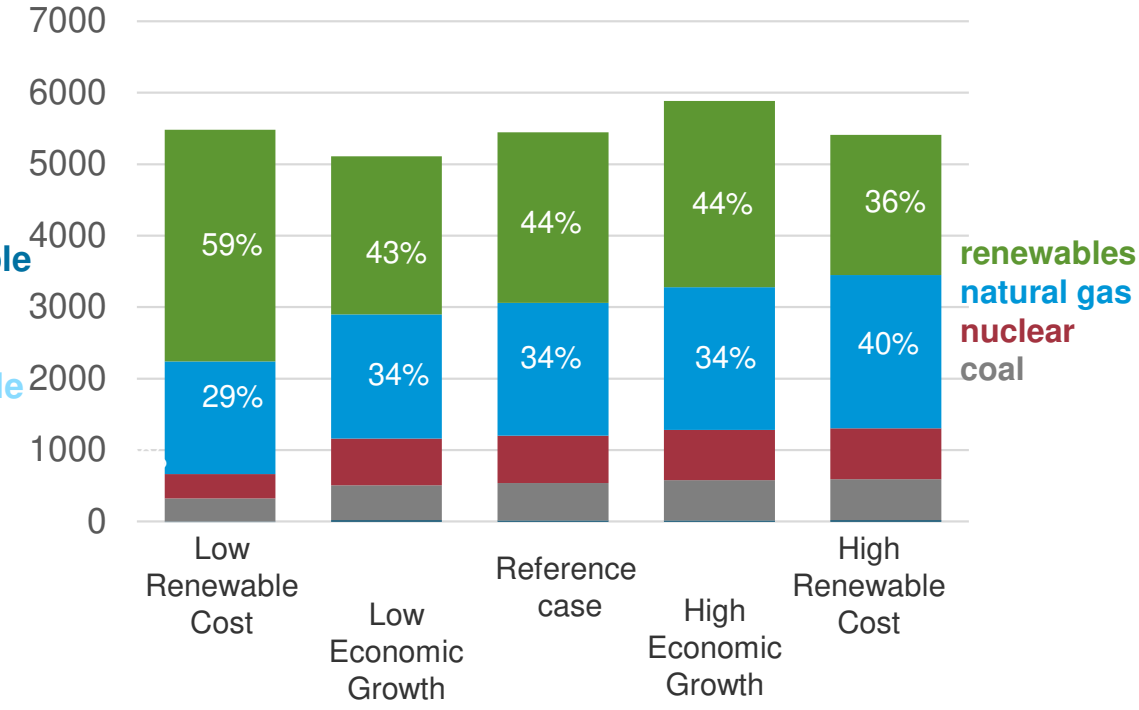


U.S. electric power sector carbon dioxide emissions vary with the generation mix and technology or fuel cost changes

U.S. electric power sector carbon dioxide emissions
AEO2022 core cases
billion metric tons

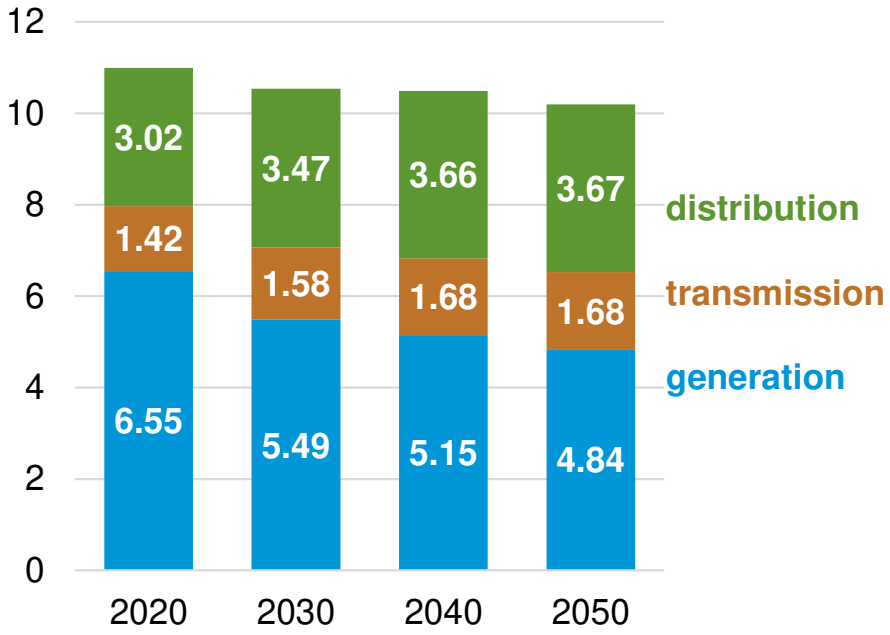


U.S. electricity generation in 2050 from selected fuels
AEO2022 selected cases
Billion kilowatthours

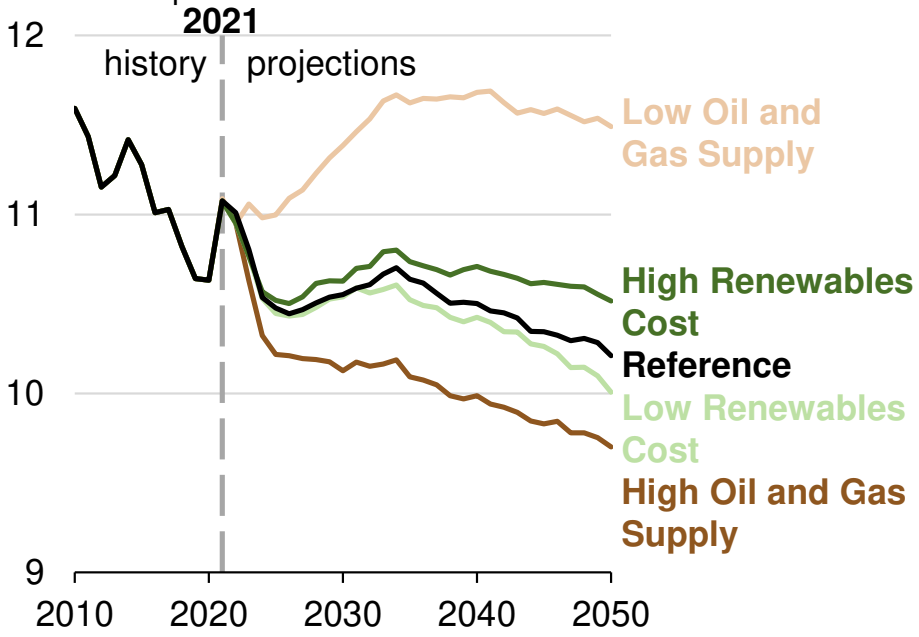


Electricity prices fall slightly; declining generation costs are offset by rising transmission and distribution costs

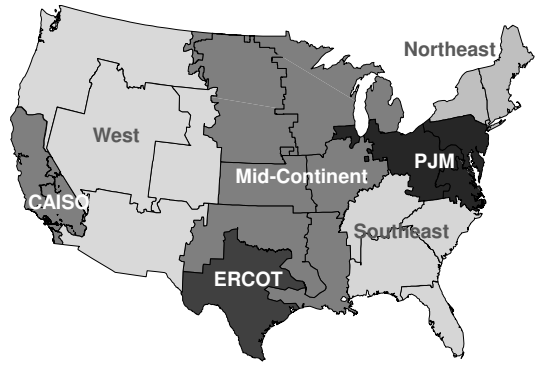
Components of U.S. electricity prices
AEO2022 Reference case
2021 cents per kilowatthour



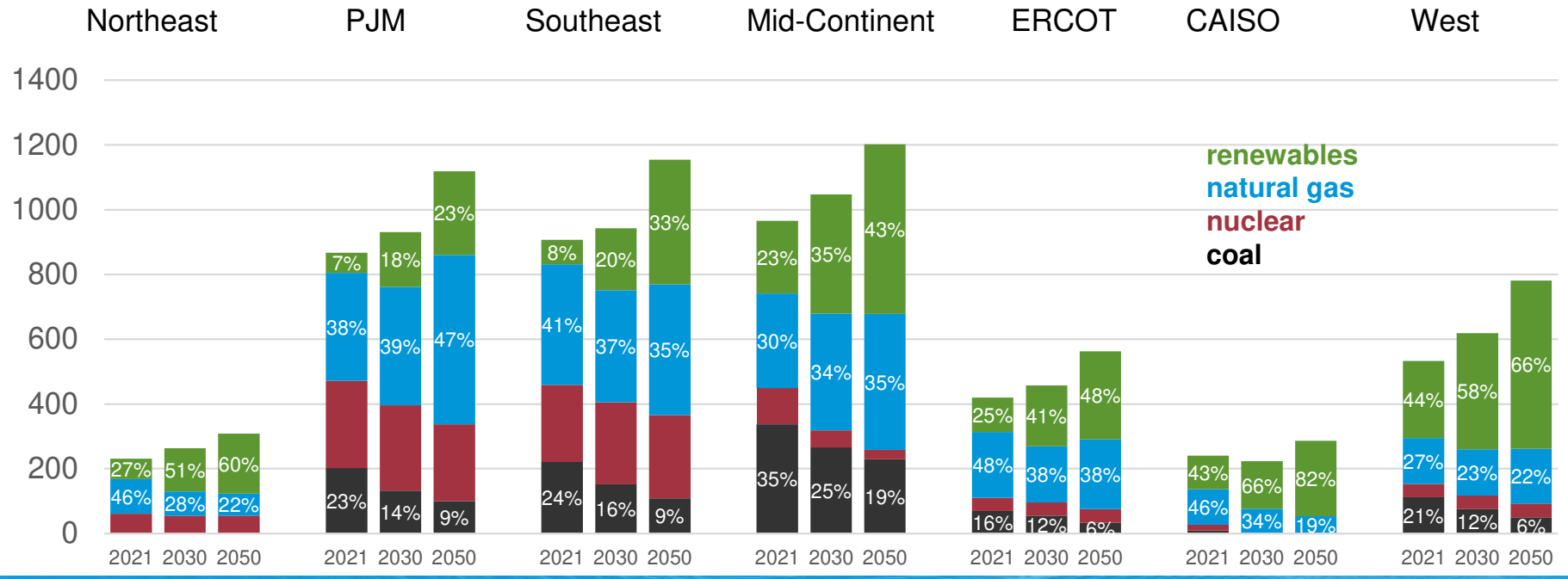
U.S. average electricity price
AEO2022 selected cases
2021 cents per kilowatthour



All regions of the country shift to higher shares of renewable generation by 2050



U.S. electricity generation
AEO2022 Reference case
billion kilowatthours

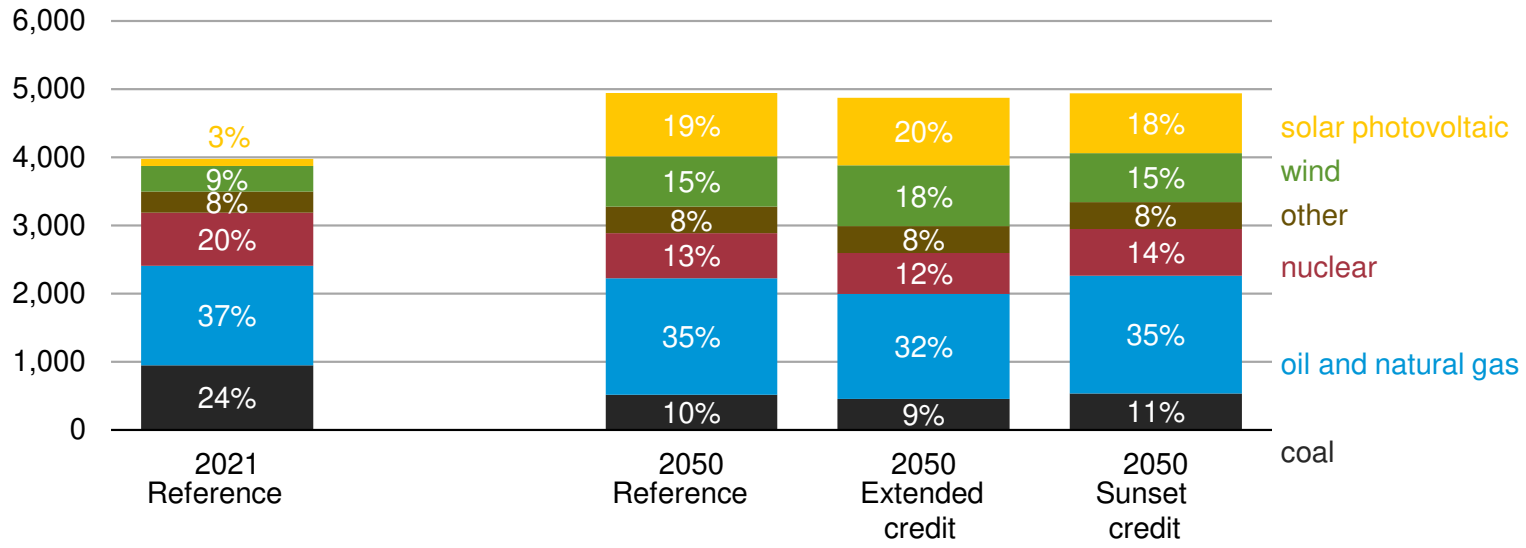


Additional analyses produced for AEO2022

- Some AEO cycles EIA produces additional Issues in Focus articles looking at specific areas of interest in different sectors; AEO2022 published these analyses throughout spring/summer 2022
  - No Interstate Natural Gas Pipeline Builds
  - Alternative Weather Assumptions (buildings sector)
  - Drivers for Standalone Battery Storage (power sector)
  - Alternative Policies
    - Extended tax credits – existing tax credits as of November 2021 were assumed to extend through 2050 at the current level
    - Sunset tax credits – all tax credits expire in 2023
    - Carbon fees – assumes a range of carbon fees are implemented in 2023 ($15, $25, $35/ton) and increase by 5% per year through 2050

Extending tax credits (as of Nov 2021) increases renewable share of generation

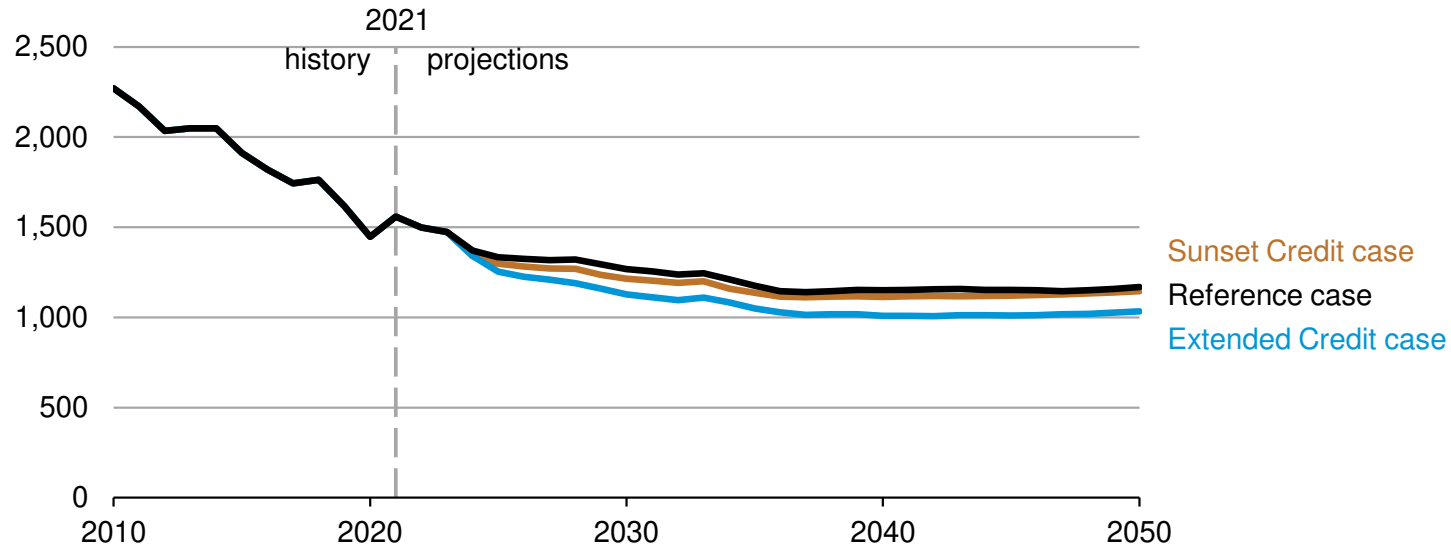
Power sector electricity generation by fuel type
AEO2022 Reference and Credit cases
billion kilowatthours



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

Power sector emissions are 10% lower in 2050 with higher renewable generation from extended credits

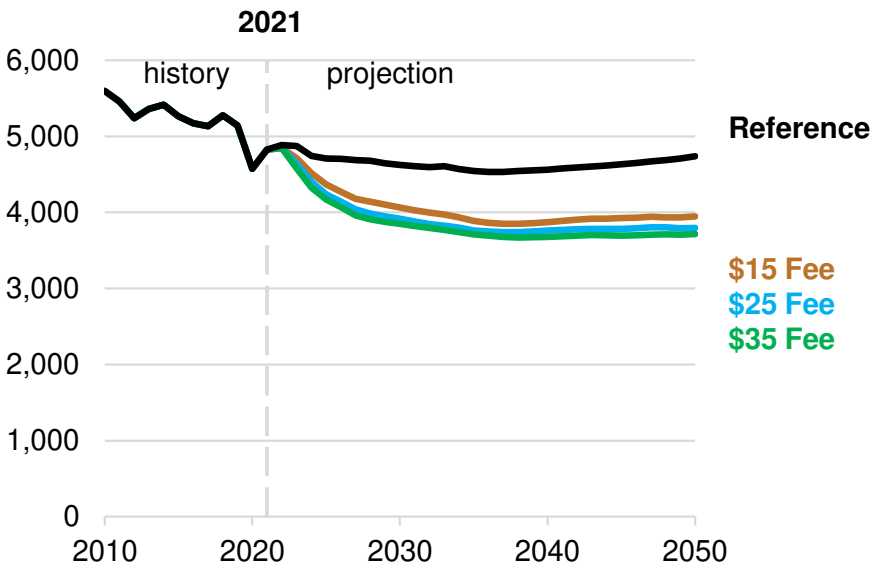
U.S. electric power sector carbon dioxide emissions
AEO2022 Credit cases
million metric tons



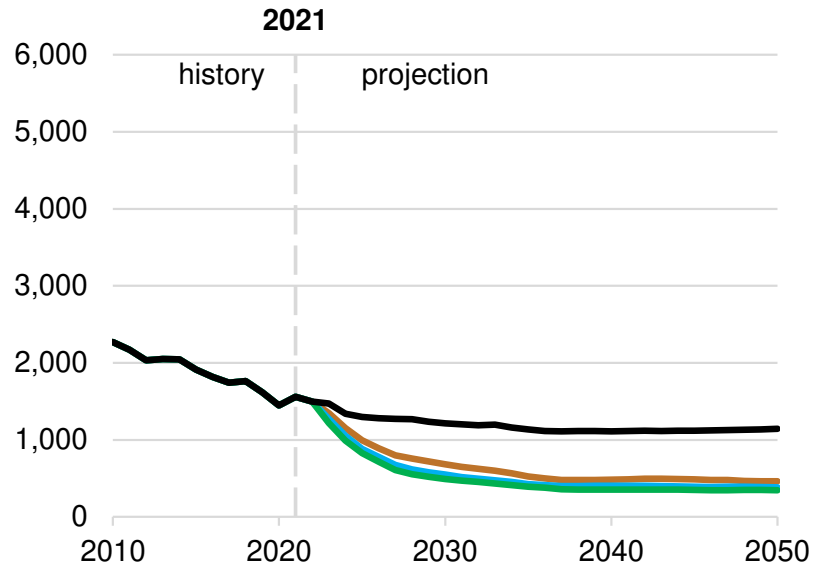
Source: U.S. Energy Information Administration, Annual Energy Outlook 2022

Carbon emissions in 2050 decline 17-22% with a carbon fee, most of reduction is from the power sector

U.S. energy-related carbon dioxide emissions
AEO2022 economic growth cases
million metric tons



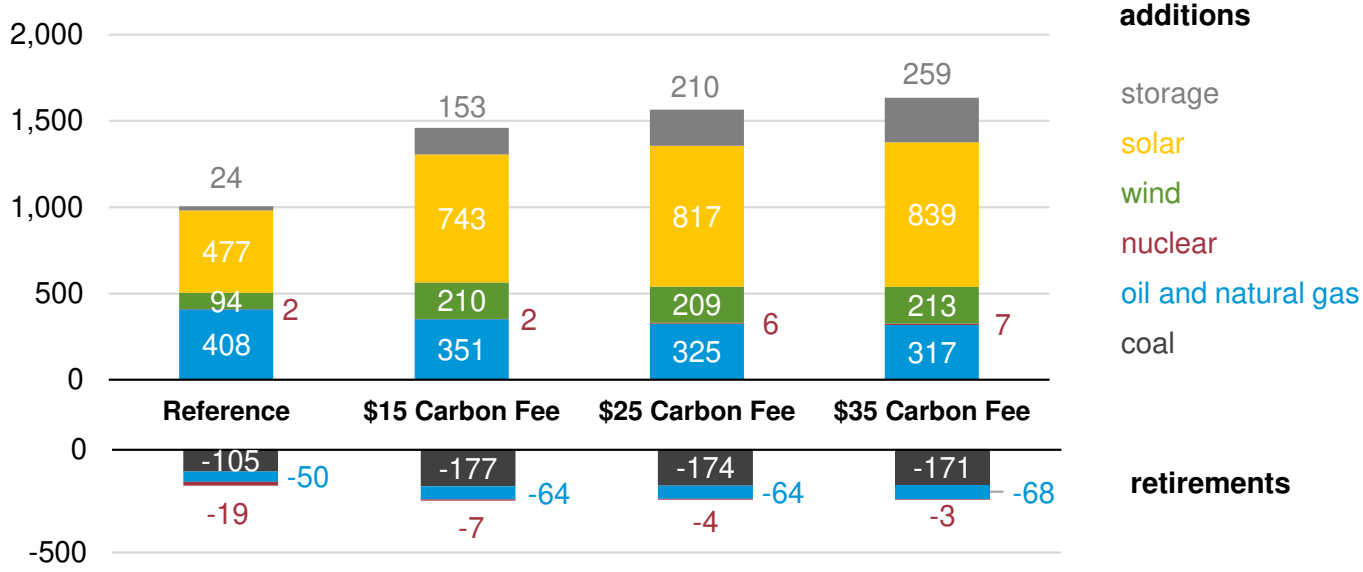
U.S. electric power sector carbon dioxide emissions
AEO2022 carbon fee cases
million metric tons



Source: U.S. Energy Information Administration, Annual Energy Outlook 2022 Reference case and carbon fee case runs

Most coal capacity is retired under a carbon fee, while renewables dominate new additions

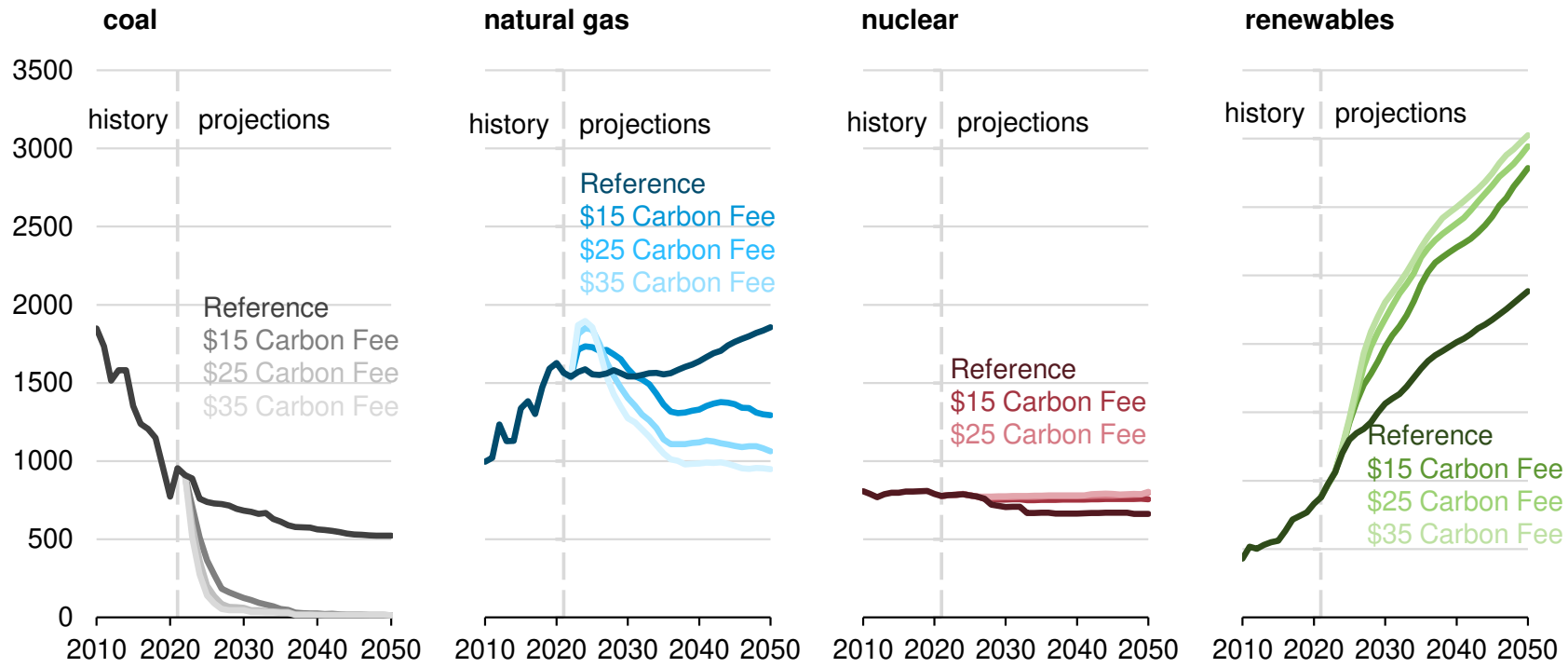
Total all-sector cumulative capacity additions and retirements
Reference case and carbon fee cases (2021 to 2050)
gigawatts



Source: U.S. Energy Information Administration, Annual Energy Outlook 2022 Reference case and carbon fee case runs

Coal generation declines with carbon fee, while renewables sees substantial growth

Net electricity generation from all sectors by fuel type, Reference case and carbon fee cases
billion kilowatthours



Source: U.S. Energy Information Administration, Annual Energy Outlook 2022 Reference case and carbon fee case runs

For more information

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Annual Energy Outlook | www.eia.gov/aeo

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

International Energy Outlook | www.eia.gov/outlooks/ieo/

Monthly Energy Review | www.eia.gov/mer

Today in Energy | www.eia.gov/todayinenergy