

Annual Energy Outlook 2021

with projections to 2050

Chart library



#AEO2021

February 3, 2021
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Annual Energy Outlook 2021 with projections to 2050

February 2021

U.S. Energy Information Administration
Office of Energy Analysis
U.S. Department of Energy
Washington, DC 20585











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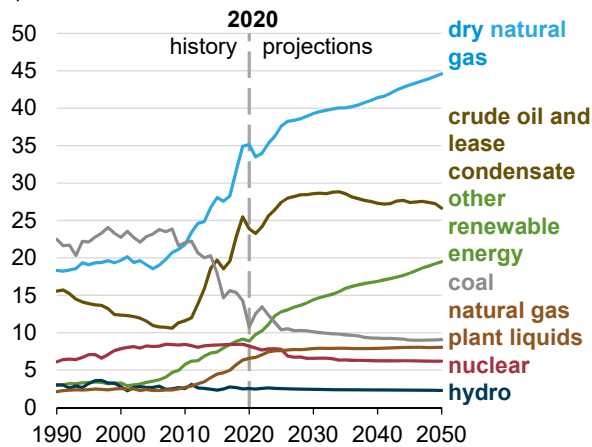
Overview of U.S. energy markets

The *Annual Energy Outlook* (AEO) presents modeled projections of future energy production and energy use in the United States.

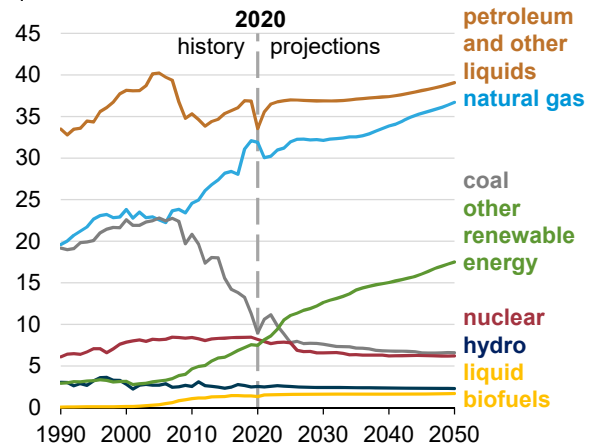


Energy production and consumption

Energy production by source
AEO2021 Reference case
quadrillion British thermal units



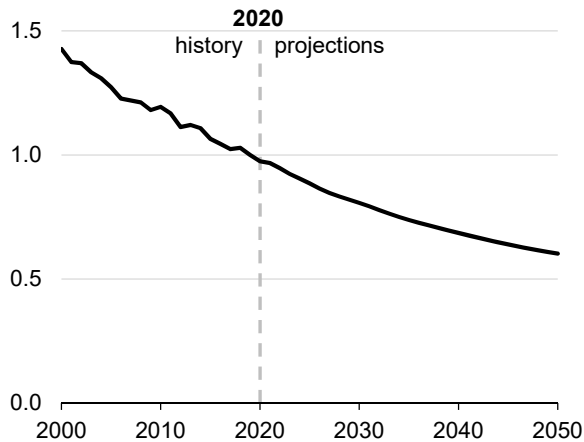
Energy consumption by fuel
AEO2021 Reference case
quadrillion British thermal units



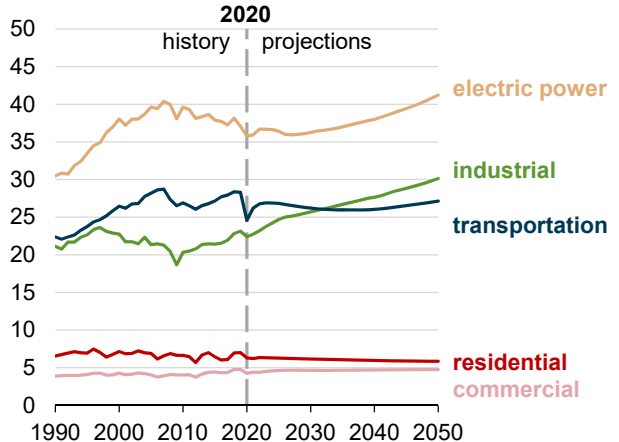


Energy intensity and consumption

Indexed total energy intensity of the U.S. economy
AEO2021 Reference case
2019 = 1.0



Energy consumption by sector
AEO2021 Reference case
quadrillion British thermal units



Note: Total energy intensity calculation reflects primary energy, which includes electricity losses.



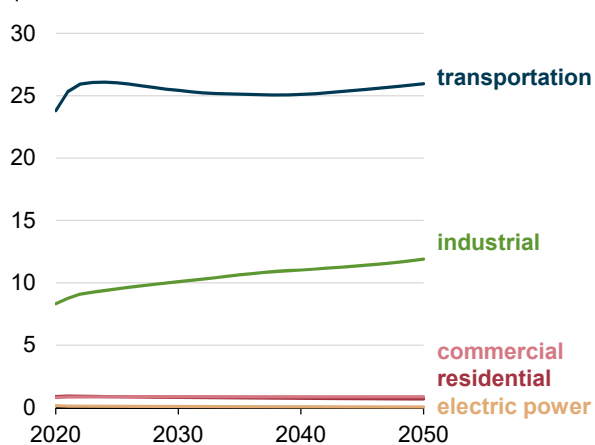
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

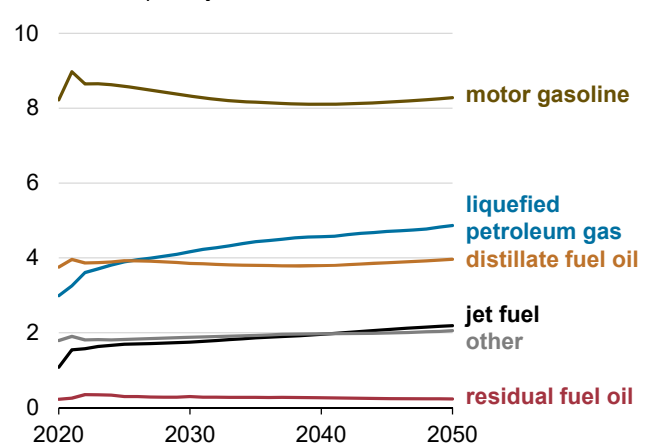


Petroleum consumption by sector and fuel type

Petroleum and other liquids consumption by sector
AEO2021 Reference case
quadrillion British thermal units



Petroleum and other liquids consumption by fuel type
AEO2021 Reference case
million barrels per day



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo



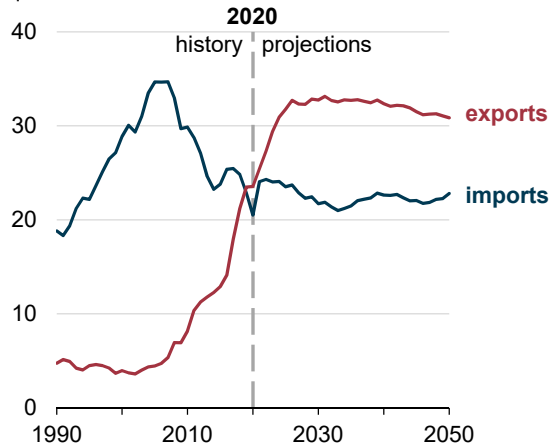


Energy imports and exports

Gross energy trade

AEO2021 Reference case

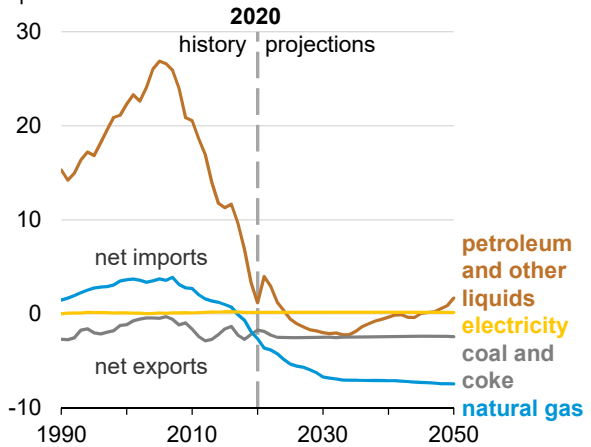
quadrillion British thermal units



Net energy imports

AEO2021 Reference case

quadrillion British thermal units



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

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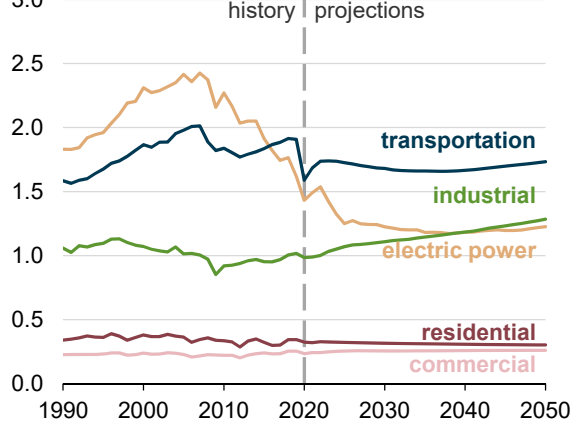


Energy-related carbon dioxide emissions by sector and fuel source

Energy-related carbon dioxide emissions by sector

AEO2021 Reference case

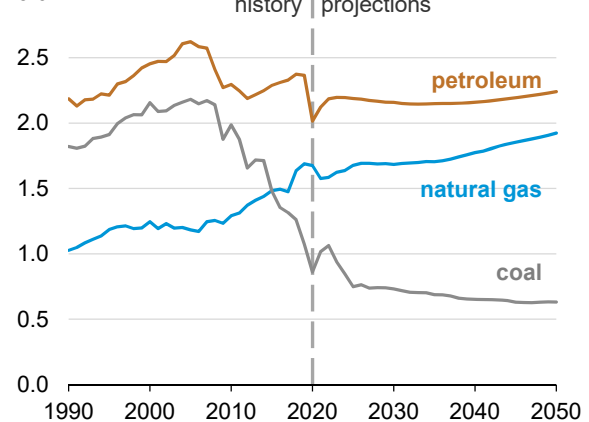
billion metric tons



Energy-related carbon dioxide emissions by fuel

AEO2021 Reference case

billion metric tons



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

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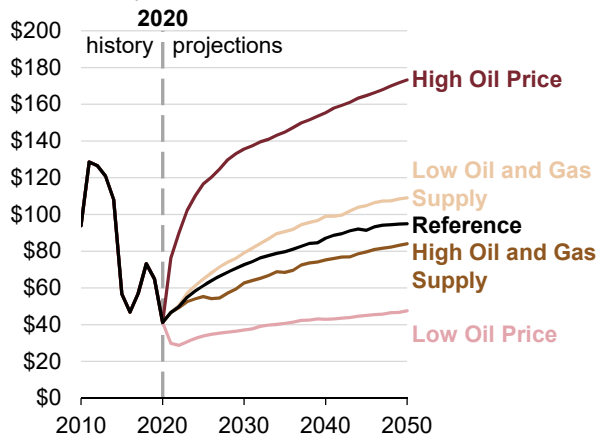


Critical drivers

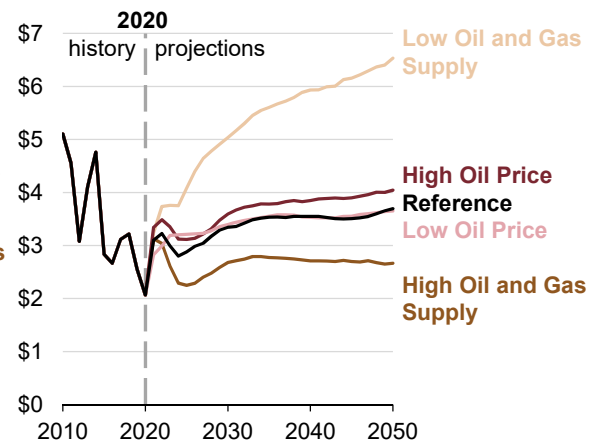


Crude oil price assumptions and natural gas price projections

North Sea Brent crude oil price
AEO2021 side cases
 2020 dollars per barrel



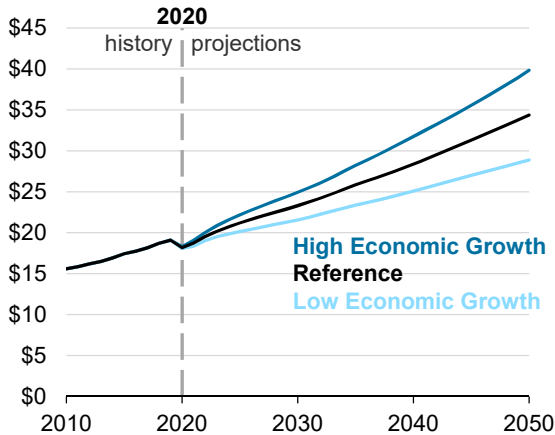
Natural gas price at Henry Hub
AEO2021 side cases
 2020 dollars per million British thermal units



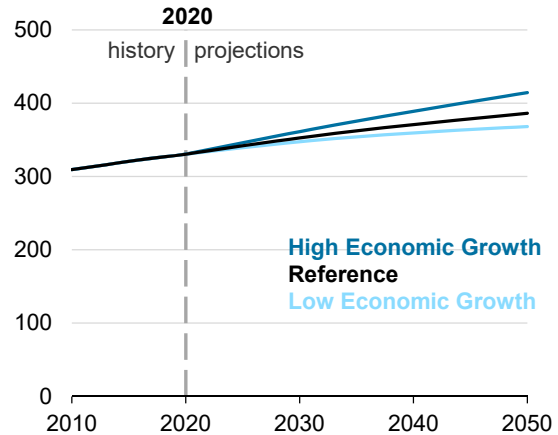


Gross domestic product and population growth assumptions

U.S. gross domestic product assumptions
AEO2021 economic growth cases
trillion 2012 dollars



U.S. population assumptions
AEO2021 economic growth cases
millions



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

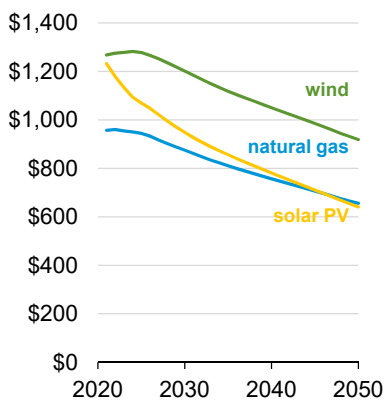
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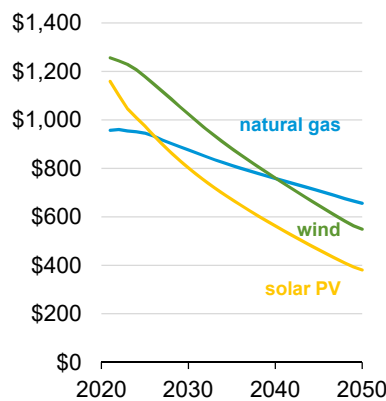
Installation cost for solar photovoltaic (PV), wind, and natural gas capacity in renewable cost cases

Overnight installation cost, AEO2021 renewables cost cases

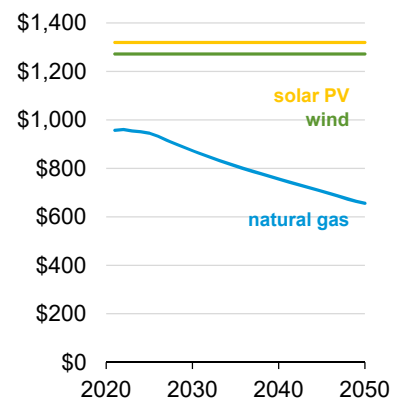
Reference case
2020 dollars per kilowatt



Low Renewables Cost case
2020 dollars per kilowatt



High Renewables Cost case
2020 dollars per kilowatt



Note: Series begin in 2021.



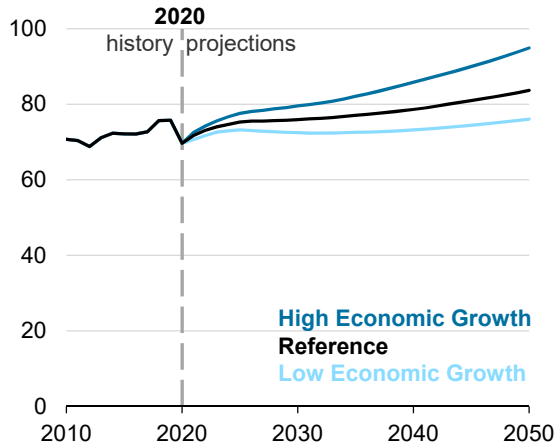
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

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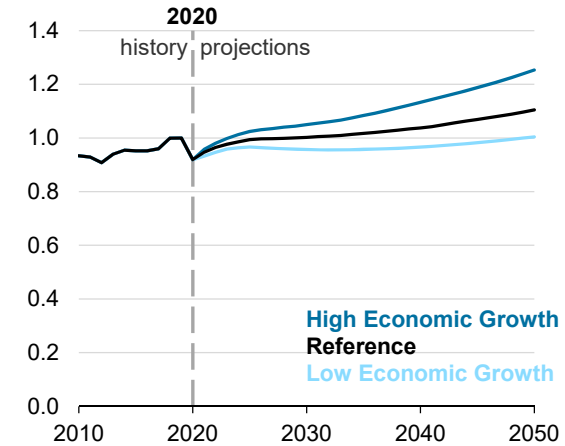


Delivered energy

Delivered energy across end-use sectors
AEO2021 economic growth cases
quadrillion British thermal units



Indexed delivered energy across end-use sectors
AEO2021 economic growth cases
2019 = 1.0



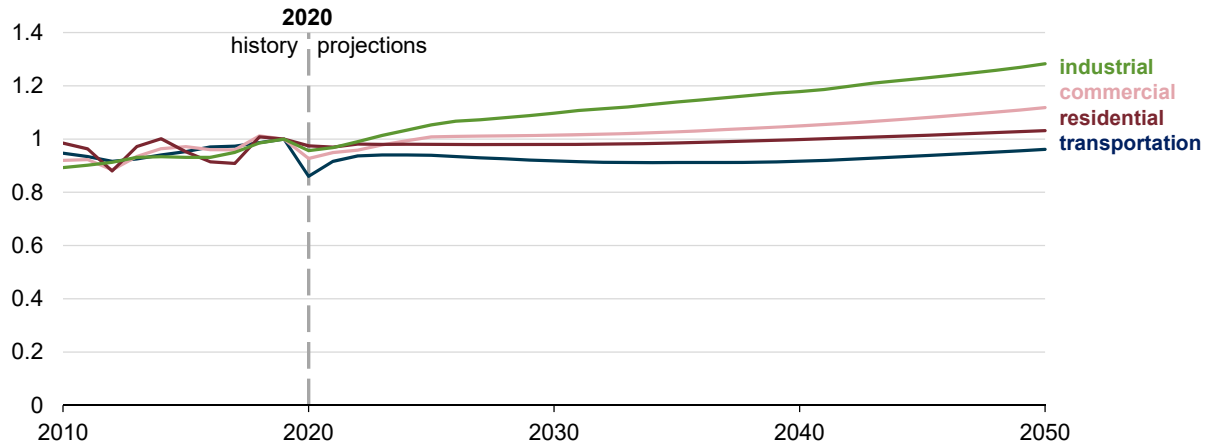
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

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Delivered energy by end-use sector

Indexed delivered energy by end-use sector
AEO2021 Reference case
2019 = 1.0



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

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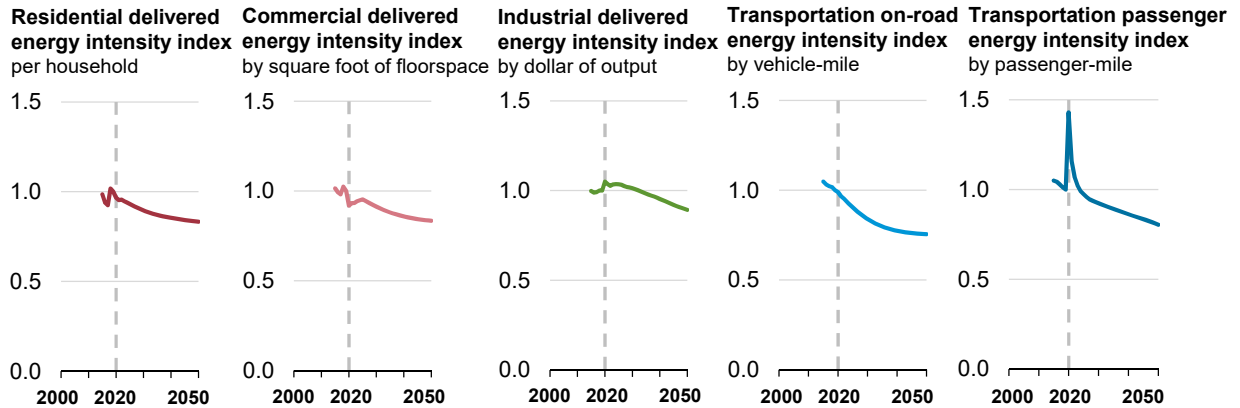


Delivered energy intensity by sector

Indexed delivered energy intensity by sector

AEO2021 Reference case

2019 = 1.0



Note: Energy intensity at the end-use sector level is typically measured relative to an indicator that most directly affects delivered energy consumption within the sector (for example, household, dollar of output, or vehicle-mile).



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

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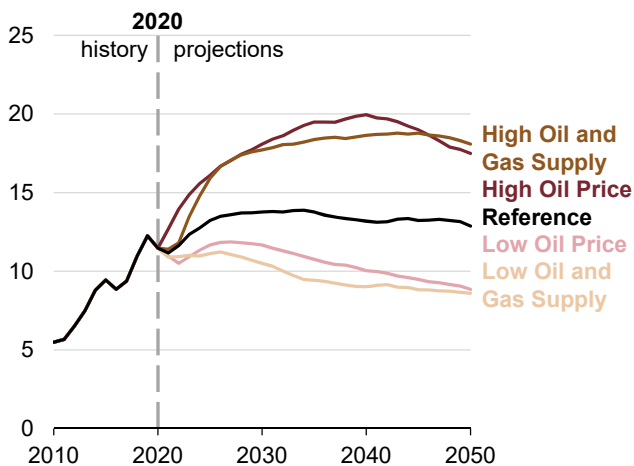


Petroleum and other liquids

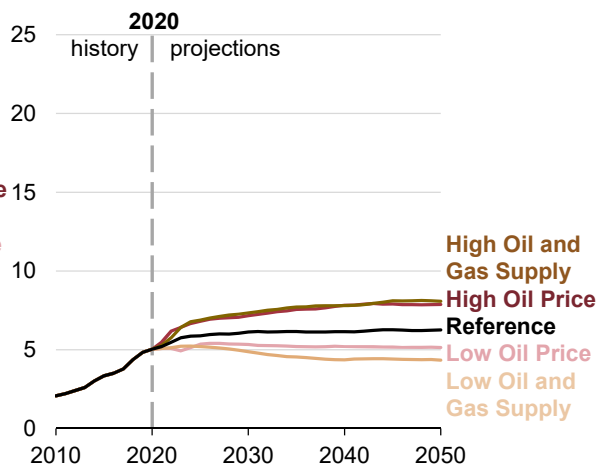


Production of U.S. crude oil and natural gas plant liquids

U.S. crude oil production
AEO2021 side cases
million barrels per day



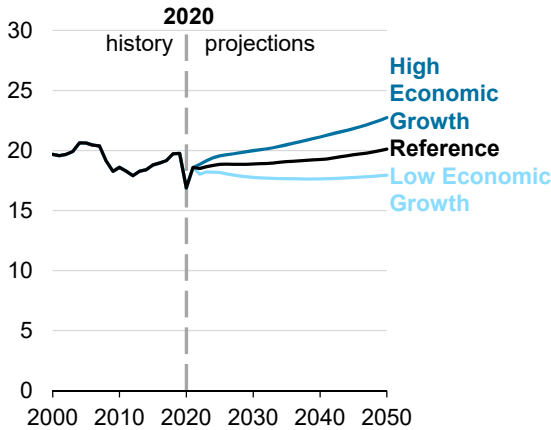
U.S. natural gas plant liquids production
AEO2021 side cases
million barrels per day



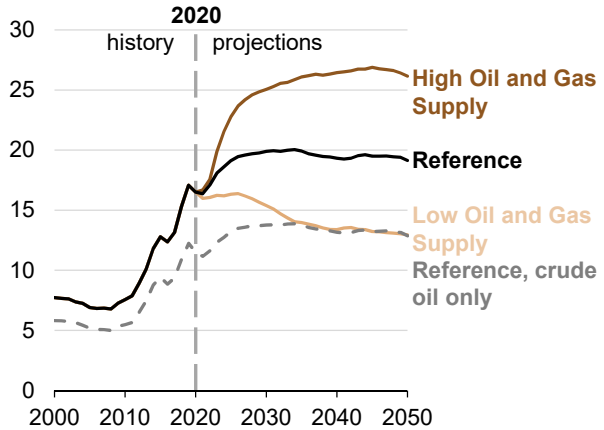


U.S. crude oil and natural gas plant liquids production and consumption

U.S. petroleum and other liquids consumption
AEO2021 economic growth cases
million barrels per day



U.S. crude oil and natural gas plant liquids production
AEO2021 oil and gas supply cases
million barrels per day



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

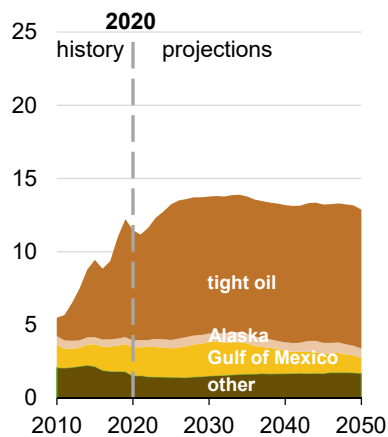
www.eia.gov/aeo



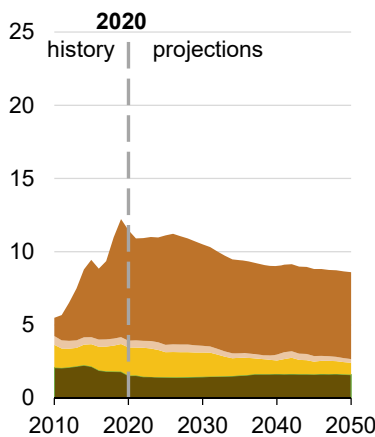
U.S. crude oil production

U.S. crude oil production, AEO2021 oil and gas supply cases

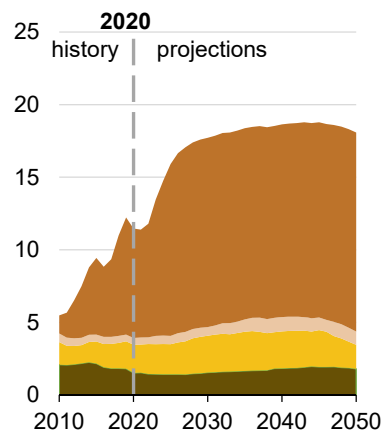
Reference case
million barrels per day



Low Oil and Gas Supply case
million barrels per day



High Oil and Gas Supply case
million barrels per day



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

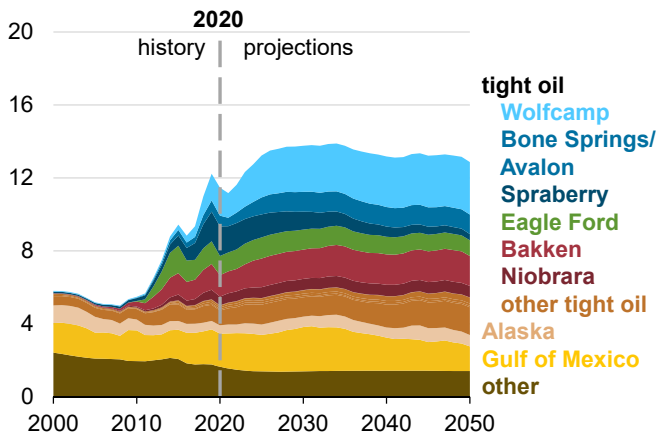
www.eia.gov/aeo



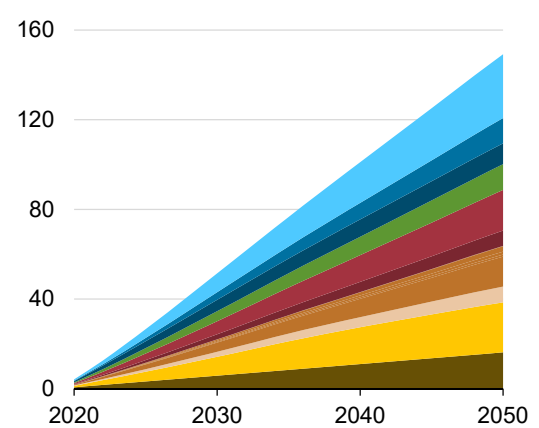


U.S. crude oil levels and cumulative production

Crude oil production
AEO2021 Reference case
million barrels per day



Cumulative crude oil production
AEO2021 Reference case
billion barrels



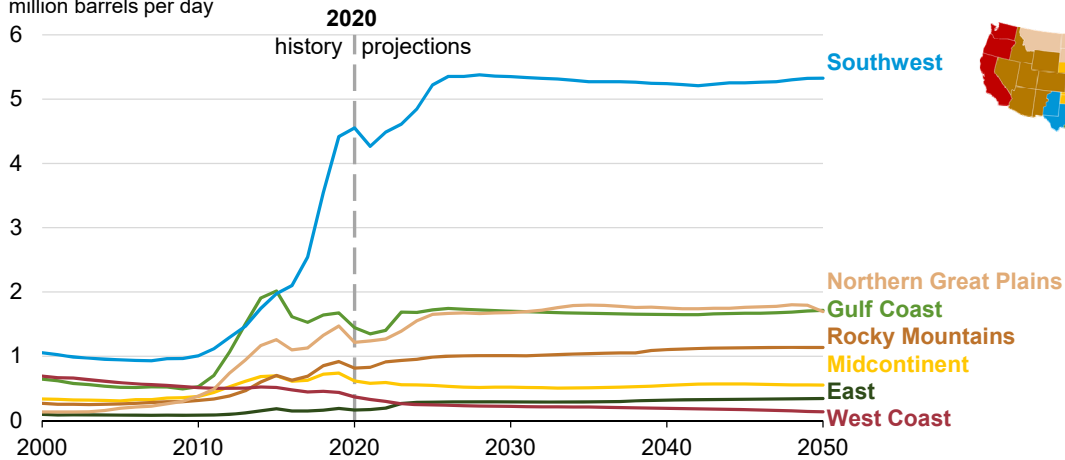
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

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Onshore crude oil production in the Lower 48 states

Onshore crude oil production in the Lower 48 states by region
AEO2021 Reference case
million barrels per day



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

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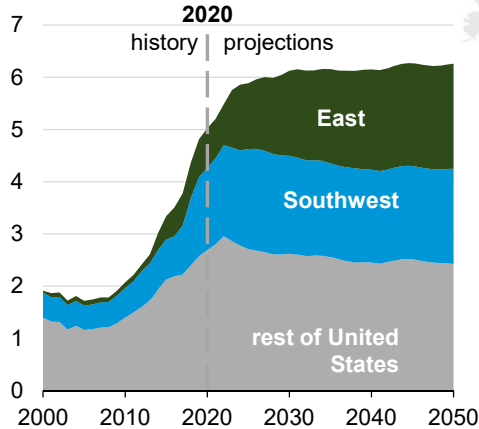




Natural gas plant liquids production by region and type

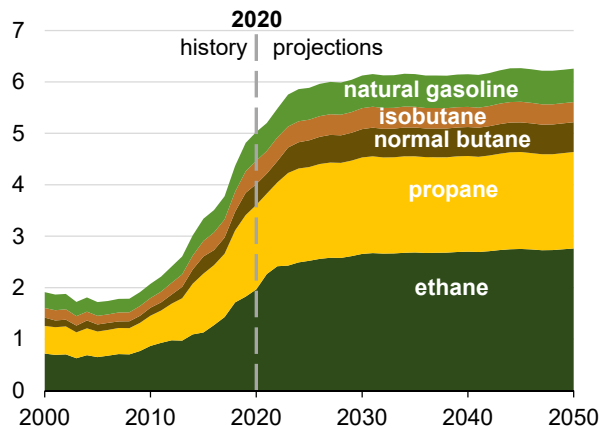
U.S. natural gas plant liquids production by region
AEO2021 Reference case

million barrels per day



U.S. natural gas plant liquids production by type
AEO2021 Reference case

million barrels per day



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

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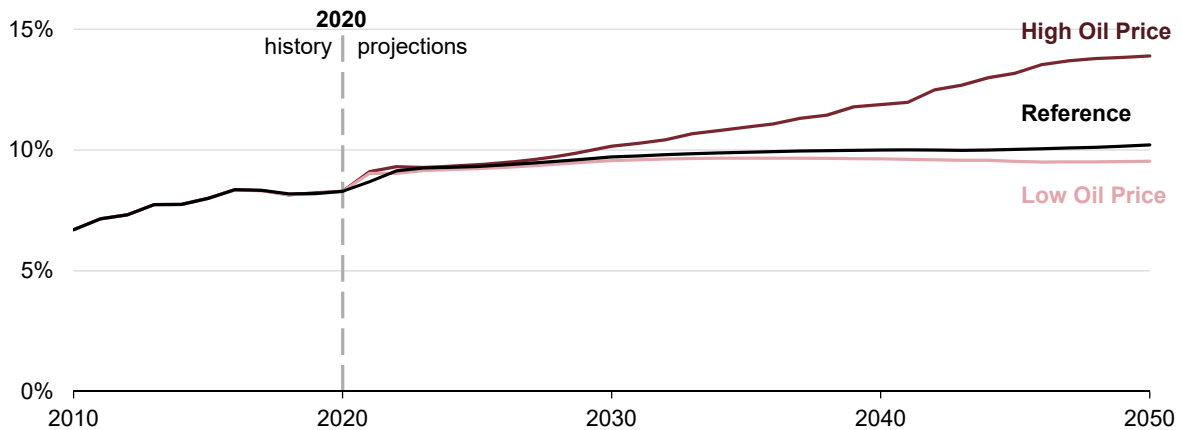


Biofuels as a percentage of motor gasoline and diesel

Projected biofuels percentage of gasoline and diesel consumption

AEO2021 oil price cases

percentage



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

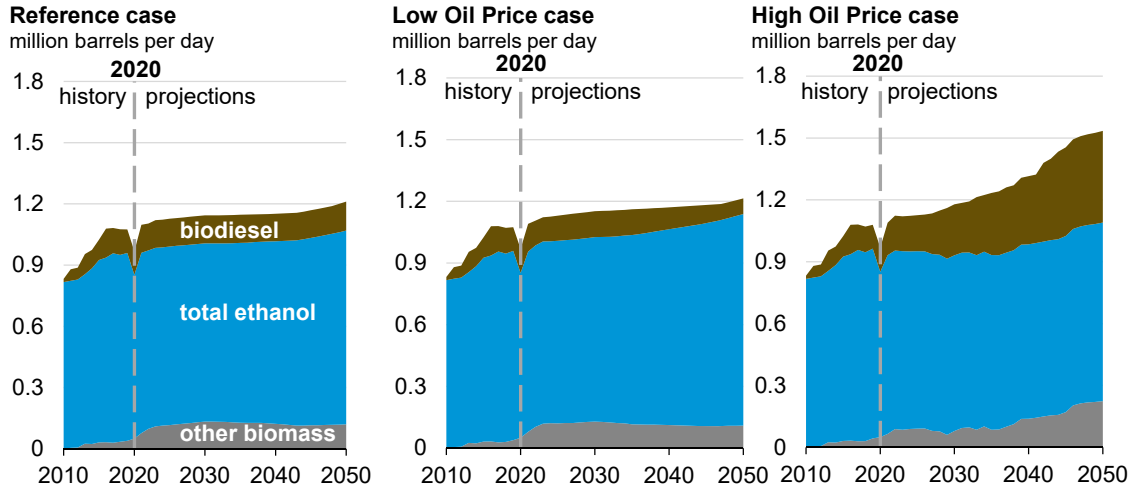
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U.S. biofuels production by type

Biofuels production by type, AEO2021 high and low price cases



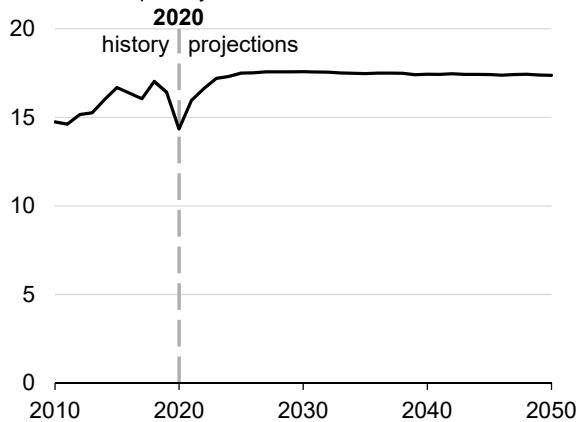
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

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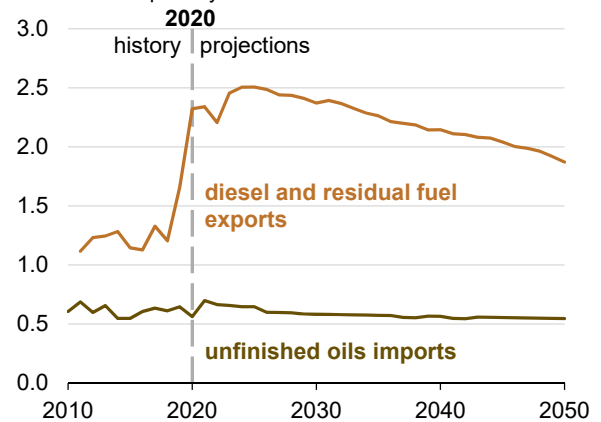


U.S. refinery utilization

U.S. total crude supply
AEO2021 Reference case
million barrels per day



U.S. diesel and residual fuel exports and unfinished oils imports, AEO2021 Reference case
million barrels per day



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

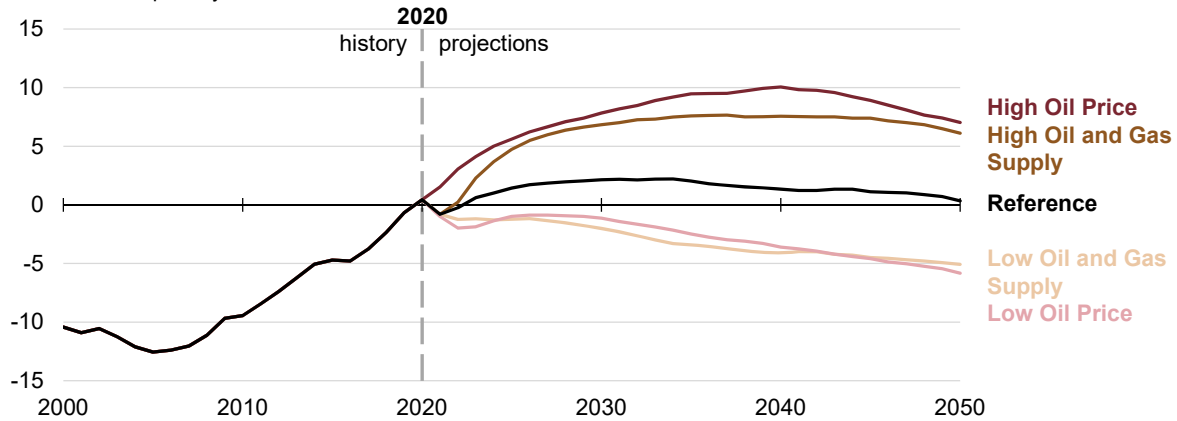
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U.S. petroleum and other liquids trade

U.S. petroleum and other liquids net exports
AEO2021 supply and price side cases
million barrels per day



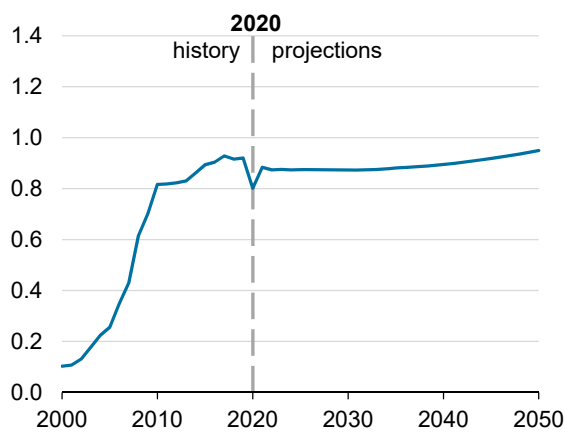
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021 (AEO2021)*

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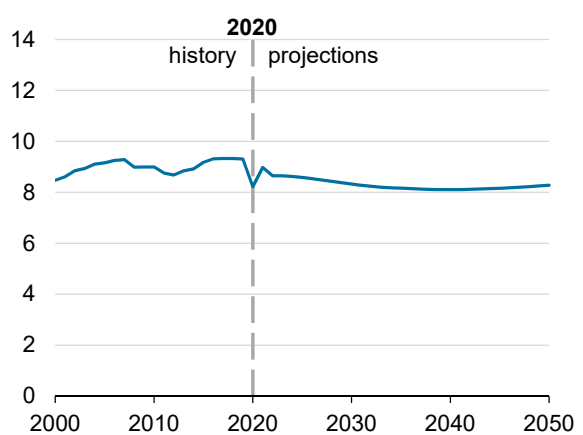


Ethanol and motor gasoline consumption

Total ethanol consumption
AEO2021 Reference case
million barrels per day



Total motor gasoline consumption
AEO2021 Reference case
million barrels per day



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021 (AEO2021)*

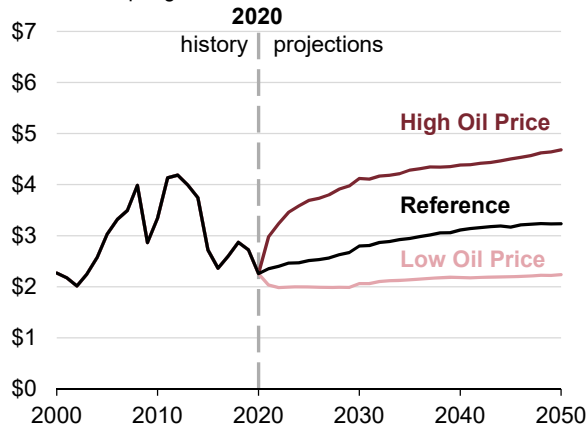
www.eia.gov/aeo



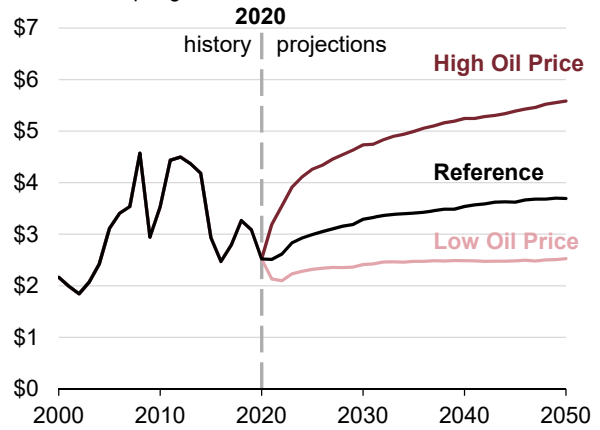


Motor gasoline and diesel prices

Retail prices of motor gasoline
AEO2021 oil price cases
2020 dollars per gallon



Retail prices of diesel
AEO2021 oil price cases
2020 dollars per gallon



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021 (AEO2021)*

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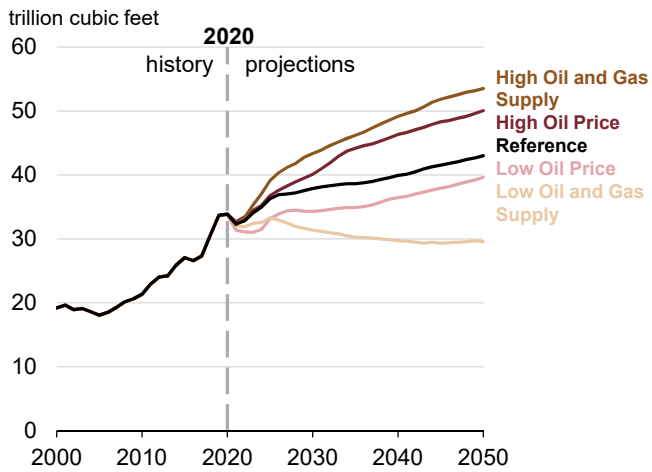


Natural gas

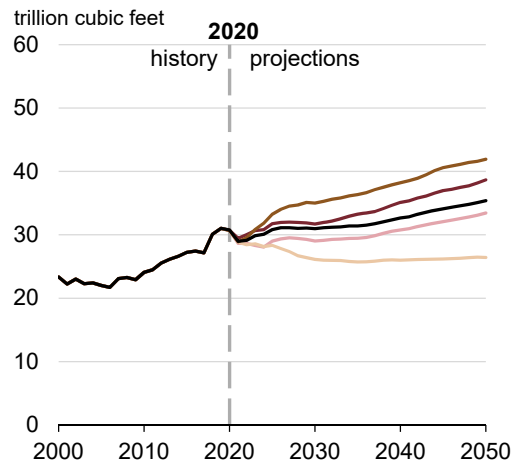


U.S. dry natural gas production and consumption

U.S. dry natural gas production
AEO2021 side cases



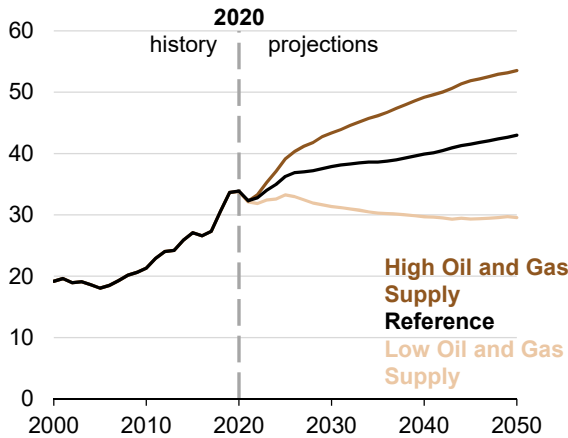
U.S. natural gas consumption
AEO2021 side cases



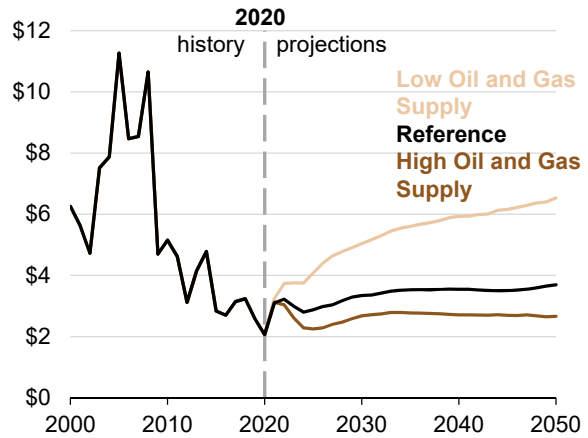


Natural gas production and prices

U.S. dry natural gas production
AEO2021 oil and gas supply cases
trillion cubic feet



Natural gas spot price at Henry Hub
AEO2021 oil and gas supply cases
2020 dollars per million British thermal units



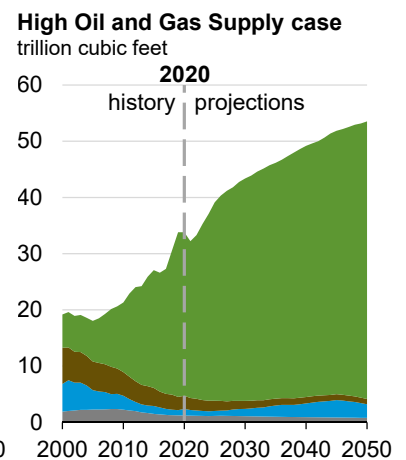
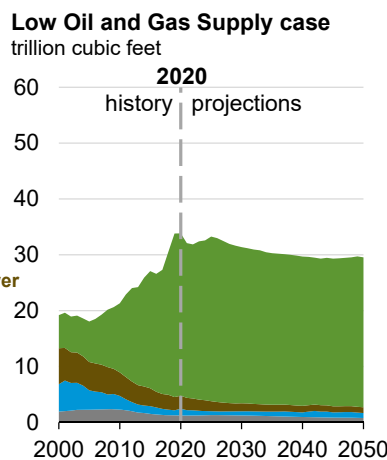
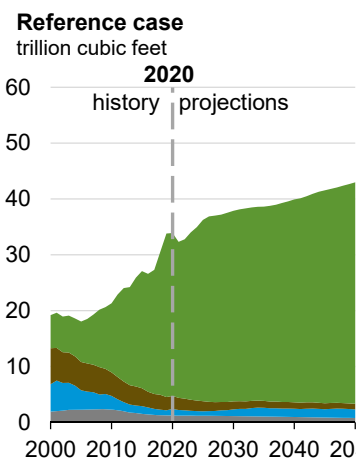
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021 (AEO2021)*

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U.S. dry natural gas production by type

U.S. dry natural gas production by type, AEO2021 oil and gas supply cases



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021 (AEO2021)*

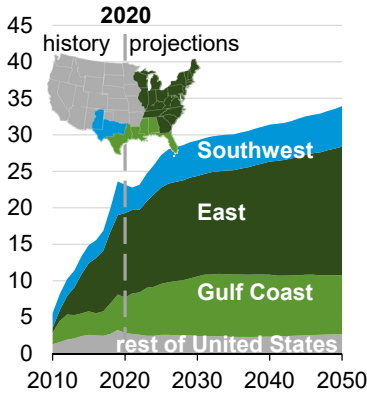
www.eia.gov/aeo



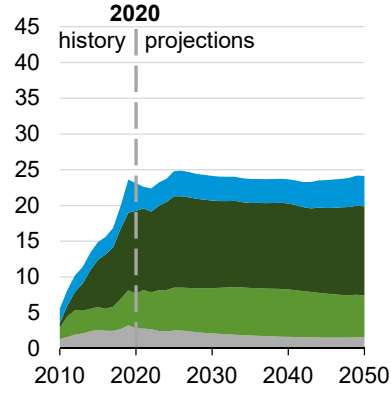
U.S. production of natural gas from shale resources

U.S. dry natural gas production from shale resources by region, AEO2021 oil and gas supply cases

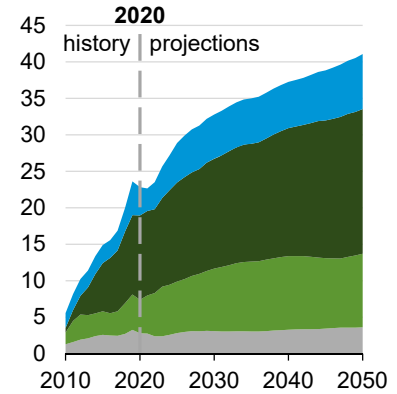
Reference case
trillion cubic feet



Low Oil and Gas Supply case
trillion cubic feet



High Oil and Gas Supply case
trillion cubic feet



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

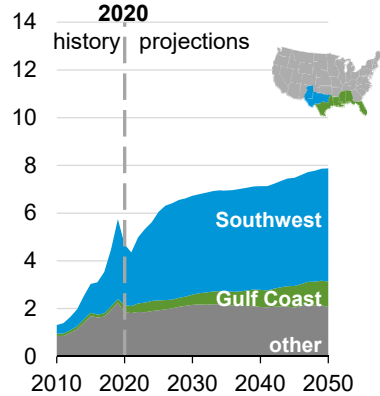
www.eia.gov/aeo



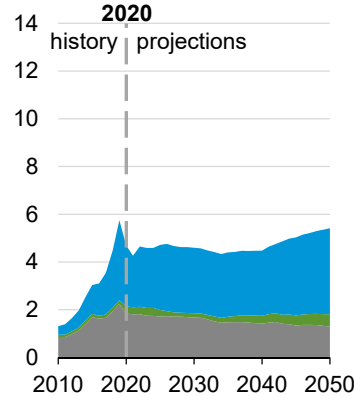
U.S. production of natural gas from oil formations

U.S. dry natural gas production from oil formations by region, AEO2021 oil and gas supply cases

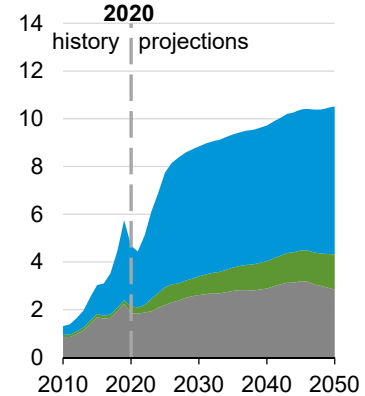
Reference case
trillion cubic feet



Low Oil and Gas Supply case
trillion cubic feet



High Oil and Gas Supply case
trillion cubic feet



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

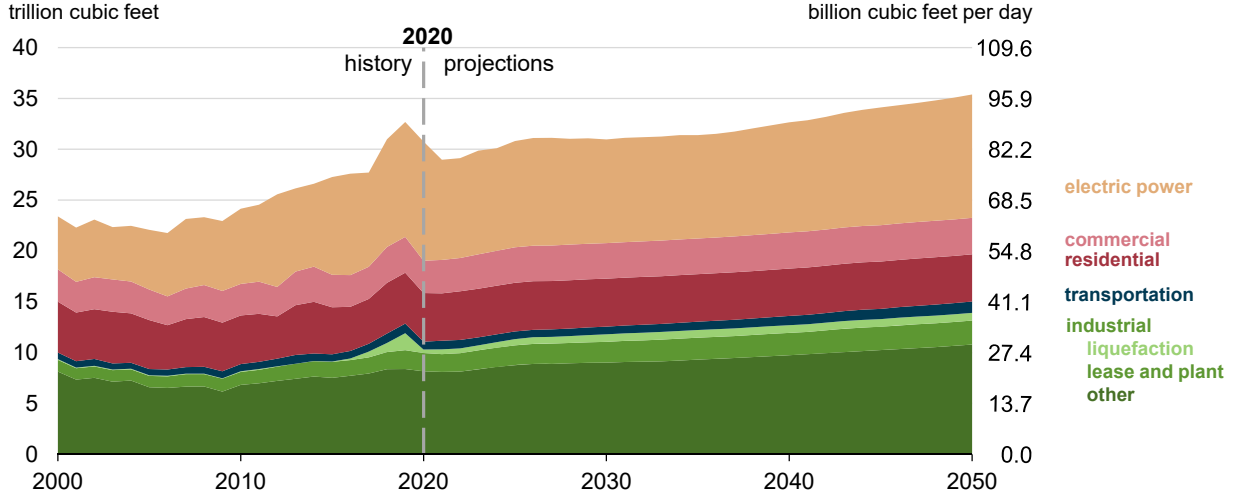
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U.S. natural gas consumption by sector

Natural gas consumption by sector, AEO2021 Reference case



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

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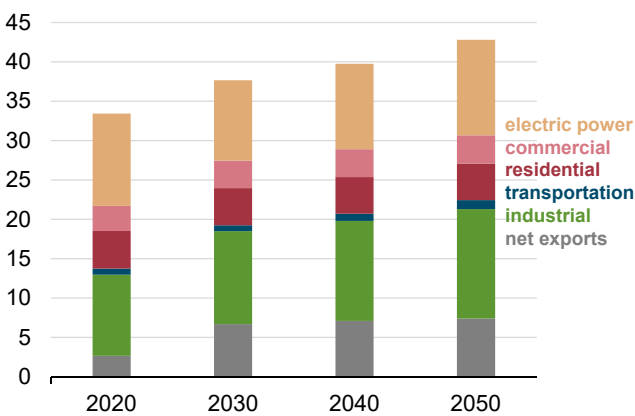


Change in natural gas disposition by sector and net exports

Natural gas disposition by sector and net exports

AEO2021 Reference case

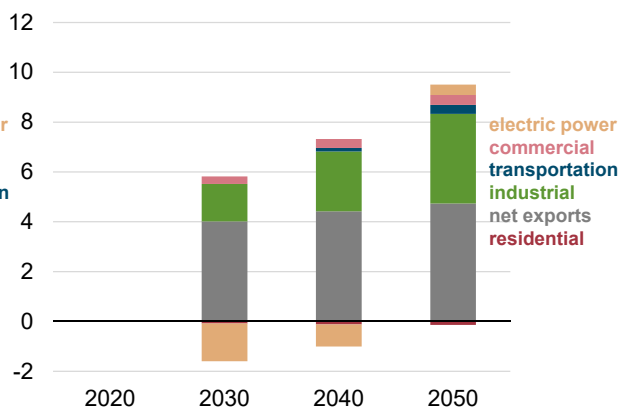
trillion cubic feet



Change in natural gas disposition and net exports

AEO2021 Reference case

relative to 2020 in trillion cubic feet



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

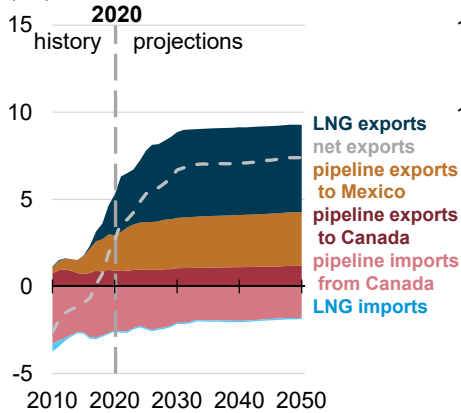
www.eia.gov/aeo



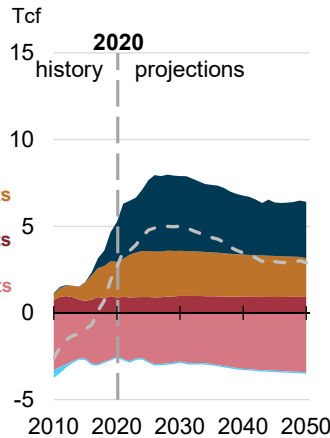
U.S. natural gas and liquefied natural gas (LNG) trade

U.S. natural gas and LNG trade, AEO2021 oil and gas supply cases

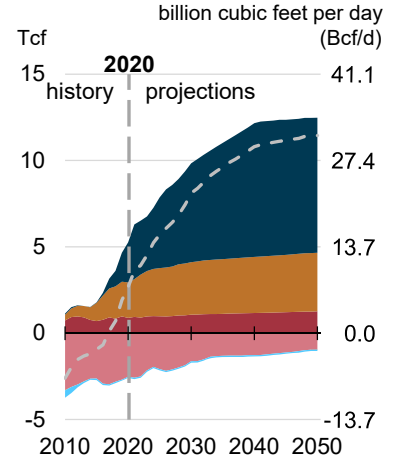
Reference case
trillion cubic feet
(Tcf)



Low Oil and Gas Supply case



High Oil and Gas Supply case



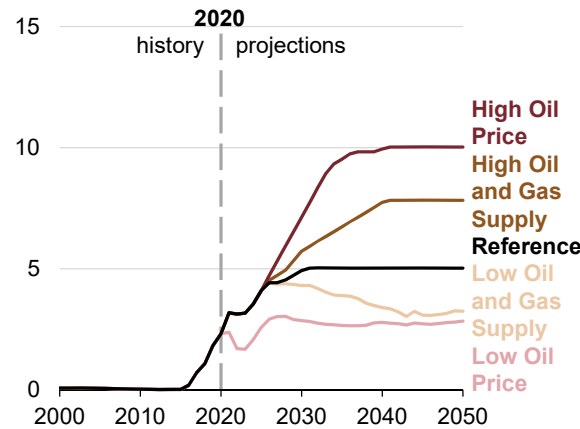
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

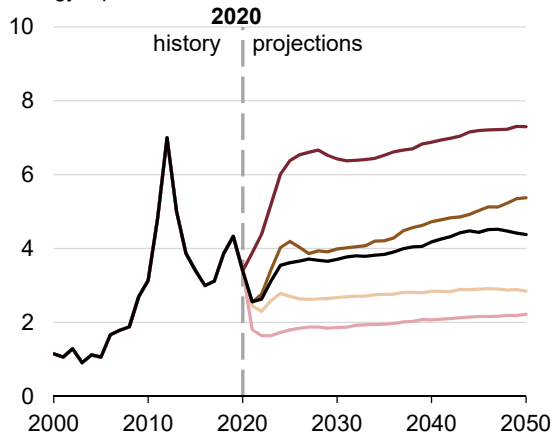


U.S. liquefied natural gas (LNG) exports and oil and natural gas prices

U.S. liquefied natural gas exports
AEO2021 supply and price cases
trillion cubic feet



Ratio of Brent crude oil price to natural gas price at Henry Hub, AEO2021 supply and price cases
energy-equivalent terms



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

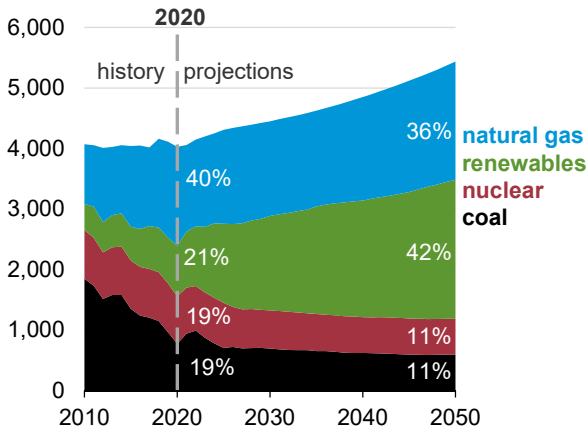


Electricity

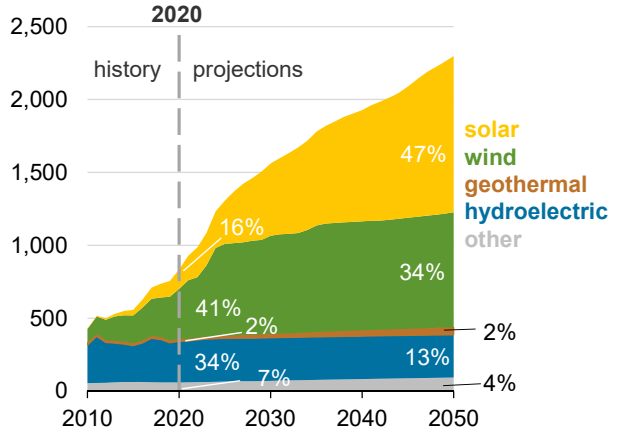


U.S. electricity generation and share from selected fuels and renewable sources

U.S. electricity generation from selected fuels
AEO2021 Reference case
billion kilowatthours



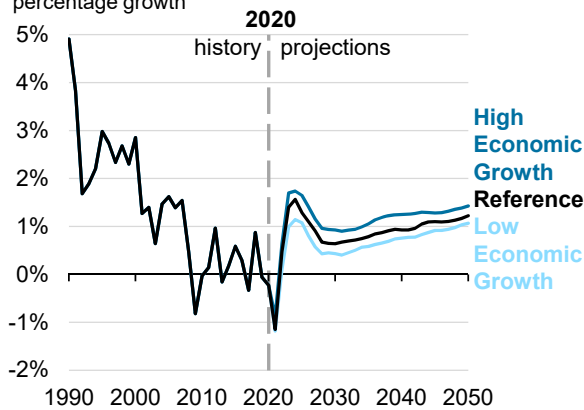
U.S. renewable electricity generation, including end use
AEO2021 Reference case
billion kilowatthours



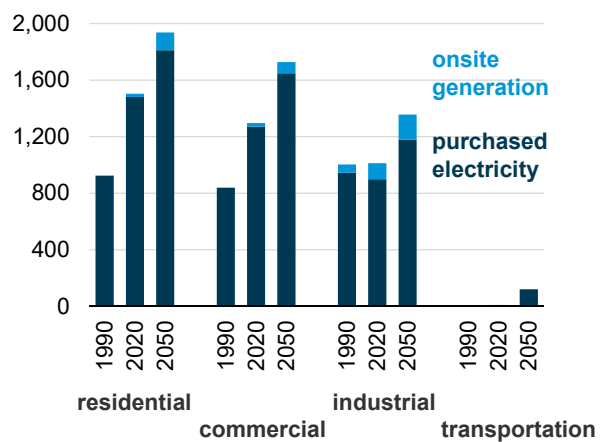


U.S. electricity demand

U.S. electricity use growth rate, three-year rolling average
AEO2021 economic growth cases
percentage growth



U.S. electricity use by end-use sector
AEO2021 Reference case
billion kilowatthours



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



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

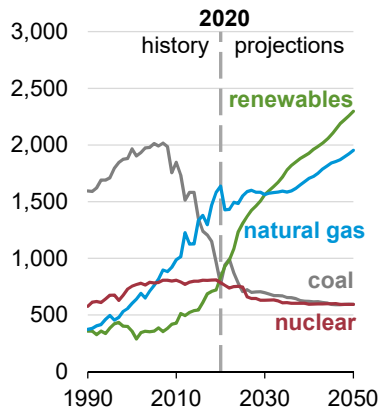
www.eia.gov/aeo



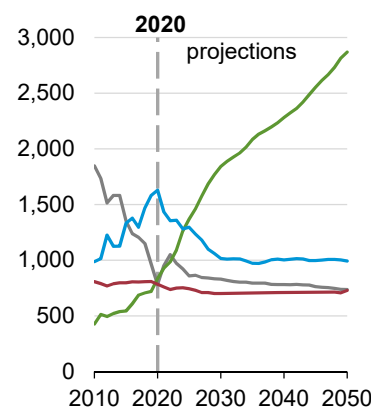
U.S. electricity generation levels from selected fuels and renewable sources

U.S. electricity generation, AEO2021 oil and gas supply cases

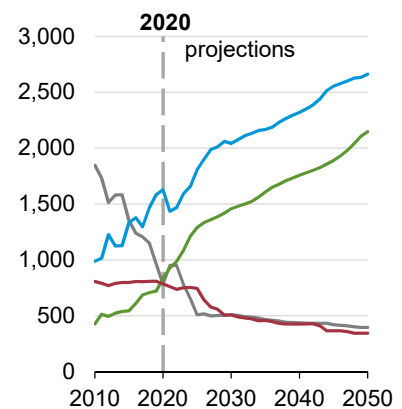
Reference case
billion kilowatthours



Low Oil and Gas Supply case
billion kilowatthours



High Oil and Gas Supply case
billion kilowatthours



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



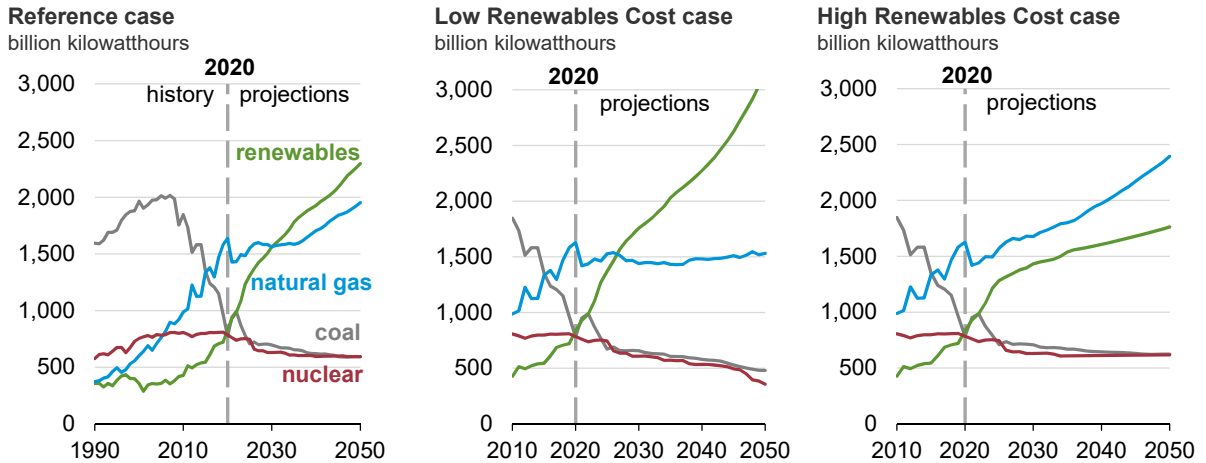
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo



U.S. electricity generation levels from selected fuels and renewable sources

U.S. electricity generation, AEO2021 renewables cost cases



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



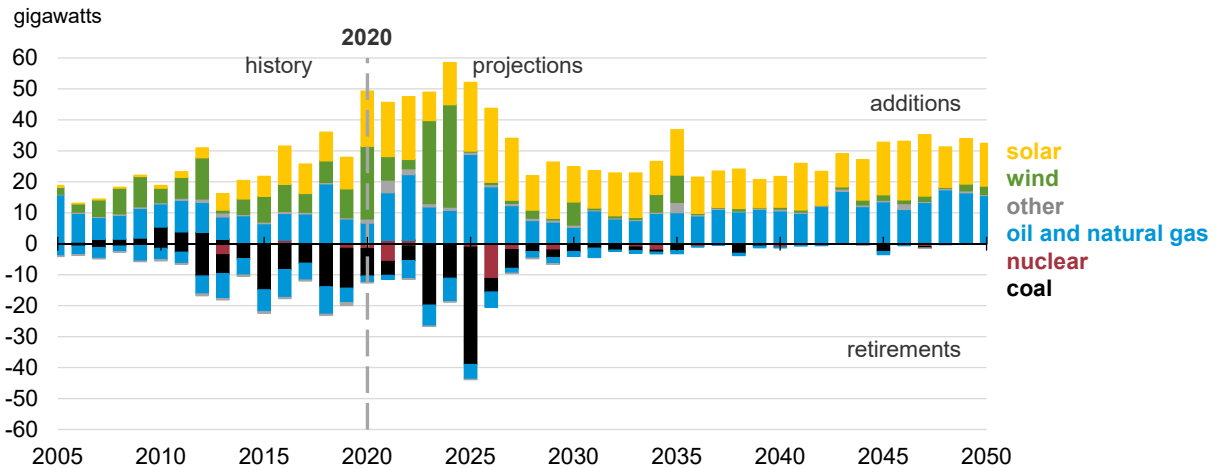
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021 (AEO2021)*

www.eia.gov/aeo



U.S. retiring and new generating capacity

Annual electricity generating capacity additions and retirements AEO2021 Reference case



Source: Form EIA-860M, *Monthly Update to the Annual Electric Generator Report*, July 2020



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021 (AEO2021)*

www.eia.gov/aeo

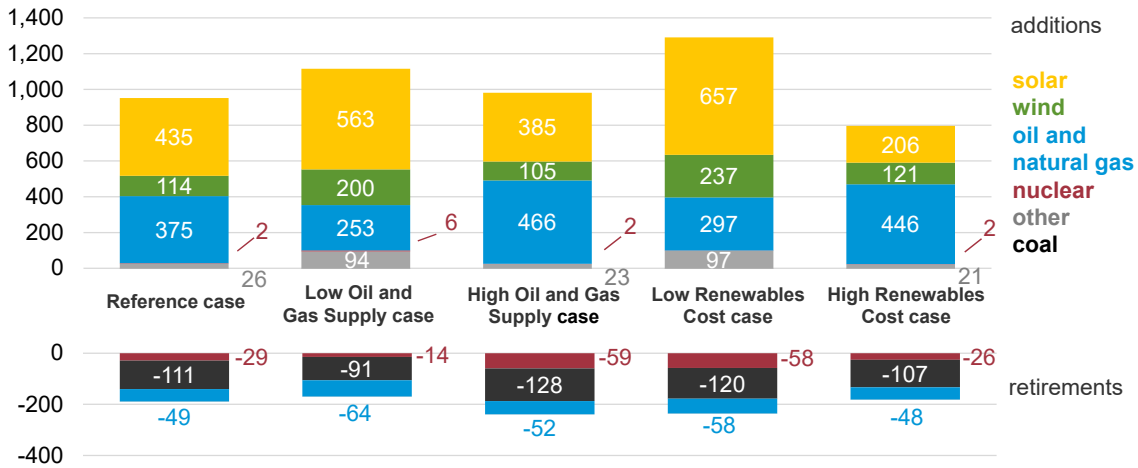


U.S. cumulative retiring and new generating capacity

Cumulative electricity generating capacity additions and retirements (2021–2050)

AEO2021 selected cases

gigawatts



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/ao

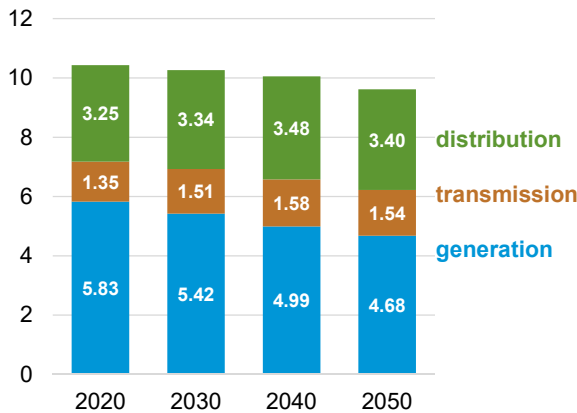


Electricity prices by components and long-term average electricity prices

Components of U.S. Electricity Prices

AEO2021 Reference case

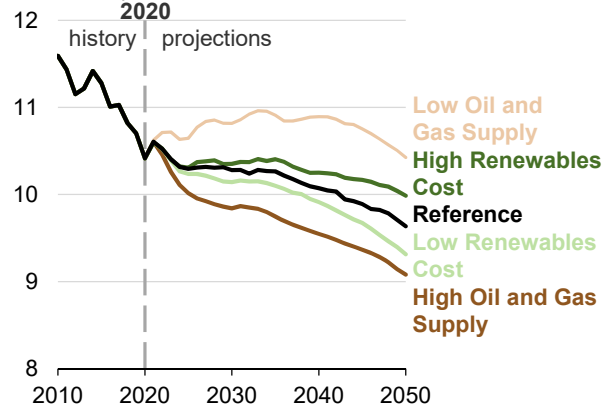
2020 cents per kilowatthour



U.S. average electricity price

AEO2021 selected cases

2020 cents per kilowatthour



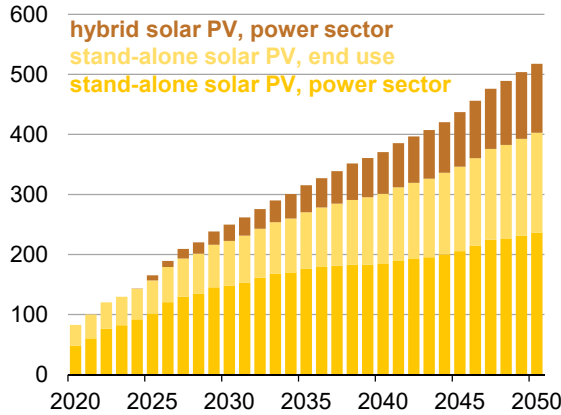
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/ao

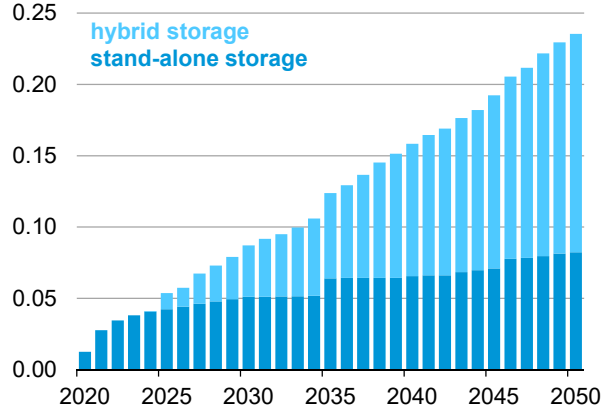


Hybrid versus stand-alone solar photovoltaic (PV) and energy storage systems

U.S. solar PV generating capacity, all sectors
AEO2021 Reference case
gigawatts



U.S. storage energy capacity, power sector
AEO2021 Reference case
billion kilowatthours



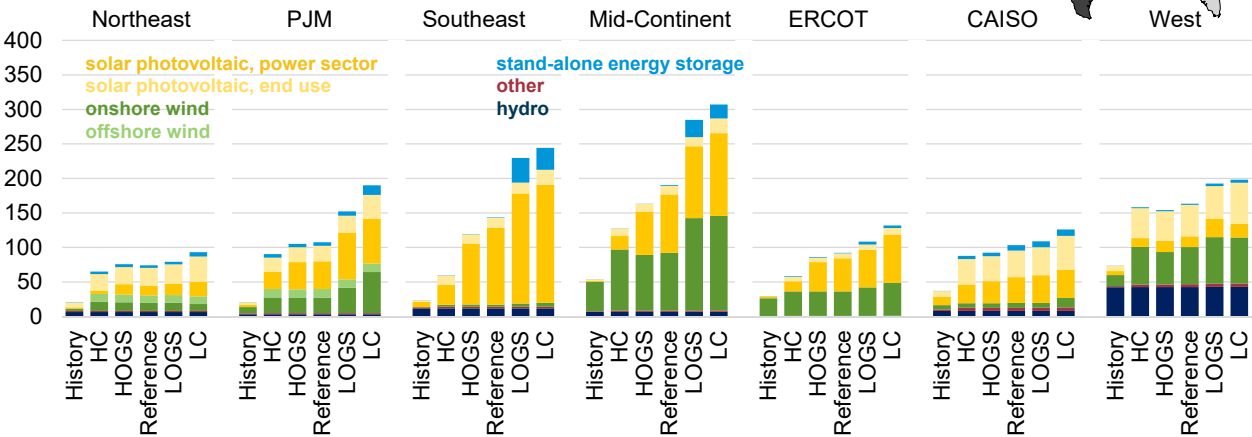
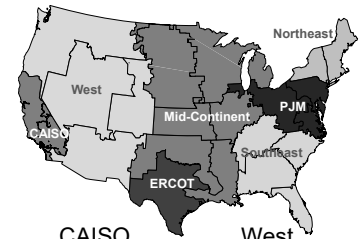
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo



Renewable capacity by source and region

Total renewables capacity in all sectors, 2019 and 2050
AEO2021 selected side cases
gigawatts



HC: High Renewable Cost; LC: Low Renewable Cost; HOGS: High Oil & Gas Supply; LOGS: Low Oil & Gas Supply; other: geothermal, biomass, municipal waste



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

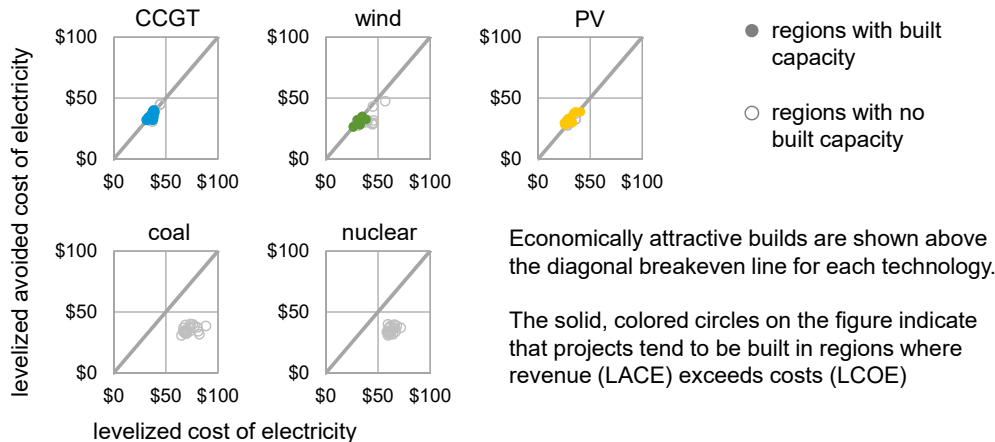
www.eia.gov/aeo



Economic cost competitiveness of generating technologies

Levelized avoided cost of electricity (LACE) and levelized cost of electricity (LCOE) by technology, 2026 online year, AEO2021 Reference case

2020 dollars per megawatthour



Note: CCGT = natural gas combined cycle, PV = solar photovoltaic



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

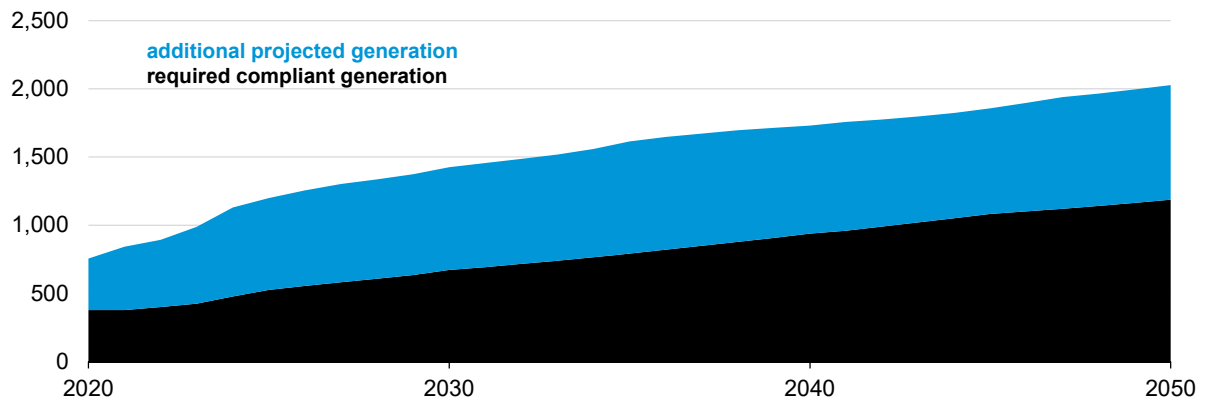


U.S. renewable portfolio standards

Total qualifying renewables generation required for combined state renewable portfolio standards and projected total generation from compliant technologies

AEO2021 Reference case

billion kilowatthours



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

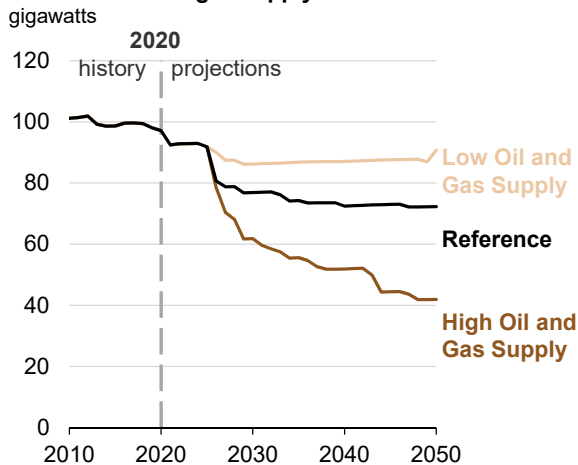
www.eia.gov/aeo



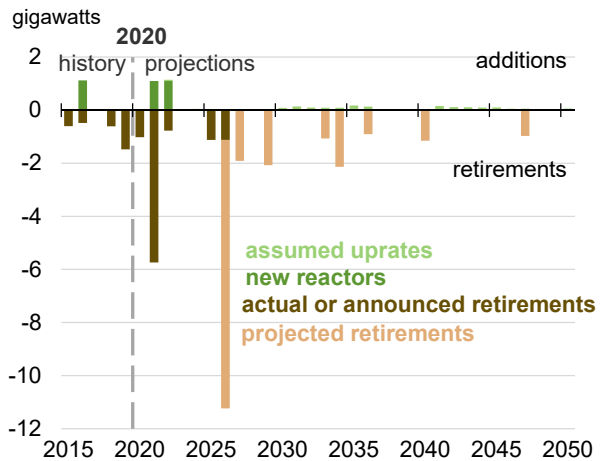


U.S. nuclear capacity and annual capacity changes

U.S. nuclear electricity generating capacity
AEO2021 oil and gas supply cases



Year-over-year nuclear capacity changes
AEO2021 Reference case



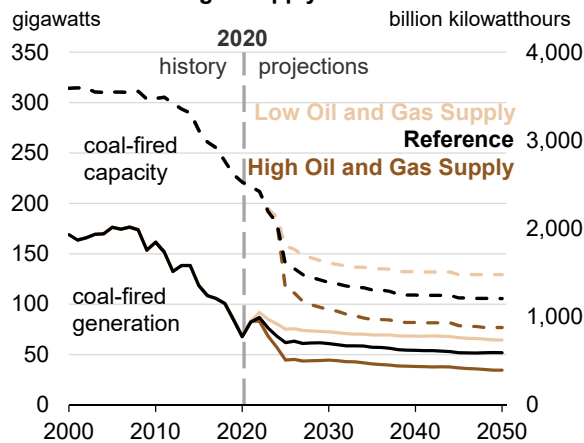
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

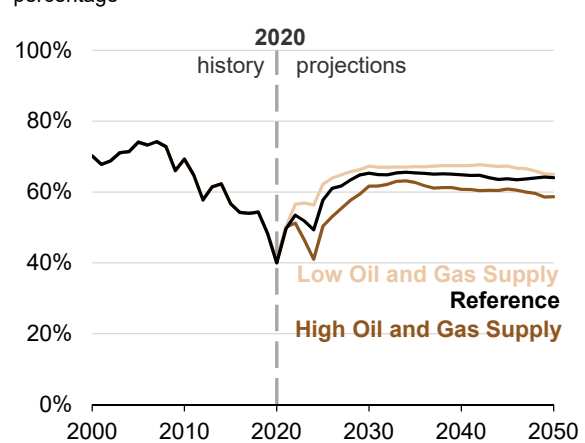


U.S. coal-fired generation, capacity, and capacity factors

U.S. electric generating capacity
AEO2021 oil and gas supply cases



U.S. capacity factor for coal-fired generation
AEO2021 oil and gas supply cases



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

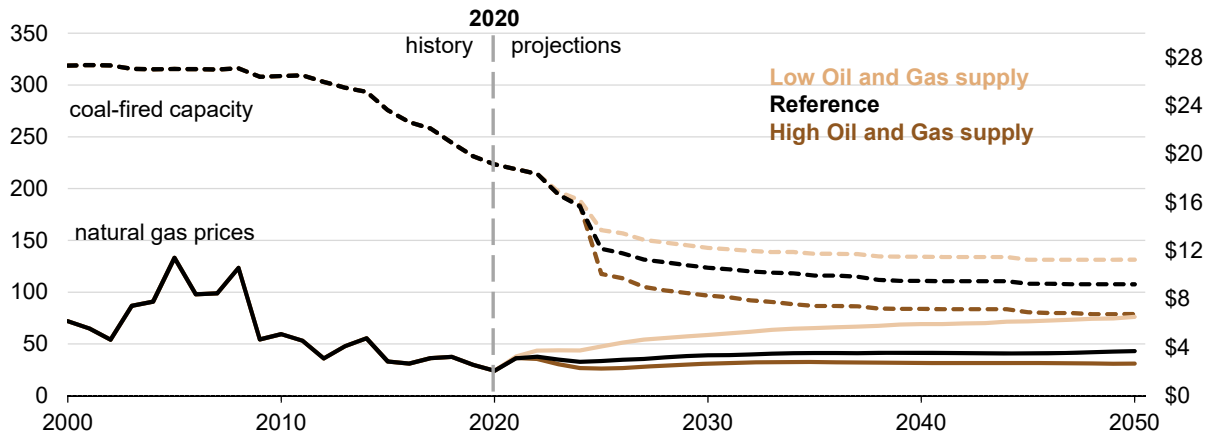




U.S. coal-fired generating capacity relative to natural gas prices

U.S. electric generating capacity
AEO2021 oil and gas supply cases
gigawatts

Average delivered natural gas prices to the electric
power sector
2020 dollars per million British thermal units



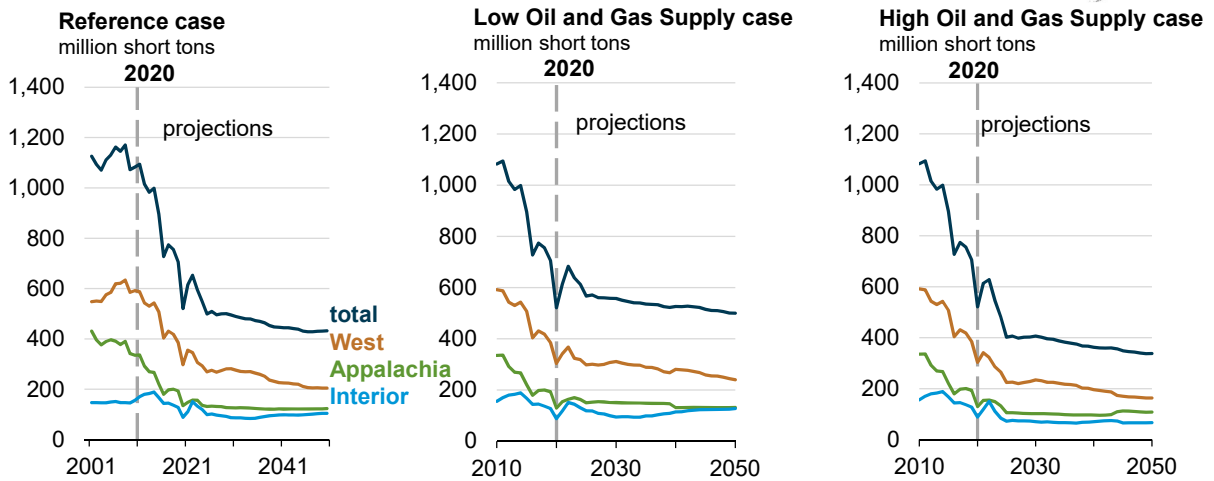
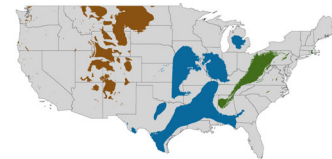
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo



Coal production by U.S. region

U.S. coal production by region, AEO2021 oil and gas supply cases



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

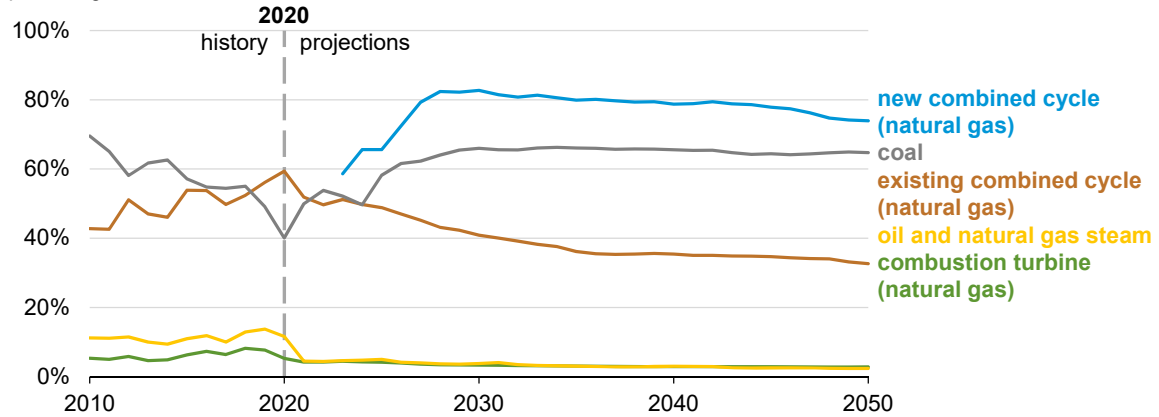


U.S. fossil fuel-fired plant capacity factors

Capacity factor for U.S. fossil fuel-fired plants

AEO2021 Reference case

percentage



Note: New combined-cycle (natural gas) plants are assumed to come online in 2023. New builds as shown are multi-shaft combined-cycle units. Existing combined cycle units include both multi-shaft and single-shaft; 12 gigawatts of new single-shaft combined-cycle units are included in existing.



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/ao



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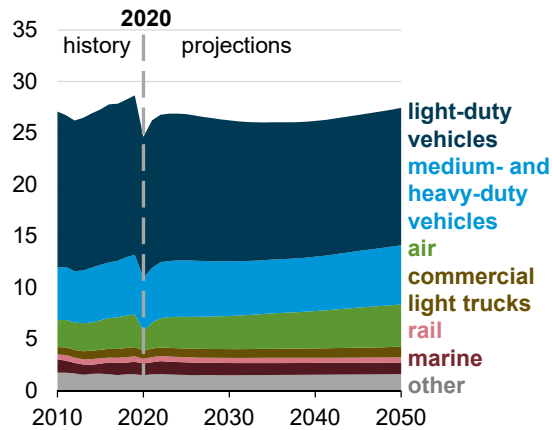


Transportation

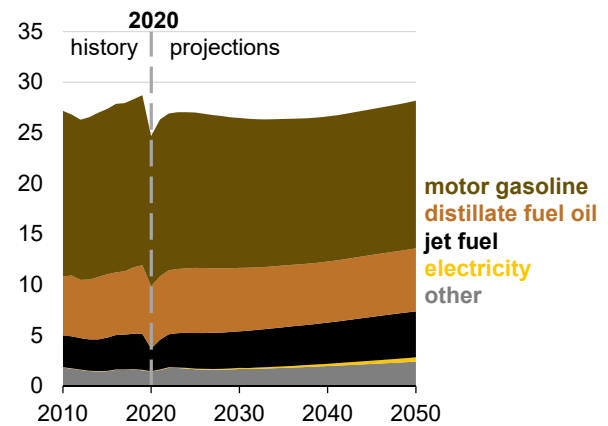


Transportation sector energy consumption

Transportation sector consumption by mode
AEO2021 Reference case
quadrillion British thermal units



Transportation sector consumption by fuel
AEO2021 Reference case
quadrillion British thermal units



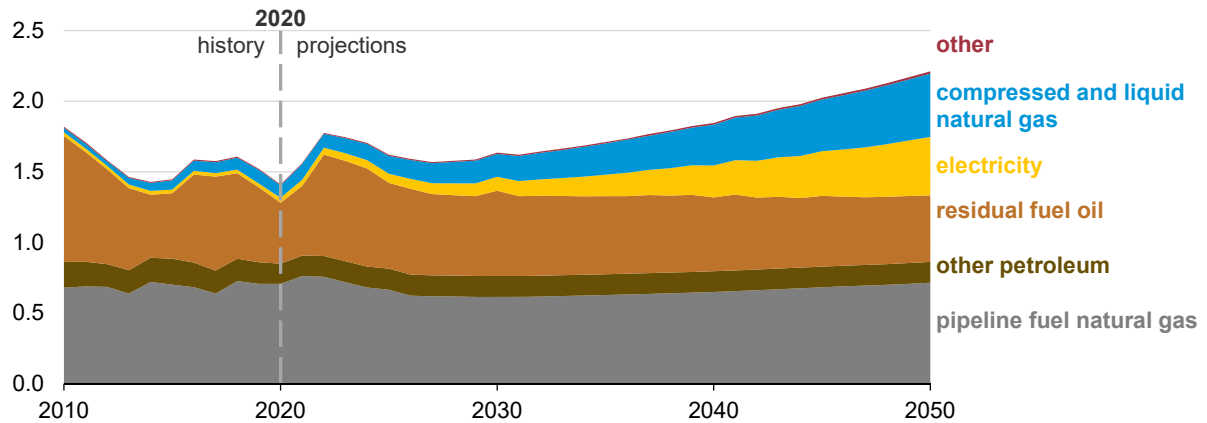


Transportation sector minor petroleum and alternative fuels consumption

Transportation sector consumption of minor petroleum and alternative fuels

AEO2021 Reference case

quadrillion British thermal units



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/ao

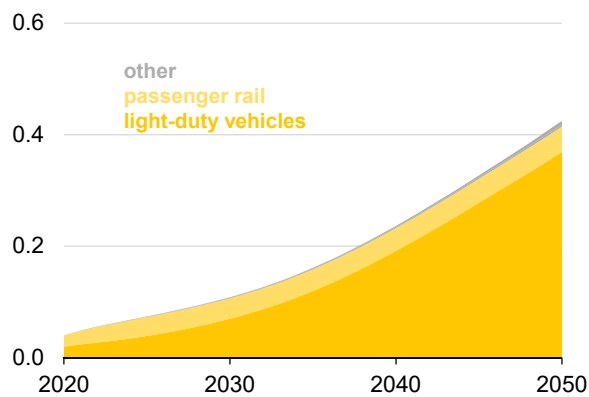


Transportation sector delivered electricity and natural gas

Delivered electricity by mode

AEO2021 Reference case

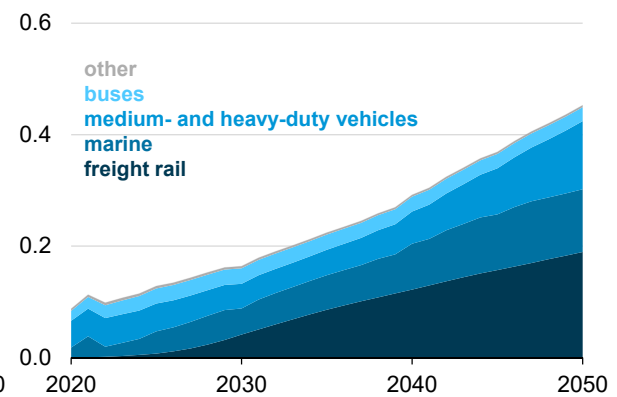
quadrillion British thermal units



Delivered compressed and liquefied natural gas by mode

AEO2021 Reference case

quadrillion British thermal units



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

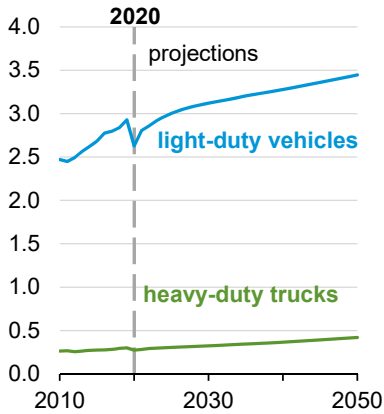
www.eia.gov/ao



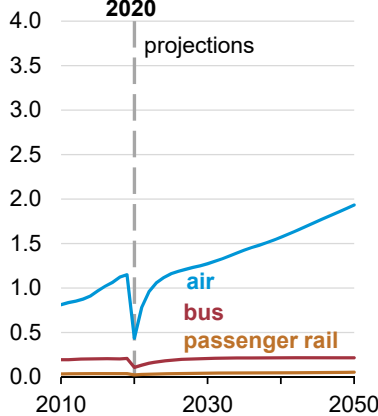


Passenger and freight travel by mode

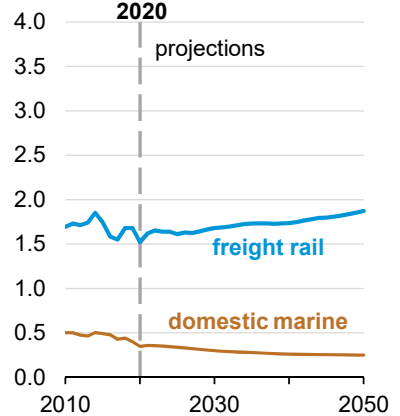
Vehicle travel
AEO2021 Reference case
trillion vehicle-miles



Passenger travel
AEO2021 Reference case
trillion revenue passenger-miles



Rail and domestic shipping
AEO2021 Reference case
trillion ton-miles traveled



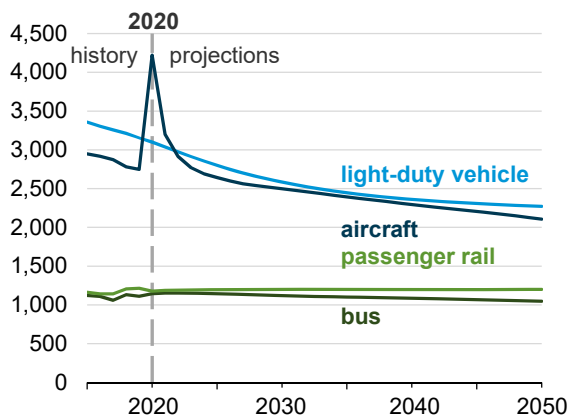
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

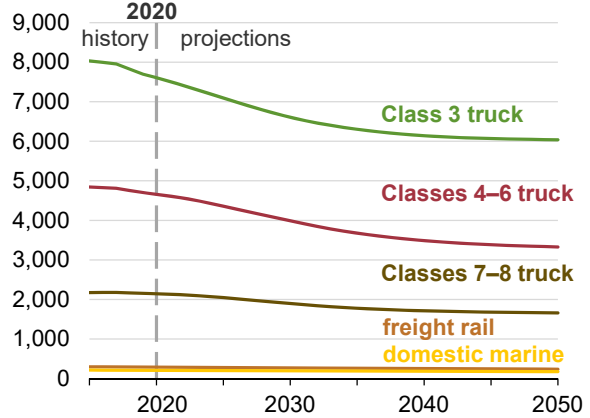


Energy intensity by transportation mode

Passenger travel energy intensity by mode
AEO2021 Reference case
British thermal units per passenger-mile



Freight travel energy intensity by mode
AEO2021 Reference case
British thermal units per ton-mile



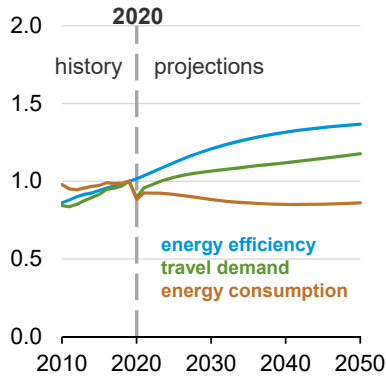
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

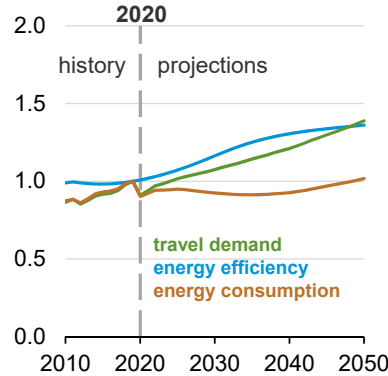


Indexed travel indicators and energy use by mode

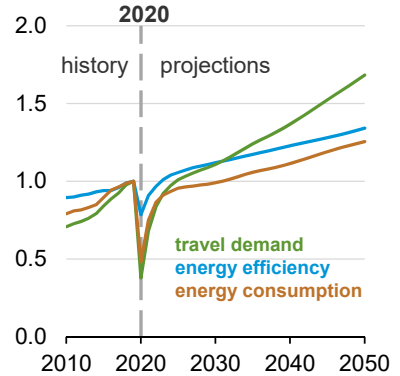
Indexed light-duty vehicle travel and energy use
AEO2021 Reference case
2019 = 1.0



Indexed freight and commercial truck travel and energy use
AEO2021 Reference case
2019 = 1.0



Indexed aircraft travel and energy use
AEO2021 Reference case
2019 = 1.0



Note: Indexed freight and commercial truck energy efficiency is weighted by each vehicle type's relative share of energy consumption.



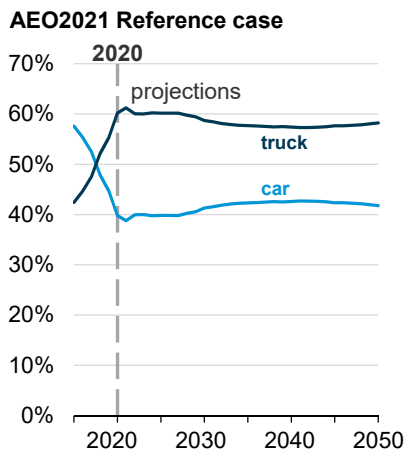
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

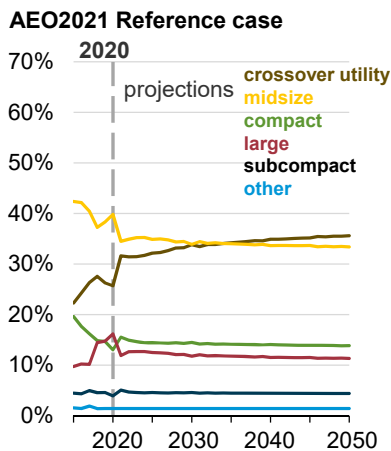


New light-duty vehicle sales shares

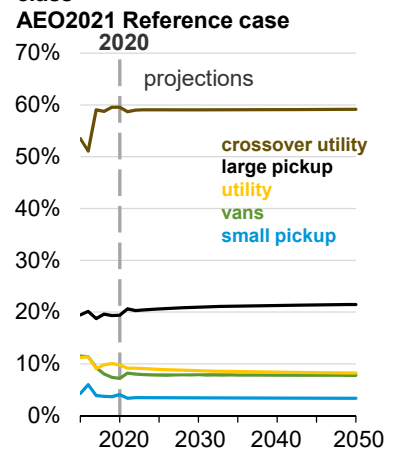
Light-duty vehicle sales shares



Car sales shares by size class



Light truck sales shares by size class



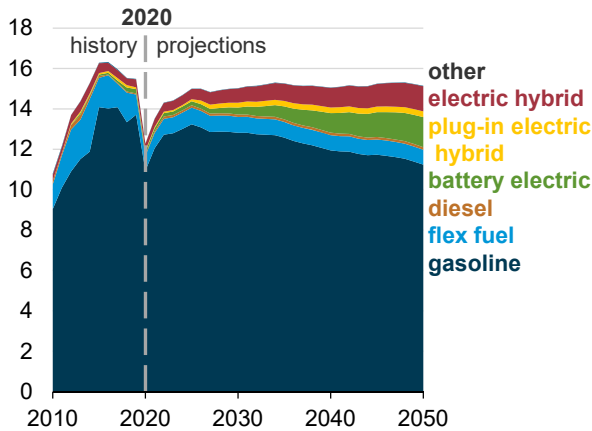
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

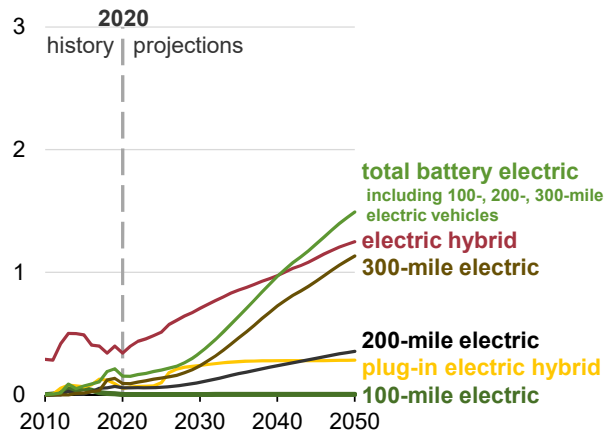


Light-duty vehicle sales by technology/fuel type

Light-duty vehicle sales by technology/fuel
AEO2021 Reference case
millions of vehicles



New vehicle sales of battery-powered vehicles
AEO2021 Reference case
millions of vehicles



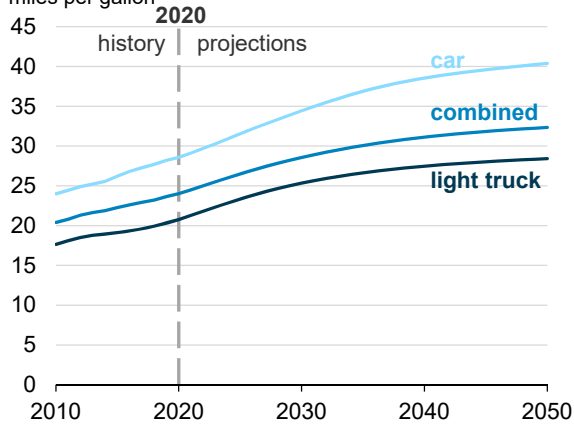
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/ao

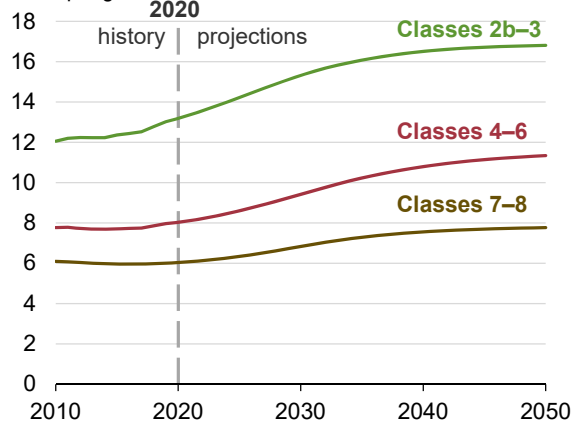


On-road vehicle fuel economy

Light-duty fuel economy by vehicle type
AEO2021 Reference case
miles per gallon



Heavy-duty fuel economy
AEO2021 Reference case
miles per gallon



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/ao

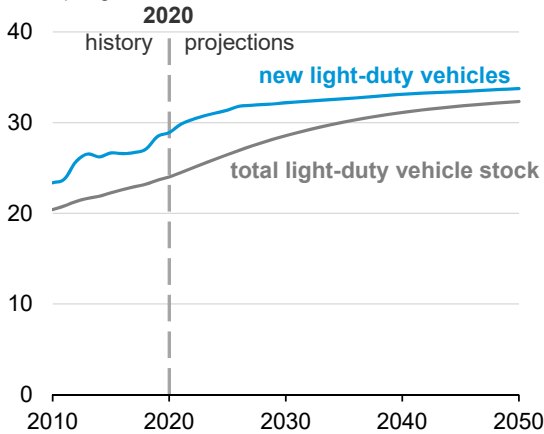


Light-duty vehicle fuel economy and per capita travel

Light-duty vehicle average fuel economy

AEO2021 Reference case

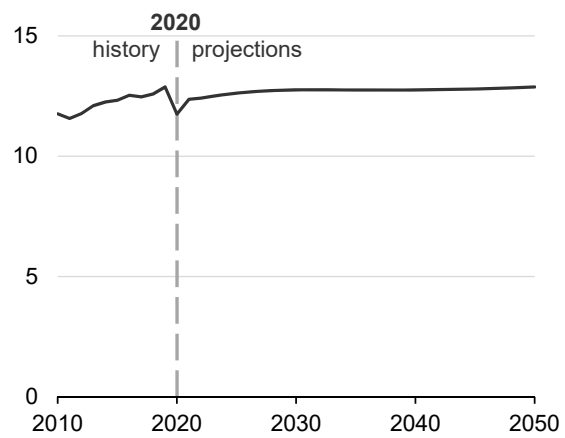
miles per gallon



Light-duty vehicle miles traveled per licensed driver

AEO2021 Reference case

thousand miles



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021 (AEO2021)*

www.eia.gov/aeo

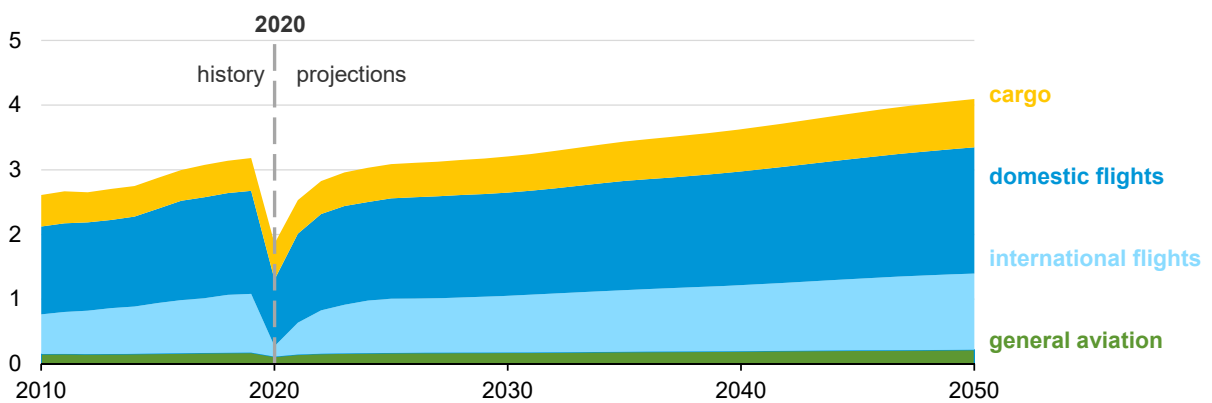


Air travel energy use by mode

Energy use by air mode

AEO2021 Reference case

quadrillion British thermal units



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021 (AEO2021)*

www.eia.gov/aeo



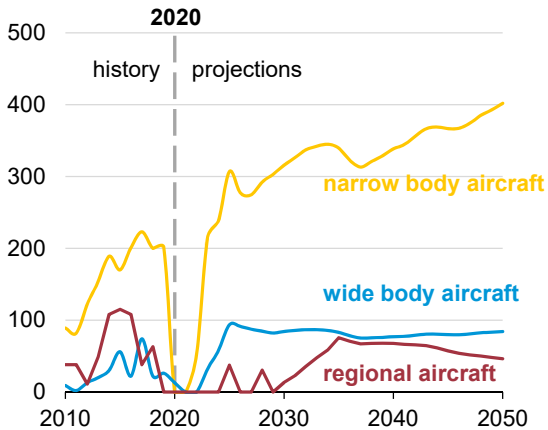


Passenger aircraft sales and jet fuel efficiency

U.S. passenger jet sales by body type

AEO2021 Reference case

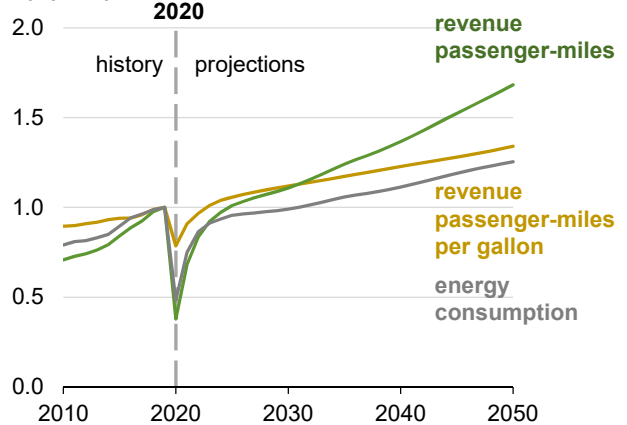
individual aircraft sold



U.S. passenger jet fuel efficiency index

AEO2021 Reference case

2019 = 1.0



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/ao



Passenger travel demand and aircraft stock

Revenue passenger-miles

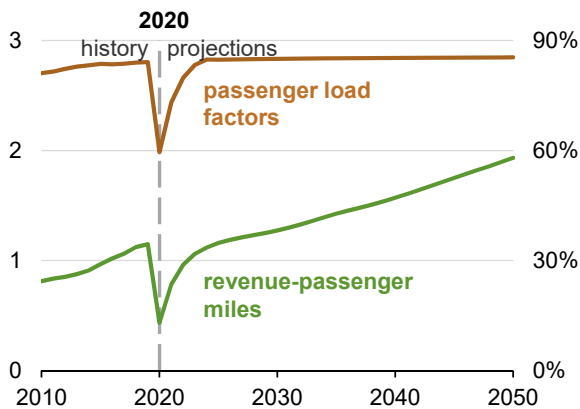
AEO2021 Reference case

trillion passenger-miles

Average passenger

load factors

percentage



Active versus parked passenger and cargo stock

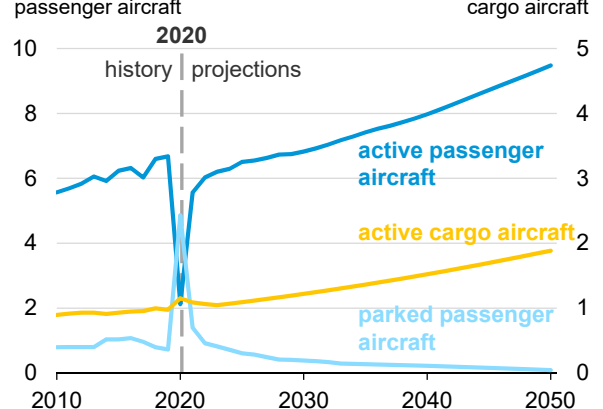
AEO2021 Reference case

thousand active and parked

thousand active

passenger aircraft

cargo aircraft



Note: Load factors are weighted by domestic and U.S.-originating or U.S.-bound flights' relative share of revenue passenger-miles.



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/ao





Buildings

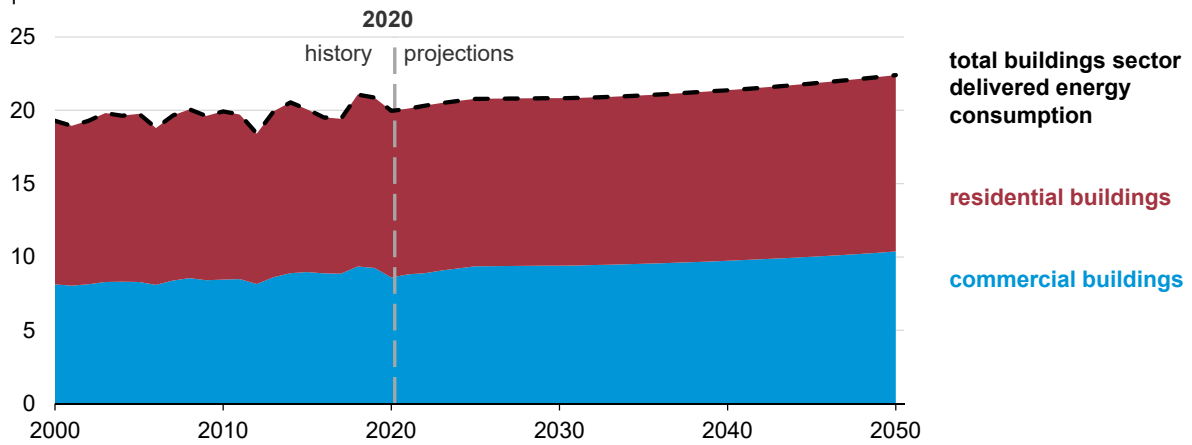


Buildings sector delivered energy consumption

Buildings delivered energy consumption

AEO2021 Reference case

quadrillion British thermal units



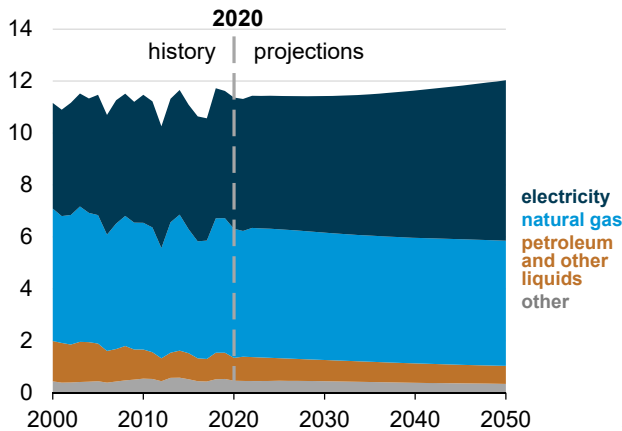


Residential and commercial buildings energy consumption

Residential sector delivered energy consumption

AEO2021 Reference case

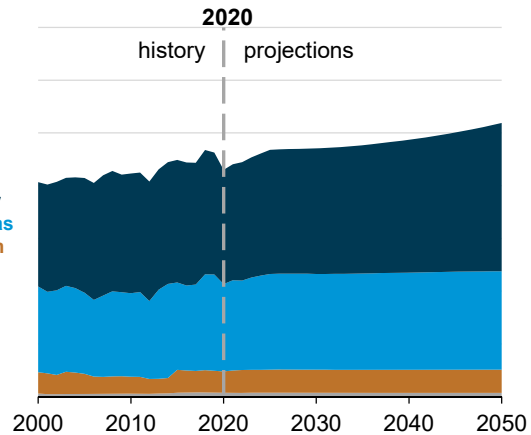
quadrillion British thermal units



Commercial sector delivered energy consumption

AEO2021 Reference case

quadrillion British thermal units



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo



Change in population and residential housing stocks

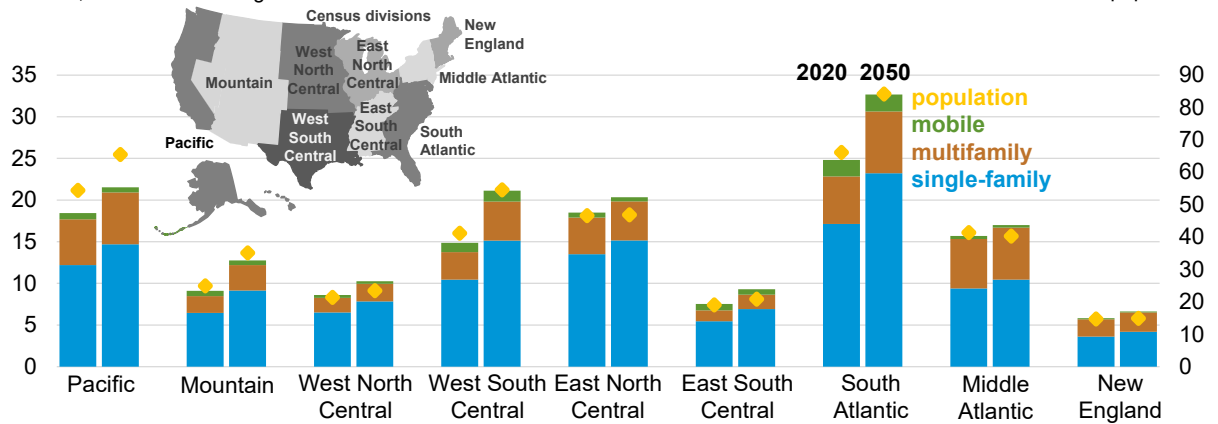
Residential housing unit and population changes by region and type in 2020 and 2050

AEO2021 Reference case

millions, residential housing units

◆ population

millions, U.S. population



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

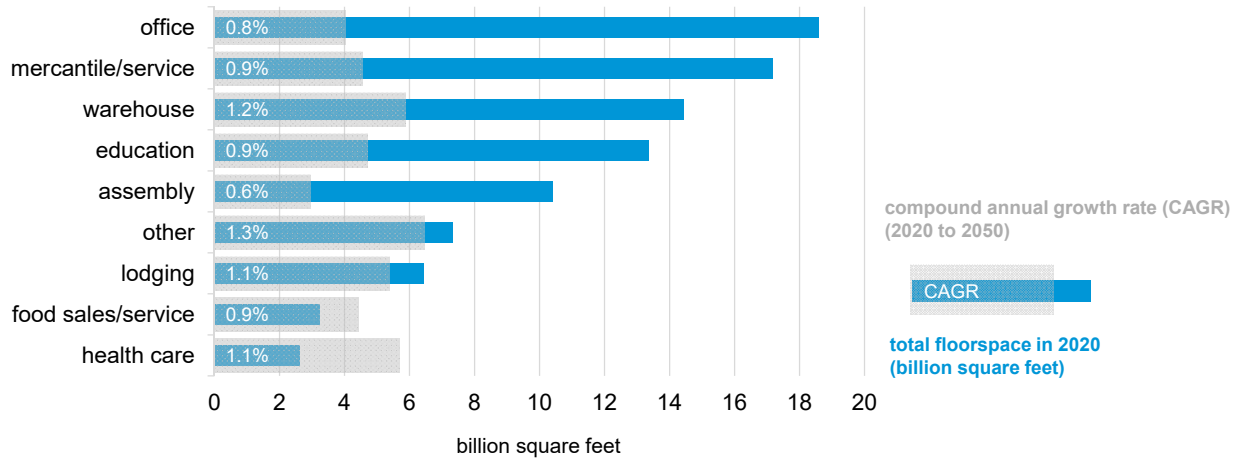


Commercial buildings floorspace growth

Commercial floorspace in 2020 and growth in floorspace from 2020 to 2050

AEO2021 Reference case

percentage growth



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

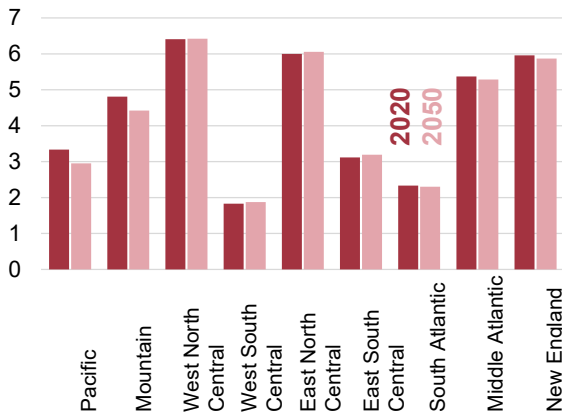


Population-weighted heating and cooling degree days

Population-weighted heating degree days by census division

AEO2021 Reference case

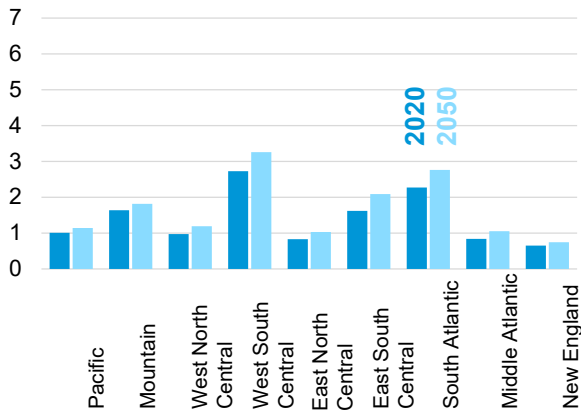
thousand degree days



Population-weighted cooling degree days by census division

AEO2021 Reference case

thousand degree days



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

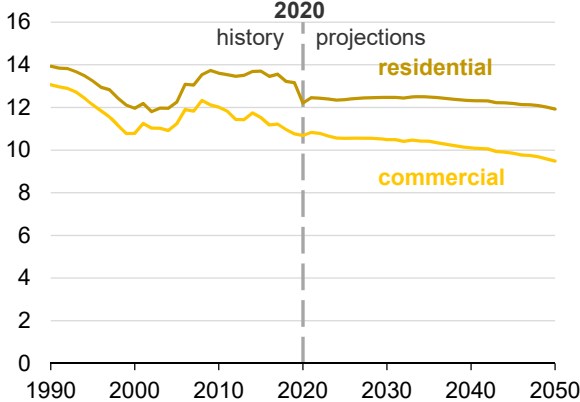


Residential and commercial electricity and natural gas prices

Electricity prices in the residential and commercial sectors

AEO2021 Reference case

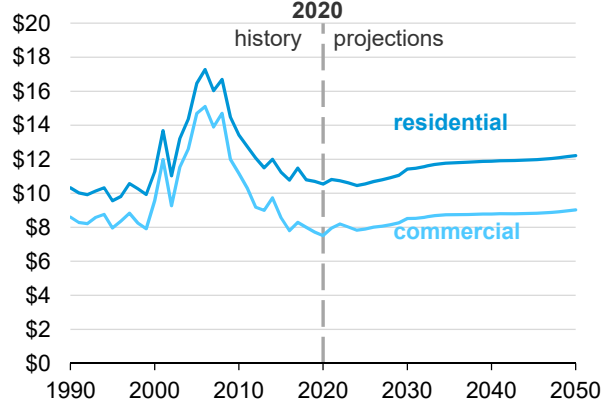
2020 cents per kilowatthour



Natural gas prices in the residential and commercial sectors

AEO2021 Reference case

2020 dollars per thousand cubic feet



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

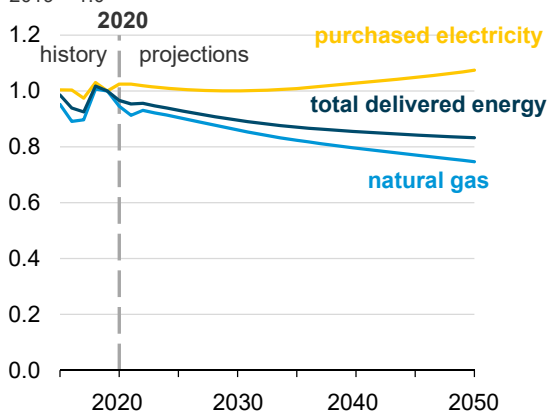


Residential and commercial energy intensity

Indexed residential delivered energy intensity

AEO2021 Reference case

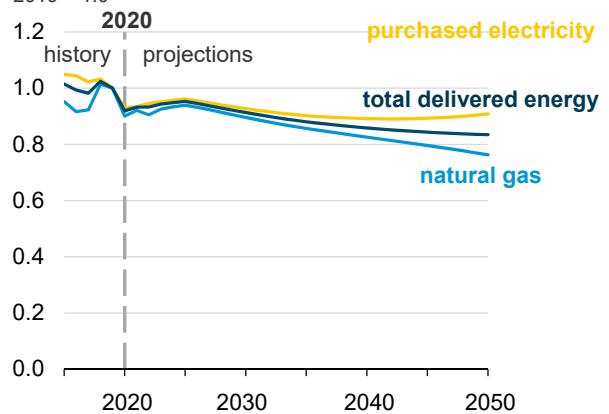
indexed annual energy use per household
2019 = 1.0



Indexed commercial delivered energy intensity

AEO2021 Reference case

indexed annual energy use per square foot
2019 = 1.0



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

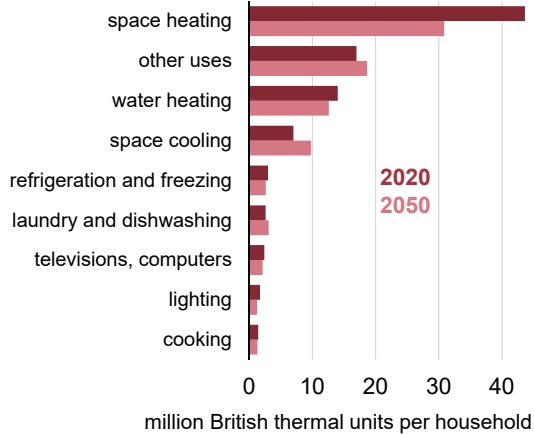
www.eia.gov/aeo



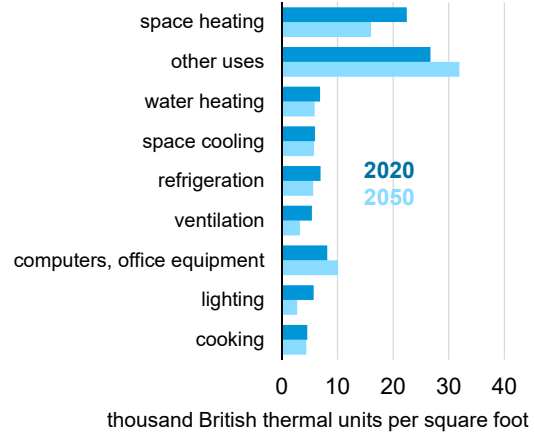


Residential and commercial overall energy intensity by end use

Residential energy intensity by end use
AEO2021 Reference case



Commercial energy intensity by end use
AEO2021 Reference case



Note: Intensities reflect all energy sources consumed, including both purchased electricity and electricity produced onsite for own use.



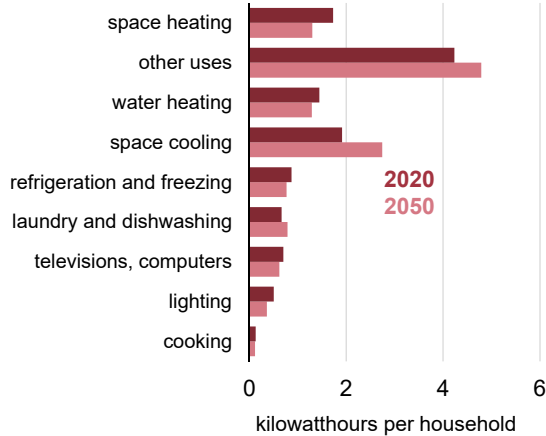
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/ao

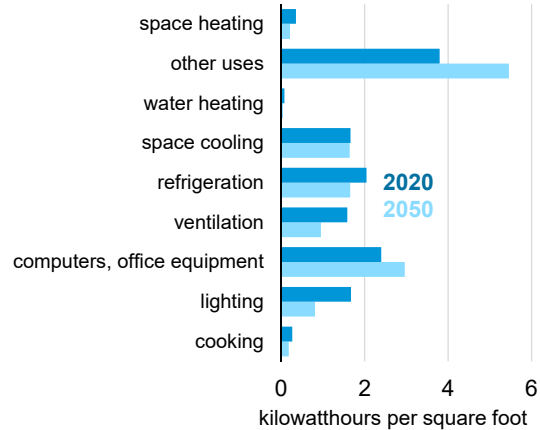


Residential and commercial electricity intensity by end use

Residential electricity intensity by end use
AEO2021 Reference case



Commercial electricity intensity by end use
AEO2021 Reference case



Note: Intensities reflect both purchased electricity and electricity produced onsite for own use.



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/ao



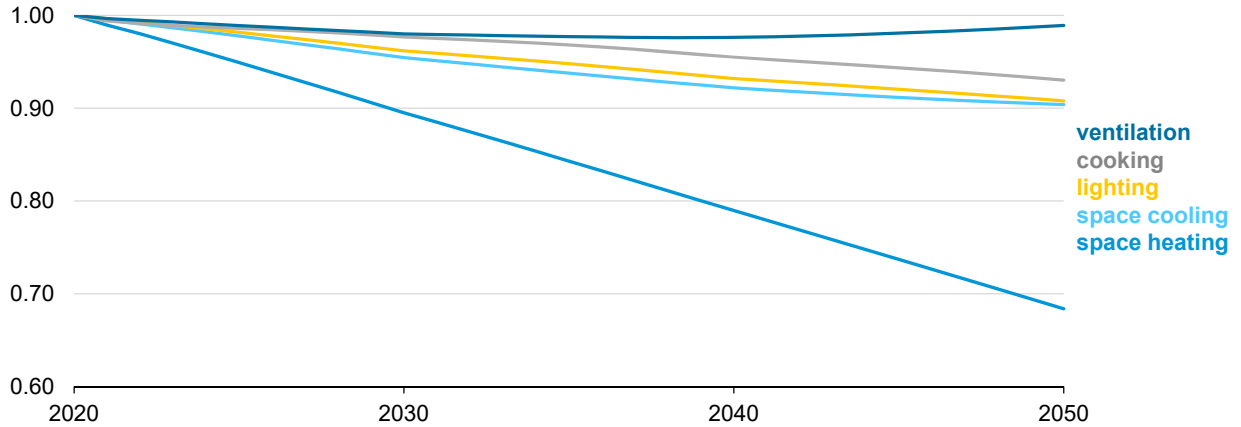


Commercial building end-use intensities

Indexed commercial service provided per square foot of floorspace

AEO2021 Reference case

2020 = 1.0



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

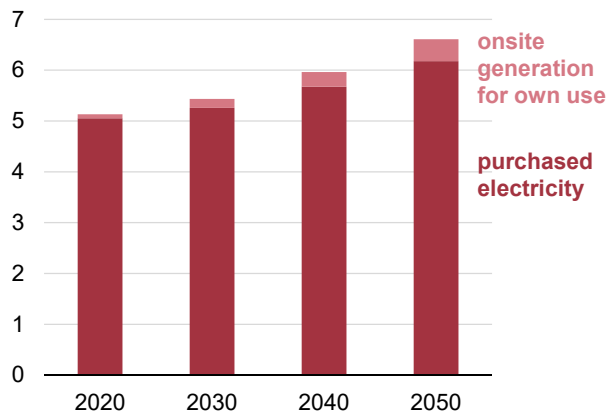


Residential and commercial onsite generation versus purchased electricity

Residential sector electricity consumption

AEO2021 Reference case

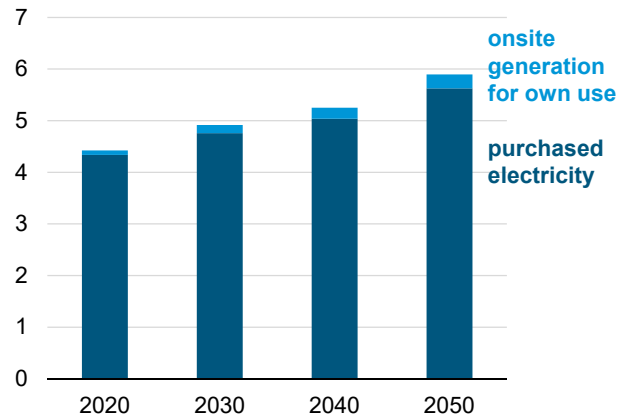
quadrillion British thermal units



Commercial sector electricity consumption

AEO2021 Reference case

quadrillion British thermal units



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

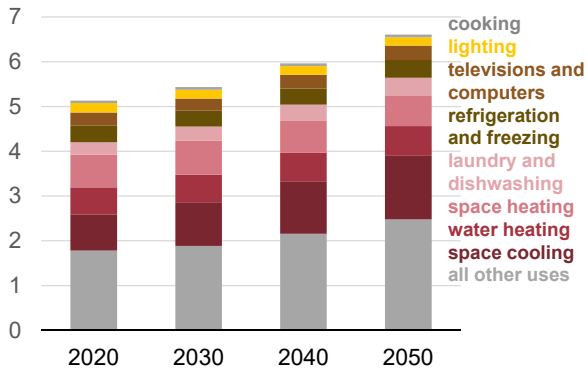




Residential consumption of onsite generation versus purchased electricity

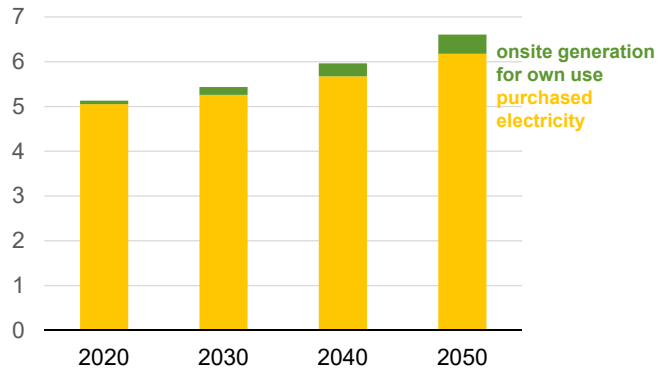
Electricity consumed to meet residential end-use demand

AEO2021 Reference case
quadrillion British thermal units



Onsite generation and purchased electricity consumed to meet residential end-use demand

AEO2021 Reference case
quadrillion British thermal units



Note: Onsite generation projections are not attributed to any particular end use.



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

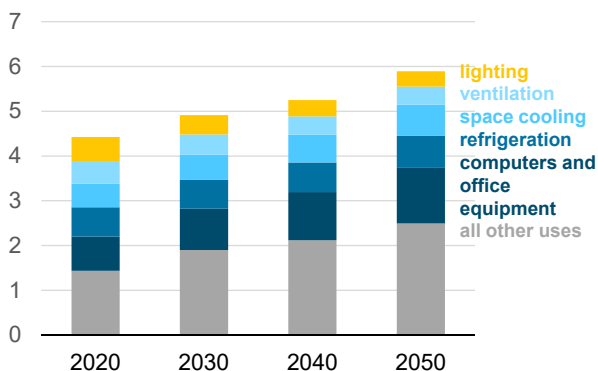
www.eia.gov/aeo



Commercial consumption of onsite generation versus purchased electricity

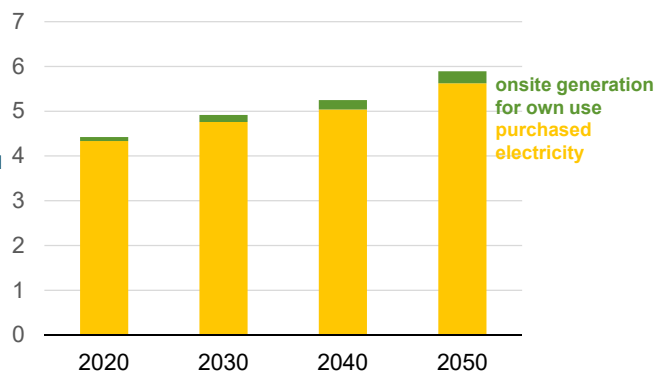
Electricity consumed to meet commercial end-use demand

AEO2021 Reference case
quadrillion British thermal units



Onsite generation and purchased electricity consumed to meet commercial end-use demand

AEO2021 Reference case
quadrillion British thermal units



Note: Onsite generation projections are not attributed to any particular end use.



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo



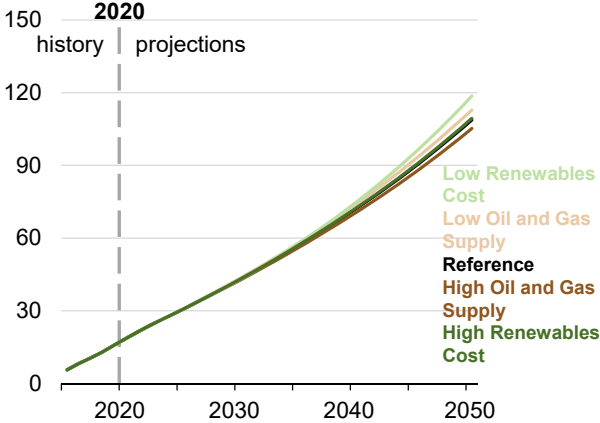


Residential and commercial solar photovoltaic generation capacity

Residential solar distributed generation capacity

AEO2021 Reference case

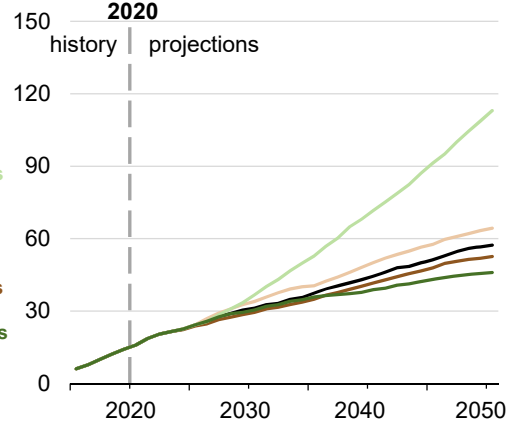
gigawatts direct current



Commercial solar distributed generation capacity

AEO2021 Reference case

gigawatts direct current



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

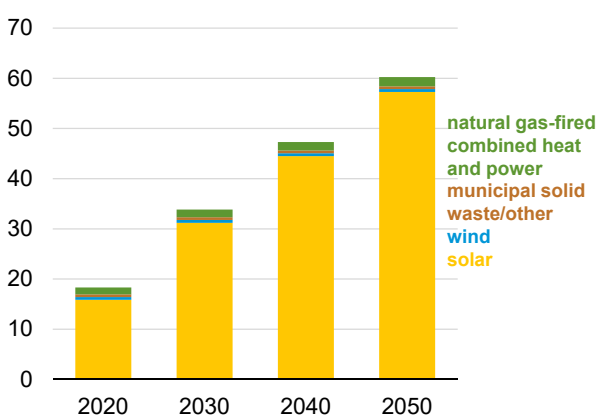


Commercial distributed generation capacity

Commercial distributed generation capacity

AEO2021 Reference case

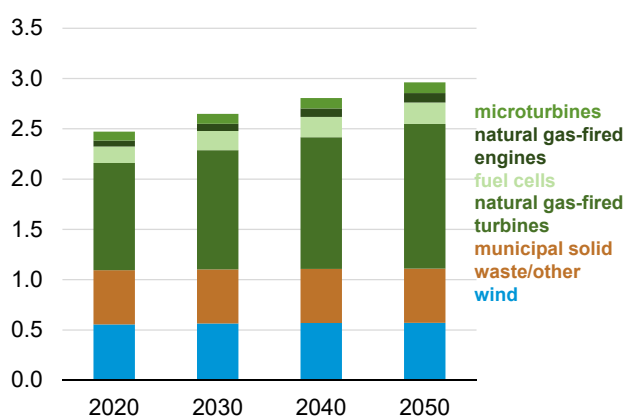
gigawatts direct current



Commercial non-solar distributed generation capacity

AEO2021 Reference case

gigawatts direct current



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

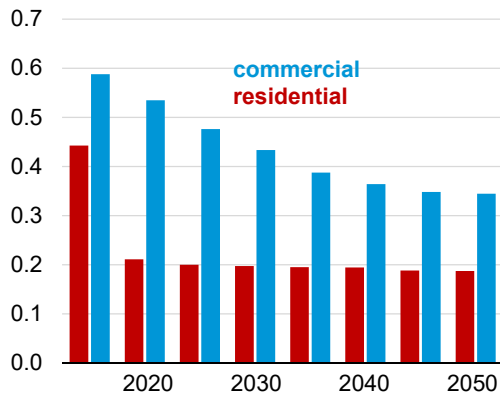
www.eia.gov/aeo





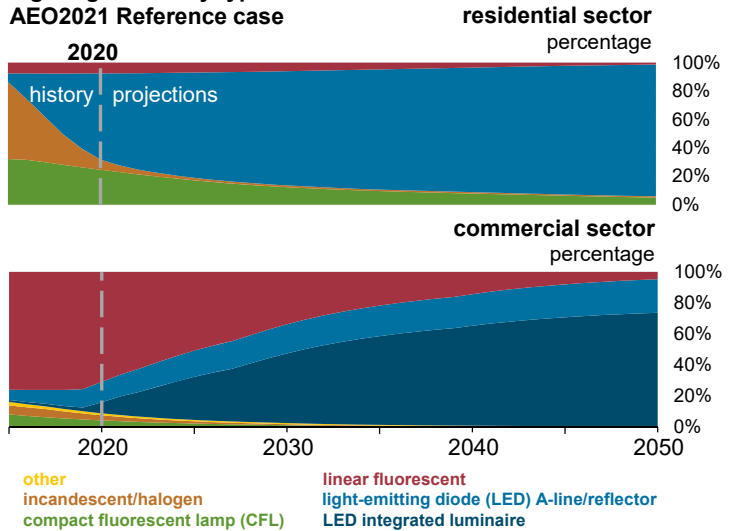
Residential and commercial lighting consumption and lighting shares

Electricity consumed to meet lighting demand
AEO2021 Reference case
quadrillion British thermal units



Note: Includes both purchased electricity and onsite generation for own use

Lighting shares by type
AEO2021 Reference case



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

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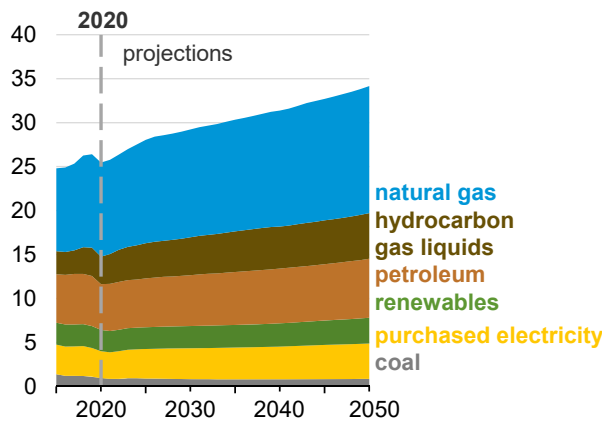


Industrial

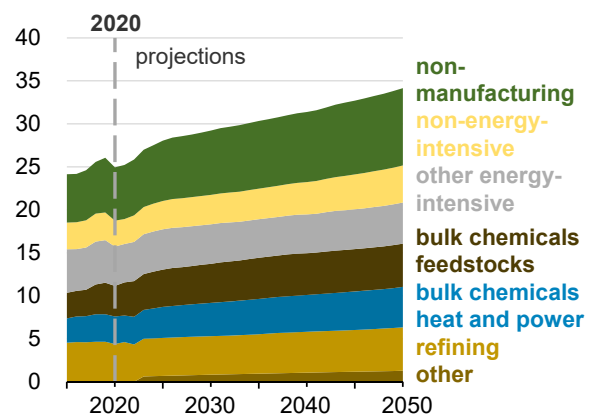


Industrial sector energy consumption

Industrial energy consumption by fuel
AEO2021 Reference case
quadrillion British thermal units



Industrial energy consumption by subsector
AEO2021 Reference case
quadrillion British thermal units



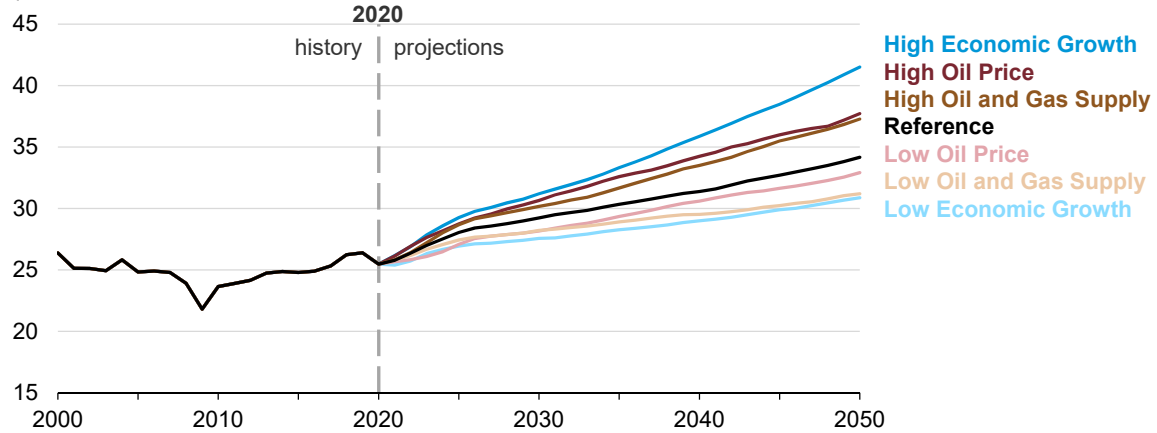


Industrial sector delivered energy consumption across cases

Industrial delivered energy consumption

AEO2021 selected side cases

quadrillion British thermal units



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

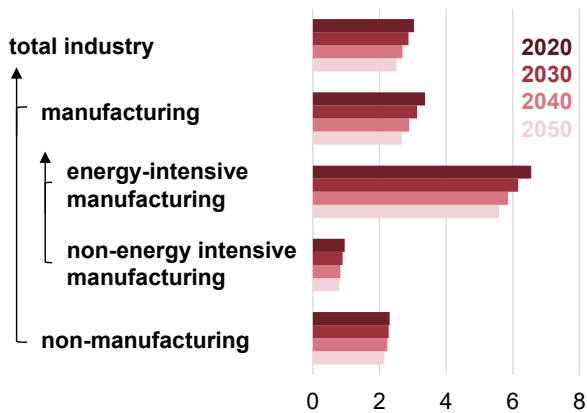
www.eia.gov/aeo



Industrial sector energy intensity

Energy intensity by subsector

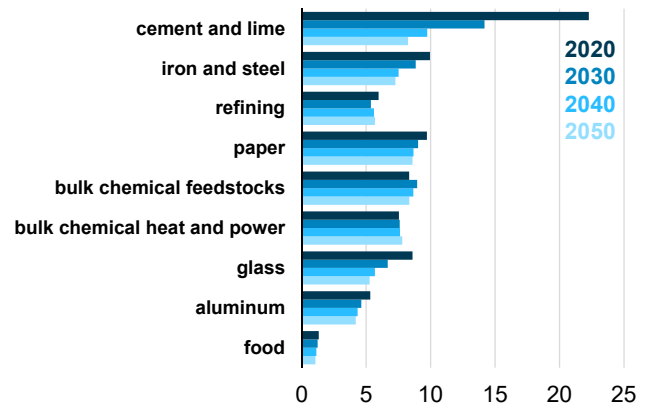
AEO2021 Reference case



trillion British thermal units per billion 2012 dollar shipments

Energy-intensive manufacturing by industry

AEO2021 Reference case



trillion British thermal units per billion 2012 dollar shipments



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

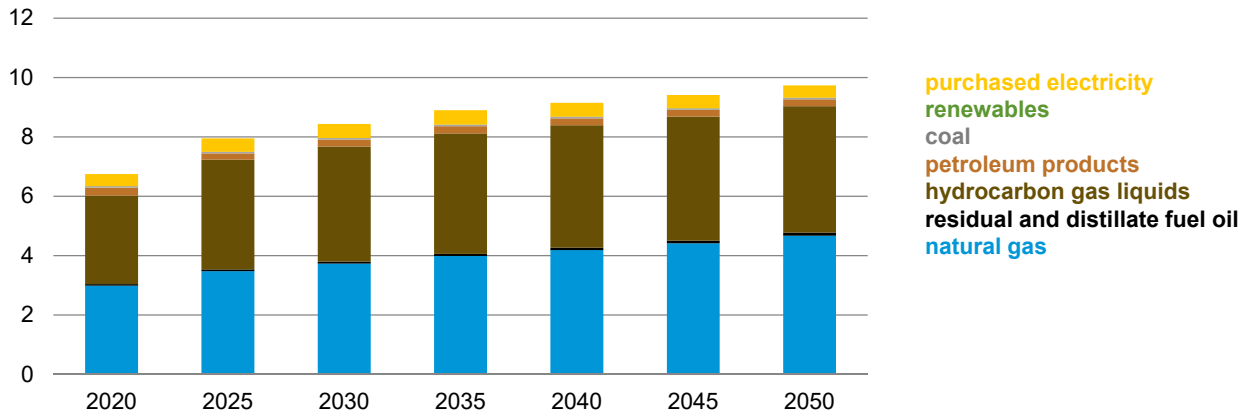


Bulk chemicals industry energy consumption by fuel

Bulk chemicals industry energy consumption by energy source, including feedstocks

AEO2021 Reference case

quadrillion British thermal units



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

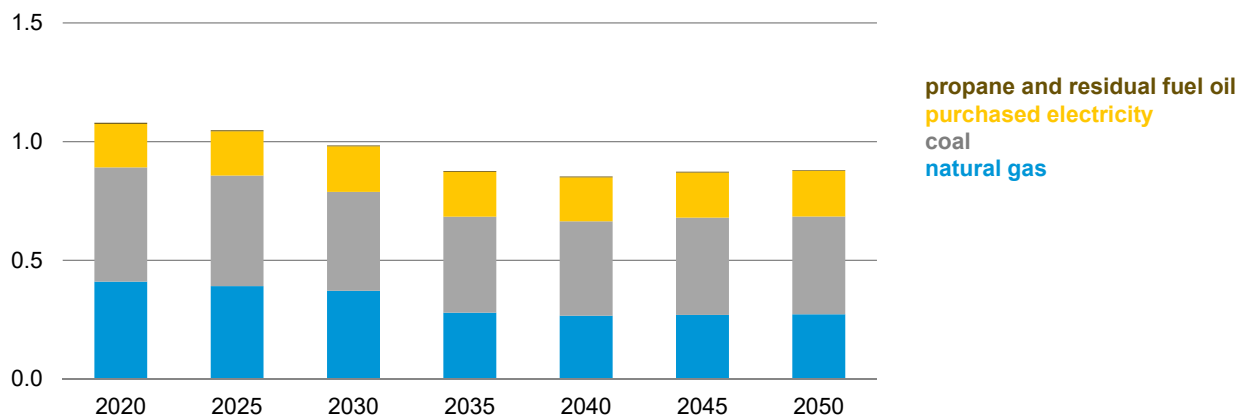


Iron and steel industry energy consumption by fuel

Iron and steel industry energy consumption by fuel

AEO2021 Reference case

quadrillion British thermal units



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo



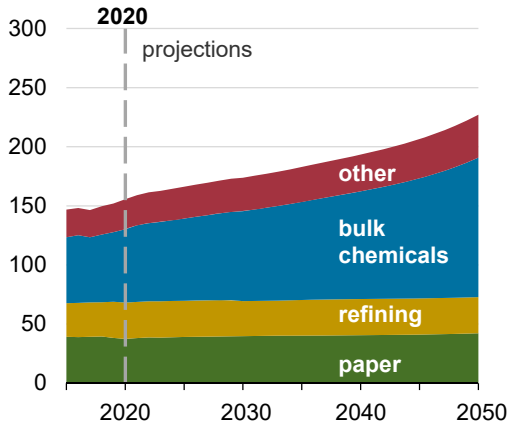


Industrial sector combined-heat-and-power (CHP) generation

CHP generation by industry

AEO2021 Reference case

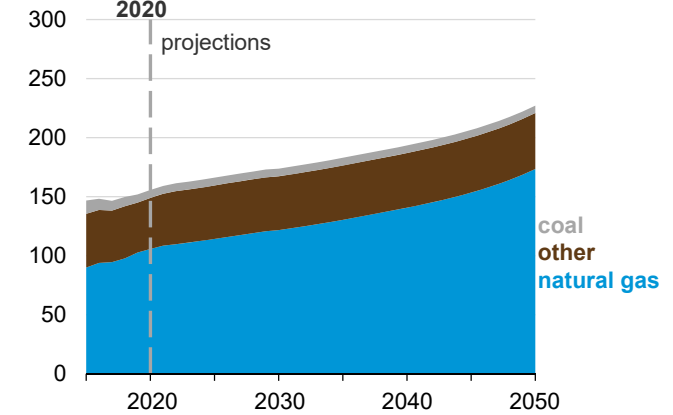
billion kilowatthours



CHP generation by fuel

AEO2021 Reference case

billion kilowatthours



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021 (AEO2021)*

www.eia.gov/aeo

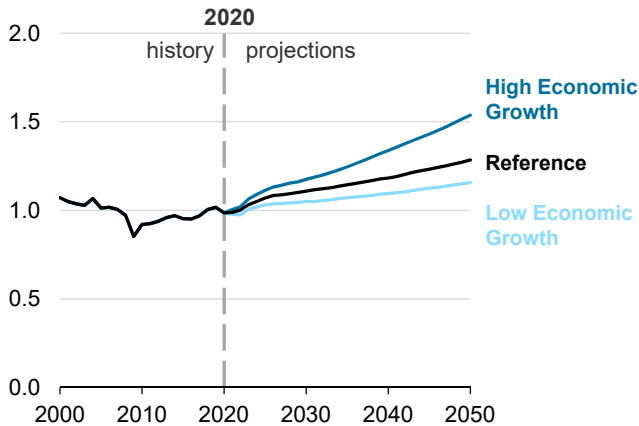


Industrial sector carbon dioxide emissions and carbon intensity

Industrial sector carbon dioxide emissions

AEO2021 economic growth cases

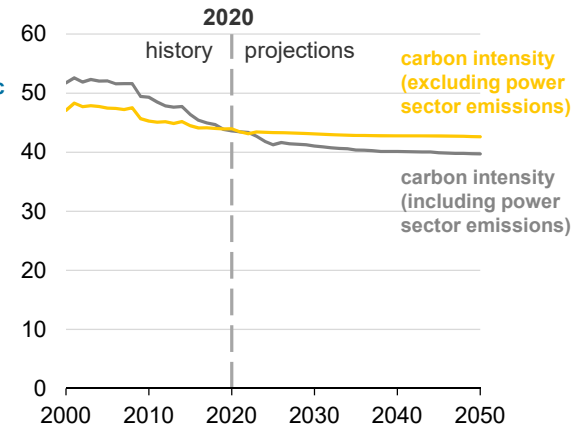
billion metric tons



Industrial sector carbon intensity

AEO2021 Reference case

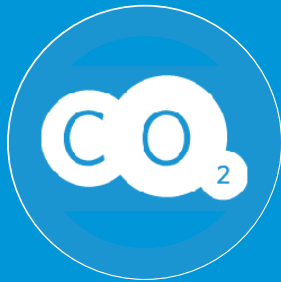
metric tons of carbon dioxide per billion British thermal units



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021 (AEO2021)*

www.eia.gov/aeo



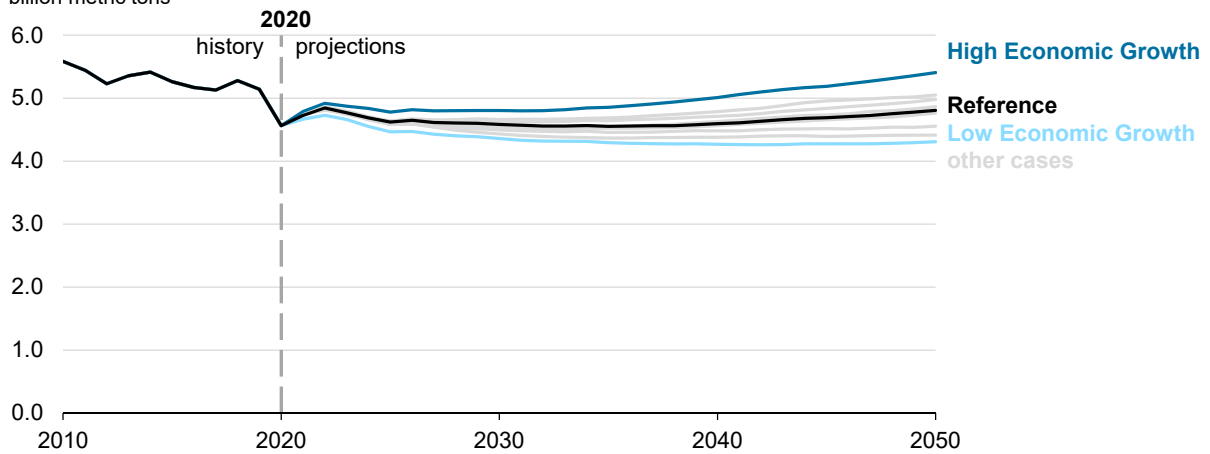


Emissions



Carbon dioxide emissions based on macroeconomic growth assumptions

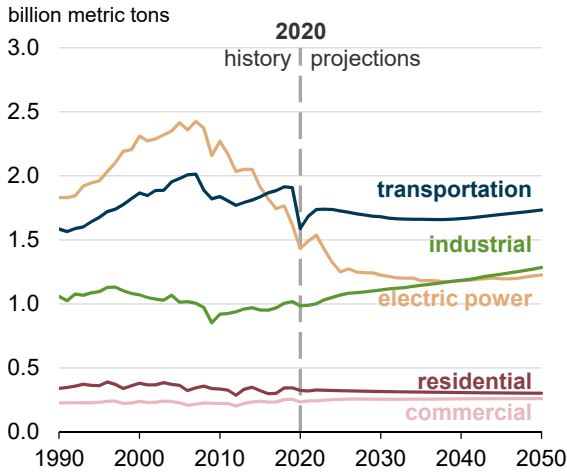
U.S. energy-related carbon dioxide emissions
AEO2021 economic growth cases
billion metric tons



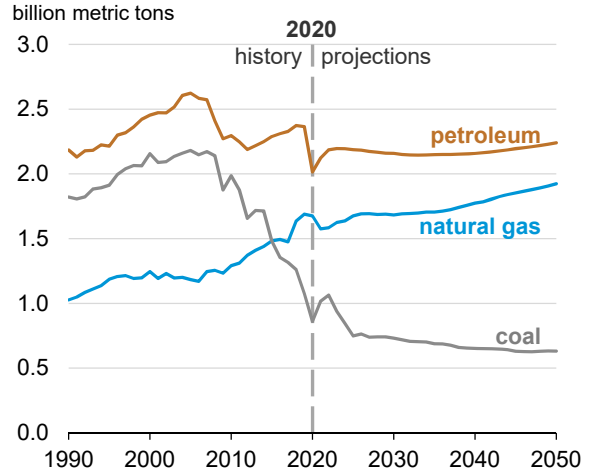


Energy-related carbon dioxide (CO2) emissions by sector and fuel source

Energy-related carbon dioxide emissions by sector
AEO2021 Reference case



Energy-related carbon dioxide emissions by fuel
AEO2021 Reference case



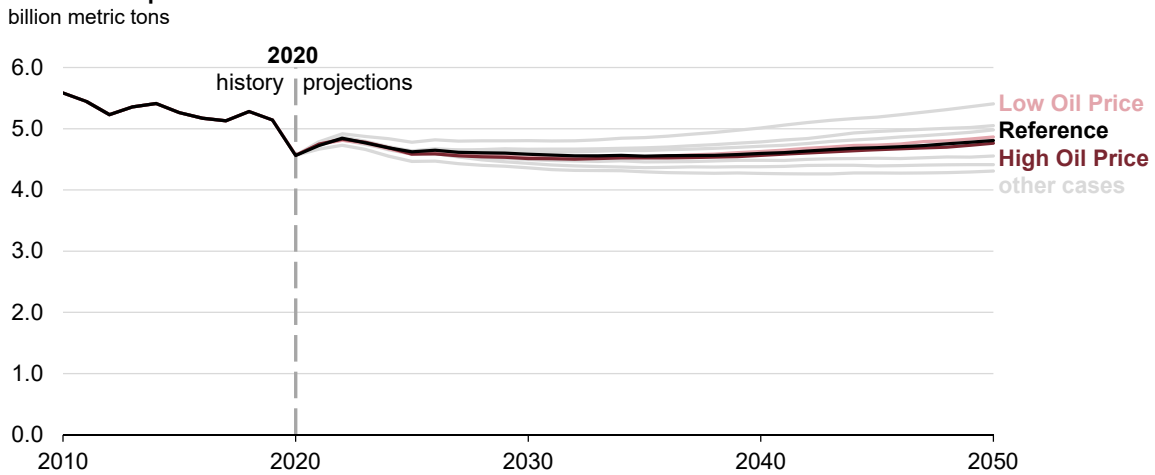
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo



Energy-related carbon dioxide emissions based on oil price assumptions

U.S. energy-related carbon dioxide emissions
AEO2021 oil price cases



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo



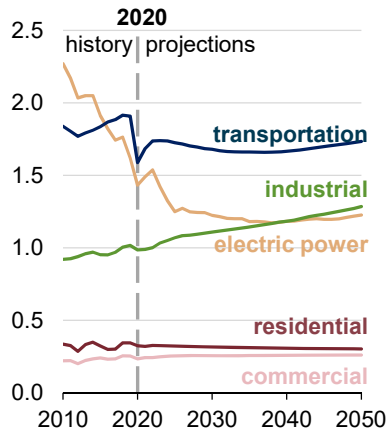


Energy-related carbon dioxide emissions by sector based on oil price assumptions

Carbon dioxide emissions by sector, AEO2021 oil price cases

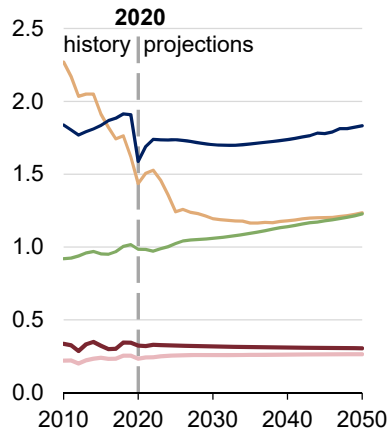
Reference case

billion metric tons



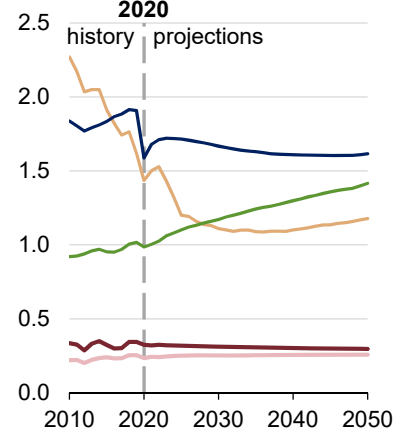
Low Oil Price case

billion metric tons



High Oil Price case

billion metric tons



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

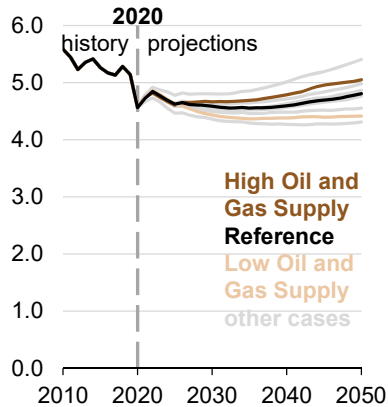


Generation and energy-related carbon dioxide emissions based on oil and natural gas supply assumptions

Generation and carbon dioxide emissions by sector, AEO2021 oil and gas supply cases

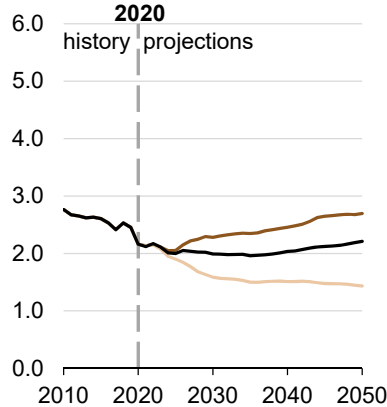
U.S. energy-related carbon dioxide emissions

billion metric tons



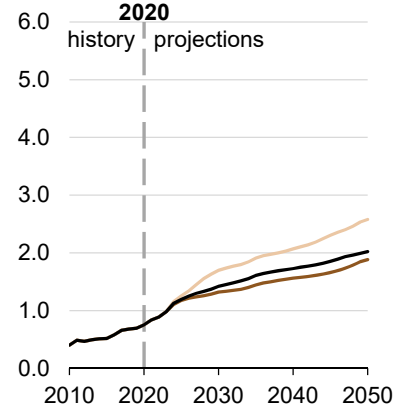
Fossil fuel-fired electric power generation

trillion kilowatthours



Renewable electric power generation

trillion kilowatthours



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

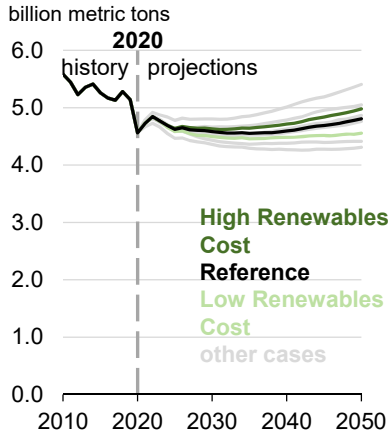




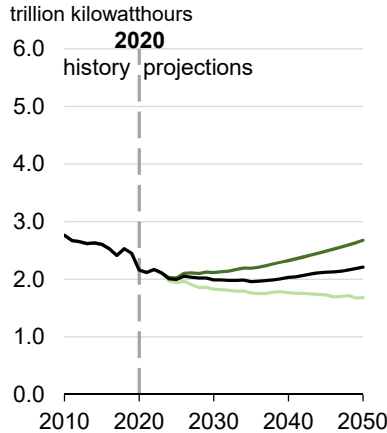
Generation and energy-related carbon dioxide emissions based on renewable cost assumptions

Generation and carbon dioxide emissions by sector, AEO2021 renewables cost cases

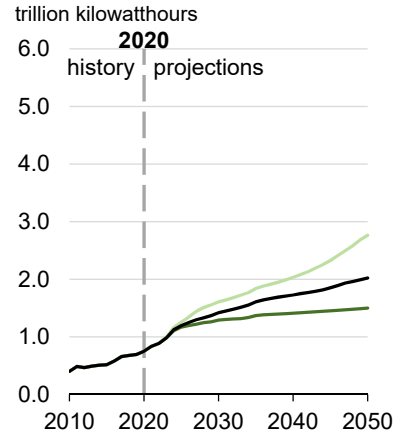
U.S. energy-related carbon dioxide emissions



Fossil fuel-fired electric power generation



Renewable electric power generation



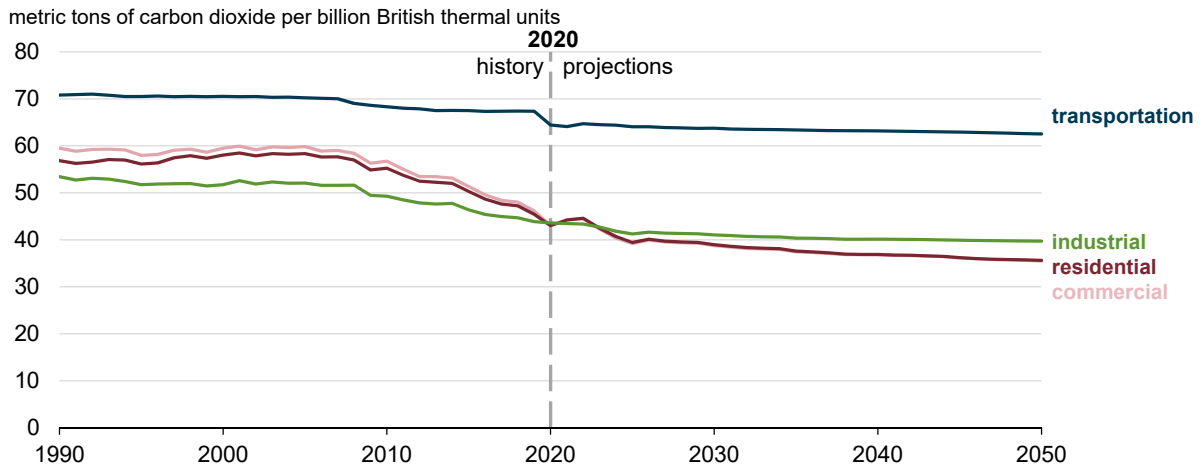
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021 (AEO2021)*

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Carbon dioxide intensity by sector

Carbon intensity by end-use sector AEO2021 Reference case



Note: Each end-use sector takes into account carbon intensity of electric power.



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021 (AEO2021)*

www.eia.gov/aeo





References



Abbreviations

AEO = *Annual Energy Outlook*

Bcf/d = billion cubic feet per day

CAGR = compound annual growth rate

CAISO = California Independent System Operator

CCGT = natural gas combined cycle

CFL = compact fluorescent lamp

CHP = combined heat and power

CO₂ = carbon dioxide

EIA = U.S. Energy Information Administration

ERCOT = Electric Reliability Council of Texas

GDP = gross domestic product

HC = High Renewable Cost case

HOGS = High Oil and Gas Supply case

LC = Low Renewable Cost case

LED = light-emitting diode

LNG = liquefied natural gas

LOGS = Low Oil and Gas Supply case

PJM = Pennsylvania-New Jersey-Maryland Interconnection

PV = photovoltaic

Tcf = trillion cubic feet

EIA Glossary | www.eia.gov/tools/glossary





Graph sources

Projected values are sourced from

Projections: EIA, AEO2021 National Energy Modeling System (runs: ref2021.d113020a, highprice.d113020a, lowprice.d113020a, highmacro.d113020a, lowmacro.d113020a, highogs.d120120a, lowogs.d113020a, hirencst.d113020a, lorencst.d113020a)

EIA historical data are sourced from

- *Monthly Energy Review* (and supporting databases), September 2020
- Form EIA-860M, *Preliminary Monthly Electric Generator Inventory*, July 2020

For source information for specific graphs published in this document, contact annualenergyoutlook@eia.gov.



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

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AEO Working Groups | <https://www.eia.gov/outlooks/aeo/workinggroup/>

AEO Analysis and Forecasting Experts | <https://www.eia.gov/about/contact/forecasting.php#longterm>

U.S. Energy Information Administration homepage | www.eia.gov

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

Annual Energy Outlook | www.eia.gov/aeo

International Energy Outlook | www.eia.gov/ieo

Monthly Energy Review | www.eia.gov/mer

Today in Energy | www.eia.gov/todayinenergy

EIA's Application Programming Interface (API) | www.eia.gov/opendata



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www.eia.gov/aeo

