

Annual Energy Outlook 2017



AEO2017 Rollout Presentation

Johns Hopkins School of Advanced International Studies

January 5, 2017 | Washington, D.C.

By

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Key takeaways from AEO2017

- With strong domestic production and relatively flat demand, the United States becomes a net energy exporter over the projection period in most cases
- U.S. crude oil production rebounds from recent lows, driven by continued development of tight oil resources; with consumption flat to down compared to recent history, net crude oil and petroleum product imports as a percentage of U.S. product supplied decline across most cases
- Across most cases, natural gas production increases despite relatively low and stable natural gas prices, supporting higher levels of domestic consumption and natural gas exports; projections are sensitive to resource and technology assumptions
- With modest demand growth, the primary driver for new electricity generation capacity in the Reference case is the retirement of older, less efficient fossil fuel units, largely spurred by the Clean Power Plan (CPP), and the near-term availability of renewable tax credits; even if the CPP is not implemented, low natural gas prices and the tax credits result in natural gas and renewables as the primary sources of new generation capacity; the future generation mix is sensitive to the price of natural gas and the growth in electricity demand

Key takeaways from AEO2017 (continued)

- Transportation energy consumption peaks in 2018 in the Reference case because rising fuel efficiency outweighs increases in total travel and freight movements throughout the projection period
- Despite growth in the number of households and the amount of commercial floorspace, improved equipment and efficiency standards contribute to residential and commercial consumption remaining relatively flat or declining slightly from 2016 to 2040 in the Reference case
- With economic growth and relatively low energy prices, energy consumption in EIA's three industrial sub-sectors (energy-intensive manufacturing, non-energy-intensive manufacturing, and nonmanufacturing) increases during the projection period across all cases; energy intensity declines in the Reference case and most side cases as a result of technological improvements

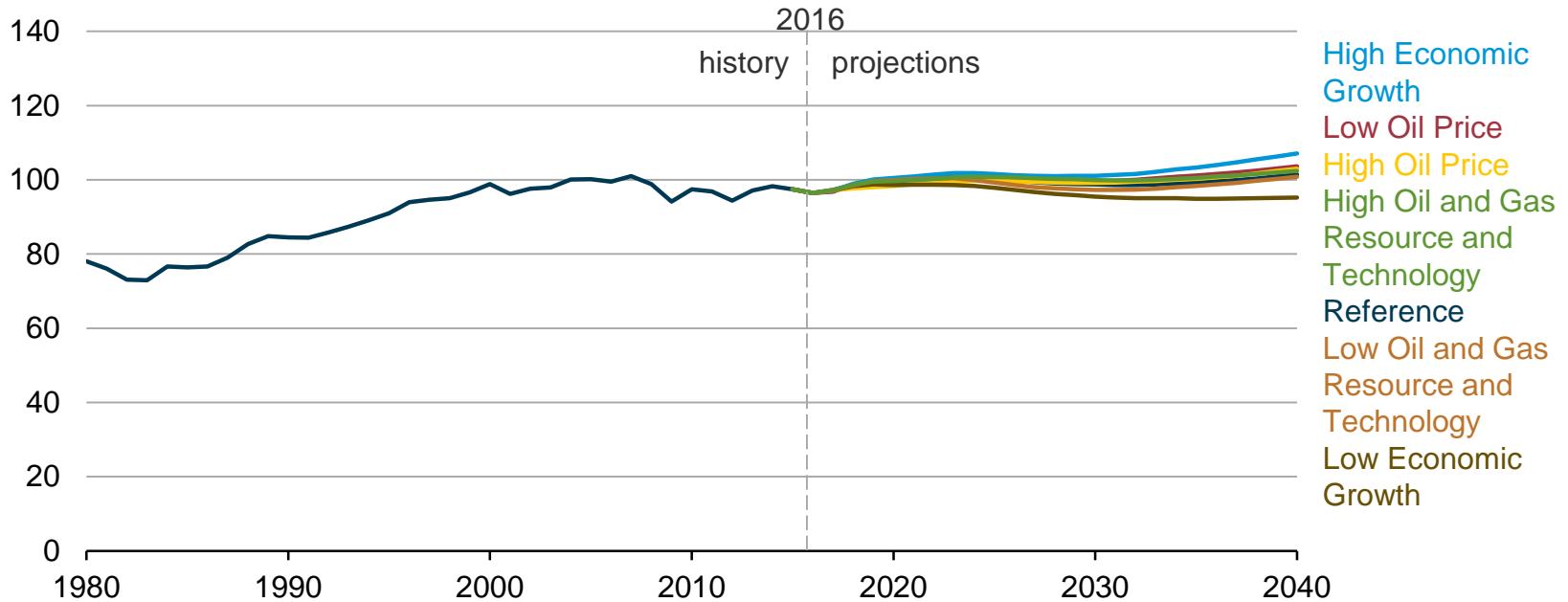
Overview

AEO2017 includes side cases with different assumptions of macroeconomic growth, world oil prices, technological progress, and energy policies

- Oil prices are primarily driven by global market balances that are mainly influenced by factors external to the NEMS model; in the High Oil Price case, the price of Brent crude in 2016 dollars reaches \$226 per barrel (b) by 2040, compared to \$109/b in the Reference case and \$43/b in the Low Oil Price case
- In the High Oil and Gas Resource and Technology case, lower costs and higher resource availability than in the Reference case allow for higher production at lower prices; in the Low Oil and Gas Resource and Technology case, more pessimistic assumptions about resources and costs are applied
- The effects of economic assumptions on energy consumption are addressed in the High and Low Economic Growth cases, which assume compound annual growth rates for U.S. gross domestic product of 2.6% and 1.6%, respectively, from 2016–40, compared with 2.2% annual growth in the Reference case
- A case assuming that the Clean Power Plan (CPP) is not implemented can be compared to the Reference case to show how that policy could affect energy markets and emissions
- Although the graphics in this presentation focus on projections through 2040, this AEO is the first projection to include model results through 2050, which are available on the [AEO page of the EIA website](#); EIA welcomes feedback on the assumptions and results from the period 2040–50

Energy consumption varies minimally across all AEO cases, bounded by the High and Low Economic Growth cases

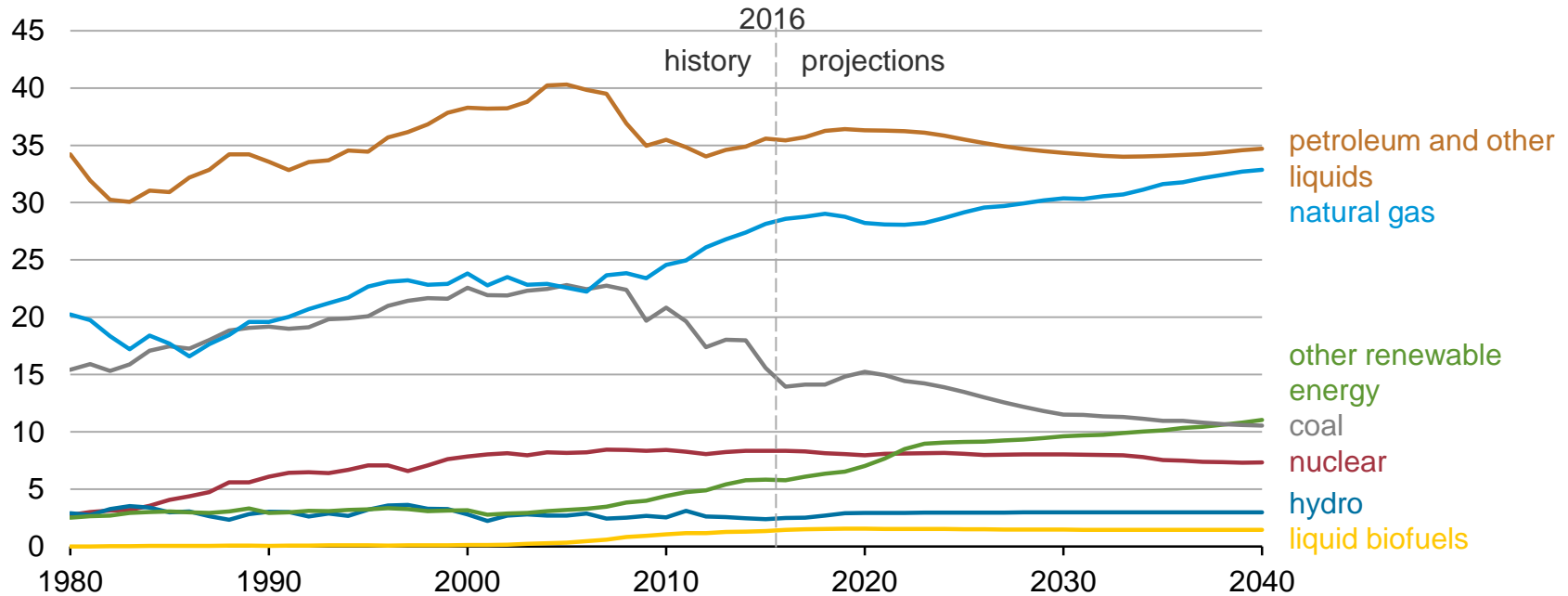
Total energy consumption
quadrillion British thermal units



Source: EIA, Annual Energy Outlook 2017

Domestic energy consumption remains relatively flat in the Reference case, but the fuel mix changes significantly

Energy consumption (Reference case)
quadrillion British thermal units

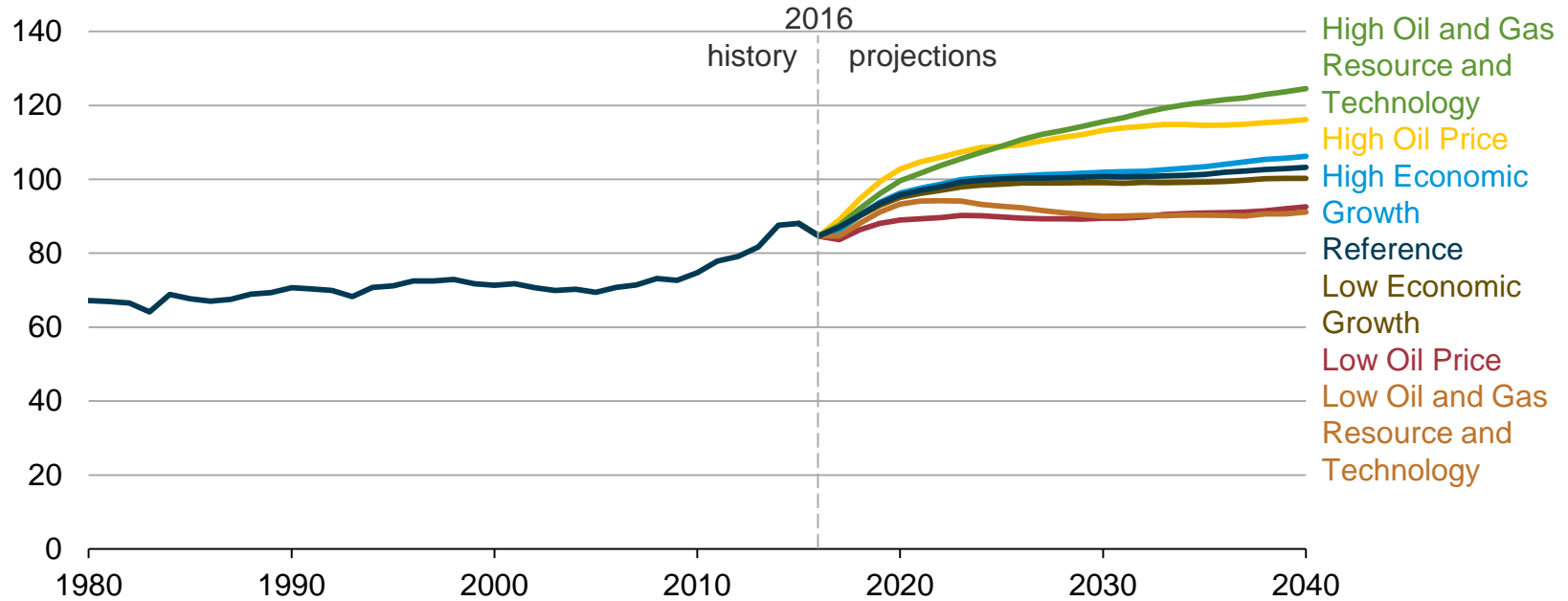


Source: EIA, Annual Energy Outlook 2017

Energy production ranges from nearly flat in the Low Oil and Gas Resource and Technology case, to continued growth in the High Resource and Technology case

Total energy production

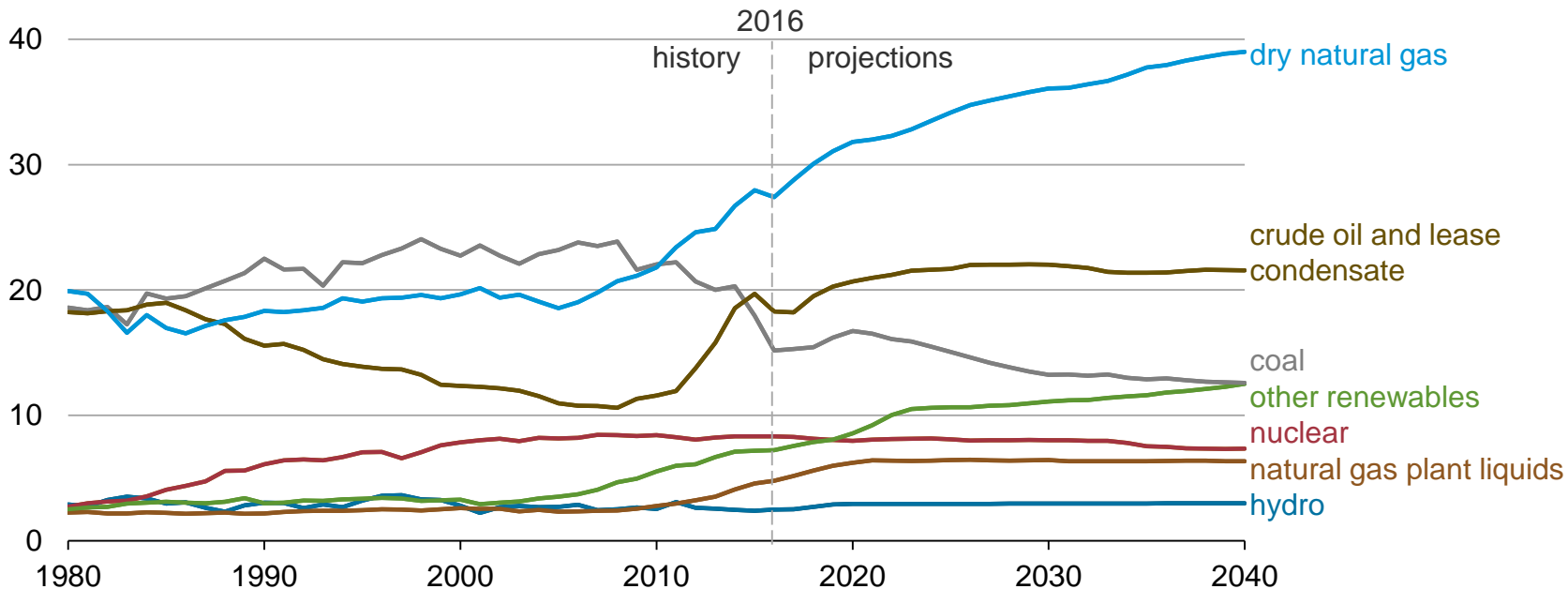
quadrillion British thermal units



Source: EIA, Annual Energy Outlook 2017

United States energy production continues to increase in the Reference case, led by growth in natural gas and renewables

Energy production (Reference case)
quadrillion British thermal units

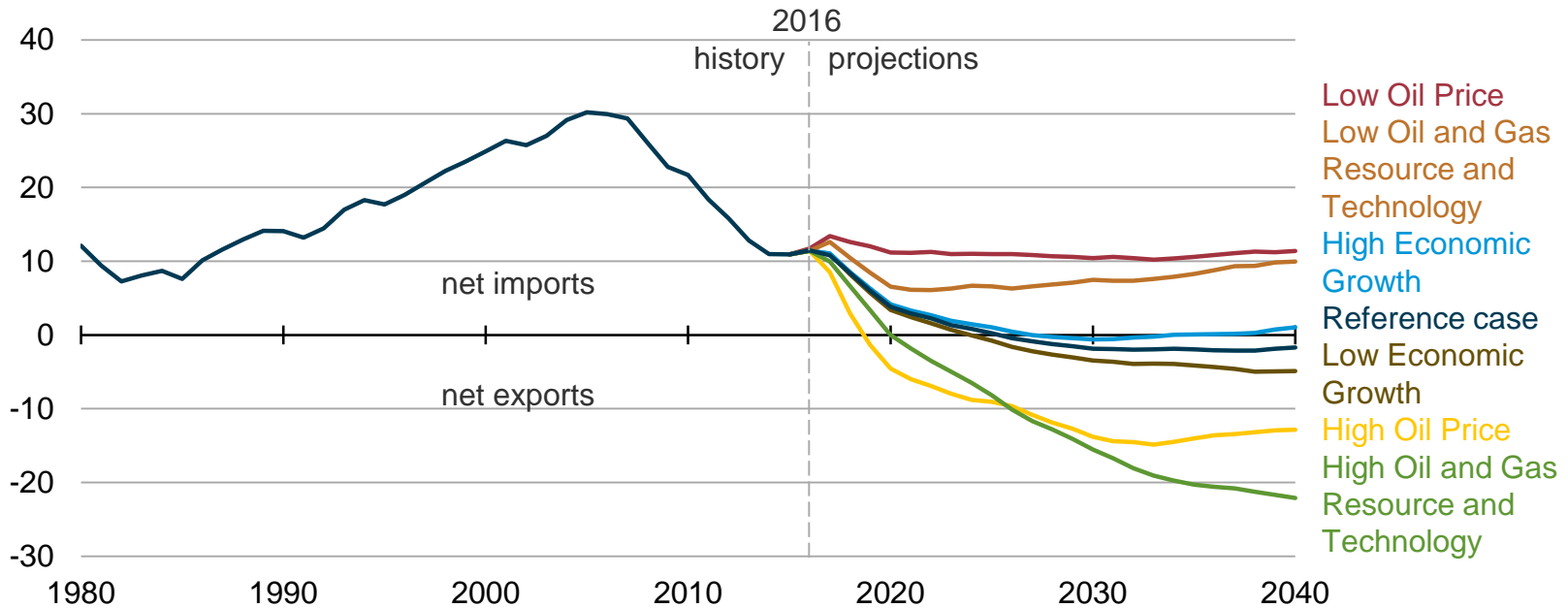


Source: EIA, Annual Energy Outlook 2017

The United States becomes a net energy exporter in most cases as petroleum liquid imports fall and natural gas exports rise

Net energy trade

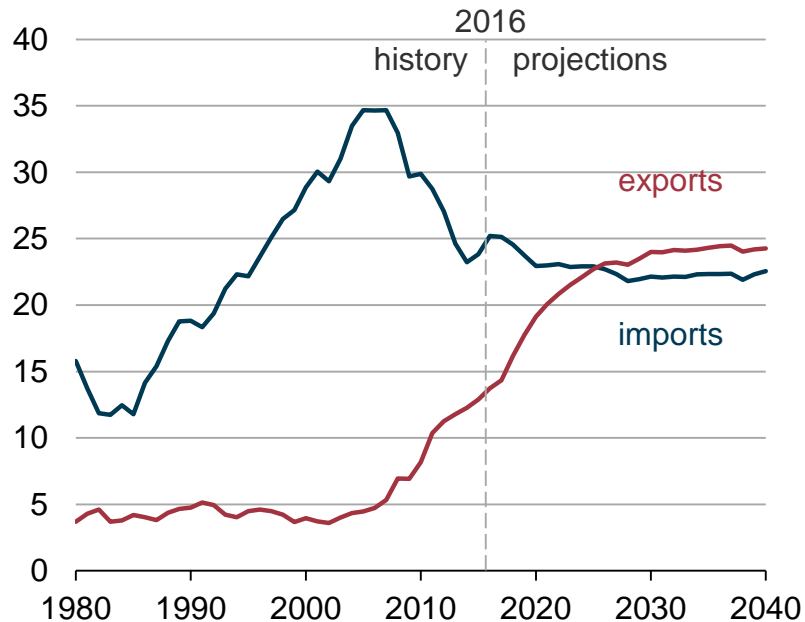
quadrillion British thermal units



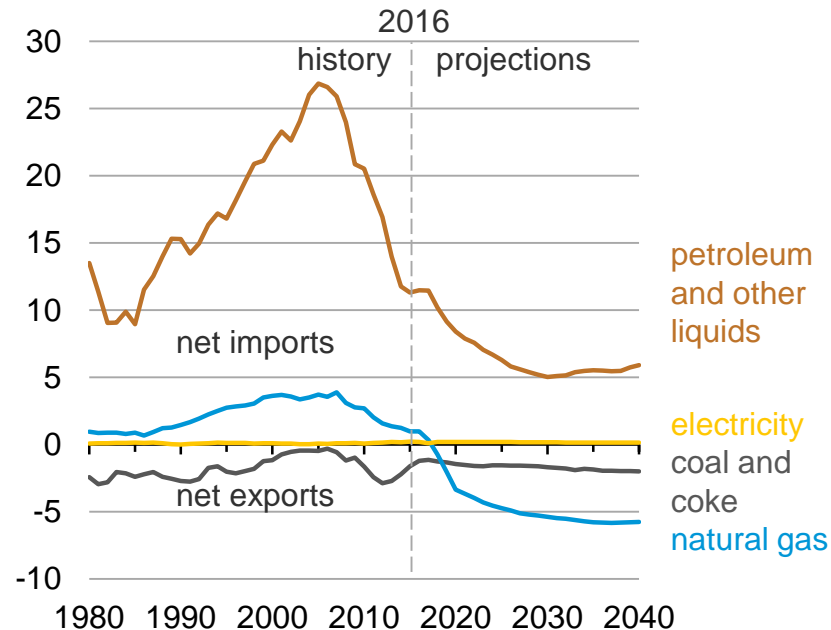
Source: EIA, Annual Energy Outlook 2017

The United States becomes a net energy exporter in the Reference case projections as natural gas exports increase and petroleum imports decrease

Energy trade (Reference case)
quadrillion British thermal units



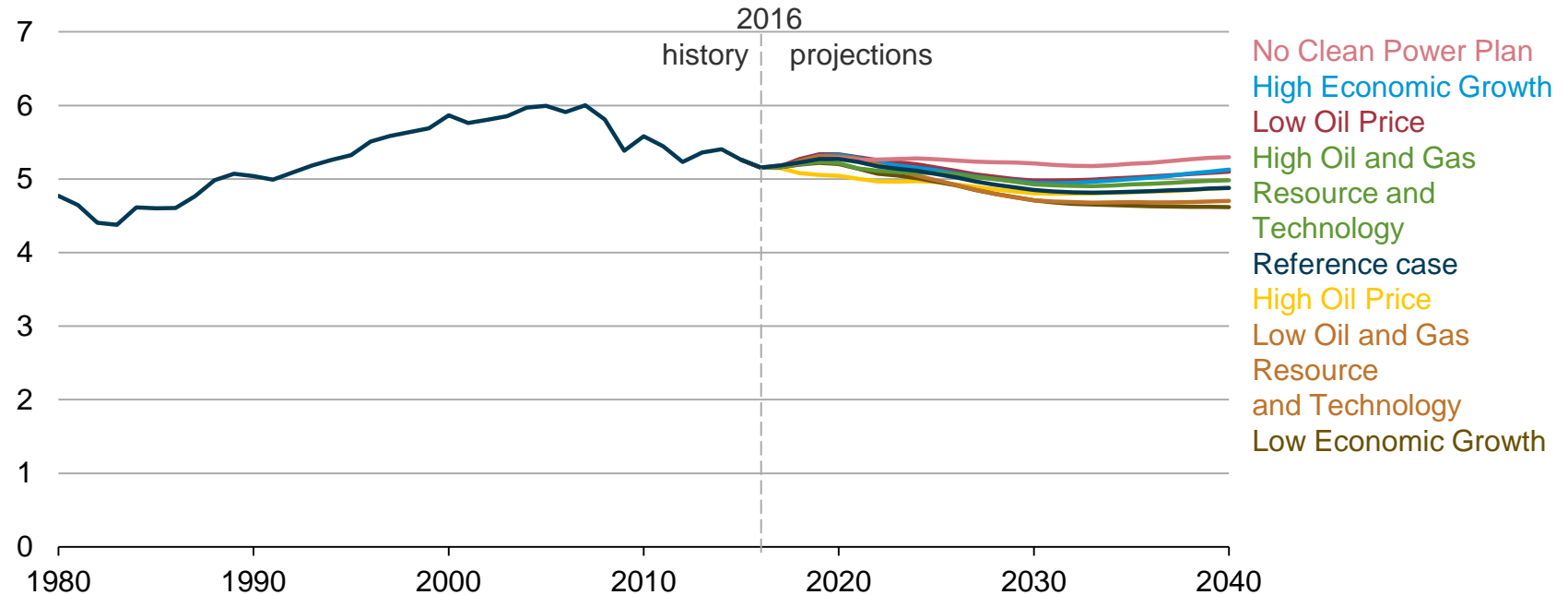
Net energy trade (Reference case)
quadrillion British thermal units



Source: EIA, Annual Energy Outlook 2017

Energy related carbon dioxide emissions decline in most AEO cases, with the highest emissions projected in the No Clean Power Plan case

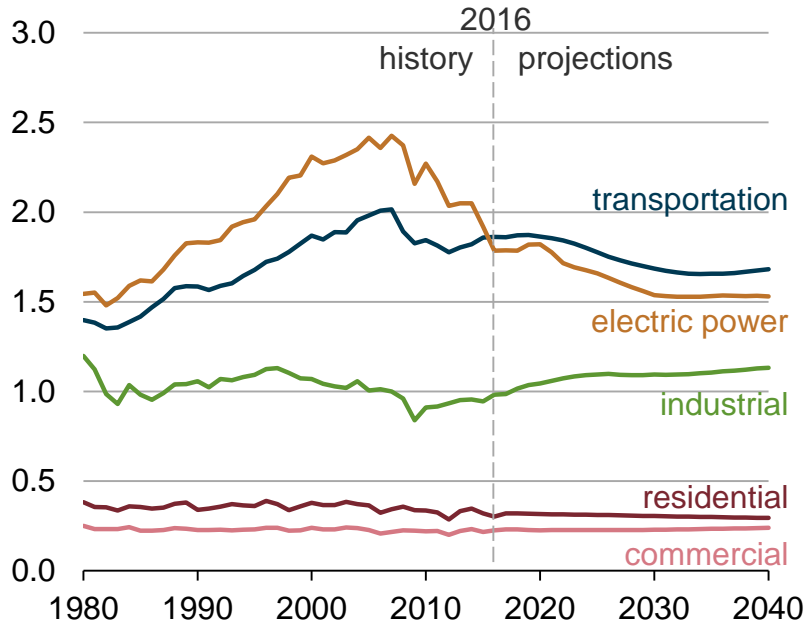
Energy-related carbon dioxide emissions
billion metric tons of carbon dioxide



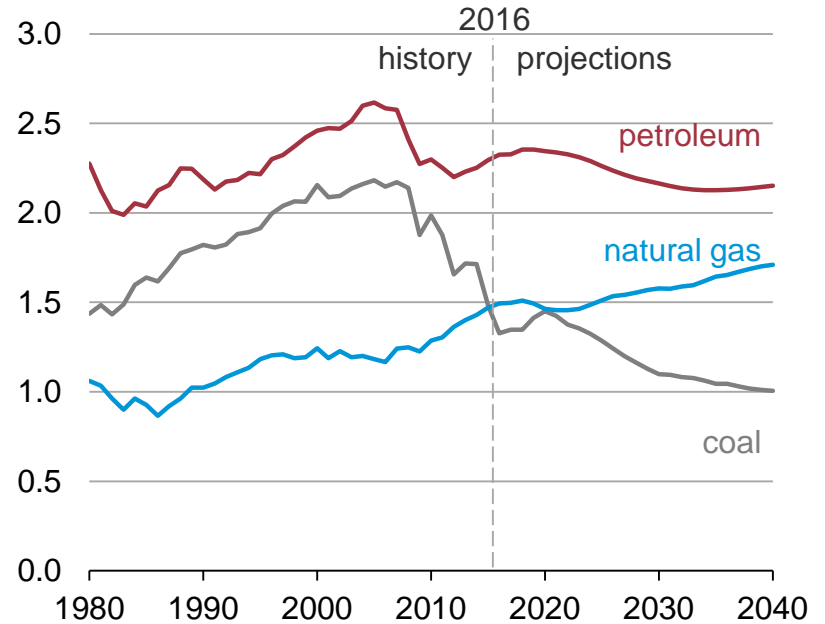
Source: EIA, Annual Energy Outlook 2017

Reference case energy-related carbon dioxide emissions fall, but at a slower rate than in the recent past

U.S. energy-related carbon dioxide emissions (Reference case)
billion metric tons of carbon dioxide



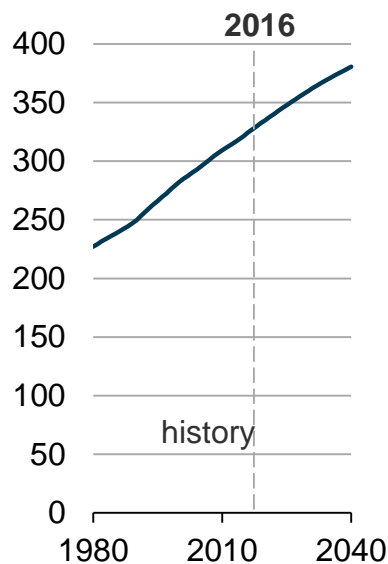
billion metric tons of carbon dioxide



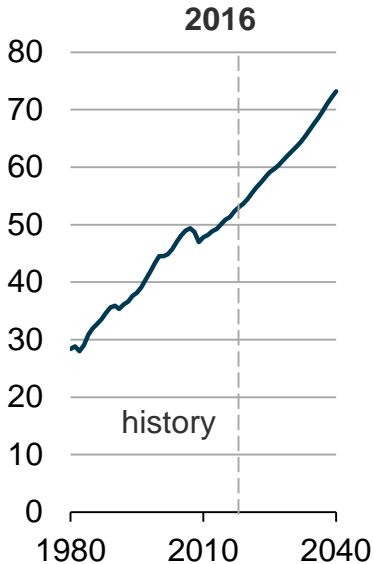
Source: EIA, Annual Energy Outlook 2017

Although population and economic output per capita are assumed to continue rising, energy intensity and carbon intensity are projected to continue falling in the Reference case

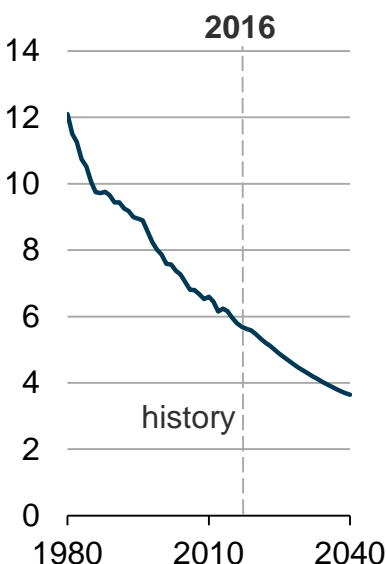
U.S. population
million people



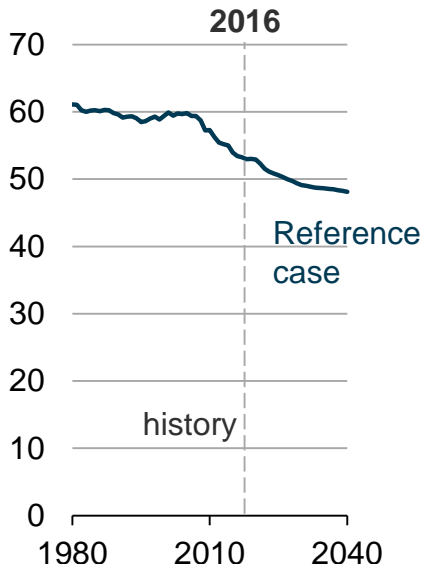
Gross domestic product per capita
thousand dollars/person



Energy intensity
thousand British thermal units per dollar



Carbon intensity
metric tons CO2 per billion British thermal units

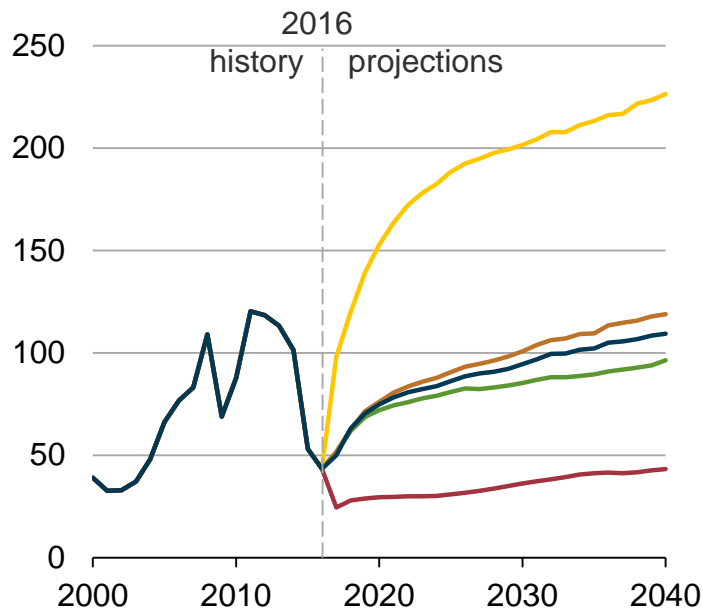


Source: EIA, Annual Energy Outlook 2017

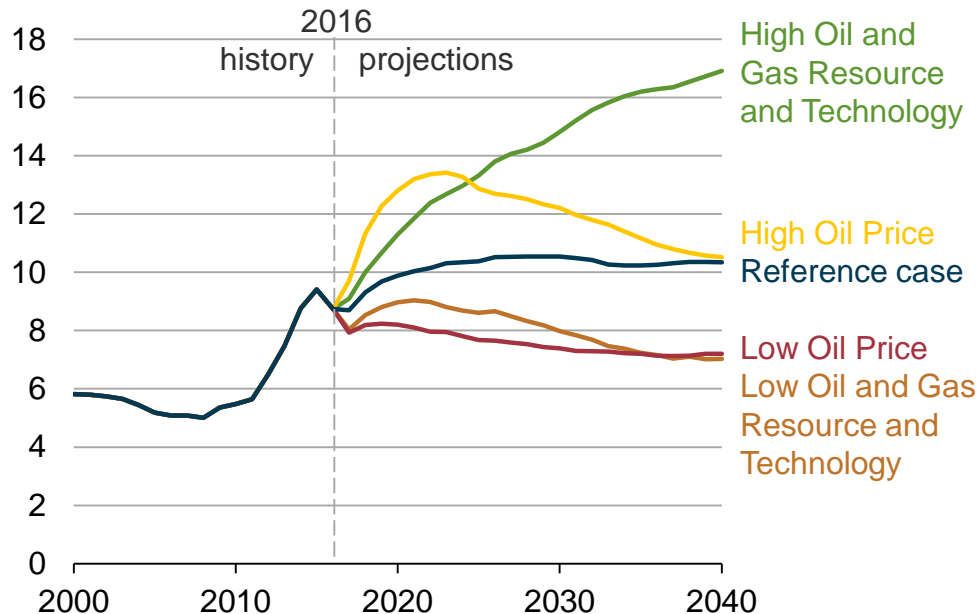
Petroleum and other liquids

Reference case oil prices and production rise from current levels, price paths and production levels in the side cases are very different from those in the Reference case

North Sea Brent oil price
2016 dollars per barrel



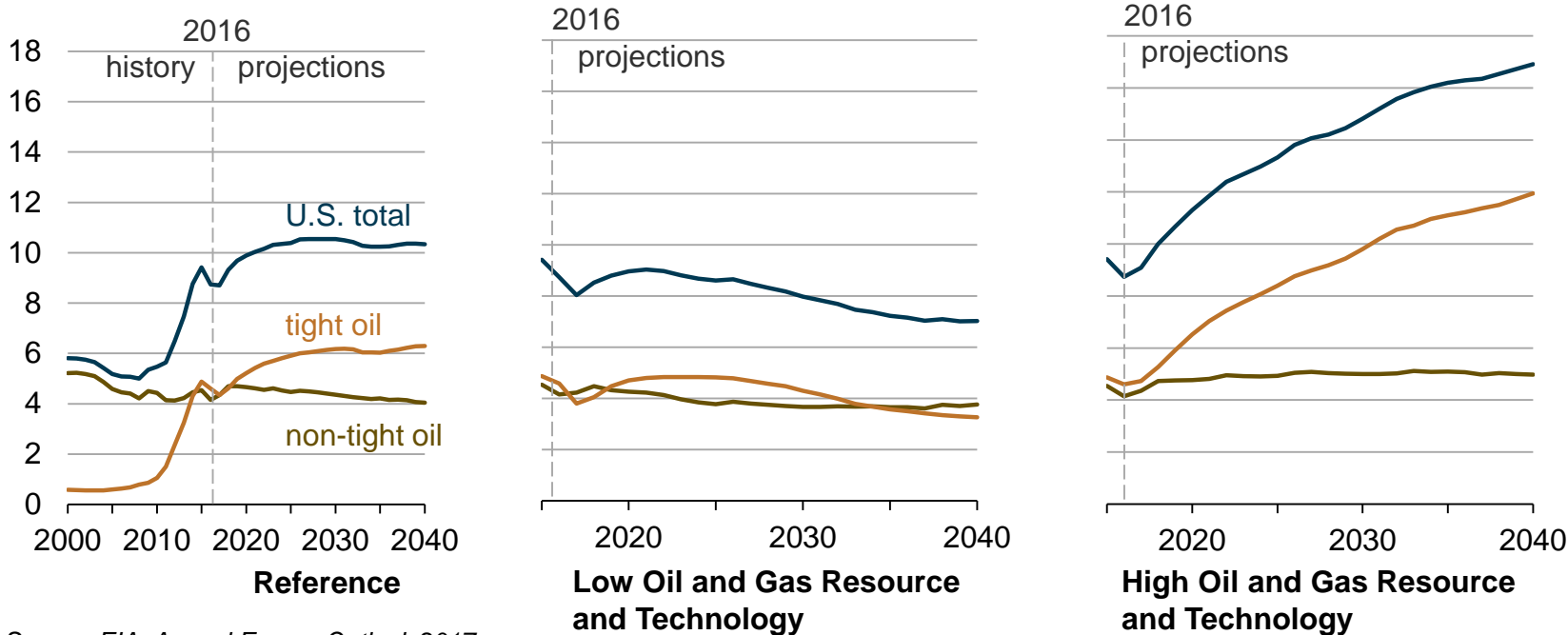
Crude oil production
million barrels per day



Source: EIA, Annual Energy Outlook 2017

Tight oil dominates U.S. production in the Reference case, but other types of oil production continue to yield significant volumes

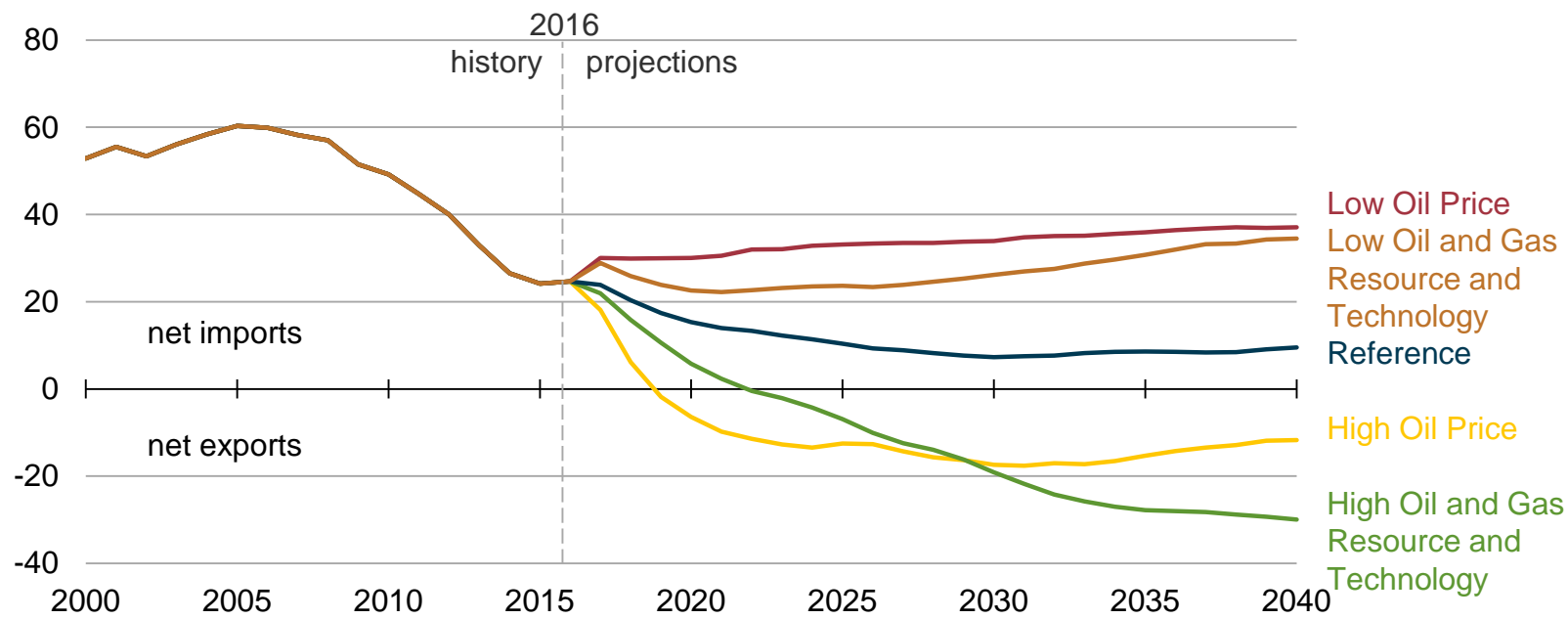
Crude oil production
million barrels per day



Source: EIA, Annual Energy Outlook 2017

In the High Oil Price and the High Oil and Gas Resource and Technology cases, the United States becomes a net petroleum exporter

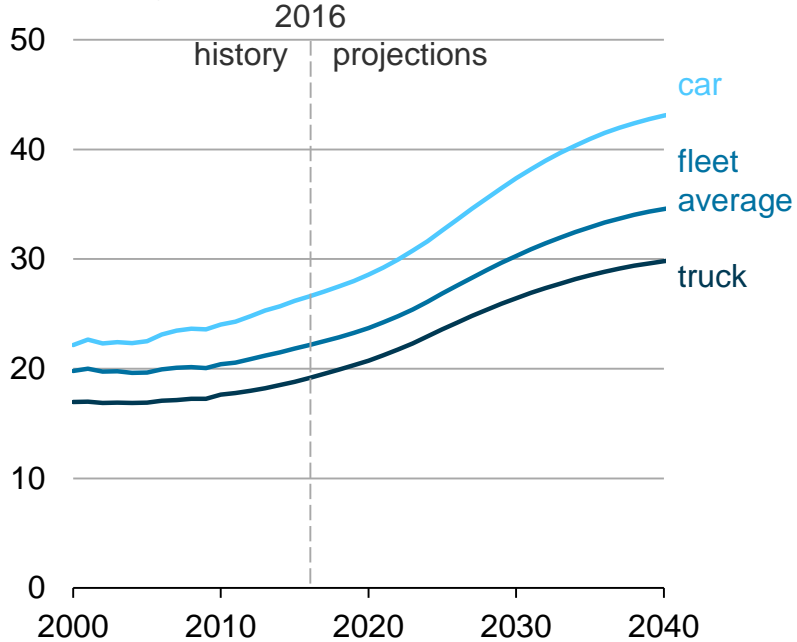
Petroleum net imports as a percentage of products supplied
percent



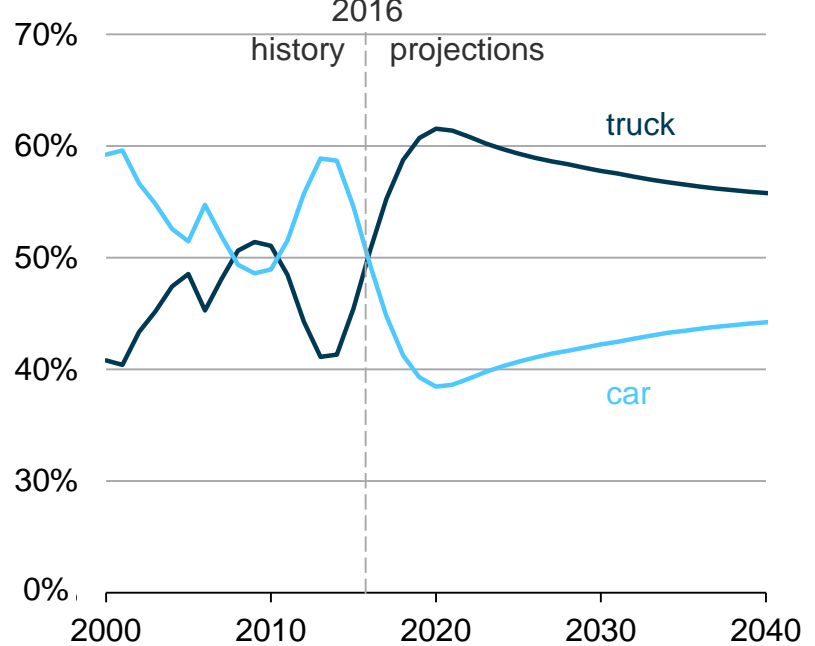
Source: EIA, Annual Energy Outlook 2017

Average light-duty fuel economy improves in the Reference case, even as the share of light-duty trucks increases

Light-duty stock fleet fuel economy
miles per gallon



Light-duty vehicle sales shares
percent



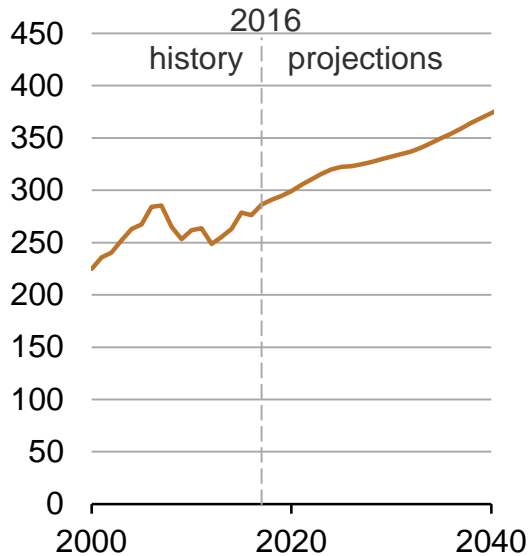
Source: EIA, Annual Energy Outlook 2017

With the second phase of fuel efficiency regulations, medium- and heavy-duty vehicle energy consumption declines over 2027-33 despite continued growth in miles traveled

Medium- and heavy-duty vehicle metrics

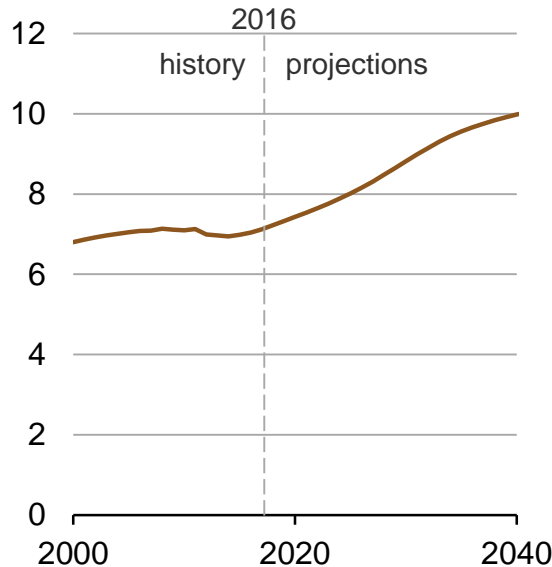
travel indicator

billion vehicle-miles traveled



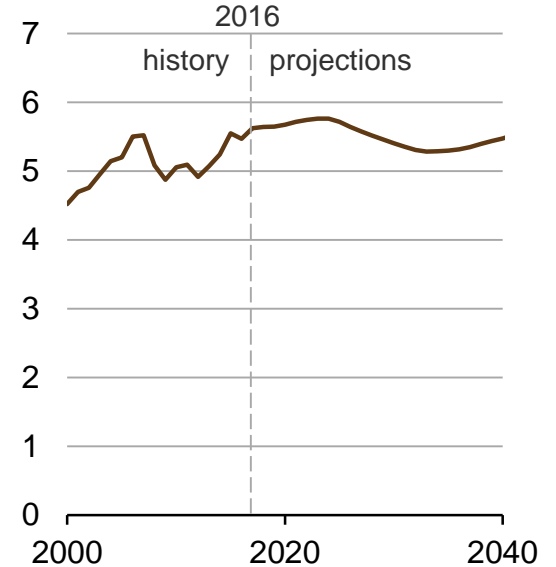
stock fuel economy

miles per gallon



energy consumption

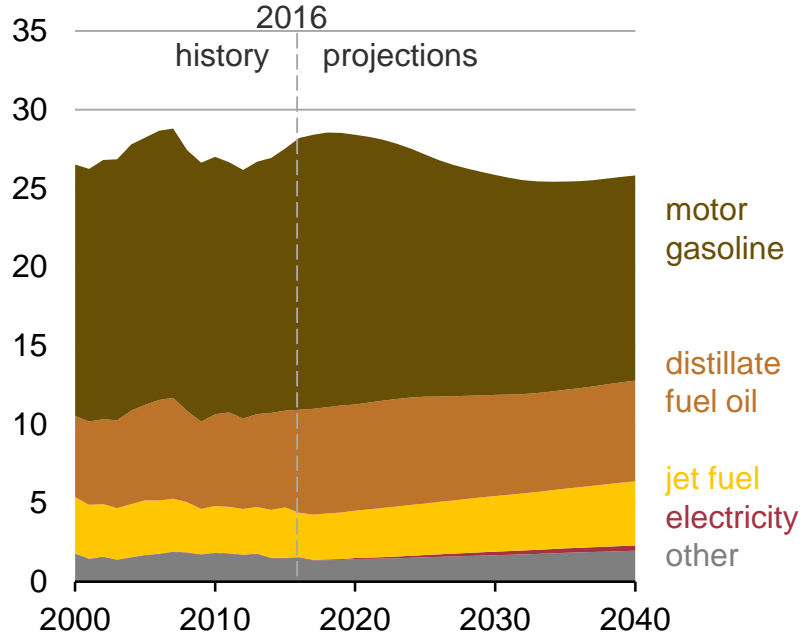
quadrillion British thermal units



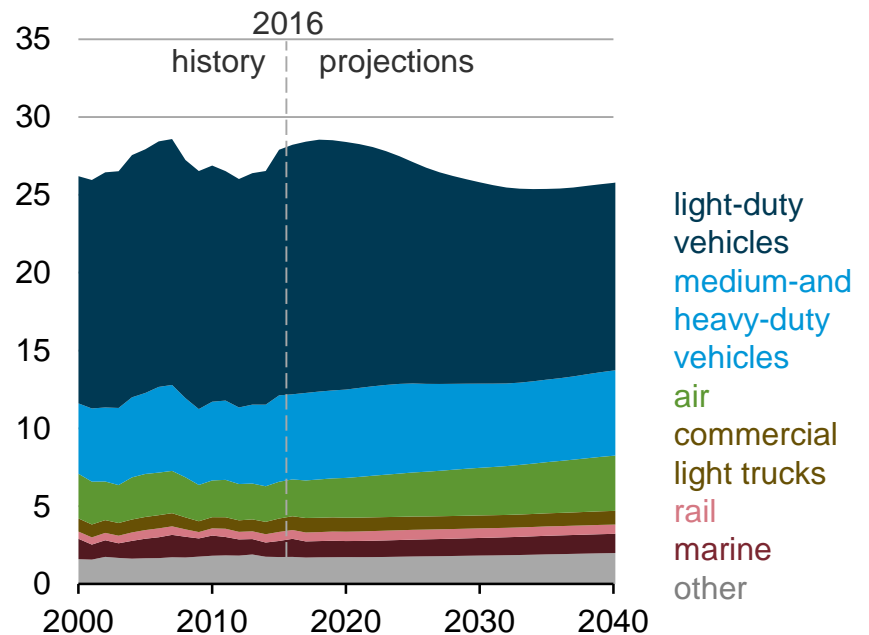
Source: EIA, Annual Energy Outlook 2017

Transportation energy use declines between 2018 and 2034 in the Reference case, driven by improvements in fuel economy

Transportation sector consumption
quadrillion British thermal units



Transportation sector consumption
quadrillion British thermal units

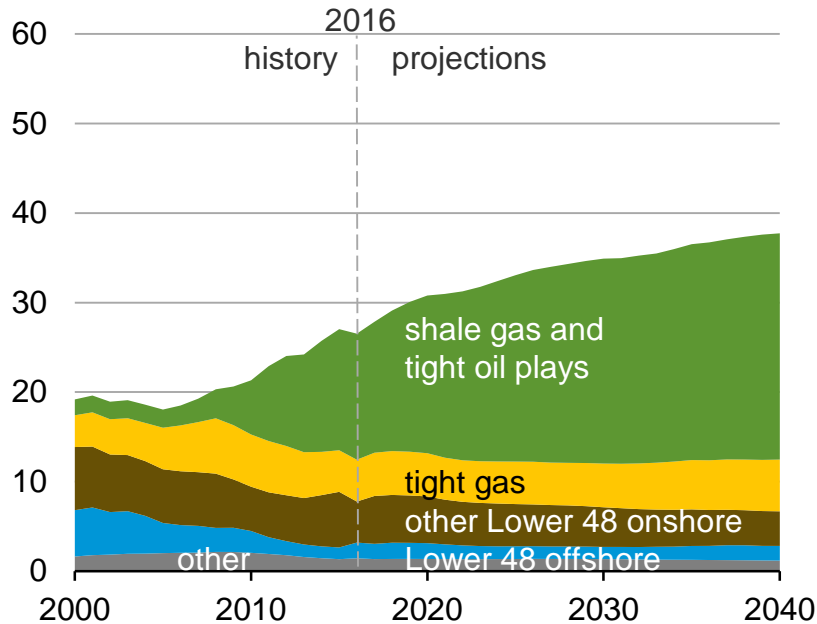


Source: EIA, Annual Energy Outlook 2017

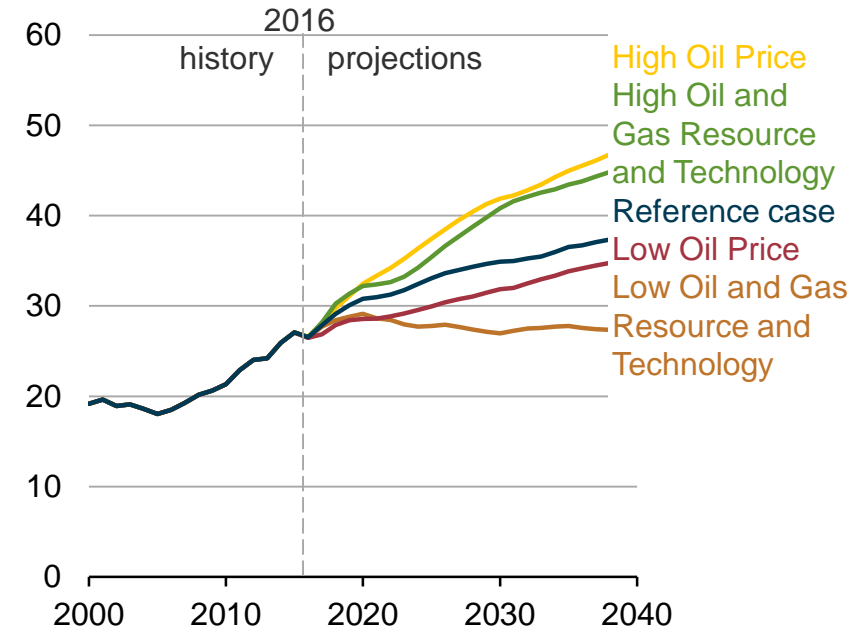
Natural gas

U.S. dry natural gas production is the result of continued development of shale gas and tight oil plays, alternative assumptions cause significant differences

U.S. natural gas production by type
trillion cubic feet



Dry natural gas production
trillion cubic feet



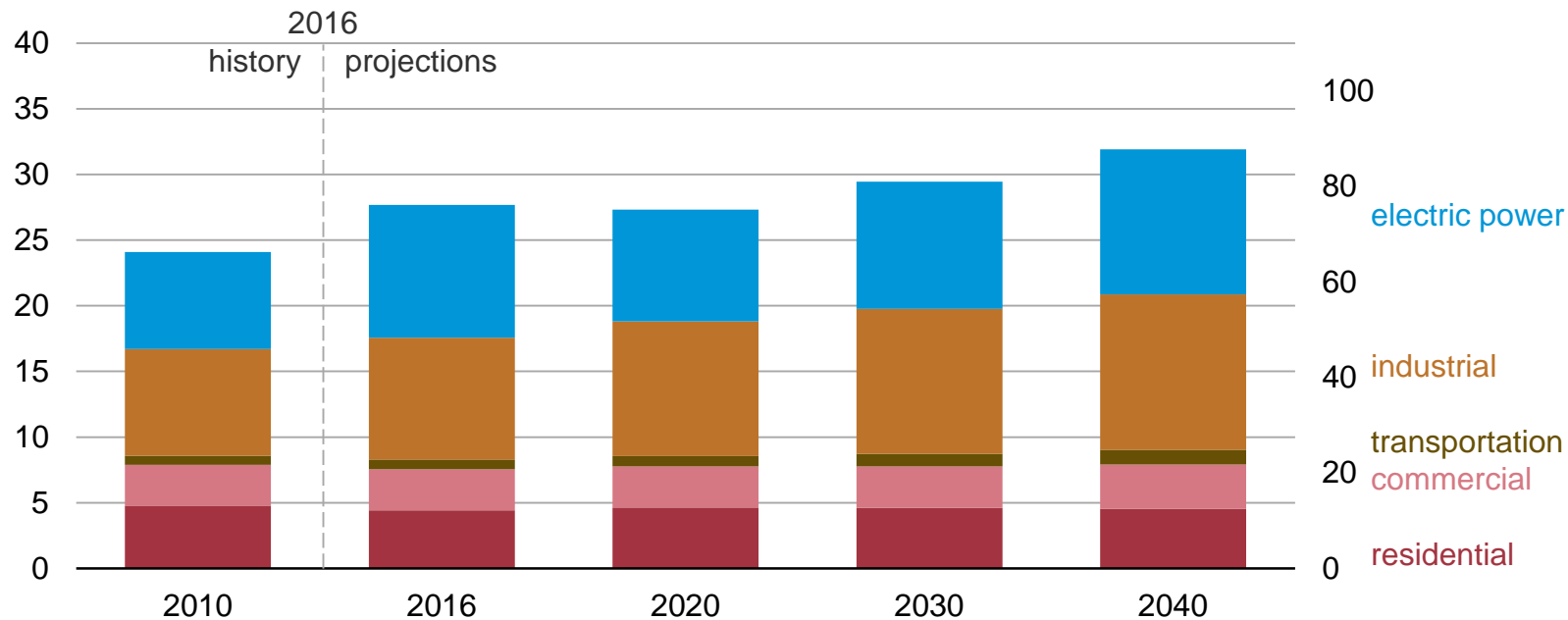
Source: EIA, Annual Energy Outlook 2017

Increasing demand from industrial and electric power markets drive rising domestic consumption of natural gas in the Reference case

Natural gas consumption by sector

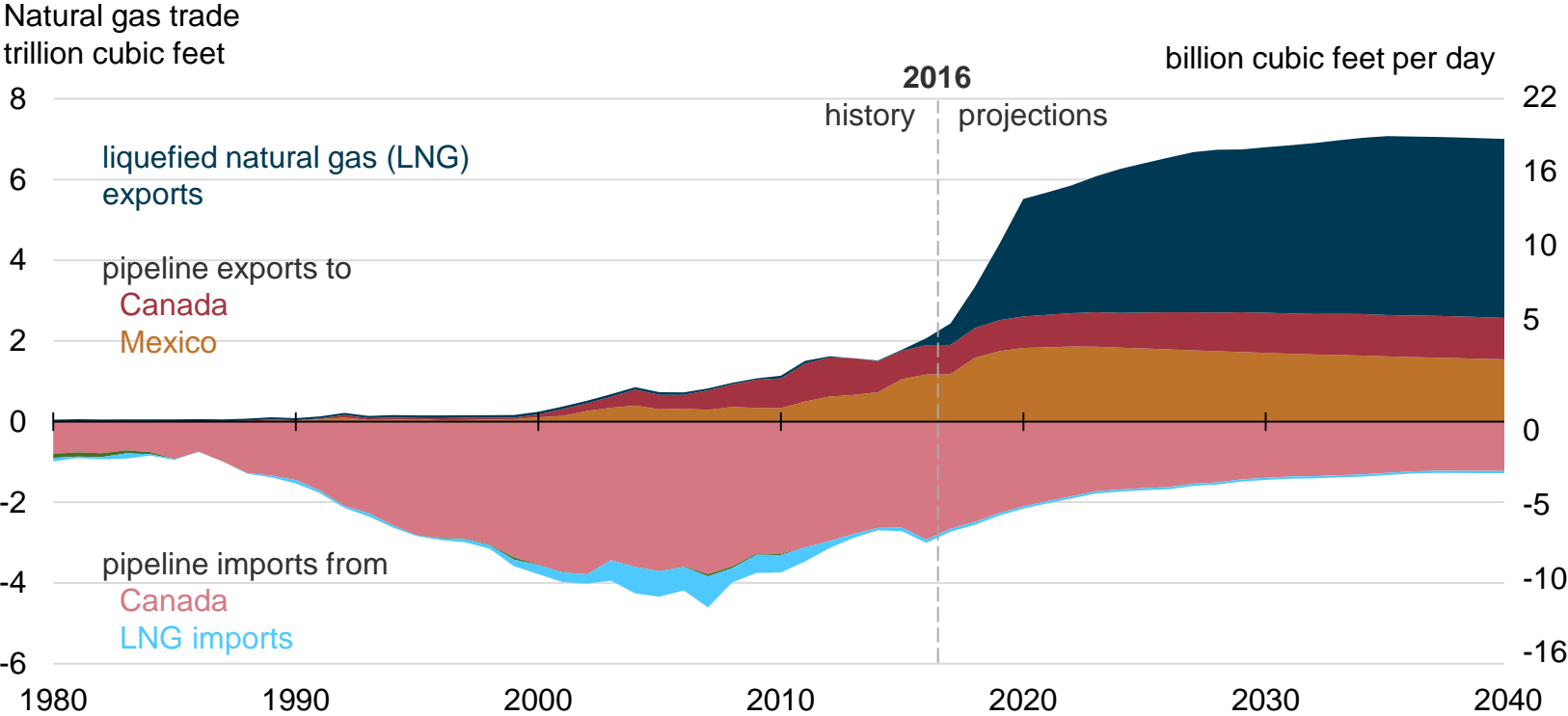
trillion cubic feet

billion cubic feet per day



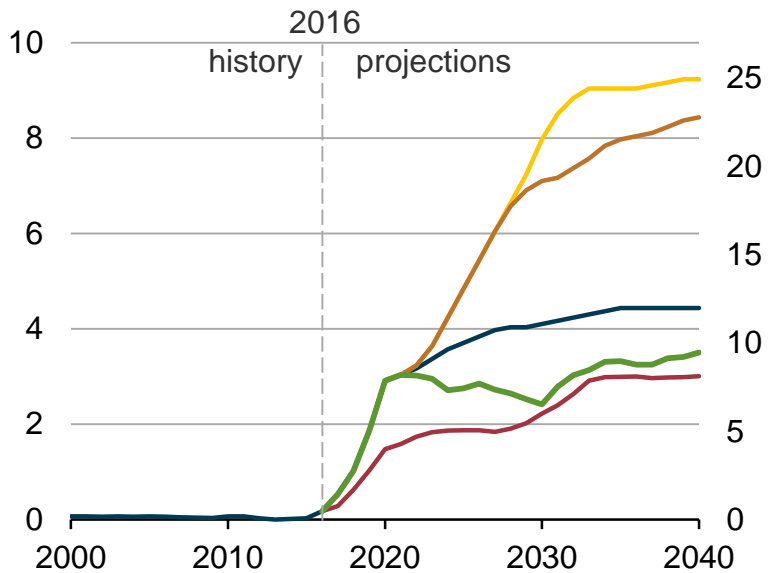
Source: EIA, Annual Energy Outlook 2017

Increased natural gas trade is dominated by liquefied natural gas exports in the Reference case



U.S. LNG export levels vary across cases and reflect both the level of global demand, as well as by the difference between domestic and global natural gas prices

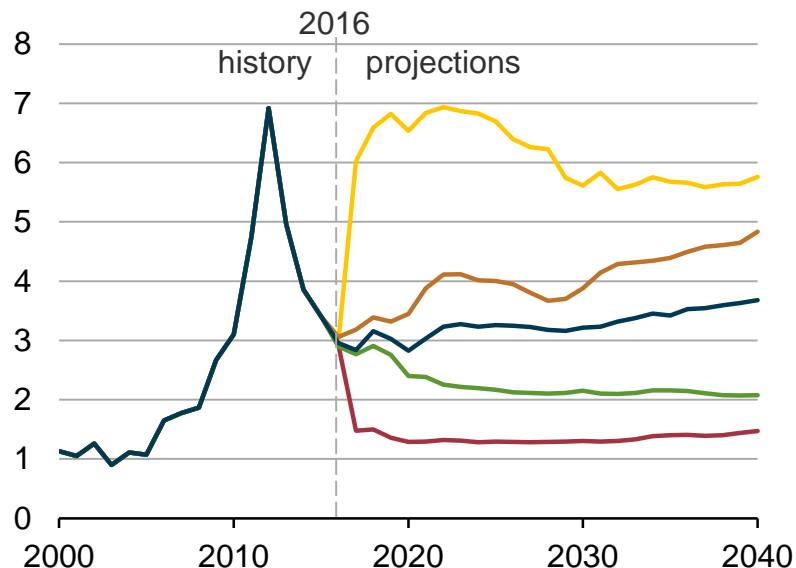
Liquefied natural gas exports
trillion cubic feet



Reference

High and Low Oil and Gas
Resource and Technology

Oil-to-natural gas price ratio
energy-equivalent terms

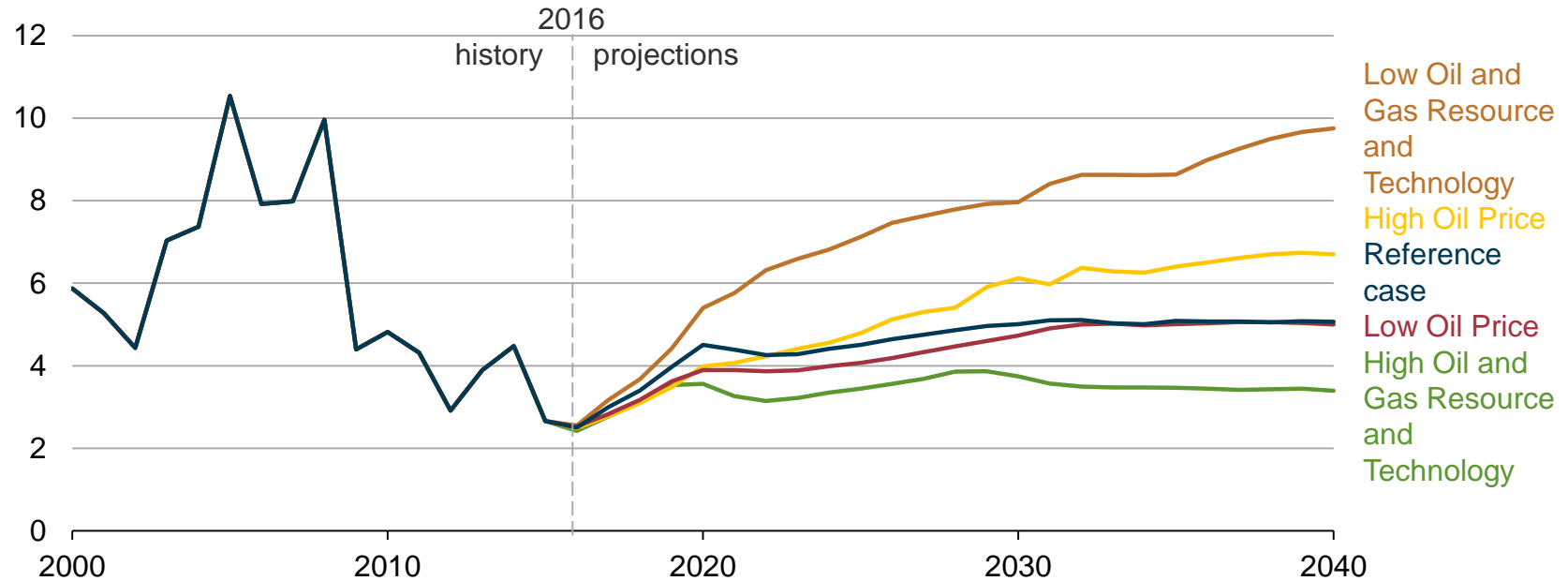


High and Low
Oil Price

Source: EIA, Annual Energy Outlook 2017

Future domestic natural gas prices depend on both domestic resource availability and world energy prices

Henry Hub natural gas price
2016 dollars per million Btu

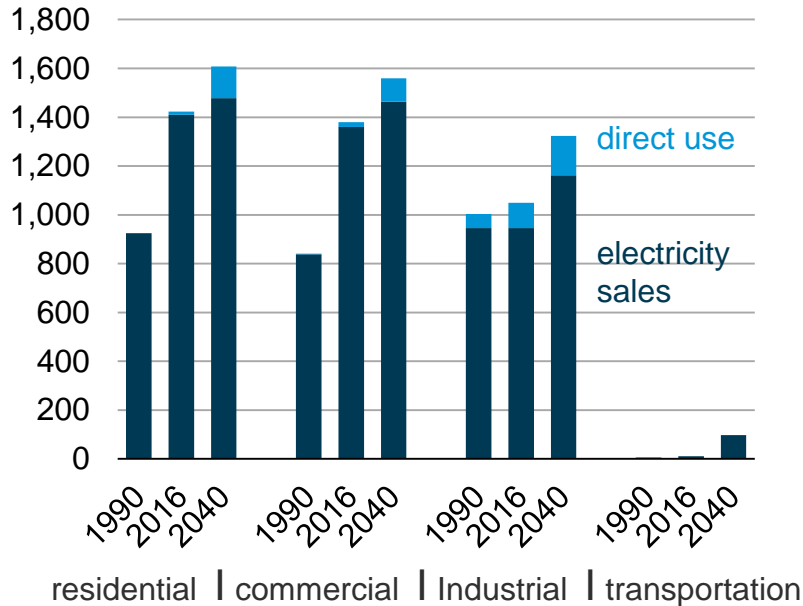


Source: EIA, Annual Energy Outlook 2017

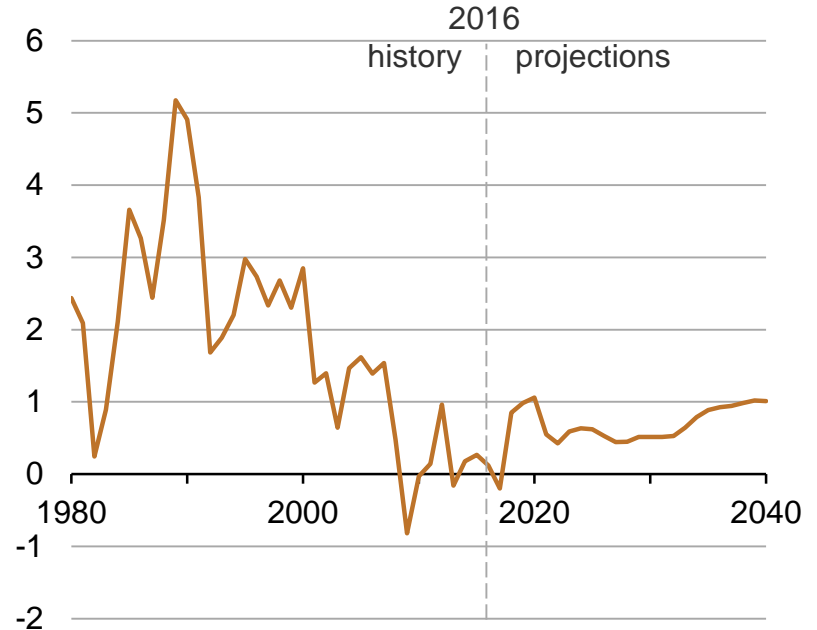
Electricity

Electricity use continues to increase, but the rate of growth remains lower than historic averages in the Reference case

Electricity use by sector
billion kilowatthours



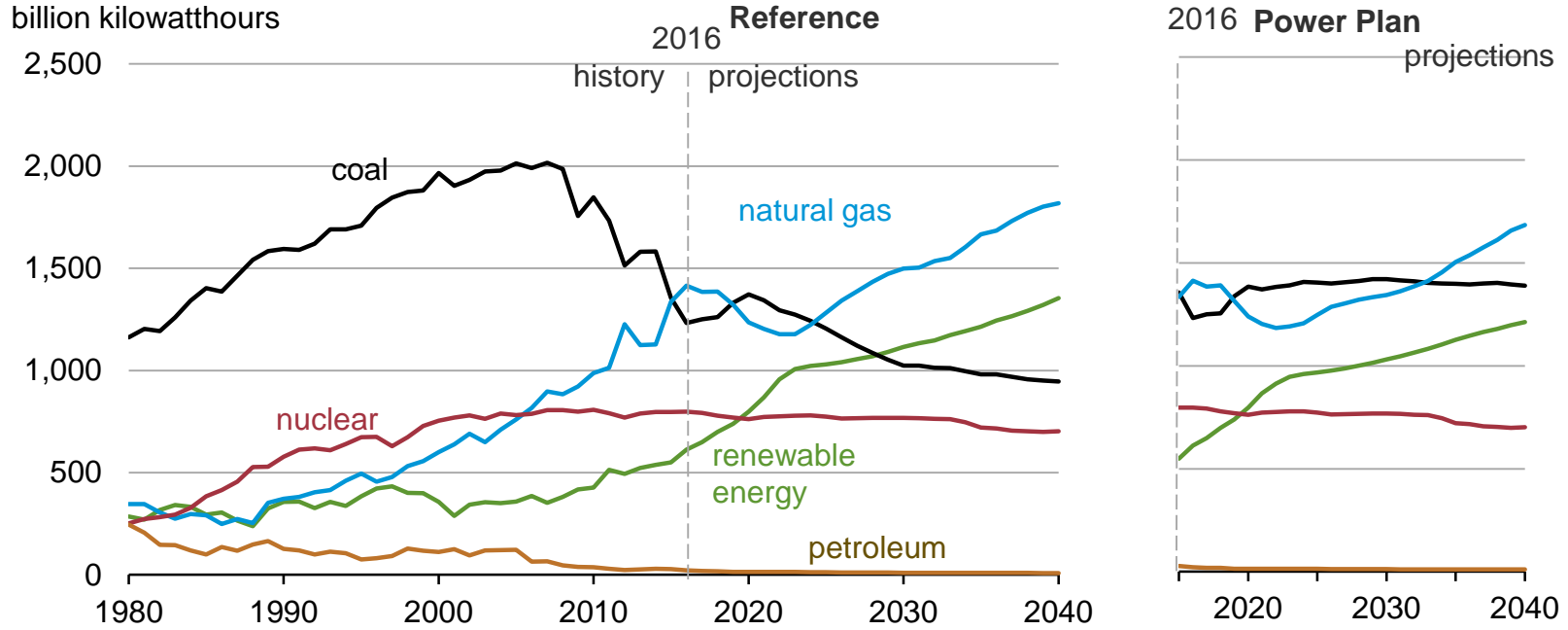
Electricity use growth rate
percent growth (three-year rolling average)



Source: EIA, Annual Energy Outlook 2017

Fuel prices and current laws and regulations drive growing shares of renewables and natural gas in the electricity generation mix as coal's share declines over time in the Reference case

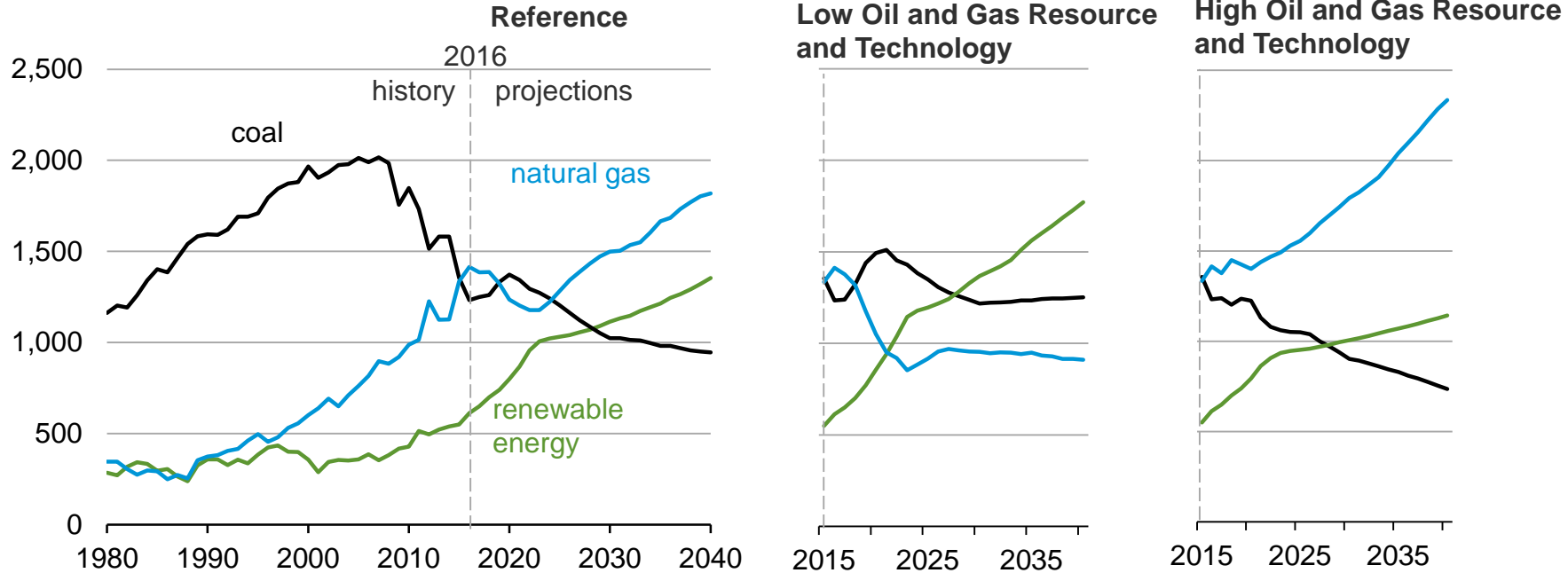
U.S. net electricity generation from select fuels
billion kilowatthours



Source: EIA, Annual Energy Outlook 2017

Natural gas resource availability affects prices and plays a critical role in determining the mix of coal, natural gas, and renewable generation

U.S. net electricity generation from select fuels
billion kilowatthours

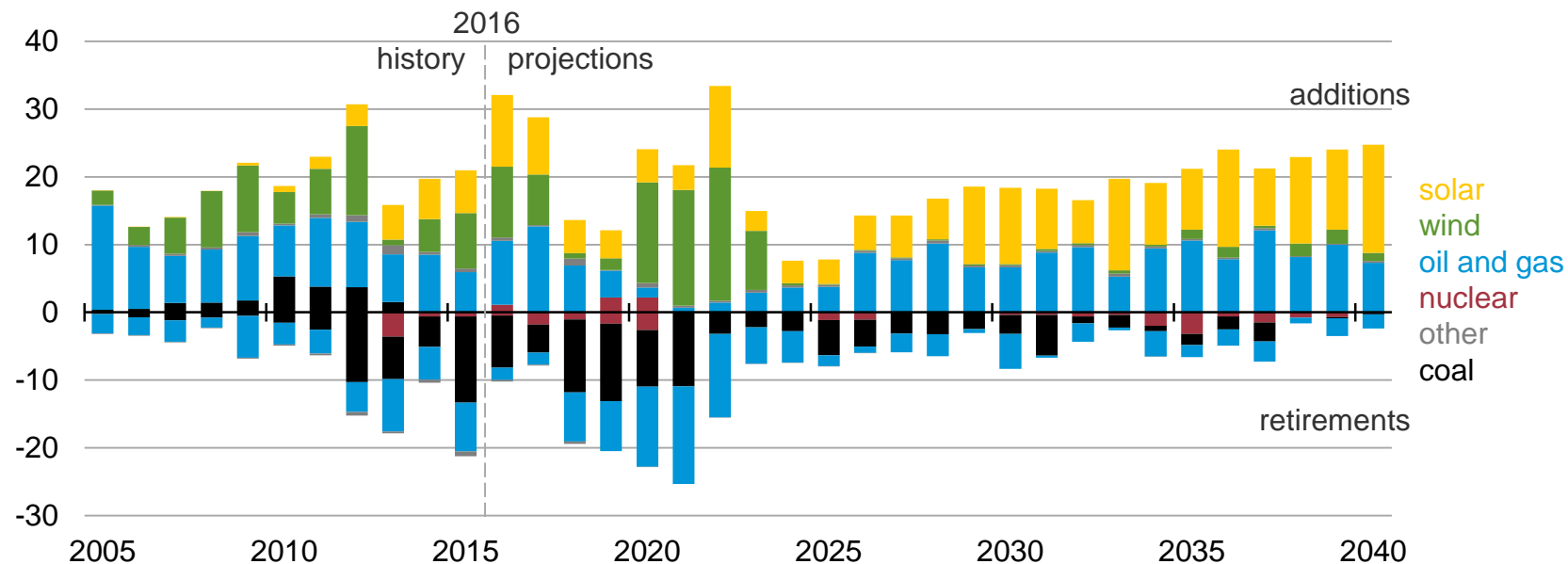


Source: EIA, Annual Energy Outlook 2017

Lower capital costs and the availability of tax credits boost near-term wind additions and sustain solar additions; whereas coal-fired unit retirements in the Reference case are driven by low natural gas prices and the Clean Power Plan

Annual electricity generating capacity additions and retirements (Reference case)

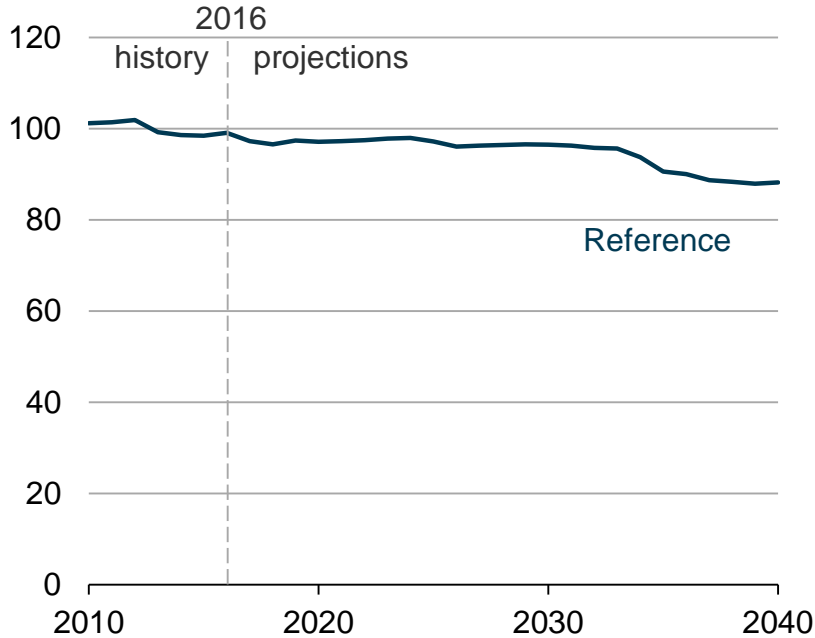
gigawatts



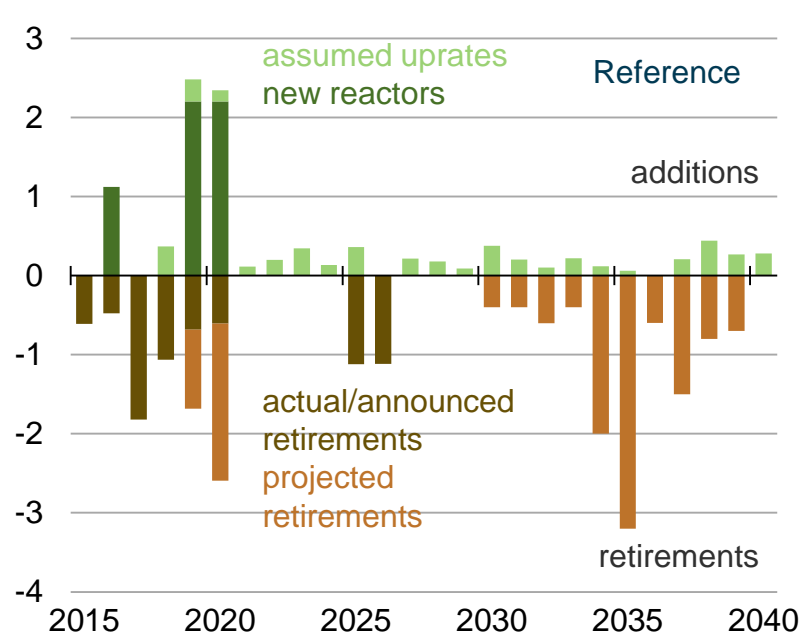
Source: EIA, Annual Energy Outlook 2017

Assumptions about license renewals in AEO2017 increase nuclear retirements, leading to net nuclear capacity decreases

Nuclear electricity generating capacity gigawatts



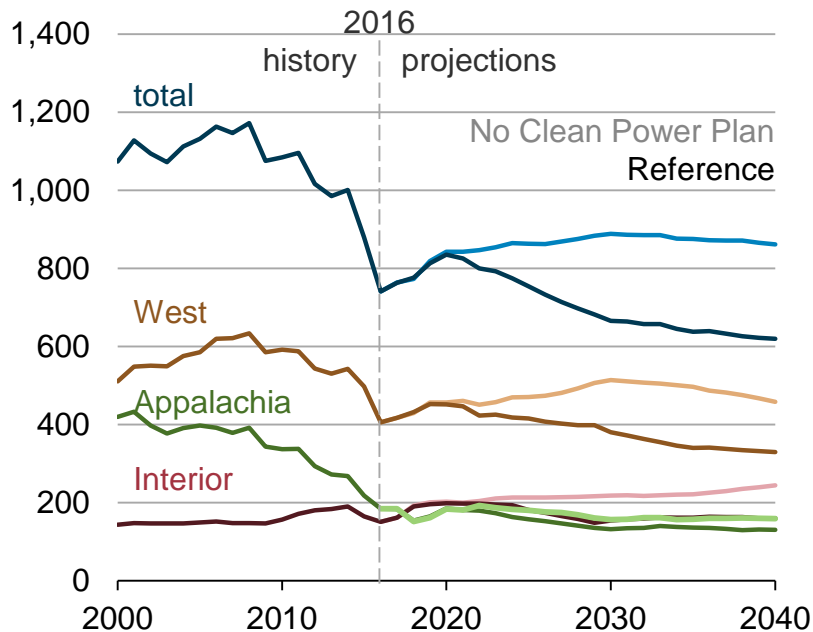
Year-over-year nuclear capacity changes gigawatts



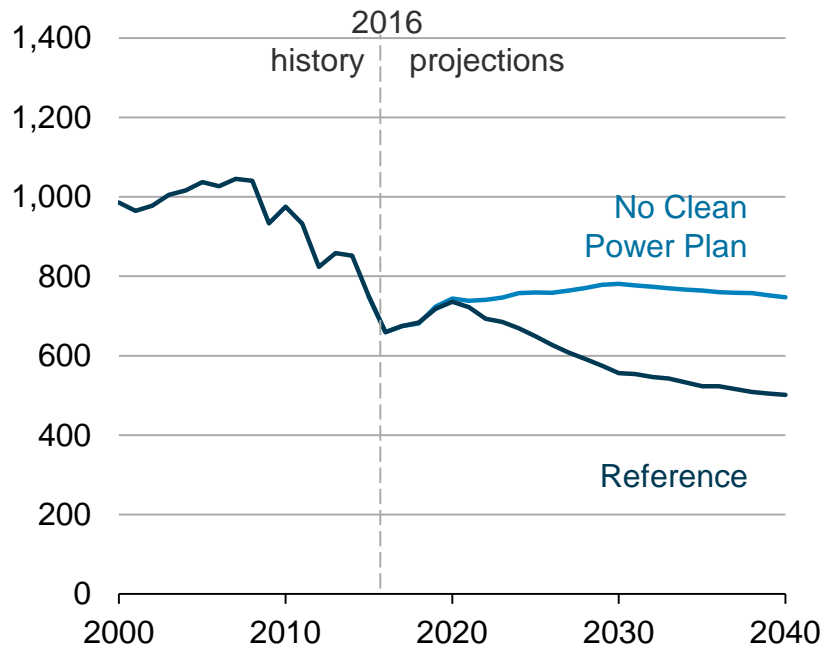
Source: EIA, Annual Energy Outlook 2017

Coal production decreases, primarily in the Western region

Coal production
million short tons



Coal consumption in electric power sector
million short tons

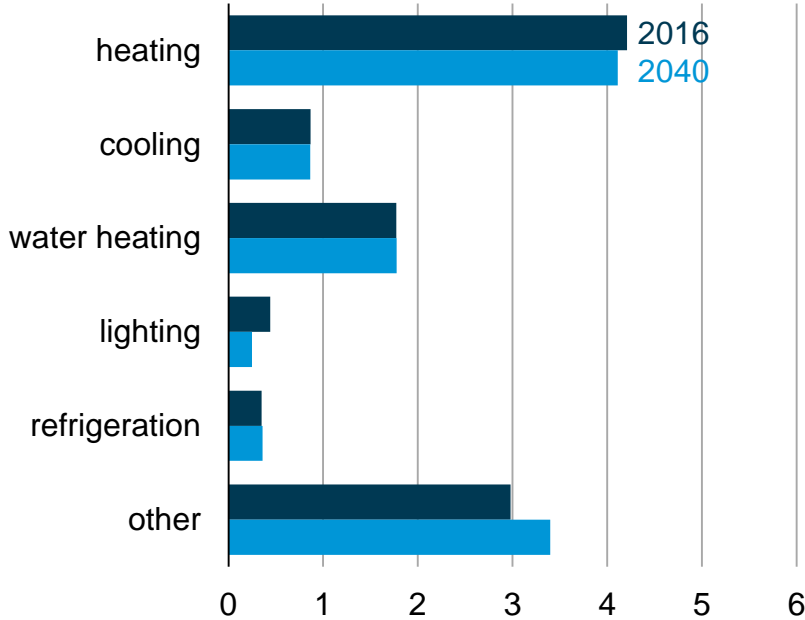


Source: EIA, Annual Energy Outlook 2017

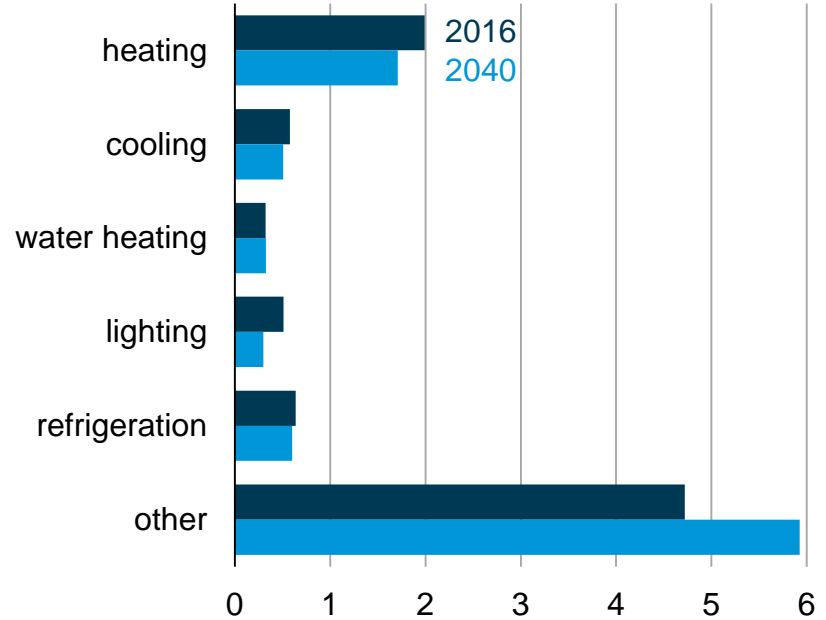
Buildings and industrial

Energy consumption decreases for most major end uses in the residential and commercial sectors with improved equipment efficiency and standards in the Reference case

Residential sector delivered energy consumption quadrillion British thermal units



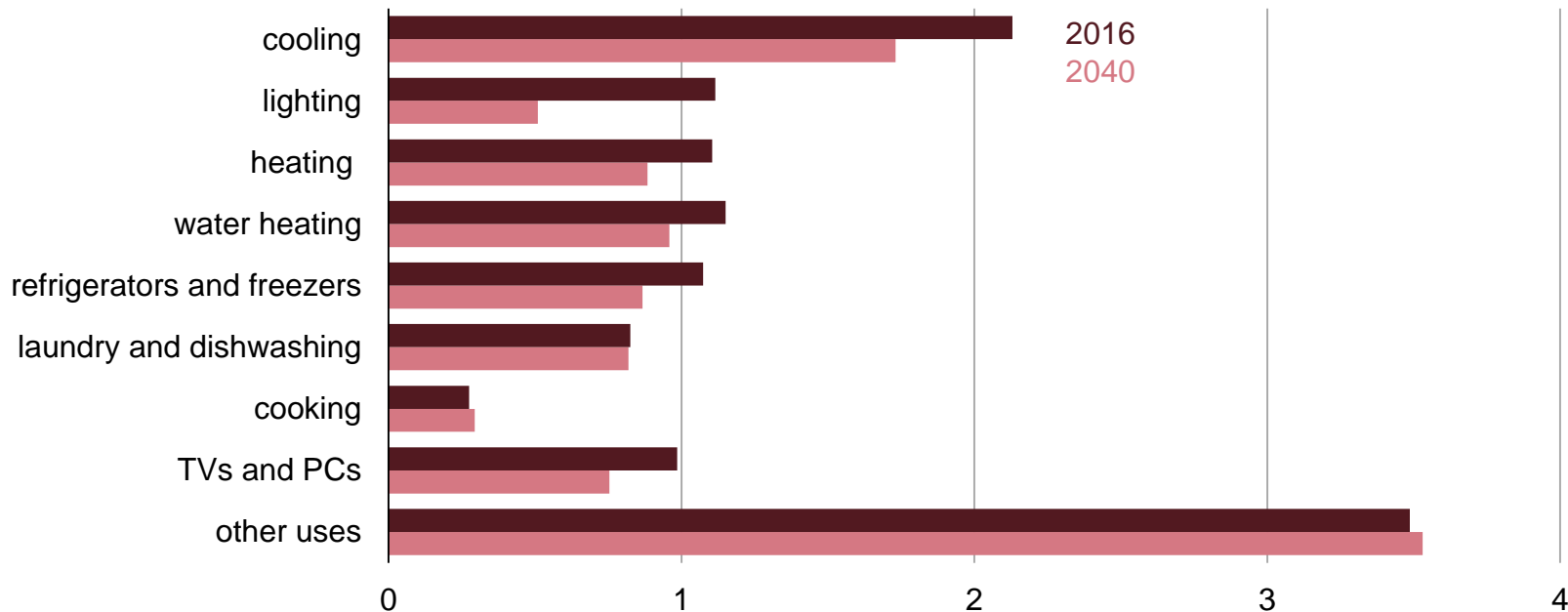
Commercial sector delivered energy consumption quadrillion British thermal units



Source: EIA, Annual Energy Outlook 2017

Per-household electricity use continues to decline in the Reference case led by efficiency improvements in lighting, cooling, and refrigeration

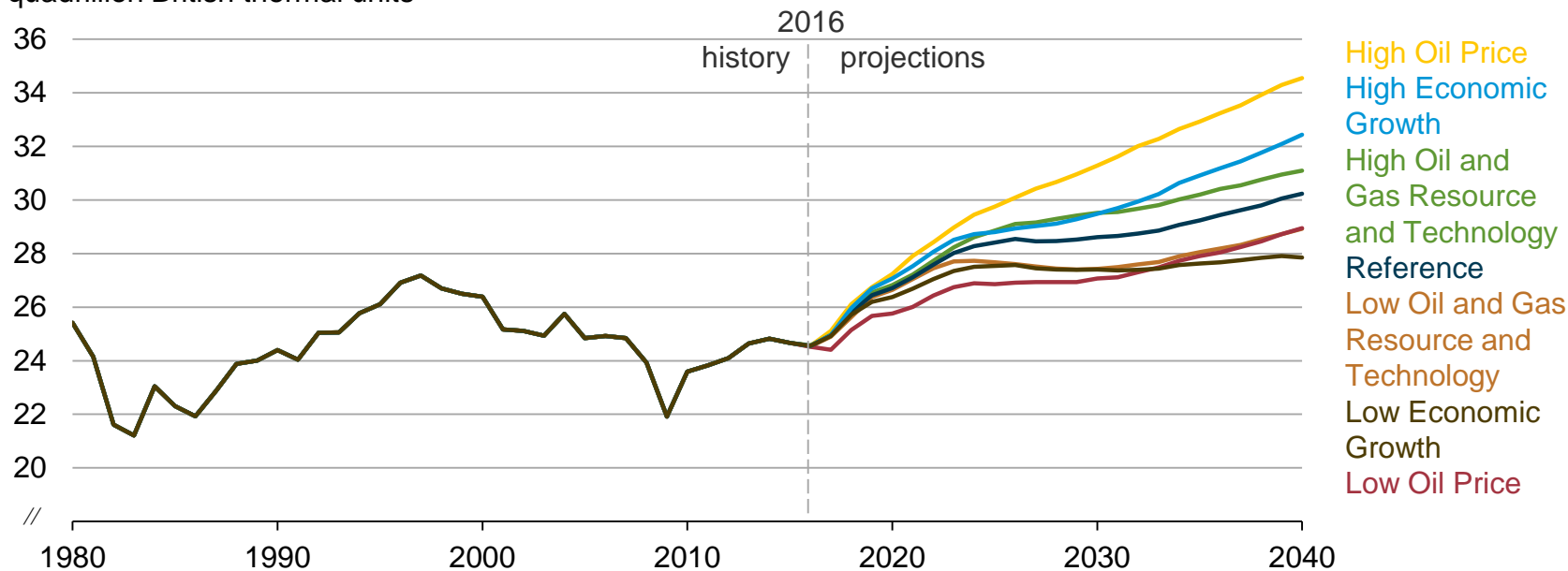
Residential electricity use per household
thousand kilowatthours per household



Source: EIA, Annual Energy Outlook 2017

Industrial energy consumption grows in all cases, but is higher in the High Oil Price case and the High Economic Growth cases over most of the projection

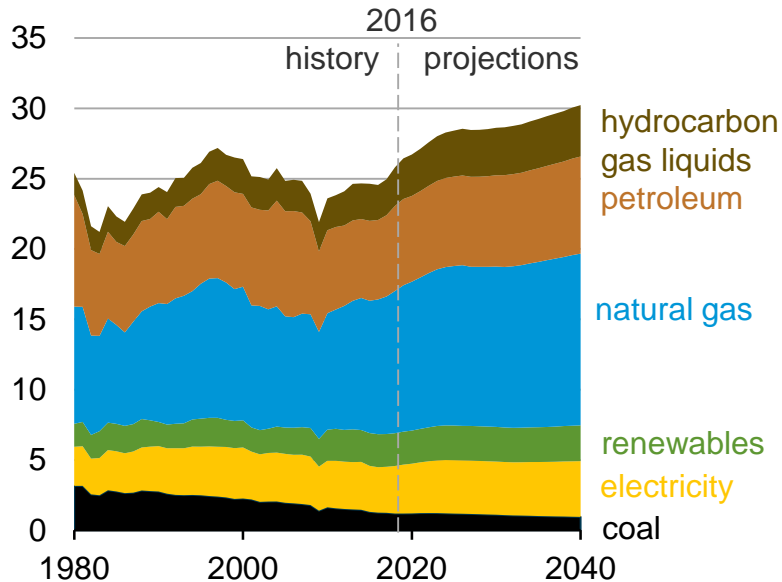
Industrial energy consumption
quadrillion British thermal units



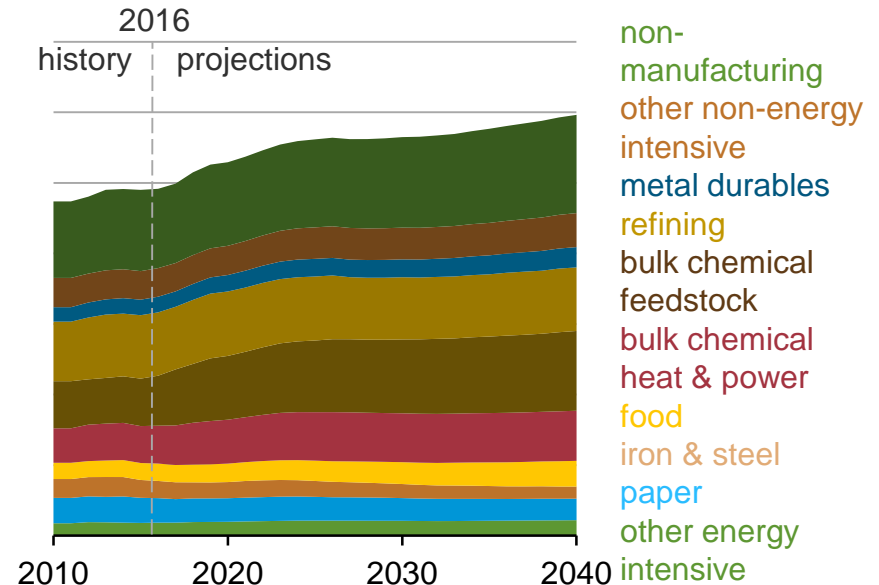
Source: EIA, Annual Energy Outlook 2017

Industrial sector energy consumption growth in the Reference case is led by increases in petroleum and natural gas consumption

Industrial energy consumption
quadrillion British thermal units



Industrial energy consumption
quadrillion British thermal units



Source: EIA, Annual Energy Outlook 2017

For more information

U.S. Energy Information Administration home page / 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

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