ZEV Scenarios and Methods, 2019-2030

DAWG Transportation Meeting

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Demand Analysis Office
Energy Assessments Division
Overview

• Overview of transportation models
• PEV scenarios
• Hydrogen Question

Next:
Transportation Energy Demand Forecast Workshop, July 22
California Energy Commission

Behavioral Light Duty Vehicle Choice Models

- Personal Vehicle Choice Model
  - Income Forecast
  - Fuel Price Forecast
  - Vehicle Attribute Forecast
  - Incentive Assumptions
- Commercial Vehicle Choice Model
  - Fuel Price Forecast
  - Incentive Assumptions
- GSP Forecast
- Population Forecast

Statewide Light Duty Vehicle Demand Forecast by 7 fuel types, including PHEV and BEVs, and 15 different vehicle classes.
California Energy Commission

Statewide Light Duty VMT & Energy Demand Forecasting Models

- Government Model VMT and Fuel Demand Forecast by Fuel Type
- Rental Model VMT and Fuel Demand Forecast by Fuel Type
- Commercial (CVC) Model VMT & Fuel Demand Forecast by Fuel Type
- Residential (PVC) LDV Forecast by Fuel Type
- Urban Travel Demand Models
- Intercity Travel Demand Model

Statewide Light Duty Vehicle VMT & Fuel Demand Forecast by 7 fuel/technology types, including: gasoline, diesel, E85, electricity & Hydrogen
Forecasting Zone (FZ) Distribution of Light duty PEV electricity Consumption

- EMFAC County Share of Statewide VMT
- FZ Share of Statewide VMT
- FZ Share of Statewide PEV
- Statewide Light Duty PEV Electricity Consumption
- FZ Light Duty PEV Electricity Consumption
PEV Scenarios
# 2019 IEPR PEV Scenarios

## Inputs

<table>
<thead>
<tr>
<th>Preference</th>
<th>Low</th>
<th>Mid</th>
<th>High</th>
<th>Aggressive</th>
<th>Bookend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumers' PEV Preference</td>
<td>Constant at 2017 Level</td>
<td>Increase with PEV market growth</td>
<td>Increase with PEV market growth</td>
<td>Increase with PEV market growth</td>
<td>Increase with PEV market growth</td>
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</tbody>
</table>

## Incentives

<table>
<thead>
<tr>
<th>Incentive</th>
<th>Low</th>
<th>Mid</th>
<th>High</th>
<th>Aggressive</th>
<th>Bookend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal Tax Credit</td>
<td>Eliminated after 2019</td>
<td>Decreasing starting 2019</td>
<td>Decreasing starting 2019</td>
<td>Decreasing starting 2019</td>
<td>Decreasing starting 2019</td>
</tr>
<tr>
<td>State Rebate</td>
<td>To 2025</td>
<td>To 2025</td>
<td>To 2025</td>
<td>To 2030</td>
<td>To 2030</td>
</tr>
<tr>
<td>HOV Lane Access</td>
<td>To 2021</td>
<td>To 2023</td>
<td>To 2025</td>
<td>To 2030</td>
<td>To 2030</td>
</tr>
</tbody>
</table>

## Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Low</th>
<th>Mid</th>
<th>High</th>
<th>Aggressive</th>
<th>Bookend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Models Available in 2030</td>
<td>PEV models available in 14 of 15 CEC LDV classes</td>
<td>PEV models available in 14 of 15 CEC LDV classes</td>
<td>PEV models available in 15 of 15 CEC LDV classes</td>
<td>PEV models available in 15 of 15 CEC LDV classes</td>
<td>Models available: BEV in 15, PHEV in 13, FCV in 8, PHFCV in 7 CEC LDV classes</td>
</tr>
<tr>
<td>Vehicle / Battery Price (by 2030)</td>
<td>PEV prices based on battery price declining to ~$120/kWh</td>
<td>PEV prices based on battery price declining to ~$100/kWh</td>
<td>PEV prices based on battery price declining to ~$80/kWh</td>
<td>PEV prices based on battery price declining to ~$70/kWh</td>
<td>PEV prices based on battery price declining to ~$70/kWh</td>
</tr>
<tr>
<td>Max EV Range (2030)</td>
<td>~333 miles</td>
<td>~341 miles</td>
<td>~341 miles</td>
<td>~341 miles</td>
<td>~341 miles</td>
</tr>
<tr>
<td>Refuel Time (2030)</td>
<td>15 - 21 min</td>
<td>15 - 21 min</td>
<td>10-16 min</td>
<td>10-16 min</td>
<td>10-16 min</td>
</tr>
<tr>
<td>Time to Station (2030)</td>
<td>7-8 min</td>
<td>Same as gasoline</td>
<td>Same as gasoline</td>
<td>Same as gasoline by 2025</td>
<td>Same as gasoline by 2025</td>
</tr>
<tr>
<td>ZEV Stock (2030)</td>
<td>2.7</td>
<td>3.7</td>
<td>4.7</td>
<td>5.5</td>
<td>5.7</td>
</tr>
<tr>
<td>Cumulative Adjusted Rebate Expenditure (2030)</td>
<td>2.3</td>
<td>2.9</td>
<td>3.4</td>
<td>5.8</td>
<td>5.9</td>
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</table>
Preliminary ZEV Stock Forecast: Statewide

Source: California Energy Commission.
Hydrogen Question
Hydrogen & Electricity Demand

• So far our transportation electricity demand forecasts have focused on light duty PEVs as well as MD/HD electric vehicles.

• But, hydrogen produced for transportation can use different production processes including:
  o Natural gas reformation, currently the dominant process
  o Electrolysis
    ▪ Processed at the station (5 stations currently funded)
    ▪ Processed at a central production facility (2 projects under consideration)
Main Hydrogen Production Options

Diagram showing the main hydrogen production options:
- Central Hydrogen Production: NG Reformation
- Central Hydrogen Production: Electrolysis
- Production at Station: Electrolysis
- Hydrogen Fuel Station
- Electricity
- Power Plant
- Natural Gas
- Renewable Methane Gas
- Natural Gas
- Renewables
  - Solar
  - Wind
  - Hydroelectric
How Many FCEVs?

- Hydrogen can be used for both LDVs as well as MD/HDVs, with a more advantageous range for long distance travel.
- E3’s 2018 decarbonization pathways included one with a large share of the transportation electricity, in the high electrification scenario, originating from production of enough hydrogen to supply 800,000 FCEVs in 2030.
- Our current high demand forecast is less than 150,000 light duty FCEVs in 2030.
Electricity Demand by Sector, E3 Pathway

Source: E3 Deep Decarbonization in a High Renewables Future - Implications for Renewable Integration and Electric System Flexibility, June 20, 2018
Energy Commission Workshop
California Energy Commission

Preliminary Hydrogen Vehicle Forecast

Source: California Energy Commission.
Green Hydrogen

• Prior legislation requires 1/3 of hydrogen produced by state-funded station to be made from renewables.

• SB 662 (Archuleta) requires the CPUC and the Energy Commission to consider opportunities to increase grid-responsive production of green electrolytic hydrogen for use in transportation sector, and incorporate “green electrolytic hydrogen” into various transportation electrification definitions.
Your Thoughts?