California Climate Change Policy and the Importance of Hydrogen Vehicles

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Greenhouse Gas Standards: 2017+ Passenger Vehicles

- In May, 2010 President directs EPA & NHTSA to develop GHG and fuel economy standards for 2017-2025 model passenger vehicles
  - Requests CA participate in technical assessment
    - Report by Sept. 30
  - We accept, and request report evaluate a range of annual GHG improvements
    - 3% to 6% per year
  - Standards provide GHG emission reductions for next few decades
Will Next National GHG Tailpipe Standards Require Fuel Cell or Electric Vehicles by 2025?

<table>
<thead>
<tr>
<th>Scenario (Improvement/year required)</th>
<th>CO2 gpm</th>
<th>Reduction in GHG</th>
<th>% Advanced Vehicles Needed - 2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016 Baseline</td>
<td>250</td>
<td></td>
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</tr>
<tr>
<td>3%</td>
<td>190</td>
<td>24%</td>
<td>0%</td>
</tr>
<tr>
<td>4%</td>
<td>173</td>
<td>31%</td>
<td>0%</td>
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<tr>
<td>5%</td>
<td>158</td>
<td>37%</td>
<td>1%</td>
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<tr>
<td>6%</td>
<td>143</td>
<td>43%</td>
<td>9%</td>
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</tbody>
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Roadmap to Reduce Passenger Vehicle GHG by 80% by 2050*

*One possible scenario
Why Hydrogen Plays a Role

- Non-carbon fuel
- Can be made from renewable sources
  - Low carbon emissions from production
- Fuel cells very efficient
- One of a portfolio of technologies necessary to achieve deep carbon reductions

Fuel Cell Vehicles in CA

Sewage digester gas

~60 mpg
CA ZEV Mandate – Passenger Vehicles

- Achieve early commercialization of ZEVs by 2025
- Sufficient volume of ZEVs to achieve major cost reductions by 2025
- Sustainable growth post-2025 – rate affected by GHG tailpipe standards

Current Thinking: ZEV Program 2018+

* Assumes max. use of plug HEVs. ** Includes plug vehicles and FCVs only; excludes NEVs
Summary

• To address climate change, carbon emissions from passenger vehicles must be reduced
  – Need more efficient vehicles, and low carbon fuels
• H2 fuel cell vehicles meet these criteria
  – Practical for larger cars and SUVs
  – Battery electric vehicles work best for smaller vehicles
• Portfolio of low carbon technologies needed to meet 2050 climate goal
  – Need early commercialization by 2025, to:
  – Provide time for market growth and fleet turnover