CALIFORNIA’S ADVANCED CLEAN CAR PROGRAM

Colorado Department of Public Health and Environment

Presentation to the Air Quality Control Commission

Thursday, November 16, 2017
CALIFORNIA’S ADVANCED CLEAN CAR PROGRAM

Is a set of three main programs all adopted as an integrated regulatory package by California in 2012.

- Low emission vehicle (LEV) emissions standards
- LEV greenhouse gas reductions
- Zero emission vehicle program
CALIFORNIA’S ADVANCED CLEAN CAR PROGRAM

Designed to harmonize with US federal standard beginning with MY 2017 (except for LEV mandate and new PM standards)

Required a midterm review before MY2022-2025 standards are implemented.

- Evaluation was due by December 2016
- Report released January 18, 2017
- Findings showed California was on track to meet the MY2025 requirements
  - Industry was over achieving
- Incremental cost of $875 per vehicle
LOW EMITTING VEHICLE (LEV) EMISSIONS STANDARDS

Central to the LEV III program are the LEV III new vehicle certification emissions standards.

tailpipe and evaporative emissions standards.

phased-in starting in 2015

final fleet wide standards reached in 2025.

are a continuation of past vehicle emissions control standards

i.e., LEV I and LEV II standards.
LOW EMITTING VEHICLE (LEV) EMISSIONS STANDARDS

Standards set through MY 2025

75% reduction in fleet average NMOG + NOx emissions

90% reduction in PM emission (1mg/mi) standard

Emissions harmonize with US federal standards starting with MY 2017
LOW EMITTING VEHICLE (LEV) EMISSIONS STANDARDS

California is unique in being able to set their own vehicle emissions certification standards.

standards predated Clean Air Act of 1970

States are allowed to adopt California standards in lieu of federal standards.

Three states that originally adopted California’s LEV standards have repealed their original commitment.

they are; Arizona, Florida, and New Mexico
States that have adopted California LEV Standards

Section 177 States
LOW EMITTING VEHICLE (LEV) EMISSIONS STANDARDS

In past, LEV standards have been set tighter than the corresponding Federal standards.

This is less true today, they are now approximately the same, starting with MY2017.

new Federal Tier 3 standards are designed to harmonize Federal and California standards

The following graph show Tier 3 and LEV III standards from 2017 through 2025
Current Projected Certification Standards
(later Tier 3 standards under review [MY2022-25])

**Tier 3 vs LEV III**
NMOG + NOx Avg Cert Stds
LDV - Passenger Car/LDT1

**Tier 3 vs LEV III**
NMOG + NOx Avg Cert Stds
Fed LDTruck2,3,4 - CA LDT2

Nov. 16, 2017 Presentation to AQCC on California's Advanced Clean Car Program
LEV GREENHOUSE GAS REDUCTION

Developed in conjunction with the US Environmental Protection Agency (EPA) and National Highway Traffic Safety Administration (NHTSA)

- 34% reduction in GHG emissions
- GHG Emissions Harmonize with US DOT and EPA GHG and Fuel Economy Standards Starting with MY 2017
- Expect that the current MY2022-2025 standards can be readily met at the same or lower cost as was set in the 2012 rulemaking.
- Projected incremental cost is projected to be $875 per vehicle

Nov. 16, 2017 Presentation to AQCC on California’s Advanced Clean Car Program
LEV GREENHOUSE GAS REDUCTION

Instituted by Pavley bill, AB 1493

The majority of the LEV GHG emissions reductions will derive from improvements in average fleet fuel economy.

The federal government has set its own fuel economy standards that will harmonize with the California GHG standards by model year 2017.

As shown in the following charts, California LEV III GHG standards have harmonized with federal fuel economy standards.
Current Projected Certification Standards (later Tier 3 standards under review [MY2022-25])

**Average GHG Emissions (Passenger Cars)**

**Average GHG Emissions (Light Trucks)**

MY2021 std kept constant

Nov. 16, 2017 Presentation to AQCC on California’s Advanced Clean Car Program
ZERO EMISSION VEHICLE (ZEV) MANDATE

Technology forcing measure to introduce zero emitting vehicles.

First introduced in 1990 with 2% mandate by 1998.

Presently, 15% of new model vehicles must meet mandate by model year 2025.

include vehicles powered by;

- fuel cells
- battery
- plug-in electric drive hybrids.

Plug-in hybrids may not make up the majority of the requirement.
ZERO EMISSION VEHICLE (ZEV) MANDATE

The ZEV requirements have been tightened to increase the number of ZEVs and PHEVs in both California and Section 177 states.

The midterm review found that nearly 230,000 ZEVs and PZEVS were registered in California with a further 62,000 in the Section 177 states.

California expects that the MY2025 goals will be met with no change to the current program.

Midterm report recommends that California’s ZEV program requirements be made more stringent for MY2026-2030.

- 3 million additional ZEVs and PHEVs will be needed in MY2026-2030 time frame to meet state’s GHG goals.
ZERO EMISSION VEHICLE (ZEV) MANDATE

The ZEV requirement has been adopted by nine states, other than California.

ZEV adopting states include:

- Connecticut
- Maine
- Maryland
- Massachusetts
- New Jersey
- New York
- Oregon
- Rhode Island
- Vermont

Three states, Washington, Delaware, and Pennsylvania, have adopted California’s LEV III certification standards, but not their ZEV component.
States that have adopted California ZEV Program
ZERO EMISSION VEHICLE (ZEV) MANDATE

Zero emission vehicles hold the promise of reducing mobile source criteria and greenhouse gas emissions.

Transfer power generation from inherently inefficient internal combustion engines to higher efficiency stationary source power generation.

Criteria pollutants can be better controlled at centralized power generation stations.

Are best served by hydroelectric or renewable sourced power.

   hydroelectric, wind, solar, geothermal, etc.

Also, as power generation move away from coal fueled power plants, greenhouse gas emissions are reduced.
## Monthly Electric Vehicle Sales for 2017

<table>
<thead>
<tr>
<th>2017-US</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tesla Model S*</td>
<td>500</td>
<td>1,700</td>
<td>3,450</td>
<td>1,125</td>
<td>1,620</td>
<td>2,350</td>
<td>1,470</td>
<td>2,150</td>
<td>4,860</td>
<td>1,120</td>
<td>29,750</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chevrolet Bolt EV</td>
<td>1,182</td>
<td>636</td>
<td>818</td>
<td>1,282</td>
<td>1,906</td>
<td>1,852</td>
<td>1,371</td>
<td>2,107</td>
<td>2,632</td>
<td>2,181</td>
<td>17,063</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chevrolet Volt</td>
<td>1,111</td>
<td>1,820</td>
<td>2,132</td>
<td>1,087</td>
<td>1,745</td>
<td>1,745</td>
<td>1,516</td>
<td>1,445</td>
<td>1,533</td>
<td>1,562</td>
<td>16,310</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toyota RAV4 Plug-in</td>
<td>1,308</td>
<td>1,302</td>
<td>1,406</td>
<td>1,010</td>
<td>1,000</td>
<td>1,070</td>
<td>1,409</td>
<td>1,820</td>
<td>1,688</td>
<td>1,626</td>
<td>16,862</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tesla Model X**</td>
<td>900</td>
<td>800</td>
<td>2,780</td>
<td>719</td>
<td>1,790</td>
<td>2,200</td>
<td>1,650</td>
<td>1,578</td>
<td>3,120</td>
<td>850</td>
<td>16,140</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nissan LEAF</td>
<td>712</td>
<td>1,037</td>
<td>1,478</td>
<td>1,063</td>
<td>1,392</td>
<td>1,509</td>
<td>1,283</td>
<td>1,154</td>
<td>1,055</td>
<td>213</td>
<td>10,953</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ford Fusion Energi</td>
<td>606</td>
<td>631</td>
<td>1,002</td>
<td>905</td>
<td>1,000</td>
<td>707</td>
<td>703</td>
<td>762</td>
<td>705</td>
<td>741</td>
<td>8,226</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ford C-Max Energi</td>
<td>473</td>
<td>699</td>
<td>662</td>
<td>720</td>
<td>950</td>
<td>936</td>
<td>844</td>
<td>705</td>
<td>863</td>
<td>569</td>
<td>7,181</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMW i3</td>
<td>382</td>
<td>318</td>
<td>703</td>
<td>516</td>
<td>506</td>
<td>567</td>
<td>601</td>
<td>594</td>
<td>538</td>
<td>686</td>
<td>5,321</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiat 500e**</td>
<td>752</td>
<td>900</td>
<td>785</td>
<td>541</td>
<td>423</td>
<td>359</td>
<td>309</td>
<td>415</td>
<td>379</td>
<td>310</td>
<td>4,995</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chrysler Pacifica Hybrid**</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>355</td>
<td>785</td>
<td>355</td>
<td>125</td>
<td>425</td>
<td>425</td>
<td>1,175</td>
<td>3,607</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMW X5 eDrive</td>
<td>262</td>
<td>278</td>
<td>387</td>
<td>281</td>
<td>403</td>
<td>498</td>
<td>463</td>
<td>317</td>
<td>398</td>
<td>379</td>
<td>3,582</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMW 330e</td>
<td>126</td>
<td>144</td>
<td>365</td>
<td>360</td>
<td>475</td>
<td>406</td>
<td>367</td>
<td>408</td>
<td>326</td>
<td>292</td>
<td>3,226</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VW e-Golf</td>
<td>352</td>
<td>293</td>
<td>342</td>
<td>307</td>
<td>361</td>
<td>232</td>
<td>308</td>
<td>317</td>
<td>187</td>
<td>263</td>
<td>2,962</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audi A3 Sportback e-tron</td>
<td>387</td>
<td>400</td>
<td>414</td>
<td>301</td>
<td>294</td>
<td>324</td>
<td>216</td>
<td>129</td>
<td>85</td>
<td>17</td>
<td>2,569</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyundai Ioniq PHEV**</td>
<td>190</td>
<td>175</td>
<td>295</td>
<td>260</td>
<td>220</td>
<td>236</td>
<td>206</td>
<td>165</td>
<td>190</td>
<td>210</td>
<td>2,795</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMW 530e</td>
<td>10</td>
<td>147</td>
<td>230</td>
<td>343</td>
<td>345</td>
<td>511</td>
<td>583</td>
<td>2,181</td>
<td>1,746</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kia Soul EV</td>
<td>117</td>
<td>152</td>
<td>177</td>
<td>167</td>
<td>179</td>
<td>120</td>
<td>100</td>
<td>145</td>
<td>300</td>
<td>210</td>
<td>1,714</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volvo XC90 T8 PHEV</td>
<td>910</td>
<td>83</td>
<td>103</td>
<td>145</td>
<td>146</td>
<td>272</td>
<td>174</td>
<td>293</td>
<td>236</td>
<td>210</td>
<td>1,024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ford Focus Electric</td>
<td>54</td>
<td>228</td>
<td>407</td>
<td>125</td>
<td>132</td>
<td>110</td>
<td>146</td>
<td>131</td>
<td>131</td>
<td>150</td>
<td>1,568</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Porche Cayenne S E</td>
<td>177</td>
<td>121</td>
<td>126</td>
<td>185</td>
<td>174</td>
<td>195</td>
<td>180</td>
<td>178</td>
<td>174</td>
<td>13</td>
<td>1,519</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kia Optima PHEV</td>
<td>18</td>
<td>61</td>
<td>70</td>
<td>65</td>
<td>96</td>
<td>78</td>
<td>130</td>
<td>62</td>
<td>228</td>
<td>285</td>
<td>1,169</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercedes C300e</td>
<td>216</td>
<td>91</td>
<td>17</td>
<td>3</td>
<td>7</td>
<td>0</td>
<td>112</td>
<td>212</td>
<td>126</td>
<td>49</td>
<td>787</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercedes S550e</td>
<td>95</td>
<td>91</td>
<td>60</td>
<td>81</td>
<td>83</td>
<td>81</td>
<td>124</td>
<td>32</td>
<td>35</td>
<td>16</td>
<td>618</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercedes B250e</td>
<td>53</td>
<td>56</td>
<td>50</td>
<td>66</td>
<td>46</td>
<td>40</td>
<td>81</td>
<td>58</td>
<td>87</td>
<td>59</td>
<td>662</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMW 740e</td>
<td>18</td>
<td>35</td>
<td>42</td>
<td>123</td>
<td>33</td>
<td>52</td>
<td>80</td>
<td>39</td>
<td>43</td>
<td>54</td>
<td>519</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testa Model 3</td>
<td>30</td>
<td>75</td>
<td>117</td>
<td>145</td>
<td>367</td>
<td>30</td>
<td>75</td>
<td>117</td>
<td>145</td>
<td>367</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMW i8</td>
<td>55</td>
<td>58</td>
<td>49</td>
<td>23</td>
<td>18</td>
<td>27</td>
<td>55</td>
<td>29</td>
<td>27</td>
<td>33</td>
<td>384</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smart ED</td>
<td>19</td>
<td>22</td>
<td>13</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>94</td>
<td>123</td>
<td>73</td>
<td>347</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mitsubishi Outlander PHEV</td>
<td>52</td>
<td>56</td>
<td>47</td>
<td>36</td>
<td>33</td>
<td>41</td>
<td>27</td>
<td>23</td>
<td>14</td>
<td>6</td>
<td>340</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyundai IONIQ Electric</td>
<td>8</td>
<td>18</td>
<td>78</td>
<td>58</td>
<td>40</td>
<td>56</td>
<td>38</td>
<td>28</td>
<td>880</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mini Cooper S E PHEV</td>
<td>10</td>
<td>7</td>
<td>8</td>
<td>6</td>
<td>8</td>
<td>5</td>
<td>10</td>
<td>7</td>
<td>10</td>
<td>74</td>
<td>325</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volvo XC60 PHEV</td>
<td>13</td>
<td>65</td>
<td>97</td>
<td>100</td>
<td>279</td>
<td>13</td>
<td>65</td>
<td>97</td>
<td>100</td>
<td>279</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadillac CT6 PHEV</td>
<td>8</td>
<td>16</td>
<td>20</td>
<td>22</td>
<td>23</td>
<td>27</td>
<td>143</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Honda Clarity Electric</td>
<td>34</td>
<td>15</td>
<td>52</td>
<td>34</td>
<td>135</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volvo S90 T8 PHEV</td>
<td>3</td>
<td>28</td>
<td>53</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadillac CT6 PHEV</td>
<td>3</td>
<td>28</td>
<td>53</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chevrolet Spark EV</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Porsche Panamera S E</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mitsubishi i-MiEV</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>InsideEV</strong></td>
<td>11,004</td>
<td>12,375</td>
<td>9,342</td>
<td>13,307</td>
<td>10,569</td>
<td>17,046</td>
<td>6,594</td>
<td>1,041</td>
<td>1,612</td>
<td>1,504</td>
<td>3,069</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Worldwide</strong>*</td>
<td>45,472</td>
<td>50,561</td>
<td>44,679</td>
<td>21,262</td>
<td>31,413</td>
<td>167,130</td>
<td>72,985</td>
<td>105,724</td>
<td>143,464</td>
<td>170,609</td>
<td>237,614</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Figures include units sold from December 1, 2017 to January 31, 2018

SOURCE: inside evs.com
Annual Electric Vehicle Sales

SOURCE: inside evs.com

• through October 2017
Electric vehicle share of new 2015 vehicle registrations by metropolitan area. (Source: New vehicle registration data from IHS Automotive)

NREL under direction of RAQC and CDOT - Electric Vehicles in Colorado: Anticipating Consumer Demand for Direct Current Fast Charging, July 2017
ZERO EMISSION VEHICLE (ZEV) MANDATE

ZEV greenhouse gas reduction is tied to the source of electrical generation.

Regions that produce electricity from predominately coal usage have less greenhouse gas emission reductions than regions that rely more hydroelectric or renewable source power generation.

Different areas of the US are in different electrical grid regions.

Each grid region has its own electrical power generation makeup.

Each electrical grid will determine the GHG benefit received from battery equipped electric vehicles.
Electric Vehicle Global Warming Pollution Ratings and Gasoline Vehicle Emissions Equivalents by Region

U.S. average (EV sales-weighted): 68 MPG

© Union of Concerned Scientists
ELECTRIC VEHICLE FUEL ECONOMY IN COLORADO

COLORADO

2017 Nissan Leaf Fuel Economy (CO₂ equivalent emissions*)

Fuel Economy (miles per gallon CO₂ equivalent)

0 20 40 60 80 100

2015 2030

* based on estimated and projected annual Colorado CO₂ emissions from electrical power generation
China wants all-electric and reactions

Electric Cars May Rule the World’s Roads by 2040

The growing list of countries vowing to ban the sale of gas-powered cars

China wants to ban gas and