California’s Low Emission Vehicle III Program

for reducing car air pollution

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California Air Resources Board

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LEV III Program

- Phase-in: 2015-2025 model year
- Combined, increasingly stringent NMOG + NOx fleet average standards
- 70% lower smog forming pollution
- 90% lower PM standards
- 150,000-mile durability
- New supplemental “real-world” cycle and evaporative control requirements
Reductions cannot be achieved without clean fuels

- How clean the fuel is
  - Reduces engine out emissions,
  - Maximizes efficiency of aftertreatment (PM, NOx)

- How well the fuel is combusted
  - Combustion chamber design, fuel control, etc.

- How effectively the exhaust is treated
  - Advanced catalysts, aftertreatment

Thus
- 2006 California Phase II Diesel
  - Sulfur levels reduced to 15 ppm

- 2002 California Phase III Cleaner Burning Gasoline
  - Prohibited use of MTBE as oxygenate - replaced by ethanol
  - Sulfur levels reduced to 15 ppm

Thus
- LEVIII advances technology development that is feasible at a reasonable cost
### Six Levels Available for Certification

<table>
<thead>
<tr>
<th>Emission Category</th>
<th>NMOG+NOx (g/mi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEV160</td>
<td>0.160</td>
</tr>
<tr>
<td>ULEV125</td>
<td>0.125</td>
</tr>
<tr>
<td>ULEV70</td>
<td>0.070</td>
</tr>
<tr>
<td>ULEV50</td>
<td>0.050</td>
</tr>
<tr>
<td>SULEV30</td>
<td>0.030</td>
</tr>
<tr>
<td>SULEV20</td>
<td>0.020</td>
</tr>
</tbody>
</table>
Why Emission Categories?

• Goal: reducing overall emissions from the vehicle fleet

• Emission categories allow manufacturers to certify vehicles to different emission standards based on technological feasibility.

• Emission reductions are achieved by declining fleet average requirement.

• Manufacturers choose the mix of vehicle standards that best meets their needs and allows them to meet the fleet average requirement.
Fleet Average Emission Requirement

150,000-mile New Vehicle Fleet Average Emissions

- Model Year
- NMOG+NOx (g/mi)

PC, LDT1
LDT2, MDPV

75% Lower
Why Fleet Average NMOG+NOx Standards?

• Allows a manufacturer to choose the standards to which each vehicle is certified provided the overall fleet meets the specified phase-in requirements.

• This provides flexibility to manufacturers because they can adapt their phase-in to better fit their product development schedules, as long as the fleet average is at or below the required levels.

• Greater emission reductions from the overall fleet are possible than from a single emission standard that applies to all vehicles.
LEV III Particulate Matter Standards

PM Emissions (mg/mi)

- Current Standard: 10 mg/mi
- 2017 Standard: 3 mg/mi
- 2025 Standard: 1 mg/mi
Supplemental Federal Test Procedure

• “SFTP” ensures low emissions during “real-world” higher speed and load driving conditions

• LEV III SFTP changes:
  • Increased stringency for ULEV and SULEV
  • Extended applicability to MDV (8,501 lbs. – 14,000 lbs. GVWR)
  • Increased durability requirement 150,000 miles
  • Now includes PM standard
Evaporative Emissions

- Extended “zero-evaporative” emission requirements to all light-duty by 2022 MY
  - Currently only required for PZEVs

- Added flexibility with two compliance options for certification testing
  - Full vehicle vs. partial system

- Extended Onboard Refueling Vapor Recovery (ORVR) requirements to all complete vehicles less than 14,000 pounds GVWR
Rapid Transition Towards the Cleanest Possible Vehicles

Model Year

2010 2015 2020 2025

Share at emission level

0% 20% 40% 60% 80% 100%

LEV ULEV ULEV50 ULEV70 SULEV SULEV20 ZEV
The first California SULEV20 already here (13 years ahead of requirement)
Defensible quantification of benefits is essential.

### Benefits

- **Technological feasibility**
- **Cost**

#### Statewide Emissions

**NMOG + NOx (tons per day)**

- **Baseline**
- **LEV III**

- **Year**
  - 2015
  - 2020
  - 2025
  - 2030
  - 2035
  - 2040
Technology and Costs (Gasoline)

Based on manufacturer input, tear-downs, projections of learned costs and design evolution, include cost of design, manufacturing, calibration, warranty, and analyze consumer costs and economic impacts.

<table>
<thead>
<tr>
<th>Systems with additional technology costs</th>
<th>Technology Component</th>
<th>From ULEV to SULEV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PC/LDT1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4-cyl</td>
</tr>
<tr>
<td>Greater catalyst loading</td>
<td>$23$</td>
<td>$31$</td>
</tr>
<tr>
<td>Optimized close-coupled catalyst(s)</td>
<td>$0$</td>
<td>$0$</td>
</tr>
<tr>
<td>Secondary air</td>
<td>$0$</td>
<td>$19$</td>
</tr>
<tr>
<td>HC adsorber (active)</td>
<td>$0$</td>
<td>$0$</td>
</tr>
<tr>
<td>Optimized thermal management</td>
<td>$6$</td>
<td>$6$</td>
</tr>
<tr>
<td>Low thermal mass turbocharger</td>
<td>$0$</td>
<td>$0$</td>
</tr>
<tr>
<td>Evaporative equipment</td>
<td>$13$</td>
<td>$13$</td>
</tr>
<tr>
<td><strong>Total incremental cost</strong></td>
<td><strong>$42</strong></td>
<td><strong>$69</strong></td>
</tr>
<tr>
<td><strong>Total incremental price</strong></td>
<td><strong>$50</strong></td>
<td><strong>$83</strong></td>
</tr>
</tbody>
</table>
## Vehicle Cost (Gasoline)

<table>
<thead>
<tr>
<th>Vehicle Category</th>
<th>Initial baseline certification level</th>
<th>Engine size</th>
<th>Average incremental price&lt;sup&gt;a&lt;/sup&gt; ($/vehicle)</th>
<th>Average incremental price&lt;sup&gt;b&lt;/sup&gt; ($/vehicle)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PC/LDT1</strong></td>
<td>LEV</td>
<td>4-cyl $87</td>
<td>6-cyl $142</td>
<td>8-cyl $248</td>
</tr>
<tr>
<td></td>
<td>ULEV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SULEV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LDT2</strong></td>
<td>LEV</td>
<td>4-cyl $87</td>
<td>6-cyl $142</td>
<td>8-cyl $248</td>
</tr>
<tr>
<td></td>
<td>ULEV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SULEV</td>
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</tbody>
</table>

<sup>a</sup> Sales-weighted average for each initial certification level  
<sup>b</sup> Sales-weighted average for vehicle category
## SIMILARITIES

- NMOG+NOx fleet average identical for 2017-2025
- Emission categories/bins essentially identical*
- Certification fuel specifications very similar (E10) and have reciprocity
- Evaporative emission standards essentially identical*

*Some minor differences may exist relative to early phase-in/first years of implementation

## DIFFERENCES

- **California Zero Emission Vehicle (ZEV) Program**
- LEV III starts in MY 2015; Tier 3 starts in MY 2017
- Full useful life standards:
  - LEV III - 150k miles; Tier 3 – 120k miles w/ optional 150k
- LEV III 1 mg/mi PM standard starting in MY 2025
  - Tier 3 remains at 3 mg/mi from MY 2017+
- LEV III fleet average based on CA+S177 state sales
- Tier 3 fleet average based on 50-state sales