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U.S. DEPARTMENT OF ENERGY

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SUBCOMMITTEE ON ENERGY AND POWER

COMMITTEE ON ENERGY AND COMMERCE

U. S. HOUSE OF REPRESENTATIVES

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Mr. Chairman and Members of the Subcommittee, I appreciate the opportunity to appear before you today to address the outlook for light-duty vehicles and the fuels used in those vehicles.

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Petroleum dominates energy use in transportation

The transportation sector and the use of petroleum fuels are tightly linked. In 2017, 38% of total U.S. energy and 72% of total U.S. petroleum and other liquids were consumed in the transportation sector, while petroleum products provided about 97% of total transportation energy. Light-duty vehicles (LDVs), including both passenger cars and light-duty trucks, accounted for 55% of total transportation energy use in 2017 (Table 1). Heavy-duty vehicles (HDVs), including freight and commercial-light trucks and buses, used 24% of transportation energy, followed by aircraft, marine, pipeline, and rail with shares of 9%, 5%, 2%, and 2% in total transportation energy use, respectively.

Table 1. Breakout of 2017 energy consumption by mode in the transportation sector

	LDV	HDV	Aircraft	Marine	Pipeline	Rail	Other
Percent of consumption by mode	55%	24%	9%	5%	2%	2%	2%

*The percentages may not sum to 100% due to rounding
Source: EIA *Annual Energy Outlook 2018*, Reference case

LDVs are almost entirely fueled by petroleum products, with motor gasoline, which includes blended ethanol, accounting for over 99% (7.2 million barrels per day crude oil equivalent (million b/d)) of energy use. On a volumetric basis, about 10% of motor gasoline is blended ethanol. The remaining 1% includes minor amounts of diesel, gaseous fuels, electricity, and E85, a blend of up to 85% ethanol with motor gasoline. For HDVs, petroleum and other liquids are central to meeting energy needs, with diesel, including biodiesel blends, accounting for 81% of consumption (2.6 million b/d) and motor gasoline, including ethanol blends, accounting for 18% (0.6 million b/d). About 6% of diesel fuel is blended biodiesel. The remaining 1% is almost entirely compressed or liquefied natural gas. Of the other transportation modes, aircraft (1.1 million b/d) and marine (0.6 million b/d) are also almost entirely dependent on petroleum products while rail energy consumption is 96% diesel (0.3 million b/d) and 4% electricity.

Table 2. Consumption of liquid fuels by mode in 2017 (million b/d)

	LDV	HDV	Air	Marine	Rail
Motor gasoline	7.2	0.6		0.1	
Diesel	0.0	2.6		0.2	0.3
Jet fuel			1.1		
Residual fuel oil				0.3	
Total	7.2	3.2	1.1	0.6	0.3

Source: EIA *Annual Energy Outlook 2018*, Reference case

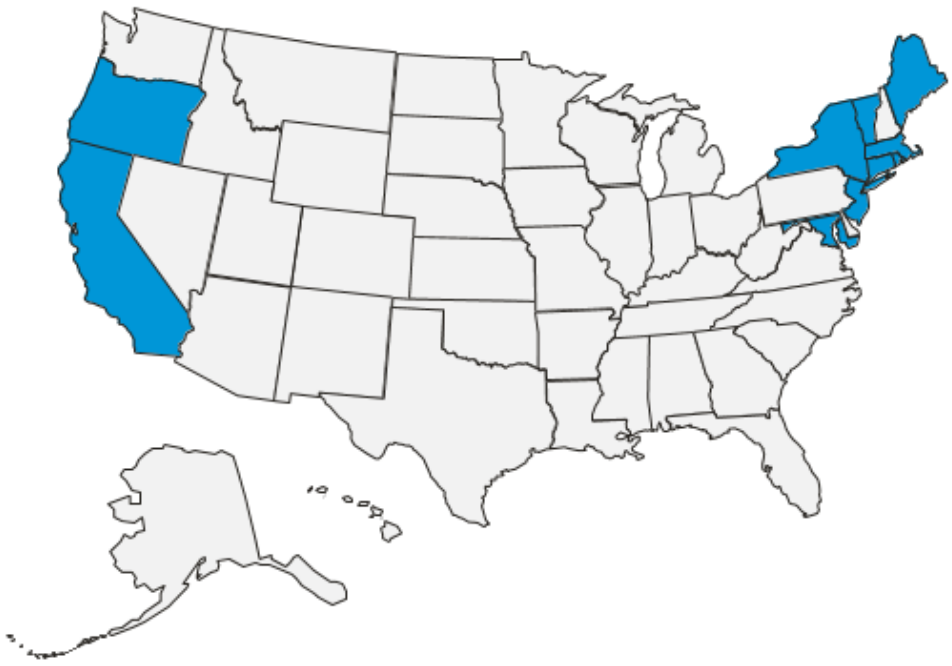
The *Annual Energy Outlook 2018*

EIA recently released the *Annual Energy Outlook 2018* (*AEO2018*), which presents projections for the U.S. energy system through 2050. The *AEO2018* Reference case is a business-as-usual trend estimate, using known technology and technological and demographic trends, and is prepared under the assumption that current laws and regulations remain unchanged throughout the projection period. The large share of U.S. energy and petroleum use by LDVs has made them a focal point for legislation, regulation, and tax policies to both improve fuel economy and promote the sale of alternatively-fueled vehicles and alternative fuels. In recent years, regulations improving the fuel efficiency of HDVs have also become prominent. Higher fuel efficiency standards reduce both petroleum and energy consumption, while alternatively-fueled vehicles and fuels displace the use of petroleum without necessarily reducing overall energy use.

The *AEO2018* Reference case includes the jointly issued Corporate Average Fuel Economy (CAFE) and LDV greenhouse gas emissions standards for model years (MY) 2017 to 2025 promulgated by the National Highway Traffic Safety Administration

(NHTSA) and the Environmental Protection Agency (EPA). This includes the final joint rulemaking for MY 2017 to 2021 and the standards in place for MY 2022 to 2025, which will undergo a midterm evaluation before finalization in the near future. In addition, the Reference case incorporates other provisions impacting the transportation sector, such as California's Zero Emission Vehicle (ZEV) program adopted by 9 additional states – Connecticut, Massachusetts, Maryland, Maine, New Jersey, New York, Oregon, Rhode Island, Vermont (Figure 1); NHTSA and EPA's jointly issued Phase I and Phase II fuel consumption and greenhouse gas emission standards for on-road heavy duty vehicles through MY 2027; existing tax credits for alternative/advanced vehicles and fuels; and ship emission regulations set under the International Convention for the Prevention of Pollution from Ships (MARPOL). Standards are held constant at the level of the last regulated year throughout the remainder of the projection.

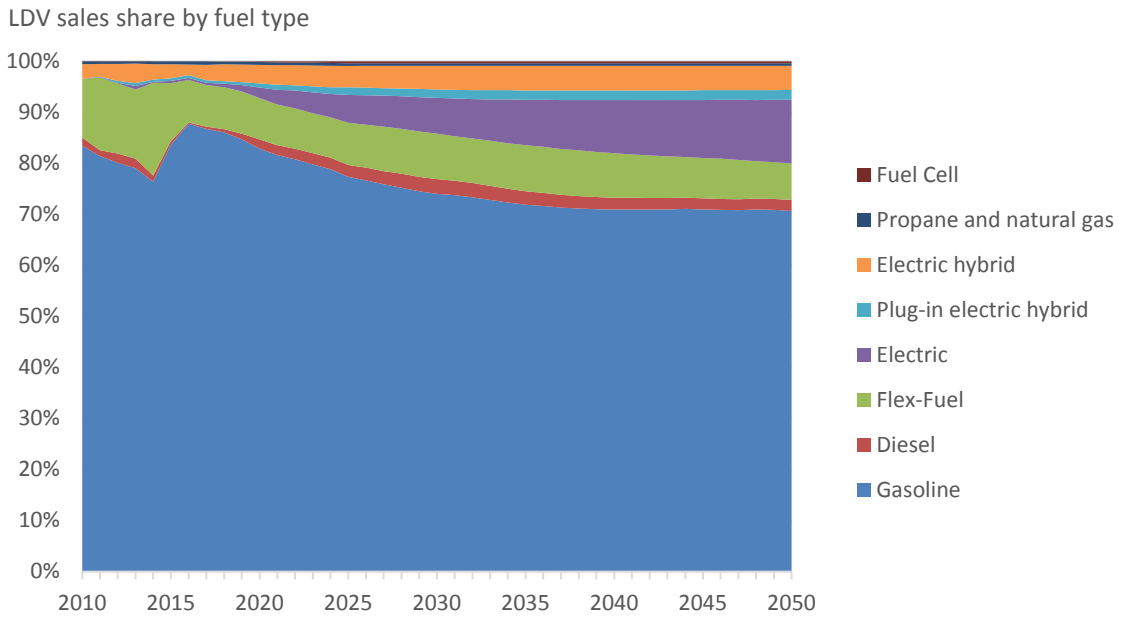
Figure 1. States with mandates for zero emission vehicles



Transportation energy consumption peaked in 2017 in the Reference case at 13.1 million b/d and declines until 2037, reaching a low of 11.2 million b/d before rising again through the end of the projection to 12.0 million b/d by 2050. Rising fuel efficiency outweighs the increases in total travel and freight movement in the first half of the projection, before reversing in the second half of the projection after the current CAFE standards are no longer in effect to increase fuel efficiency in the Reference case. LDVs see the largest change in energy consumption in transportation, because of rising fuel efficiency of all vehicle fuel types as well as growing sales of electrified and non-gasoline fueled vehicles.

While sales of conventional gasoline LDVs remain predominate throughout the *AEO2018* Reference case, the sales share declines from 87% in 2017 to 71% in 2050 **(**Figure 2**)**.

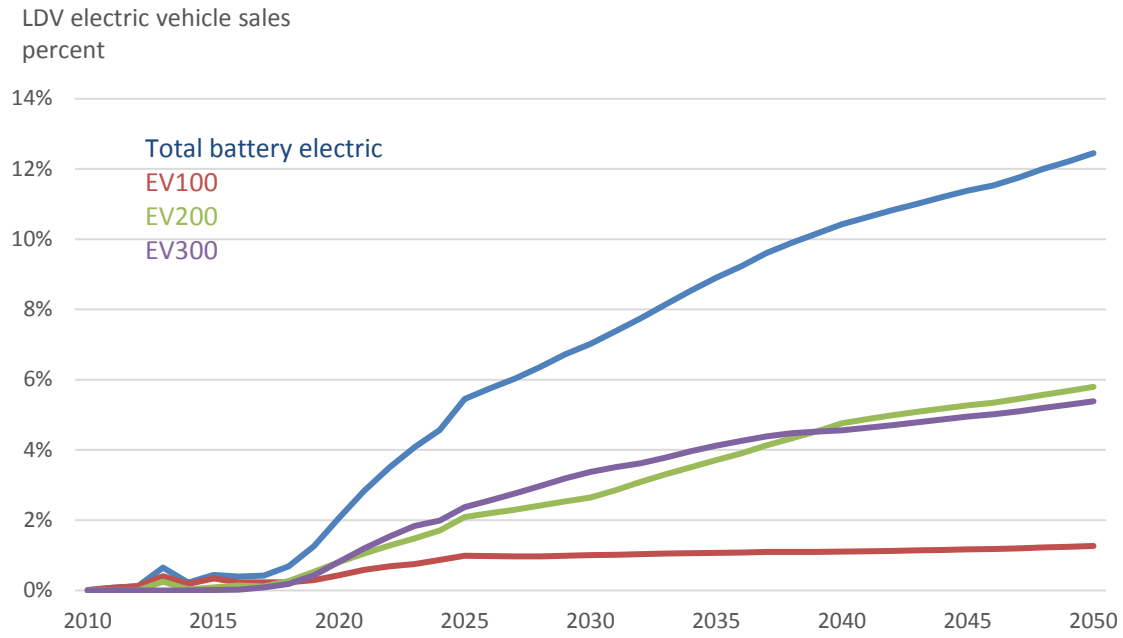
Figure 2. Light-duty vehicle powertrain market share



Source: EIA *Annual Energy Outlook 2018*, Reference case

Electrified vehicles, including battery electric (BEV), plug-in hybrid electric (PHEV), and full hybrid electric (HEV), grow strongly across the projection, rising from 4% of new LDV sales in 2017 to 19% by 2050. This sales increase is led by BEVs, which grow from less than 1% in 2017 to 12% by 2050 because of state policies such as California's ZEV regulation, declining battery costs, and the availability of longer-ranged 200- and 300-mile BEV models (Figure 3). Between 2017 and 2050, HEV sales grow from 3% of new sales to 5% while PHEVs grow from 1% to 2%, respectively.

Figure 3. Percent of electric light-duty vehicle sales out of total light-duty vehicle sales by range



Source: EIA *Annual Energy Outlook 2018*, Reference case

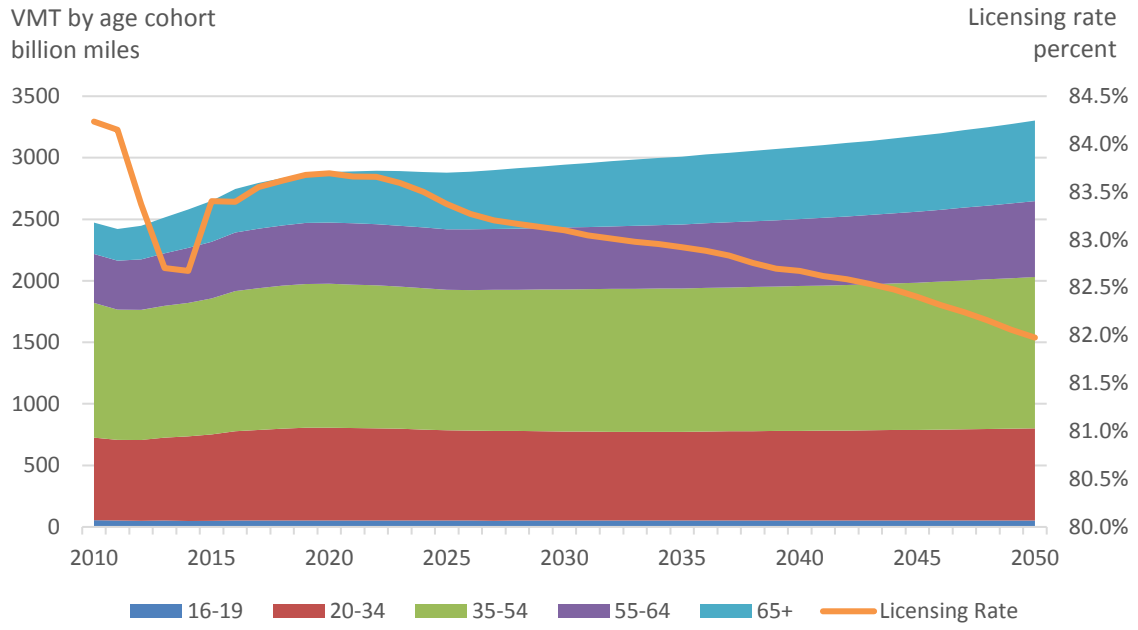
Flex-fuel vehicles (FFVs), which can use E85 blends, are projected to be 7% of LDV sales by 2050. Manufacturers selling FFVs currently receive incentives in the form of fuel economy credits earned for CAFE compliance through MY 2019. FFVs also play a

critical role in accommodating the RFS mandate for increased use of biofuels. Diesel vehicles account for 2% and natural gas, propane and fuel cell vehicles account for about 1% of new vehicle sales in 2050 (Figure 2).

In addition to the changing vehicle fuel mix, the decline in LDV energy and motor gasoline consumption in the *AEO2018* Reference case is due to rising new vehicle fuel economy. Average new LDV fuel economy rises from 33.4 miles per gallon (mpg) in 2017 to 46.9 mpg by 2025 and 48.6 mpg by 2050 because of CAFE standards and the use of advanced fuel-efficient technologies. Significant adoption of these technologies increases the fuel economy of all vehicle fuel types, including conventional gasoline, where, for example, about 20% of new conventional gasoline vehicles are equipped with micro-hybrid technology, by 2025. Micro-hybrid technologies turn the engine off when coming to a complete stop which reduces fuel consumption.

The changing mix of LDV sales is reflected over time in the composition of the LDV fleet. By 2050, about 25% of total LDVs are unconventional vehicles, non-gasoline and non-diesel vehicles, which contribute to higher efficiency or provide a capability for increased use of fuels other than petroleum. Growth in the number of drivers and vehicle miles per driver results in a projected growth of 18% in total LDV vehicle miles of travel between 2017 and 2050 in the *AEO2018* Reference case (Figure 4.**)**

Figure 4. Total light-duty vehicle miles traveled by age cohort and licensing rate



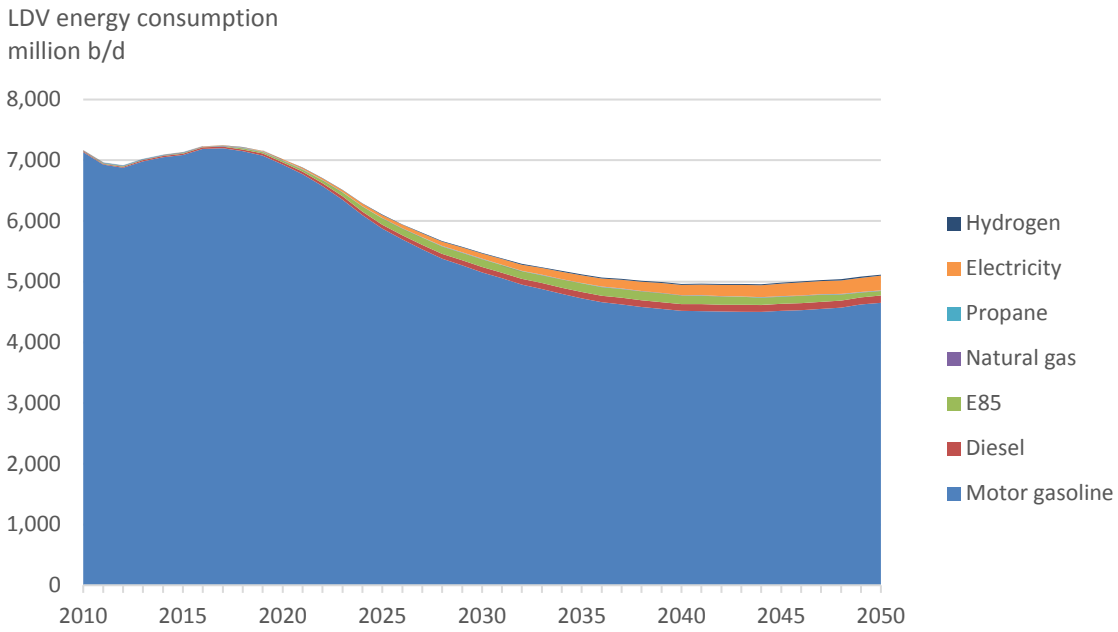
Source: EIA *Annual Energy Outlook 2018*, Reference case

However, due to rising fuel economy, overall LDV energy consumption is projected to decrease by 30%, or 4.5 quadrillion Btu, between 2017 and 2042 despite rising travel demand. After 2042, both travel demand and LDV energy consumption increase as the improvements in fuel economy level off. Projected LDV petroleum use in 2050 is about 4.8 million b/d, compared to 7.2 million b/d in 2017, reflecting both changes in the fuel mix and improved fuel economy.

Petroleum products remain the dominant LDV fuel, with the motor gasoline (including ethanol) share falling to 91% (from 99.5% in 2017) but diesel rising to 2% (from 0.4%) by 2050. E85, which contains up to 85% ethanol, plays a growing role and are projected

to provide 1.5% energy used by LDVs by 2050, up from less than 0.1% in 2017. Electricity usage grows to 4.7% while natural gas accounts for less than 0.1% (Figure 5).

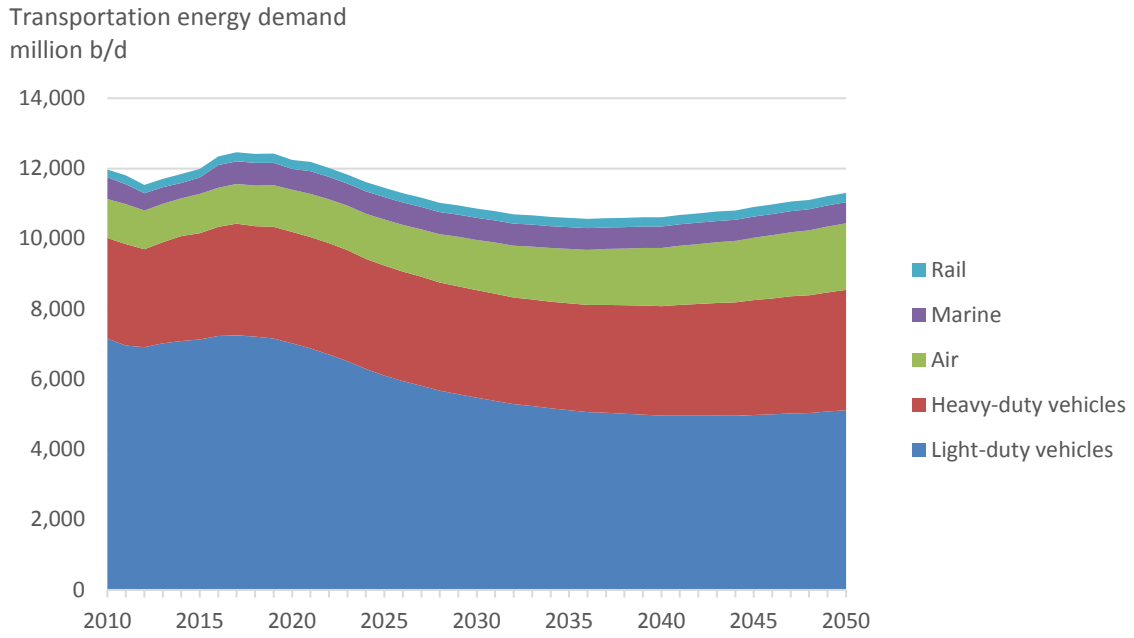
Figure 5. Light-duty vehicle energy use by fuel



Source: EIA *Annual Energy Outlook 2018*, Reference case

While total energy consumption is expected to decrease in the LDV sector other transport sectors are projected to grow during this period. Air travel demand has been growing over the last 20 years and is expected to continue growing throughout the projection. Between 1998 and 2017 revenue passenger miles and revenue ton miles have increased by 46% and 39% respectively. Over the projection period energy consumption from air travel increases by 70% while energy use by HDVs increases by 10% (Figure 6).

Figure 6. Transportation energy demand by mode



Source: EIA *Annual Energy Outlook 2018*, Reference case

Uncertainty in the *AEO2018* projections for the LDV vehicle mix and fuel use

The *AEO2018* Reference case projections for LDVs and their fuel use are inherently uncertain. The four key areas of uncertainty are: fuel prices, growth in the digital economy, consumer acceptance, and potential changes in policies.

First, all vehicle types face uncertainty regarding future fuel prices. Higher or lower fuel prices can change the relative attractiveness of all vehicle types, either making more fuel-efficient vehicles more attractive to consumers in a high oil price case or less attractive in a low oil price case. For example, in the *AEO2018* High Oil Price case, the conventional gasoline vehicle sales share declines to about 62% in 2050 compared to 71% in the Reference case, while in the Low Oil Price case, conventional gasoline make up 73% of LDV sales. Higher or lower fuel prices also affect projected vehicle efficiencies and

growth in travel, which also affect the fuel mix and the level of fuel use. In the *AEO2018* Low Oil Price case, overall LDV fuel consumption decreases by 9% between 2017 and 2050, while LDV fuel consumption decreases by 47% in the *AEO2018* High Oil Price case, compared to 30% in the *AEO2018* Reference case. LDV petroleum use in 2050 is 6.6 million b/d and 3.9 million b/d in the *AEO2018* Low and High Oil Price cases, respectively, compared to 4.8 in the *AEO2018* Reference case.

Second, the digital economy is changing transportation. On-demand ride-hailing is affecting how consumers utilize personal vehicles and mass transit. Moving forward, autonomous vehicles are expected to affect the transportation system in numerous ways. Highly automated vehicles are expected to change the perceived cost of travel, affect the use of on-demand ride-hailing services and mass transit, travel and driving patterns, the design of vehicles, the type of fuel used, and vehicle ownership. Although ride-hailing and autonomous vehicles are included in our long-run projections, there are great uncertainties over the scope of the on-demand ride-hailing and autonomous vehicles, as well as the benefits and costs of autonomous technology. Further, there remain several key inhibiting obstacles for autonomous vehicles. All of these factors combine to make the potential energy impact of autonomous vehicles unclear and open to wide variation.

Third, consumer acceptance is also a critical area of uncertainty regarding future market success of unconventional vehicles and alternative fuels. Vehicle attributes, such as cost and performance, as well as alternative fuel prices and availability, will play key roles in

the future success of alternative-fueled vehicles. Further, refueling infrastructure availability is essential to consumer acceptance.

Finally, the future regulatory environment is also uncertain. The possible effect of changes in fuel economy standards are an important uncertainty affecting projections of the LDV vehicle mix and fuel use. CAFE and greenhouse gas emission standards for LDVs are currently set in final rule form only through MY 2022. While the *AEO2018* assumes that standards are raised through MY 2025, changes in fuel efficiency requirements could impact the mix of LDV sales and projected fuel use by LDVs. State policy regarding ZEVs also relates to LDV fuel economy and sales mix and EIA includes regulatory credit requirements for ZEVs in the ten states mentioned earlier in the statement.

To further examine some of these uncertainties in the transportation sector, EIA is currently working on Issues in Focus articles associated with AEO2018 that will cover potential impacts on future transportation energy demand. These analyses, which will likely be released in late spring, will focus on framing some of the uncertainties discussed today with alternative cases, such as those that examine changes in fuel economy standards and differing levels of autonomous vehicle adoption.

This concludes my statement, Mr. Chairman, and I will be happy to answer any questions you and the other Members may have.