

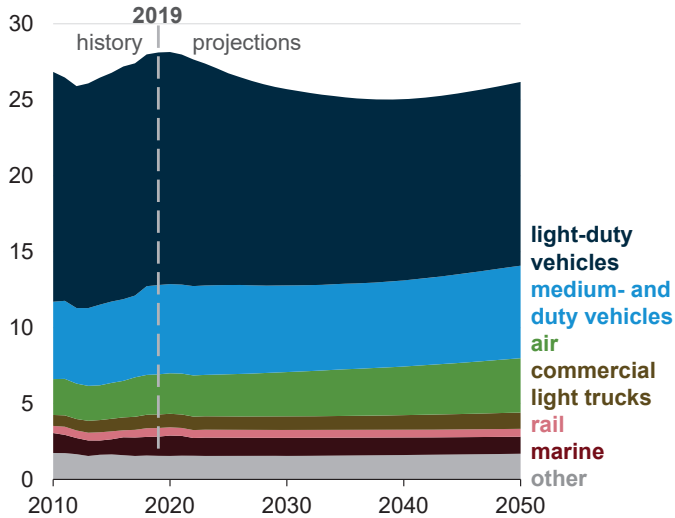


Transportation

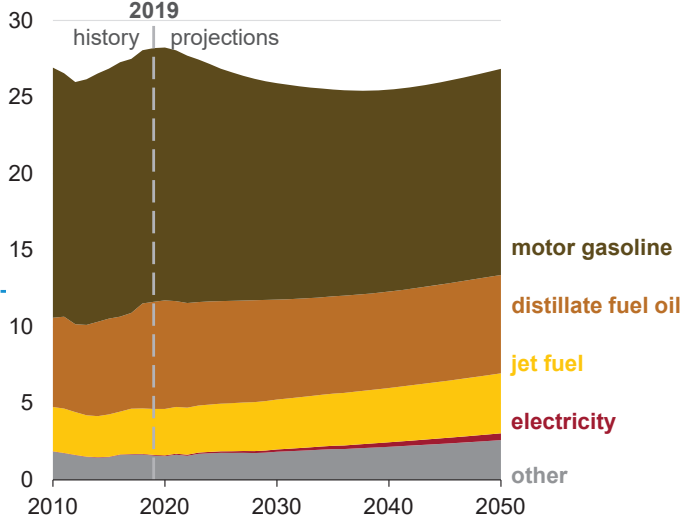
Transportation energy consumption peaks in 2020 in the AEO2020 Reference case because rising fuel efficiency more than offsets the effects of increases in total travel and freight movements, but this trend reverses toward the end of the projection period.

Transportation energy consumption declines through the 2030s in the AEO2020 Reference case—

Transportation sector consumption (by type)
(AEO2020 Reference case)
quadrillion British thermal units



Transportation sector consumption (by fuel)
(AEO2020 Reference case)
quadrillion British thermal units

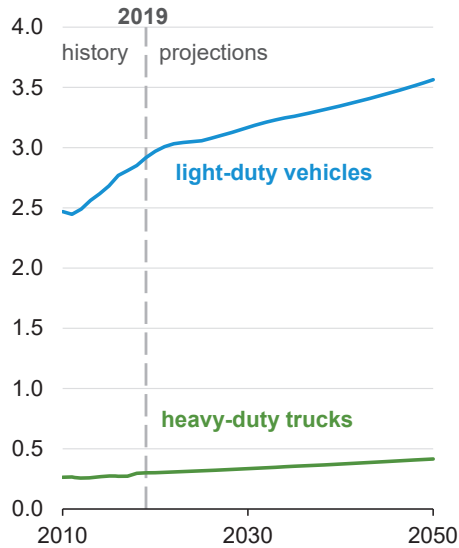


—because increases in fuel economy more than offset growth in vehicle miles traveled

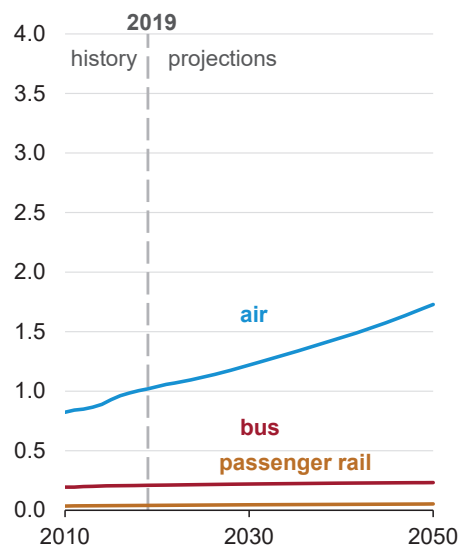
- Increases in fuel economy standards drive the decrease in U.S. motor gasoline consumption, which declines by 19% through 2050.
- Continued growth of on-road travel increases energy use later in the projection period because the travel demand for both light- and heavy-duty vehicles outpaces fuel economy improvements that result from regulatory requirements. Fuel efficiency regulations require no additional efficiency increases for new light-duty vehicles after 2025 and for new heavy-duty vehicles after 2027.
- Although increases in fuel efficiency standards slow growth in heavy-duty vehicle energy consumption and related diesel use, overall energy consumption for heavy-duty vehicles increases 4% through 2050 as a result of rising economic activity that increases demand for freight truck travel.
- Electricity is the fastest-growing energy source in the transportation sector, increasing on average 7.4% per year by 2050 as a result of increased demand for electric light-duty vehicles. Despite this growth, electricity accounts for less than 2% of transportation fuel consumption in 2050.
- Jet fuel consumption also increases through the projection period, rising 31% by 2050 because increases in air transportation outpace increases in aircraft fuel efficiency.
- Motor gasoline and distillate fuel oil's combined share of total transportation energy consumption decreases from 84% in 2019 to 74% in 2050.

Passenger travel increases across all transportation modes in the AEO2020 Reference case through 2050—

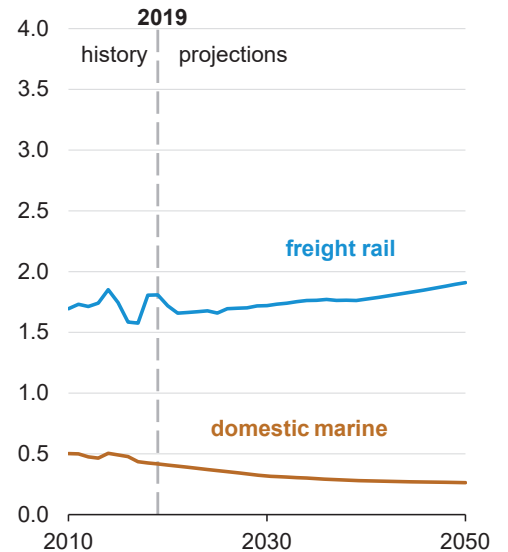
**Vehicle travel
(AEO2020 Reference case)**
trillion vehicle miles



**Passenger travel
(AEO2020 Reference case)**
trillion revenue passenger miles



**Rail and domestic shipping
(AEO2020 Reference case)**
trillion ton-miles traveled

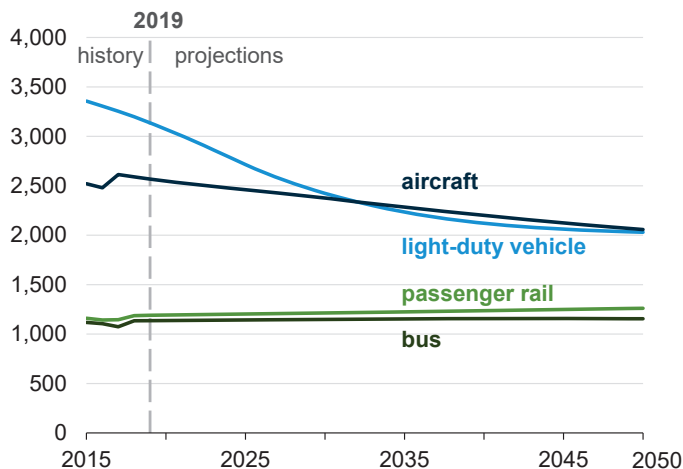


—and freight movement increases across all modes except domestic marine

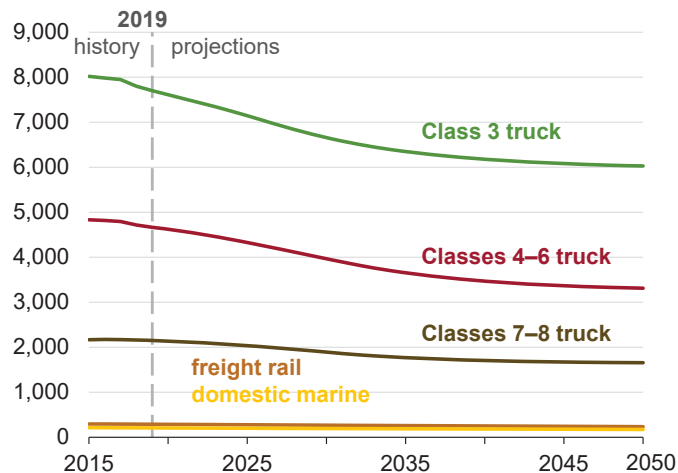
- Light-duty vehicle miles traveled increase by 22% in the AEO2020 Reference case, growing from 2.9 trillion miles in 2019 to 3.6 trillion miles in 2050 as a result of rising incomes and growing population.
- Truck vehicle miles traveled, the dominant mode of freight movement in the United States, grow by 38%, from 300 billion miles in 2019 to 415 billion miles in 2050, as a result of increased economic activity. Freight rail ton-miles decline significantly in the early part of the projection period as a result of reduced U.S. coal shipments, but overall, freight rail ton-miles grow by 6% during the projection period, led primarily by rising industrial output.
- Air travel grows 70% from 1,020 billion revenue passenger miles to 1,729 billion revenue passenger miles through the projection period in the Reference case because of increased demand for global connectivity and rising personal incomes. Bus and passenger rail travel increase 11% and 30%, respectively.
- Domestic marine shipments decline modestly during the projection period, continuing a historical trend related to logistical and economic competition with other freight modes.

Energy intensity decreases across most transportation modes in the AEO2020 Reference case

Passenger mode energy intensity (AEO2020 Reference case)
British thermal units per passenger-mile



Freight mode energy intensity (AEO2020 Reference case)
British thermal units per ton-mile



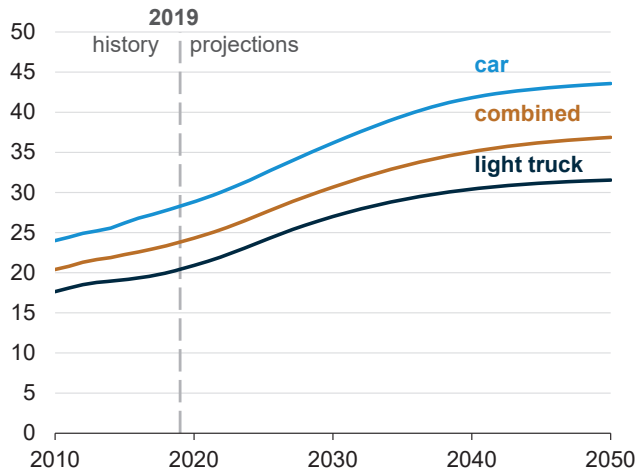
—because of policy, economic, and technological factors

- Energy use per passenger-mile of travel in light-duty vehicles declines nearly 35% by 2050 in the AEO2020 Reference case as newer, more fuel-efficient vehicles enter the market, including both more efficient conventional gasoline vehicles and highly efficient alternatives such as battery electric vehicles. Energy efficiencies for light-duty vehicles are affected by current federal fuel economy and greenhouse gas emissions standards.
- Energy use per passenger-mile of travel in aircraft decreases because of the economically driven adoption of energy-efficient technology and practices. Energy use per passenger-mile of travel on passenger rail and buses, already relatively energy-efficient modes of travel per passenger-mile, remains relatively constant.
- Energy use per ton-mile of travel by freight modes decreases, led by increases in the fuel economy of heavy-duty trucks across all weight classes as the second phase of heavy-duty vehicle efficiency and greenhouse gas standards take full effect in 2027.
- Gains in energy efficiency offset increases in travel for passenger and freight modes. These efficiency gains decrease energy consumption by light-duty vehicles in the projection period and temper the rise in energy consumption by other transportation modes.

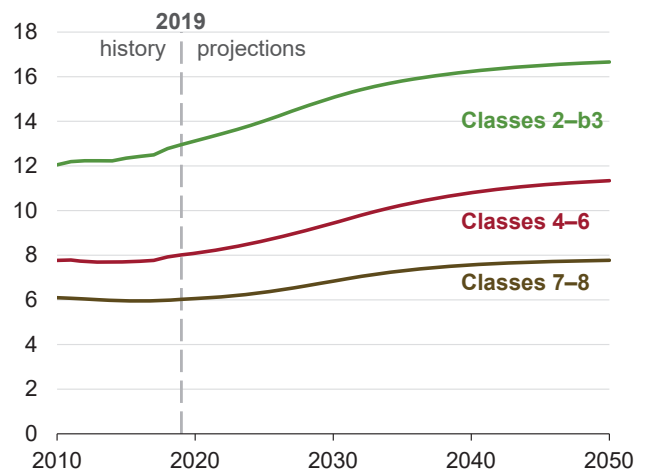


Fuel economy of all on-road vehicles increases in the AEO2020 Reference case—

Light-duty fuel economy (AEO2020 Reference case)
miles per gallon (all vehicles)



Heavy-duty fuel economy (AEO2020 Reference case)
miles per gallon (all vehicles)

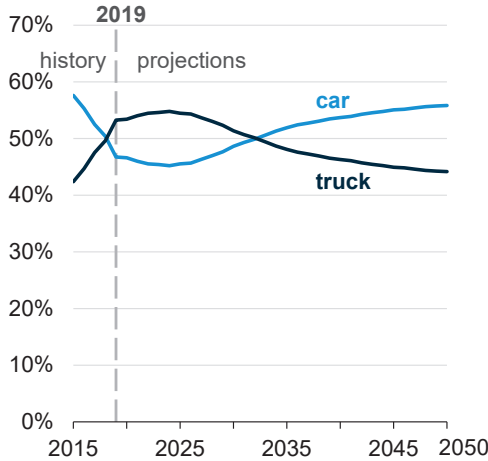


—across all vehicle types throughout the projection period

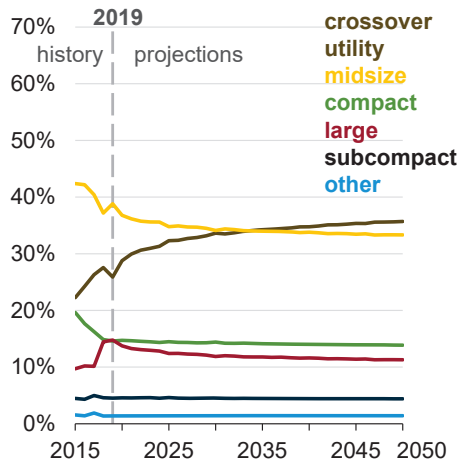
- Across all light-duty vehicles in use, fuel economy increases by 55% by 2050 in the AEO2020 Reference case as newer, more fuel-efficient vehicles enter the market and cars, which are more fuel efficient than light trucks, gain market share during the projection period. The fuel economy of cars increases from 28.3 miles per gallon (mpg) to 43.6 mpg, and the fuel economy for new light trucks increases from 20.4 mpg to 31.6 mpg.
- Fuel economy of the heavy-duty vehicles in use improves across all weight classes as the efficiency improvements required under the second phase of heavy-duty vehicle efficiency and greenhouse gas standards take full effect. Phase II of the heavy-duty vehicle efficiency and greenhouse gas standards reaches the maximum requirements in 2027. Heavy-duty vehicle fuel economy continues to improve as older vehicles are replaced with newer, more efficient vehicles.
- Gains in fuel economy temper heavy-duty vehicle energy consumption growth and decrease light-duty vehicle energy consumption. For heavy-duty vehicles after 2040, increasing vehicle travel outweighs fuel economy improvements, leading to increases in fuel demand.

Sales of more fuel-efficient cars and light-truck crossover utility vehicles increase in the AEO2020 Reference case—

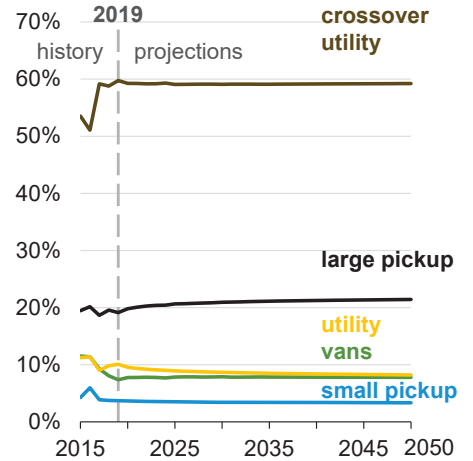
Light-duty vehicle sales shares (AEO2020 Reference case) percent



Car sales shares by size class (AEO2020 Reference case) percent



Light truck sales shares by size class (AEO2020 Reference case) percent

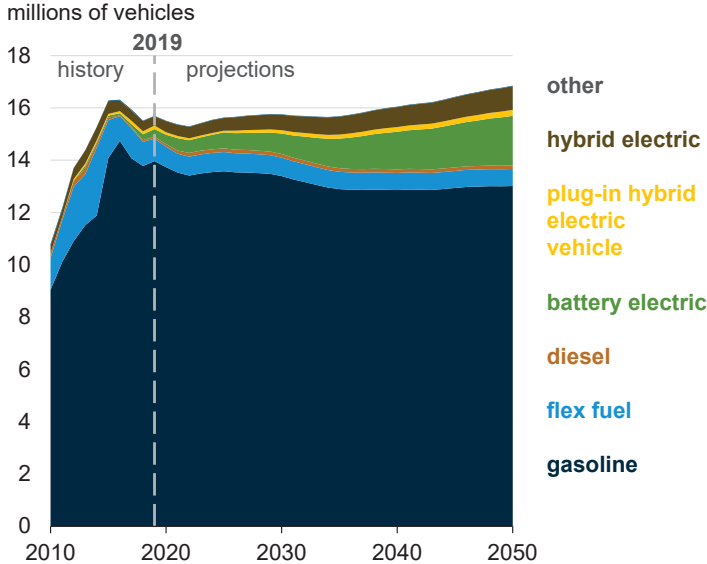


—but other vehicle types maintain significant market share through 2050

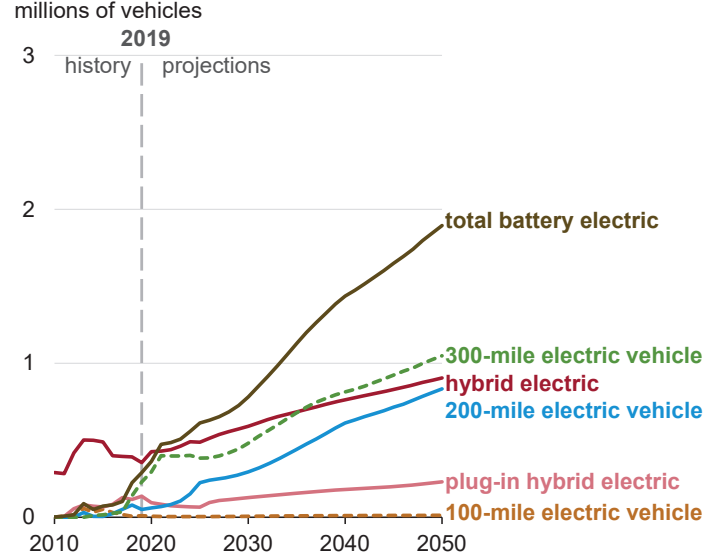
- In the AEO2020 Reference case, passenger cars gain market share in the light-duty vehicle market relative to light-duty trucks because they have higher fuel efficiency in periods when motor gasoline prices increase. They also gain market share because crossover utility vehicles, often classified as passenger cars, may replace lower fuel economy light-truck classified utility vehicles as a result of increasing availability and popularity.
- Light trucks lose some of their share in the light-duty vehicle market, and in terms of number of units sold, the classifications within light trucks shift from traditional vans and utility vehicles toward crossover utility vehicles that have higher fuel economy.
- Combined car and light-truck classified crossover utility vehicles reach 46% of new light-duty vehicle sales in 2050, largely taking away sales from traditional compact, midsize, and large cars and from truck-based sport utility vehicles.

Alternative and electric vehicles gain market share in the AEO2020 Reference case—

Light-duty vehicle sales by fuel type (AEO2020 Reference case)
millions of vehicles



New vehicle sales of battery powered vehicles (AEO2020 Reference case)
millions of vehicles



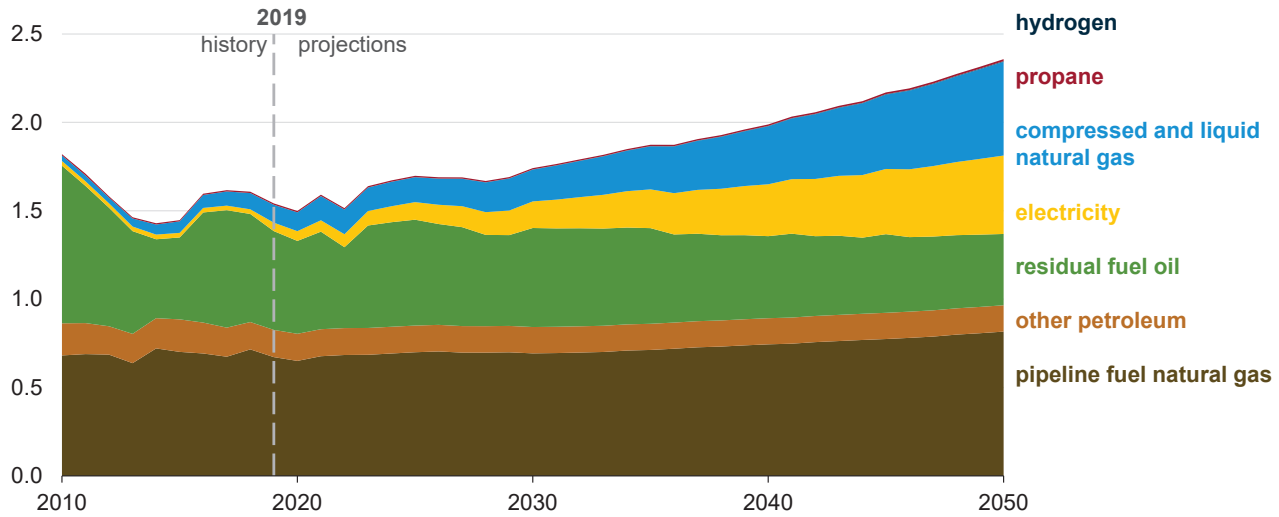
—but gasoline vehicles remain the dominant vehicle type through 2050

- The combined share of sales from gasoline and flex-fuel vehicles (which use gasoline blended with up to 85% ethanol) declines from 94% in 2019 to 81% in 2050 in the AEO2020 Reference case because of growth in sales of battery electric vehicles (BEV), plug-in hybrid electric vehicles (PHEV), and hybrid electric vehicles. BEV sales increase faster than any other type of vehicle sale, growing on average by 6% per year.
- Sales of the longer-ranged 200- and 300-mile BEVs grow during the entire projection period, tempering sales of the shorter-range 100-mile BEV and PHEV. Sales for the 200- and 300-mile BEVs increase from 280,000 in 2019 to 1.9 million in 2050, while sales of PHEVs increase from 137,000 in 2019 to 230,000 in 2050.
- Hybrid electric vehicle sales increase 3.1% per year, rising to more than 900,000 new vehicles sold by the end of the projection period.
- New light-duty vehicles of all fuel types show significant improvements in fuel economy because of compliance with increasing fuel economy standards. Light-duty vehicle fuel economy rises by 55% through the projection period.



Consumption of transportation fuels grows considerably in the AEO2020 Reference case through the projection period—

Transportation sector consumption of minor petroleum and alternative fuels (AEO2020 Reference case)
quadrillion British thermal units



—because of increased use of electricity and natural gas

- Electricity use in the transportation sector increases sharply after 2020 in the AEO2020 Reference case because of a rise in the sale of new battery-electric and plug-in hybrid-electric light-duty vehicles.
- Natural gas consumption increases through 2050 because natural gas is increasingly used as a fuel for heavy-duty vehicles and freight rail.
- In the later years of the projection period, liquefied natural gas is used in the maritime industry as an alternative to burning high-sulfur residual fuel oil to meet the new standards set for marine fuels under the International Convention for the Prevention of Pollution from Ships (MARPOL convention).