The Challenge of Meeting Deep Reductions in GHG Emissions from the Transportation Sector by 2050

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Putting Reduction Goals in Context

- Decomposition analysis for each subsector
  - LDVs, HDVs, Aviation, Marine, Rail, Ag and Offroad

\[ CO_{2,\text{Transport}} \equiv \left( \frac{\text{Population}}{\text{Person}} \right) \left( \frac{\text{Transport}}{\text{Transport}} \right) \left( \frac{\text{Energy}}{\text{Energy}} \right) \left( \frac{\text{Carbon}}{\text{Energy}} \right) \]

- Population and travel demand growth are major challenges

- 80in50 scenarios
  - get a feel for size and scope of challenge required
### 80in50 Scenario Inputs

- **Travel demand**
  - 20% reduction from BAU LDV growth in VMT
  - 25% reduction from BAU Aviation passenger miles

- **Vehicle efficiency**
  - 85 mpg LDV (on-road) 4x improvement
  - ~2-3x improvement in most other subsector fleet efficiency

<table>
<thead>
<tr>
<th>Multi-Strategy 80in50</th>
<th>% of Miles by Fuel Type</th>
<th>Energy Intensity (1990=100%)</th>
<th>Carbon Intensity (1990=100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Petroleum</td>
<td>Biofuels</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>LDV</td>
<td>0%</td>
<td>10%</td>
<td>60%</td>
</tr>
<tr>
<td>HDV</td>
<td>0%</td>
<td>63%</td>
<td>28%</td>
</tr>
<tr>
<td>Aviation</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Rail</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Marine/Ag/Off-road</td>
<td>2%</td>
<td>79%</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0%</td>
<td>36%</td>
<td>40%</td>
</tr>
</tbody>
</table>

| Fuel Demand [Billion GGE] (Carbon intensity [gCO2e/MJ]) | 2.0 (90-92) | 82 (12.3) | 39 (24.3) | 19 (43.6) |
80in50 for US Transportation Emissions

- Multi-strategy
LDV Fuel Economy

BEV or PHEV in all electric operation

Multi-Strategy 80in50
~108 mpgge

Honda FCX Clarity

2009 Toyota Prius

EUROPEAN UNION
JAPAN
CHINA
CANADA
CALIFORNIA
UNITED STATES

Test Cycle Fuel Economy (mpg)


Dotted line: Proposed or contested
Solid lines: Historical or enacted

* Timing of required new vehicle fuel economies for scenarios is approximate since it depends on fleet turnover. On-road fuel economies are assumed to be ~80% of test cycle values.
* Fuel economy of Chevy Volt is based on its classification as an EV and includes electrical energy and gasoline. An exclusive EPA testing cycle for PHEVs has not yet been developed.