Annual Energy Outlook 2011: The Long-Term Outlook for Transportation

Nicholas Chase
National Conference of State Legislatures Task Force on Energy Supply
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The Annual Energy Outlook 2011

• Focus on the factors that shape U.S. energy through 2035

• 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 generally remain unchanged throughout the projection period

• The Annual Energy Outlook 2011 includes 57 side/sensitivity cases, such as:
  – Potential impact of more stringent light-duty vehicle fuel economy and greenhouse gas emissions standards 2017 to 2025 and for heavy-duty trucks
  – High and low world oil price, high and low macroeconomic growth, etc.
Transportation sector a major consumer of energy

delivered energy consumption, quadrillion Btu

2005 2010 2015 2020 2025 2030 2035

Transportation sector a major consumer of energy

27.2 quads (40%) 31.8 quads (38%)
Transportation sector the largest consumer of petroleum

petroleum consumption, million barrels per day

- Other: 12.9 mbd (72%)
- Transportation: 13.6 mbd (72%)

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Light-duty vehicles dominate transportation consumption

delivered energy consumption, quadrillion Btu

Nicholas Chase, May 6, 2011
Fuel economy improvements partially offset underlying drivers of growth in transportation demand

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2035</th>
<th>Growth (2009-2035)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Light duty vehicles</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fuel consumption (quadrillion Btu)</td>
<td>17.0</td>
<td>18.4</td>
<td>8%</td>
</tr>
<tr>
<td>Number of licensed drivers (millions)</td>
<td>207</td>
<td>265</td>
<td>28%</td>
</tr>
<tr>
<td>Miles per licensed driver</td>
<td>13,100</td>
<td>15,300</td>
<td>17%</td>
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<tr>
<td>Fuel economy of vehicle stock (mpg)</td>
<td>20.8</td>
<td>27.9</td>
<td>34%*</td>
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<tr>
<td><strong>Heavy duty vehicles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel consumption (quadrillion Btu)</td>
<td>4.9</td>
<td>6.8</td>
<td>39%</td>
</tr>
<tr>
<td>Manufacturing output (billion 2005 dollars)</td>
<td>4,197</td>
<td>6,770</td>
<td>61%</td>
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<tr>
<td>Number of freight trucks (millions)</td>
<td>8.7</td>
<td>16.6</td>
<td>90%</td>
</tr>
<tr>
<td>Miles per vehicle</td>
<td>23,700</td>
<td>20,200</td>
<td>-15%</td>
</tr>
<tr>
<td>On-road fuel economy of vehicle stock (mpge)</td>
<td>6.1</td>
<td>6.6</td>
<td>9%**</td>
</tr>
</tbody>
</table>

* Equal to a 25% reduction in fuel use per mile. ** Equal to an 8% reduction in fuel use per mile.
Petroleum products account for vast majority of light-duty vehicle energy consumption

energy consumption, quadrillion Btu

- Motor Gasoline: 81%
- Diesel: 14%
- Biofuels: 5%
- Electricity: 14%
- Natural Gas: 5%

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New light-duty vehicle sales

millions

- Conventional gasoline
- Flex-fuel
- Diesel
- Hybrid electric
- Plug-in electric
- Micro hybrid
- Plug-in hybrid electric
- Gaseous

15 % unconventional share 42%

Nicholas Chase, May 6, 2011
Major factors impacting light-duty energy demand (I)

$ per gallon

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<tr>
<td>1995</td>
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<td>2000</td>
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<td>2015</td>
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<td>2020</td>
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<td>2025</td>
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<td>2030</td>
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<td>2035</td>
<td>5.5</td>
<td>Projection</td>
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Major factors impacting light-duty energy demand (II)

- Vehicle miles travelled per licensed driver
- Real disposable personal income per capita (2009$)

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Major factors impacting light-duty energy demand (III)

- **annual fuel cost as percentage of real disposable personal income per capita**
- **fuel cost of driving one mile (2009$)**
Uncertainty

• Fuel price (High and Low World Oil Price cases)
  – Fuel price significantly impacts the economic decision making between fuel choices
  – Relative fuel price spread

• Cost and effectiveness of technology (High and Low Tech)
  – Future cost of technologies
    • Batteries
    • Game changers?

• Consumer acceptance
  – Diminishing returns for fuel economy improvement
  – Early adopters
  – Uncertainty and consumer decision making (risk aversion and range anxiety)
  – Infrastructure

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Policy uncertainty scenarios in transportation

• Light-duty vehicle increased fuel economy and greenhouse gas emissions standards, 2017 – 2025
  – 3% annual increase in standards stringency
  – 6% annual increase in standards stringency

• Heavy-duty vehicle fuel consumption and greenhouse gas emissions standards, 2014 – 2017
  – Light- and medium-heavy duty 8% increase in on-road fuel economy
  – Heavy-heavy duty 10% increase in on-road fuel economy

• Heavy-duty vehicle natural gas incentives, *Annual Energy Outlook* 2010
  – Vehicle, fuel, and infrastructure incentive; ‘expanded market potential’
More stringent fuel economy standards reduce transportation energy consumption

quadrillion Btu

2005 2010 2015 2020 2025 2030 2035

Reference CAFE3 CAFE6

new light-duty CAFE standard 2025:
Reference: 35.6 mpg
CAFE3: 46.1 mpg
CAFE6: 59.3 mpg

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Heavy-duty truck energy consumption declines due to fuel consumption standards

new heavy-duty on-road fuel economy 2017:
Reference: 7.9 mpg (light- and medium-) 6.2 mpg (heavy-)
HDVstandard: 8.5 mpg (light- and medium-) 6.7 mpg (heavy-)

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(2010) Incentives can increase natural gas use in heavy trucks under ‘expanded market’ case

reduction in petroleum product use

- 0.67 mbd petroleum
- 40% of trucks are natural gas
- 3% of trucks are natural gas

**Base market**: centrally refueled onsite

**Expanded market**: operate primarily within 200 miles of central refueling facility

- No natural gas vehicle incremental cost
- $0.50/gal equivalent fuel tax credit
- $100,000 infrastructure tax credit

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Questions?

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