<table>
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<th><strong>DOCKETED</strong></th>
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<tr>
<td><strong>Docket Number:</strong></td>
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<td><strong>Project Title:</strong></td>
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<td><strong>Submission Date:</strong></td>
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Light-Duty Vehicle Forecast:
2021 IEPR

December 2, 2021
## 2021 Light Duty ZEV Forecast Scenarios

<table>
<thead>
<tr>
<th>Category</th>
<th>Low</th>
<th>Mid</th>
<th>High</th>
<th>Aggressive</th>
<th>Bookend</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consumers’ PEV Preference</strong></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>
</tr>
<tr>
<td><strong>Federal Tax Credit</strong></td>
<td>Decreasing starting 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><strong>Clean Fuel Rewards</strong></td>
<td>2030</td>
<td>2030</td>
<td>2035</td>
<td>2035</td>
<td>2035</td>
</tr>
<tr>
<td><strong>State Rebate</strong></td>
<td>To 2023</td>
<td>To 2025</td>
<td>BEV &amp; FCV To 2030</td>
<td>BEV &amp; FCV To 2035</td>
<td>BEV, PHEV &amp; FCV To 2035</td>
</tr>
<tr>
<td><strong>HOV Lane Access</strong></td>
<td>To 2023</td>
<td>To 2025</td>
<td>BEV &amp; FCV to 2030</td>
<td>BEV &amp; FCV to 2030</td>
<td>BEV &amp; FCV to 2030</td>
</tr>
<tr>
<td><strong>Availability of PEVs (2035)</strong></td>
<td>ZEV models available in 14 of 15 CEC LDV classes</td>
<td>ZEV models available in 15 of 15 CEC LDV classes</td>
<td>ZEV models available in 15 of 15 CEC LDV classes</td>
<td>ZEV models available in 15 of 15 CEC LDV classes</td>
<td>ZEV models available in 15 of 15 CEC LDV classes</td>
</tr>
<tr>
<td><strong>PEV Cost Component / Battery Price (2035)</strong></td>
<td>~$93/kWh</td>
<td>~$69/kWh</td>
<td>~$46/kWh</td>
<td>~$32/kWh</td>
<td>~$32/kWh</td>
</tr>
<tr>
<td><strong>BEV Max. Range</strong></td>
<td>~255 miles</td>
<td>~300 miles for Standard, 350 Premium</td>
<td>~400 miles for Standard, 450 for premium</td>
<td>~400 miles for Standard, 450 for premium</td>
<td>~450 miles for Standard, 500 for premium</td>
</tr>
<tr>
<td><strong>Refuel Time (2030)</strong></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><strong>Time to Station (2030)</strong></td>
<td>7-8 min</td>
<td>Same as gasoline</td>
<td>Same as gasoline</td>
<td>Same as gasoline</td>
<td>Same as gasoline</td>
</tr>
</tbody>
</table>
Total Light-Duty ZEV Stock

Source: CEC Staff.
<table>
<thead>
<tr>
<th>Year</th>
<th>Low</th>
<th>Mid</th>
<th>High</th>
<th>Aggressive</th>
<th>Bookend</th>
</tr>
</thead>
<tbody>
<tr>
<td>2025</td>
<td>1.7</td>
<td>2.2</td>
<td>2.8</td>
<td>3.5</td>
<td>3.6</td>
</tr>
<tr>
<td>2030</td>
<td>2.5</td>
<td>3.7</td>
<td>5.6</td>
<td>7.7</td>
<td>7.8</td>
</tr>
<tr>
<td>2035</td>
<td>3.1</td>
<td>5.4</td>
<td>8.3</td>
<td>12.4</td>
<td>12.9</td>
</tr>
</tbody>
</table>
Battery Electric Vehicle Stock

Source: CEC Staff.
Plug-in Hybrid Vehicle Stock

Source: CEC Staff.
Fuel Cell Electric Vehicle Stock

Forecasted Light-Duty FCEV Stock, 2021-2035

Includes plug-in hybrid FCEVs. Source: CEC Staff.
Significantly fewer PHEVs in Aggressive and Bookend Cases

ZEV + PHEV Fleet Fuel Distribution by Scenario, 2035

Source: CEC Staff.
Jesse Gage
Aniss Bahreinian
Mark Palmere
Elizabeth Pham
Appendix
Transportation Energy Demand Cases

Demand cases represent different levels of transportation electricity demand.

<table>
<thead>
<tr>
<th>Demand Case</th>
<th>Population</th>
<th>Income</th>
<th>Petroleum Fuel Prices</th>
<th>Electricity, Natural Gas, and Hydrogen Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Demand</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Mid</td>
<td>Mid</td>
<td>Mid</td>
<td>Mid</td>
<td>Mid</td>
</tr>
<tr>
<td>Low Demand</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>
Light Duty Vehicle Classes: 15 New Classes in Standard & Luxury vs 18 Legacy Classes

- **Car**
  - Subcompact (Nissan Versa)
  - Compact (Honda Civic)
  - Midsize (Tesla Model 3)
  - Large (Mercedes E-Class)
  - Sport (Ford Mustang)

- **SUV/Crossover**
  - Subcompact (Hyundai Kona EV)
  - Compact (Toyota RAV4)
  - Midsize (Toyota Highlander)

- **Van**
  - Compact (Dodge Grand Caravan)
  - Large (Honda Odyssey)
  - Heavy, 8,500-10,000 GVW (Ford Transit)

- **Pickup**
  - Compact (Toyota Tacoma)
  - Standard (Ford F-150)
  - Heavy, 8,500-10,000 GVW (Ford F-250)

Source: CEC staff
Battery price background information

- Scenarios based on estimates from publicly available battery price forecasts
- Lithium-ion batteries only (no solid-state battery or other battery chemistry)
- Prices shown are for battery packs ($/kWh), not battery cells

Source: CEC Staff
Battery Price Estimates from External Sources

External Sources
- Ahmed et al. - Pouch NMC 6,2,2 (2018)
- Anderman - Pouch NMC 8,1,1 (2018)
- Berckmans - Pouch NMC 6,2,2 (2017)
- Bloomberg bottom-up Model - NMC 811 pouch (2021)
- Bloomberg Learning Curve (2020)
- Cairn Energy Research Advisors - cylinder (2020)
- Cairn Energy Research Advisors - pouch (2020)
- Cairn Energy Research Advisors - prismatic (2020)
- DNV (2020)
- DOE (2017)
- Electrification Coalition (2020)
- Electric Power Research Institute (low) (2020)
- Electric Power Research Institute (high) (2020)
- Electric Power Research Institute (conservative) (2020)
- Electric Power Research Institute (reasonable) (2020)
- Electric Power Research Institute (optimistic) (2020)
- Ford (2016)
- GM - Pouch NMC 6,2,2 (2018)
- Guidehouse (2020)
- ICCT SUV Mid range (2019)
- Navigant Consulting (2020)
- Tesla (2018)
- UBS - pouch (2017)
- Volkswagen (2021)
CEC Battery Price Scenarios

CEC Scenarios & Other Sources:
- Low
- Mid
- High
- Bookend
- DNV
- DOE
- Electrification Coalition
- ICCT SUV Mid range
- Nature Energy
- Navigant Consulting
- Guidehouse
- UBS - pouch
- Ahmed et al. - Pouch NMC 6,2,2
- Anderman - Cylindrical 21700, NCA 83,13,4
- Anderman - Pouch NMC 8,1,1
- Berckmans - Pouch NMC 8,2,2
- Bloomberg Learning Curve
- Bloomberg bottom up Model - NMC 811 pouch
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