Light-duty vehicle energy demand, demographics, and travel behavior

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By
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Examining changes in light-duty vehicle travel trends

• Recent data indicate possible structural shift in travel behavior, measured as vehicle miles traveled (VMT)
  – VMT per licensed driver, vehicles per capita, vehicles per licensed driver, and vehicles per household peaked in 2006-2007
  – Macroeconomic indicators such as household income and employment now appear more correlated with VMT than disposable income and unemployment
  – Shifting demographic factors are also influencing VMT, along with technological, social, and environmental factors

• Changes in AEO2014 to explore these shifts
  – Uses employment instead of unemployment as a determinant of travel
  – Includes more detailed information on driver demographics
  – Created a Low VMT case that continues post-recession trend
  – Created a High VMT case that takes into account limits based on demographic factors
Examining changes in light-duty vehicle travel trends (cont’d)

• EIA results from AEO2014
  – In the Reference case, total VMT continues to grow with population and income
  – Increasing light-duty vehicle fuel efficiency offsets growth in VMT to result in falling light-duty vehicle energy demand in all cases
  – Total light-duty vehicle transportation energy demand falls from 6.7 million barrels of oil equivalent per day in the High VMT case to 5.3 in the Low VMT case
  – Total transportation carbon dioxide emissions fall from 1,742 million metric tons in the High VMT case to 1,552 in the Low VMT case
Personal travel may be shifting away from economic indicators
Macroeconomic factors are still the dominant influence on passenger travel

• Unemployment vs. employment
  – Previously, EIA used unemployment as an indicator
  – As individuals stop looking for work, they are removed from the labor pool
  – Federal reserve employment rate data series removes labor force participation and reveals historically volatile trend; current trend is unusual/unprecedented

• Other macroeconomic factors also influence travel
  – Income, fuel price, costs of purchasing a vehicle, vehicle operating costs
Household income also deviates from personal disposable income

Demographic, technological, social, and environmental factors also play an important role in influencing personal travel

- Demographic changes may counteract or reinforce economic influence on travel
  - Aging of the driving population
  - Age and gender distributions within driving population
  - Driver licensing rates

- Technological, social, and environmental factors
  - Telecommuting, e-commerce, etc.
  - Access to alternative transportation options (public transport, car-sharing, car-pooling, car-rental, etc.)
  - LDV fuel efficiency changes (rebound effect)
  - Social media as substitute for travel
  - Urbanization, geographic population shifts
Other factors may influence personal travel

- *Teleworking* at least one day per week increased from 7% to 9.5% since 1997; exclusive teleworking increased from 4.8% to 6.6%

- *Work-related travel* in 2009 was 25% of total personal travel

- *Regional* differences and *population density* influence driving behavior
  - Highest density locations have the highest percentage of households without personal vehicles
  - Urban drivers average 9,930 mi/yr
  - Rural drivers average 14,856 mi/yr
Population, demographics, and travel behavior are important determinants of light-duty vehicle energy demand.

(1) \[
\text{Population}_{G, AC} \times \text{Licensing Rate}_{G, AC} \times \left(\frac{\text{VMT}}{\text{LD}}\right)_{G, AC} = \text{Total VMT}
\]

(2) \[
\frac{\text{Total VMT}}{\text{MPG}} = \text{Energy Demand}
\]

where:
- \( G \) = gender (male, female)
- \( AC \) = age cohort (5)
- \( \left(\frac{\text{VMT}}{\text{LD}}\right) \) = vehicle miles traveled per licensed driver
- \( \text{MPG} \) = stock average light-duty vehicle fuel efficiency
Historic and projected age cohort distribution for this analysis

- VMT estimated by Census Division and aggregated to national level
- Based on travel behavior and regional licensing rates for males/females
- 13 licensing rate age groups and 5 VMT age groups

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Percent of population aged 16 and above</th>
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<tbody>
<tr>
<td></td>
<td>2012</td>
</tr>
<tr>
<td>&lt;20</td>
<td>6.9</td>
</tr>
<tr>
<td>20-34</td>
<td>26.1</td>
</tr>
<tr>
<td>35-54</td>
<td>34.1</td>
</tr>
<tr>
<td>55-64</td>
<td>15.5</td>
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<tr>
<td>65+</td>
<td>17.4</td>
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Source: U.S. Census Bureau, U.S. Energy Information Administration AEO2014
Declining and flattening licensing rates for age cohorts under 54 years old, while increasing rates for age cohorts above 54

Change in driver licensing by age cohort

Age cohort distribution and changes in licensing rates impact average licensed driver age relative to the driver population; females 65+ licensing rate is fastest growing.


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**AEO2014 VMT cases consider alternate trends in travel behavior**

- **Low VMT case**: continues recent trend in travel behavior (0.5% annual decrease in VMT per licensed driver since 2007)

- **High VMT case**: gradual increase in VMT per licensed driver

<table>
<thead>
<tr>
<th>High VMT case annual increase in VMT per licensed driver</th>
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<td>0.3%</td>
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**Average vehicle travel per licensed driver**

- **2000-2010**: Historical data
- **2012-2040**: Projections for Low VMT, Reference, and High VMT scenarios
Personal travel for younger age cohorts levels off or declines, while personal travel for older age cohorts continues or grows through projection.

Source: U.S. Energy Information Administration, AEO2014
Total light-duty vehicle miles traveled ranges from 3.6 trillion miles in the High VMT case to 2.8 trillion miles in the Low VMT case.

Source: U.S. Energy Information Administration AEO2014
Total light-duty vehicle transportation energy demand decreases by an average annual rate of 0.8% in the High VMT case, and 1.7% in the Low VMT case.

Source: U.S. Energy Information Administration AEO2014
Total U.S. transportation carbon dioxide emissions increase by 3% in the High VMT case, decrease by 9% in the Low VMT case when compared to the Reference case.
Discussion/questions

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Supplemental slides
Total light-duty vehicle transportation energy demand decreases by an average annual rate of 0.9% in the High VMT case, and 1.8% in the Low VMT case.

Source: U.S. Energy Information Administration AEO2014
Employment indexed to 1995

Consumer spending and household income indexed to 1995

Source: Federal Reserve
Income by quintile

Mean personal disposable income

Source: U.S. Census Bureau
Top 5 percent of population shows greatest increase in income through recent history

mean personal disposable income

Source: U.S. Census Bureau
Annual vehicle miles traveled by licensed drivers

Source: U.S. Department of Transportation, National Personal Travel Survey
Male licensing rates by Census Division (CD), age 25-29 years

Source: U.S. Energy Information Administration AEO2014
Female licensing rates by Census Division (CD), age 25-29 years

Source: U.S. Energy Information Administration AEO2014