Annual Energy Outlook 2019

Review of AEO2018 and potential updates for AEO2019

For
AEO2019 Transportation Working Group
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By
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Outline

• Recap of AEO2018 Reference case

• AEO2018 Reference case projections and discussion on proposed model updates for AEO2019 affecting key projections

• Ongoing automated vehicle model development

• Other potential updates for AEO2019
Transportation energy consumption declines between 2019 and 2035 in the Reference case

Source: EIA, AEO2018 Reference case
Discussion and request for feedback on key AEO2018 projections
Light-duty vehicles
Proposing to add crossover utility vehicle (CUV) size classes to car and light-truck groups to improve modeling

AEO2018 Reference case

Discussion points

- Considering adding 2 size classes to both car and light-truck
  - Small CUV
  - Large CUV
- For cars (~26% of 2016 car sales):
  - Differentiates sedans and hatchbacks from CUVs
- For light-trucks (~54% of LTs):
  - Differentiates SUVs from CUVs

Source: EIA, AEO2018 Reference case
Proposing to align light-duty vehicle stock classification to NHTSA/EPA classification to better model stocks and VMT

AEO2018 Reference case

Discussion points

- The historic vehicle stock is based on industry classification of car versus light-truck
- Update would align stock data (sourced from Polk IHS Markit) with NHTSA/EPA classifications for car and light-truck
- Will influence scrappage and VMT

Source: EIA, AEO2018 Reference case
Proposing to regionalize light-duty stock fuel economy to improve modeling of regional energy consumption

AEO2018 Reference case

Discussion points

- Regionalizing stock fuel economy components and projections
  - VMT/vintage by car and light-truck
  - Vehicle scrappage

Source: EIA, AEO2018 Reference case
Policy uncertainty could affect fuel economy and sales projections in AEO2019

- Fuel economy and alternative vehicle sales projections will reflect current policy
- Technology menu could be updated with assumptions made in CAFE/GHG midterm review
- Policy changes affecting the California ZEV Mandate and adopting states would be captured
Automated vehicle model development
EIA plans automated vehicle working group or workshop

• To be held later this summer

• If you would like to be involved please let us know
Automated vehicle development for AEO2019

• Adding automated levels 1-3 technologies into the tech adoption list
  – Would be added as technologies up to an assumed max penetration at different uptake rates
  – Captures cost of technology adoption
  – Assumes no fuel economy effect besides small weight addition

• Adding heavy truck platooning
The BRAIN Model

- Availability of transit
- Availability of ride hailing
- Urban v. suburban v. rural
- Population density
- Cost & utility of vehicle ownership
- Cost transit
- Cost ride hailing
- ROI
- Tech cost curve
- Fuel economy
- Scrappage rates
- Deliveries
- Empty miles
- Traditional
- PMT
- VMT
- Underserved population
Proposed automated vehicle development for AEO2019

• Create a new fleet – taxis/ride-hailing

• Economic decision for adoption of three levels of highly automated vehicles in the taxi fleet model
  – 4a – low speed level 4 vehicle
  – 4b – high speed level 4 vehicle
  – 5 – level 5 vehicle

• Production based Lidar cost projection

• Assumption driven household adoption lags fleet adoption
Proposed automated vehicle development for AEO2019

• Powertrains are assumed to be the same as non-automated taxi powertrains
  – Dedicated 48 volt battery added to vehicle
  – High voltage power for sensors and processing
  – Would have fuel economy degradation factor
  – Has to have the ability to operate 24 hours a day

• Feedback on other transportation modes
  – Reduces transit rail passenger miles traveled
  – Reduces transit bus passenger miles traveled, until automated micro-buses are introduced
  – Increases commuter rail passenger miles traveled, as a first-last-mile solution
Public transit
Public transit continues to grow in all modes

- Limited infrastructure and peaking or declining ridership in transit rail
- Competition with TNC ride-hailing is changing transit passenger miles
- Introduction of automated micro-buses
International marine
Review of NEMS integration of International Convention for the Prevention of Pollution from Ships (MARPOL)

AEO2018 Reference case

Discussion points

• Ocean-going vessels will be required to use fuel with a sulfur content of no more than 0.5% m/m, against the current limit of 3.5%, or install on-board scrubbers

• New requirement takes effect in 2020

• Fuel prices are planned drivers for fuel choice

Source: EIA, AEO2018 Reference case
Discussion/questions

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Annual Energy Outlook | www.eia.gov/forecasts/aeo

Alternative Policies Issues in Focus |
https://www.eia.gov/outlooks/aeo/section_issues.php?src=home-b1#ppg

Autonomous Vehicle Issues in Focus |
https://www.eia.gov/outlooks/aeo/section_issues.php?src=home-b1#av
Supplemental slides
Passenger travel increases across all transportation modes in the Reference case through 2050

Source: EIA, AEO2018 Reference case
Fuel economy of all on-road vehicles increases in the Reference case

Light-duty vehicle stock fuel economy
miles per gallon

<table>
<thead>
<tr>
<th>Year</th>
<th>2017</th>
<th>History</th>
<th>Projections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Combined</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light truck</td>
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</tr>
</tbody>
</table>

Heavy-duty vehicle stock fuel economy
miles per gallon

<table>
<thead>
<tr>
<th>Year</th>
<th>2017</th>
<th>History</th>
<th>Projections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classes 2b - 3</td>
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<tr>
<td>Classes 4 - 6</td>
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<tr>
<td>Classes 7 - 8</td>
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</tbody>
</table>

Source: EIA, AEO2018 Reference case
Light-duty vehicle fuel economy improves as sales of more fuel-efficient cars grow and as electrified powertrains gain market share.
Sales of electric and plug-in hybrid electric light-duty vehicles increase in the Reference case.

New vehicle sales of battery powered vehicles
thousands of vehicles

2017

history projections

2010 2015 2020 2025 2030 2035 2040 2045 2050

- total battery electric
- 200 mile EV
- 300 mile EV
- hybrid electric
- plug-in hybrid
- 100 mile EV

Source: EIA, AEO2018 Reference case
Consumption of total non-major transportation fuels grows in the Reference case between 2017 and 2050.

Source: EIA, AEO2018 Reference case
Transportation related Issues in Focus side cases in AEO2018

• Alternative Policies in Power Generation and Energy Demand Markets
  – New Efficiency Requirements case
    • Increases LDV CAFE and GHG emissions standards through 2050
  – No New Efficiency Requirements case
    • Holds LDV CAFE and GHG emission standards constant at MY 2021 levels

• Autonomous Vehicles: Uncertainties and Energy Implications
  – Autonomous Battery Electric Vehicle case
    • More widespread autonomous LDVs that are increasingly battery electric by 2050
  – Autonomous Hybrid Electric Vehicle case
    • More widespread autonomous LDVs that are increasingly hybrid electric by 2050
Alternative Policies in Power Generation and Energy Demand Markets case

Transportation delivered energy consumption (quadrillion Btu)

- **Reference**
- **No New Efficiency Requirements**

- **2017 projections**

New LDV CAFE standard (miles per gallon)

- **Reference**
- **New Efficiency Requirements**

- **2017 projections**

Source: EIA, AEO2018 Reference case, New Efficiency Requirements case, and No New Efficiency Requirements case
Autonomous Vehicles: Uncertainties and Energy Implications case

**Transportation delivered energy consumption**

<table>
<thead>
<tr>
<th>Year</th>
<th>Energy Consumption (quadrillion Btu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>Reference: 26.5, Autonomous Hybrid: 26.8, Autonomous Battery: 27.0</td>
</tr>
</tbody>
</table>

**Light-duty vehicle sales**

<table>
<thead>
<tr>
<th>Year</th>
<th>Reference</th>
<th>Autonomous Battery Electric Vehicle</th>
<th>Autonomous Hybrid Electric Vehicle</th>
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<tbody>
<tr>
<td>2020</td>
<td>15</td>
<td>13</td>
<td>12</td>
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<tr>
<td>2050</td>
<td>20</td>
<td>18</td>
<td>16</td>
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**Source:** EIA, AEO2018 Reference case, Autonomous Battery Electric Vehicle case, and Autonomous Hybrid Electric Vehicle case