Autonomous Vehicles: Uncertainties and Energy Implications

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By

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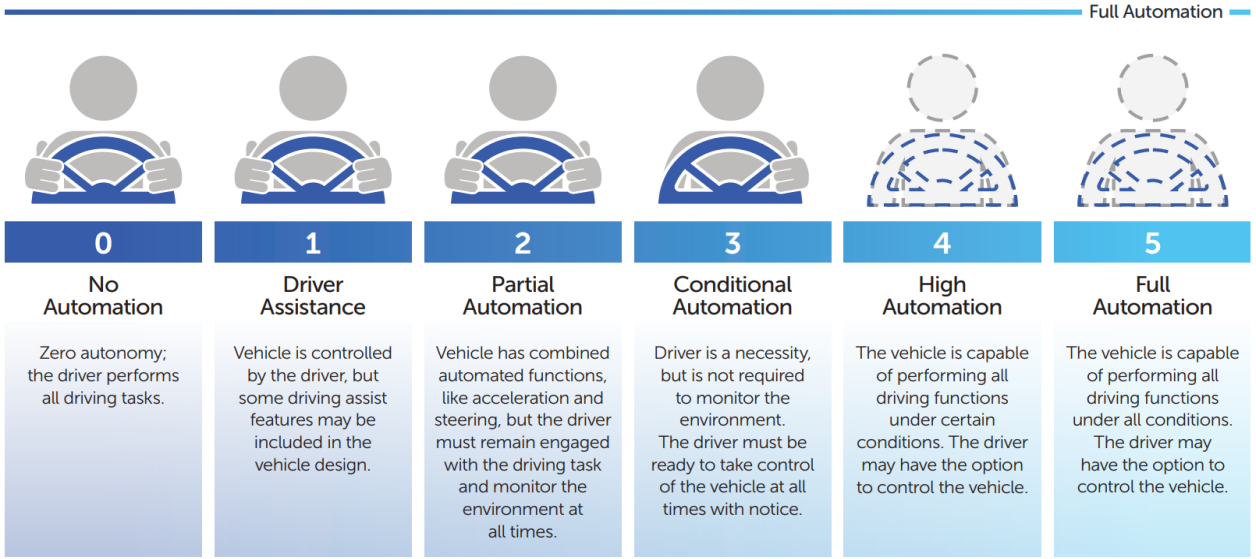
Overview

- Background
  - Definitions
  - Potential benefits
  - Potential obstacles
  - Potential energy effects
- Autonomous vehicle scenarios in AEO2018
  - Scenario descriptions
  - Results

Background

Definition of vehicle automation

- Operational and safety-critical control functions occur without driver input
- Connected and automated vehicles



Source: U.S. Department of Transportation, Automated Driving Systems 2.0, A Vision for Safety

Potential benefits

- Road safety
- Increased system efficiency
  - Route harmonization
  - Reduced congestion
- Increased mobility for underserved population
- Less time driving

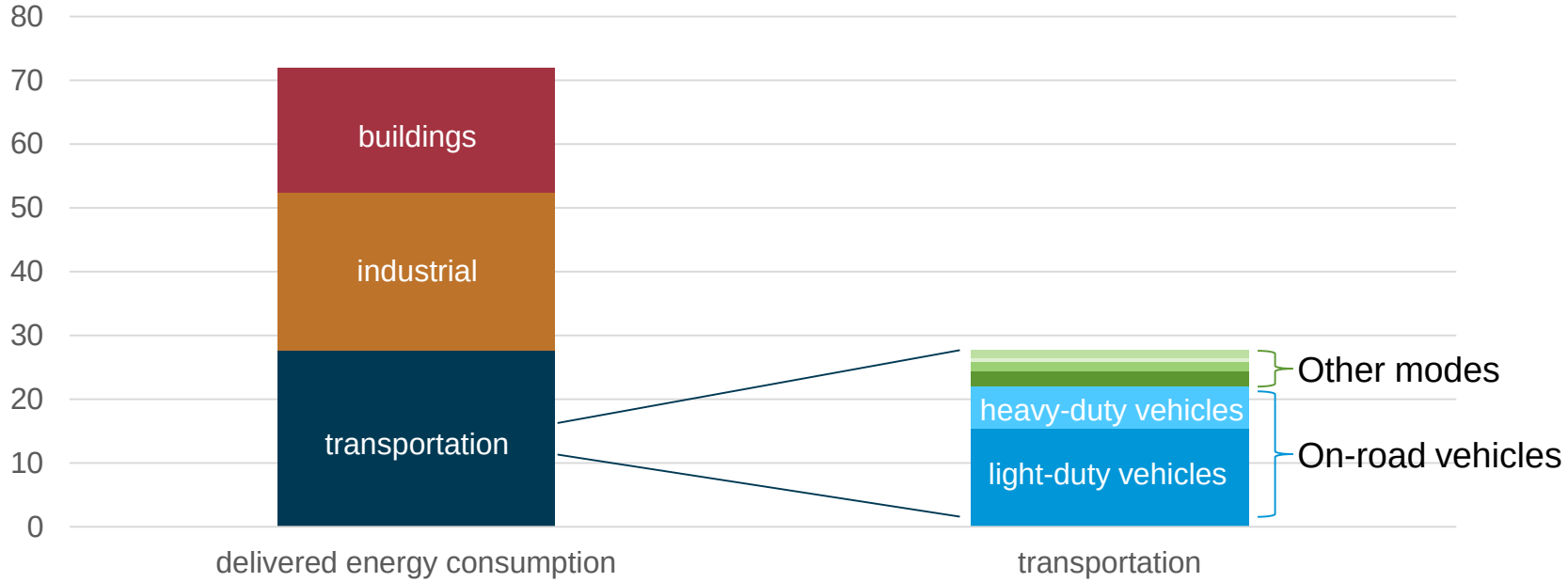
Potential obstacles

- Consumer acceptance
- Technology cost and function
- Cybersecurity
- Legal framework
- Infrastructure
- Policy

On-road vehicles accounted for 31% of delivered U.S. energy consumption in 2017, making potential energy effects from autonomous vehicles important

2017 U.S. delivered energy consumption

quadrillion Btu

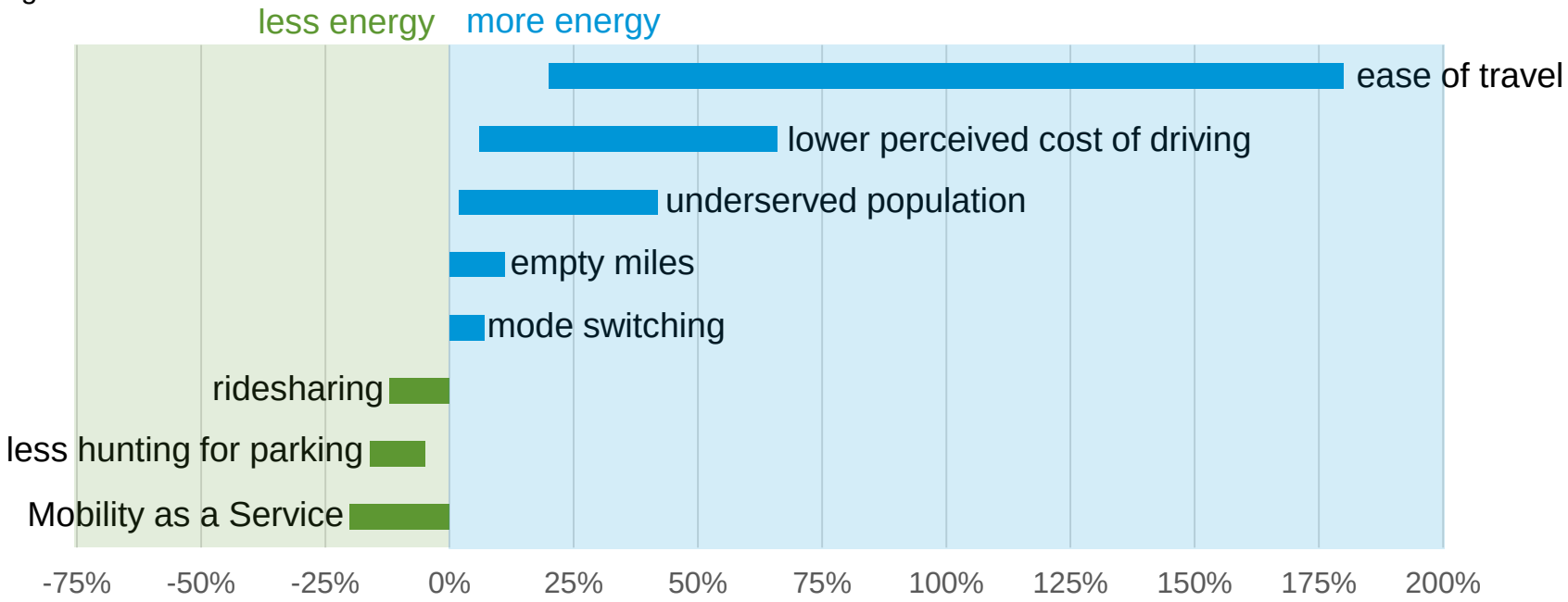


Source: EIA, AEO2018 Reference case

Range of potential autonomous vehicle effects on light-duty vehicle travel demand

Changes in light-duty vehicle miles traveled

% range

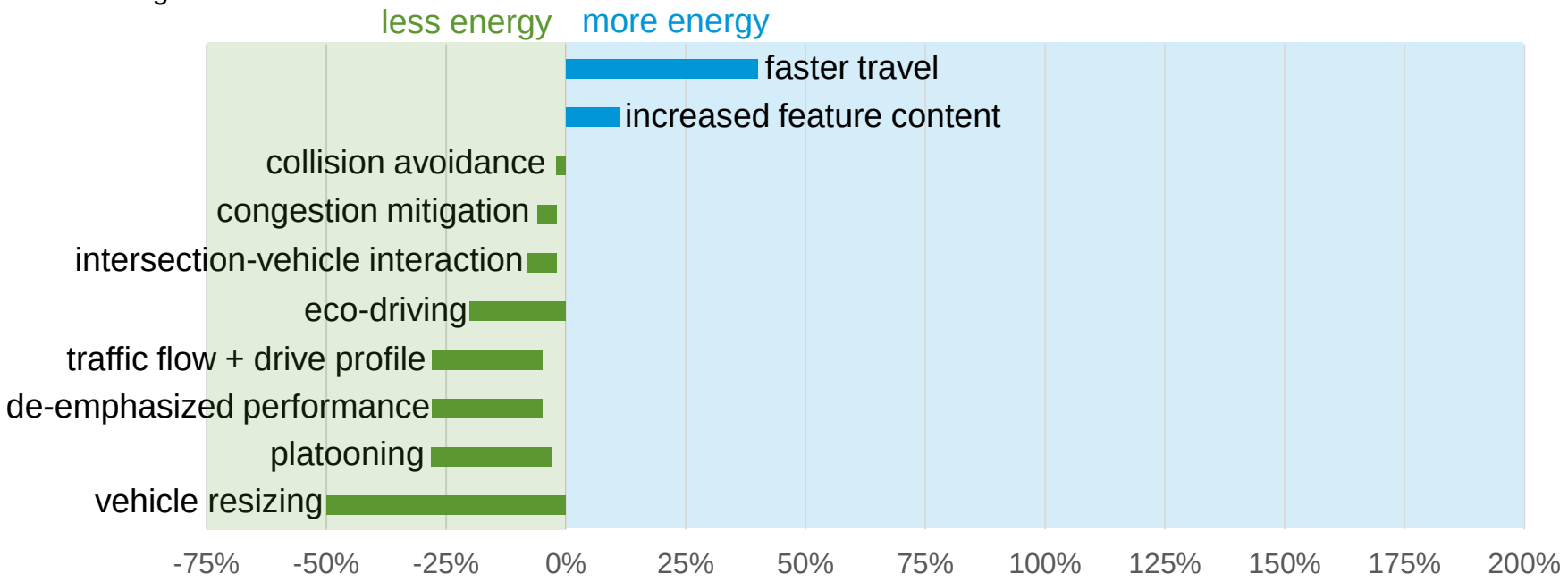


Sources: Help or Hindrance? The Travel, Energy, and Carbon Impacts of Highly Automated Vehicles (Wadud et al); Estimated Bounds and Important Factors for Fuel Use and Consumer Costs of Connected and Automated Vehicles (Stephens et al)

Range of potential autonomous vehicle effects on light-duty vehicle energy efficiency

Changes in light-duty energy efficiency

% range

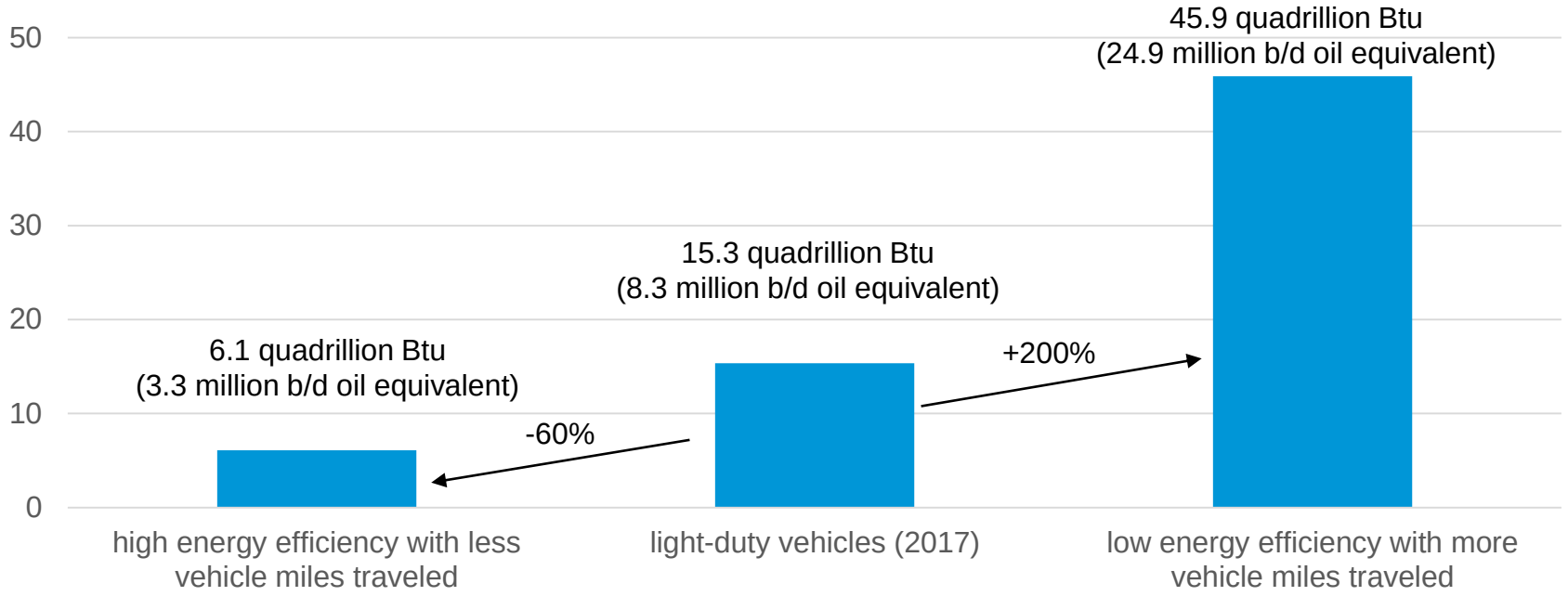


Sources: Help or Hindrance? The Travel, Energy, and Carbon Impacts of Highly Automated Vehicles (Wadud et al); Estimated Bounds and Important Factors for Fuel Use and Consumer Costs of Connected and Automated Vehicles (Stephens et al)

Range of potential effects of autonomous vehicles on light-duty vehicle energy consumption

2017 U.S. delivered energy consumption

quadrillion Btu



Source: 2017: EIA, AEO2018 Reference case, extrapolation based on upper and lower limits from Estimated Bounds and Important Factors for Fuel Use and Consumer Costs of Connected and Automated Vehicles (Stephens et al)

Additional ways vehicle automation technology could affect transportation energy consumption

- Alternative fuels and energy efficient powertrains
- Commercial trucks
- Mass transit

Autonomous vehicle scenarios in AEO2018

Description of scenarios

- Reference case
  - Autonomous vehicles enter fleet light-duty vehicles
    - 1% of new sales by 2050
  - Autonomous vehicles used more intensively
    - 65,000 miles/year and scrapped more quickly
  - Autonomous vehicle fuel type
    - 100% conventional gasoline internal combustion engine
  - Autonomous vehicles affect mass transit
    - Increases use of commuter rail
    - Decreases use of transit bus and transit rail

Description of scenarios–two scenarios examine energy implications from more widespread use of autonomous vehicles

- Identical assumptions
  - Autonomous vehicles enter household and fleet light-duty vehicles
    - 31% of new sales by 2050
  - Autonomous vehicles used more intensively
    - 65,000 miles/year (fleet) ; +10% miles/year (household) on average
  - Autonomous vehicles affect mass transit modes
    - Increases use of commuter rail
    - Decreases use of transit rail
    - Decreases use of transit bus until mid-2030s, thereafter, increases transit bus use from automation technology
  - Automation technology included on long-haul fleet commercial trucks enables platooning

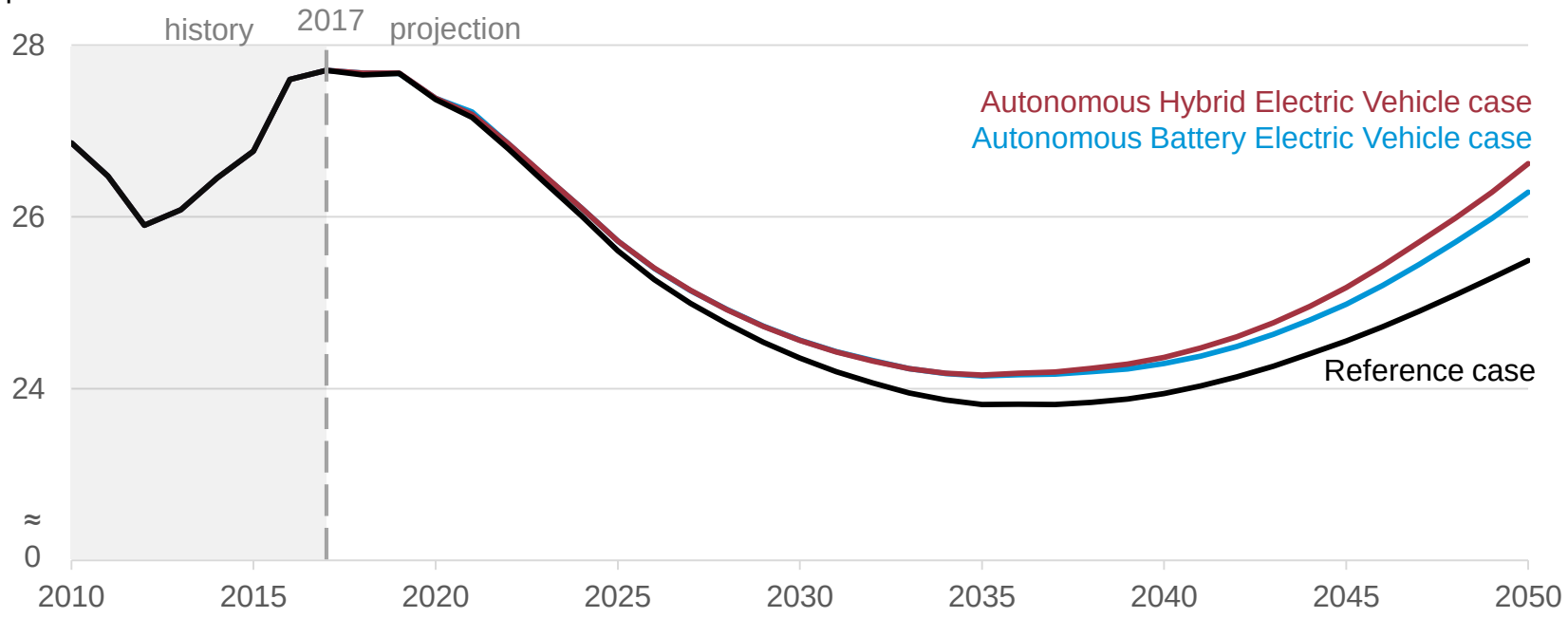
Description of scenarios–two scenarios examine energy implications from more widespread use of autonomous vehicles

- Autonomous Battery Electric Vehicle case
  - Increasing share of autonomous vehicles are battery electric through 2050
    - 96% of fleet and 82% of household autonomous vehicles by 2050
- Autonomous Hybrid Electric Vehicle case
  - Increasing share of autonomous vehicles are hybrid electric through 2050
    - 96% of fleet and 71% of household autonomous vehicles by 2050

Transportation energy consumption higher in both cases compared to Reference case but still lower than 2017

U.S. transportation energy consumption

quadrillion Btu

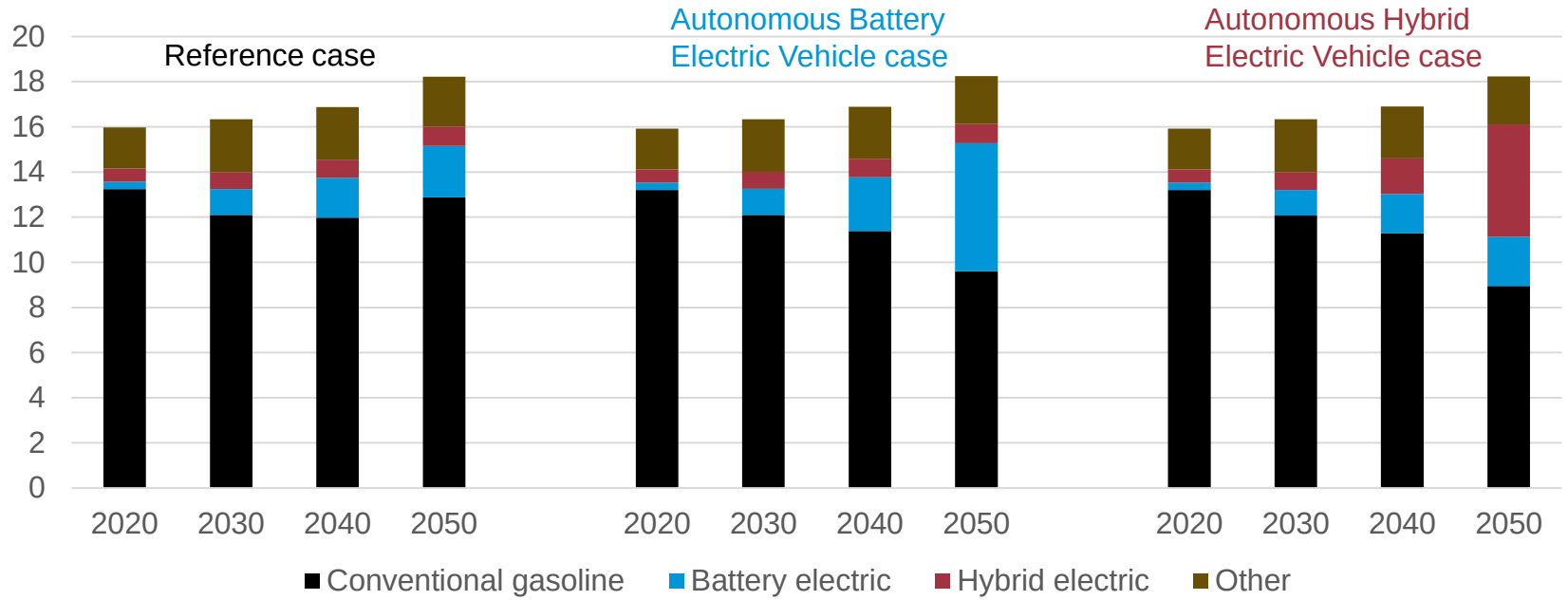


Source: EIA, AEO2018 Reference case, Autonomous Battery Electric Vehicle case, Autonomous Hybrid Electric Vehicle case

Light-duty vehicle sales by fuel type across scenarios

U.S. light-duty vehicle sales

million

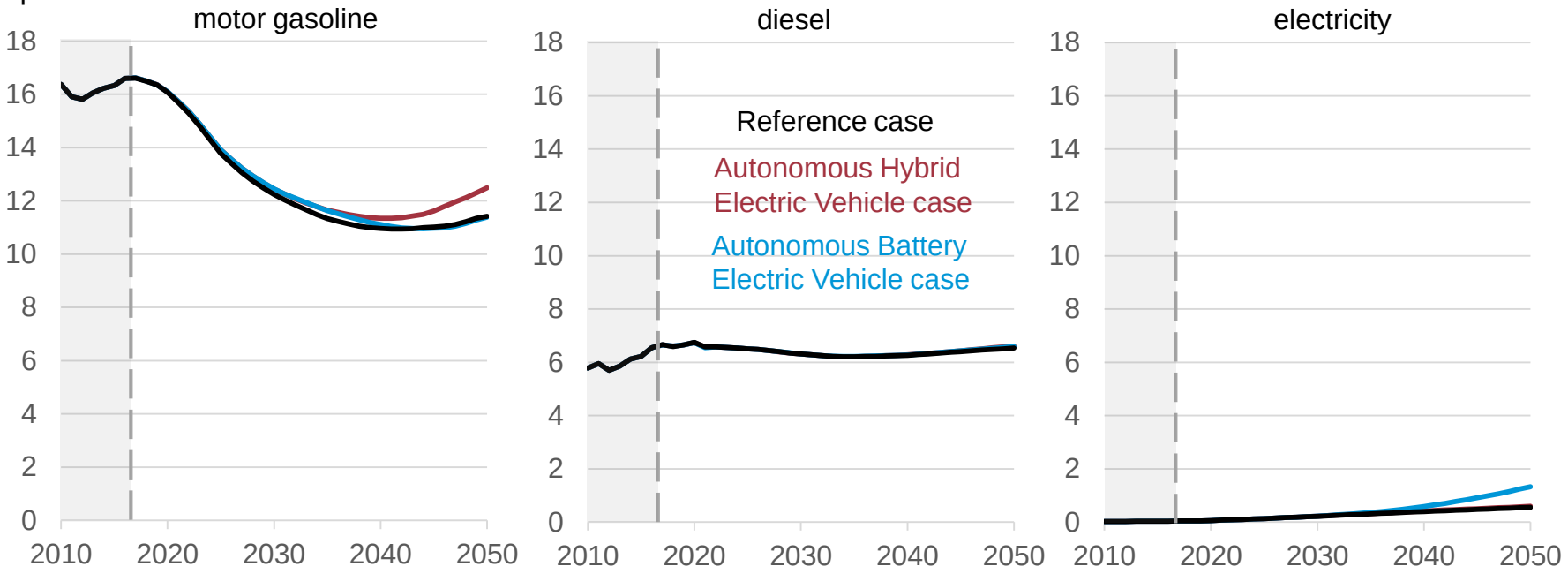


Source: EIA, AEO2018 Reference case, Autonomous Battery Electric Vehicle case, Autonomous Hybrid Electric Vehicle case

Transportation fuel consumption differs between cases because of changes in light-duty vehicle fuel type

Transportation energy consumption by fuel

quadrillion Btu

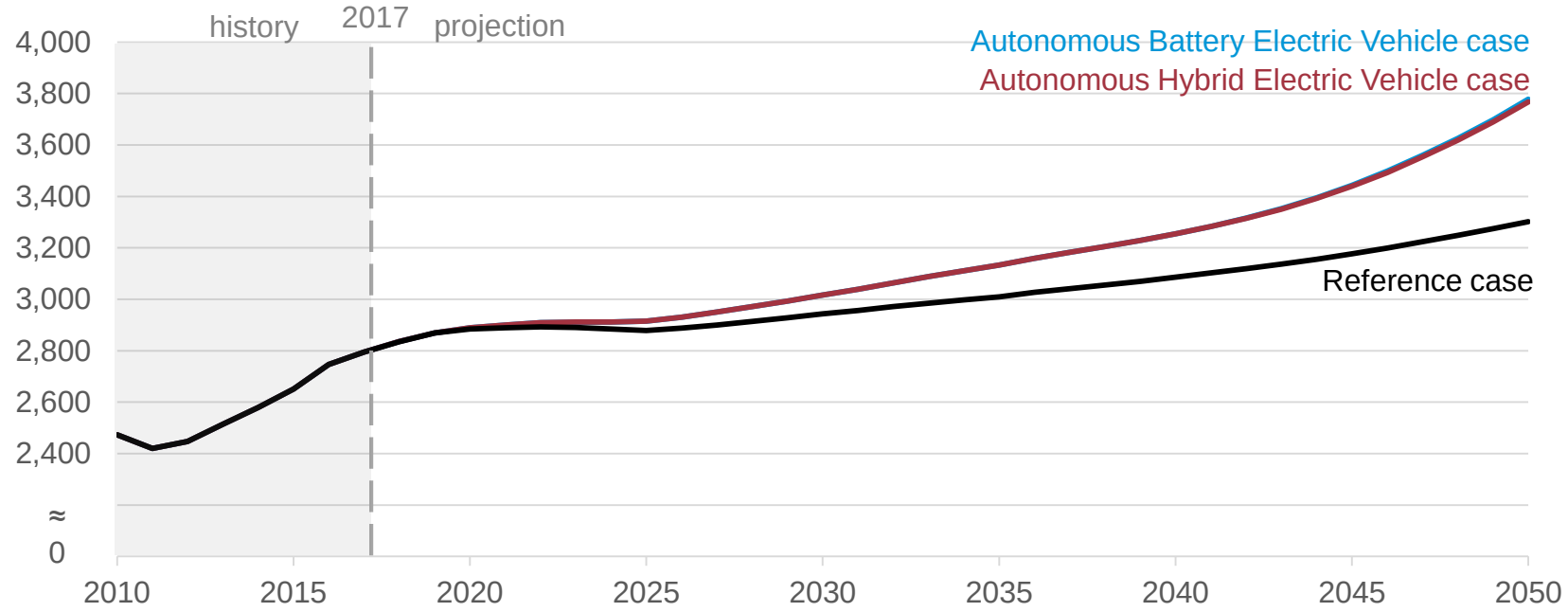


Source: EIA, AEO2018 Reference case, Autonomous Battery Electric Vehicle case, Autonomous Hybrid Electric Vehicle case

Light-duty vehicle miles traveled 14% above Reference case in 2050 and 35% higher in 2050 than in 2017

U.S. light-duty vehicle miles traveled

billion

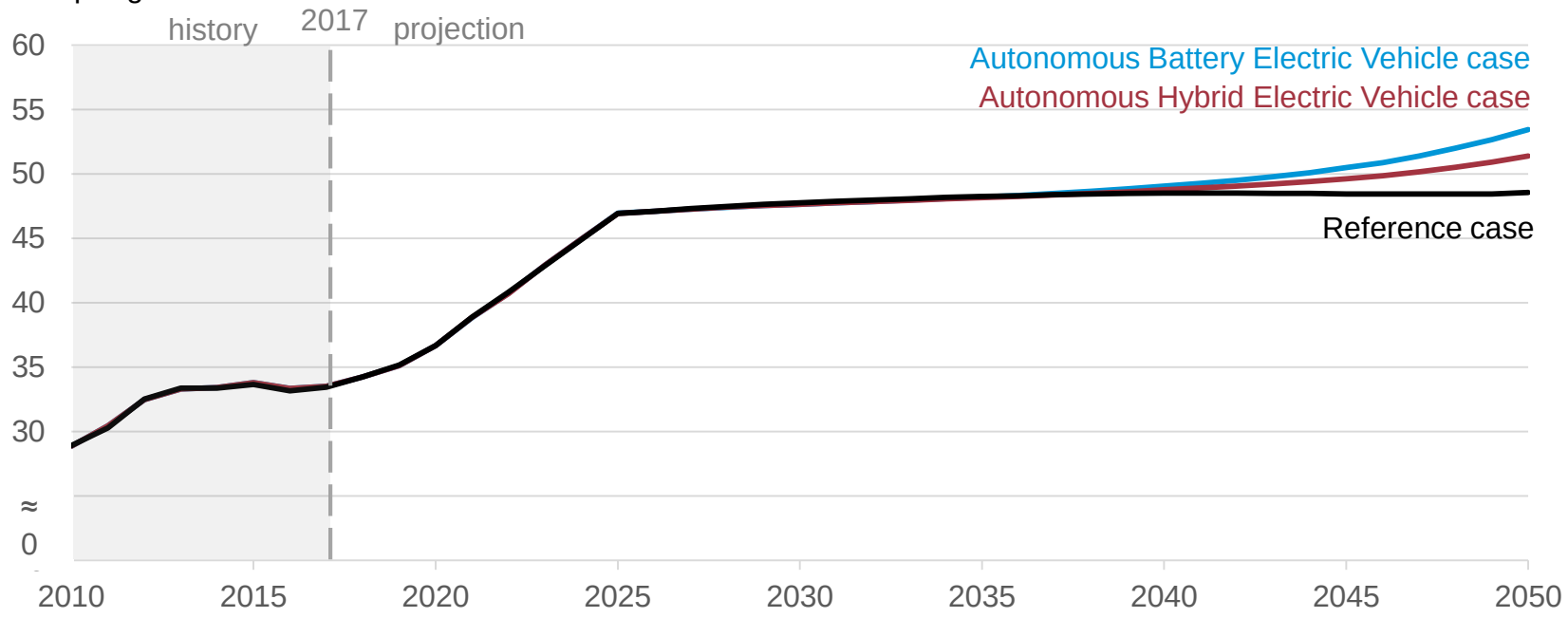


Source: EIA, AEO2018 Reference case, Autonomous Battery Electric Vehicle case, Autonomous Hybrid Electric Vehicle case

New light-duty vehicle fuel economy increases from growing use of fuel efficient autonomous battery and hybrid electric vehicles

New light-duty vehicle compliance fuel economy

miles per gallon

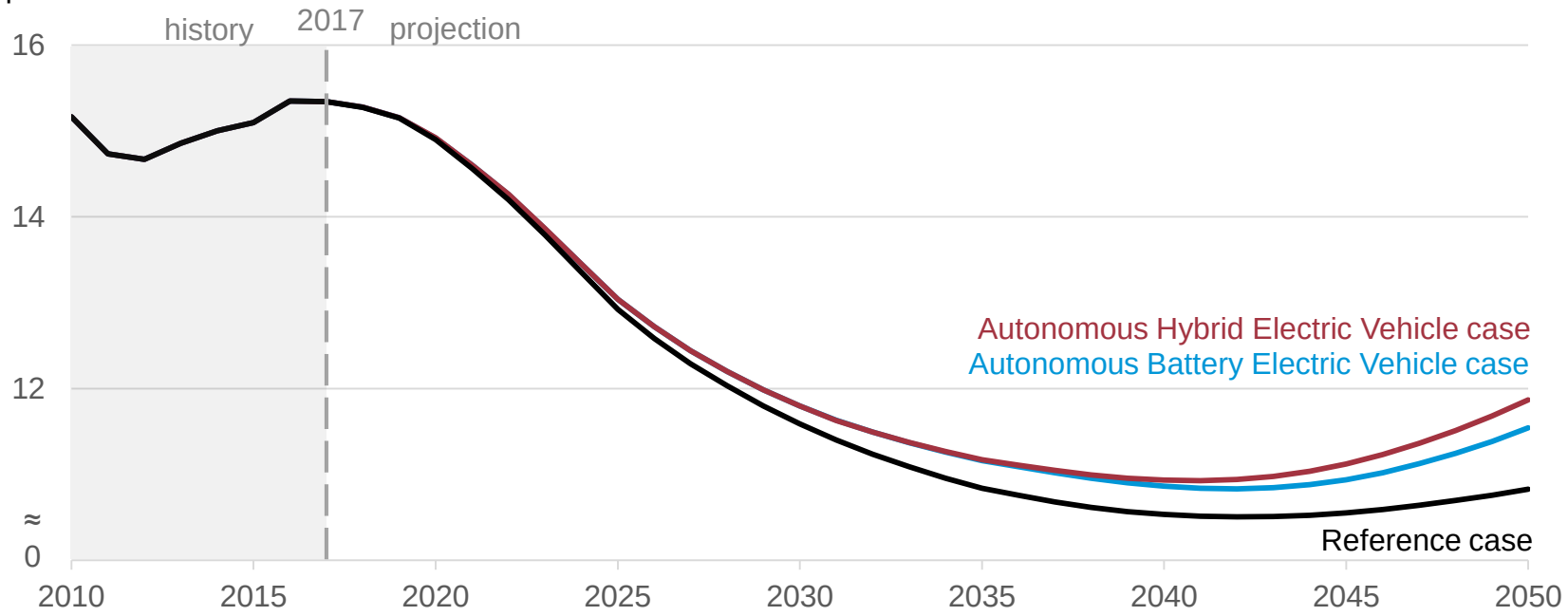


Source: EIA, AEO2018 Reference case, Autonomous Battery Electric Vehicle case, Autonomous Hybrid Electric Vehicle case

Light-duty vehicle energy consumption 7% to 10% above Reference case in 2050 but are 23% to 29% lower in 2050 than in 2017

U.S. light-duty vehicle energy consumption

quadrillion Btu

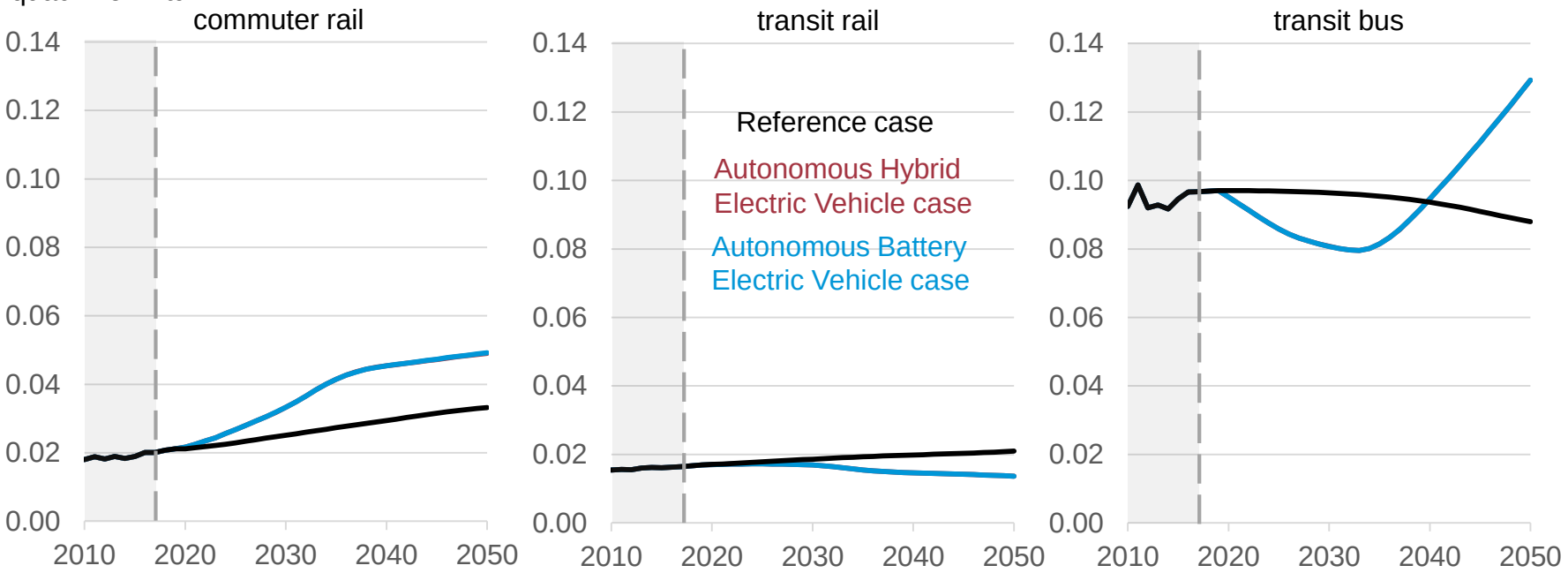


Source: EIA, AEO2018 Reference case, Autonomous Battery Electric Vehicle case, Autonomous Hybrid Electric Vehicle case

Assumptions about automation technology affects energy consumption of mass transit modes

Select mass transit energy consumption

quadrillion Btu



Note: Consumption in side cases are nearly identical so they are not visible in graphics

Source: EIA, AEO2018 Reference case, Autonomous Battery Electric Vehicle case, Autonomous Hybrid Electric Vehicle case

Thank you

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Autonomous Vehicles: Uncertainties and Energy Implications | https://www.eia.gov/outlooks/aeo/section_issues.php#av

U.S. Energy Information Administration home page | www.eia.gov

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