Clean Diesel Technology Options

Dr. Joe Kubsh
Clean Diesel 10
October 2010

Manufacturers of Emission Controls Association
www.meca.org
www.dieselretrofit.org

DERA Funding Utilizes a Variety of Clean Diesel Technology Options

- Retrofit
- Repower
- Replacement
- Refuel
- Anti-idling & Shorepower

Figure 7. Technologies Employed in FY 2008 DERA Grants
The List of Verified Level 3 Technologies Continues to Expand

- 8 - Active On-Road DPFs (includes one DPF + LNC)
- 7 - Passive On-Road DPFs (includes one DPF + SCR)
- 5 - Active Off-Road DPFs (includes one DPF + LNC)
- 4 - Passive Off-Road DPFs
- 10 - Level 3 Devices for Stationary Engines
- 4 - Level 3 Devices for other applications like TRUs and APU

Diesel Retrofit Technology – What’s Coming

- Marine DOC, CCV, PM & NOx Control Systems
- Locomotive DOC + SCR System
- On-Road DPF with Syn-Gas Regeneration
- On-Road and Off-road DPF + SCR Systems for EGR and non-EGR Engines
- Off-Road and On-road SCR-only Systems for EGR and non-EGR Engines
- On-road DPF, LNT + SCR system for EGR and non-EGR engines

From U.S. EPA’s Emerging Technology List
U.S. Diesel Retrofit Technology
MECA Sales Survey Results for ‘07, ’08, ‘09

<table>
<thead>
<tr>
<th></th>
<th>DPFs</th>
<th>Flow-thru Filters</th>
<th>DOCs</th>
<th>Crankcase Filters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>07</td>
<td>08</td>
<td>09</td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td>3,193</td>
<td>5,390</td>
<td>4,962</td>
<td></td>
</tr>
<tr>
<td></td>
<td>66</td>
<td>3</td>
<td>305</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>164</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>124</td>
</tr>
<tr>
<td>Rest of U.S.</td>
<td>5,174</td>
<td>4,640</td>
<td>3,329</td>
<td></td>
</tr>
<tr>
<td></td>
<td>411</td>
<td>2,018</td>
<td>11,881</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,435</td>
<td>12,106</td>
<td>11,906</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5,625</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6,892</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6,424</td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>8,367</td>
<td>10,030</td>
<td>8,291*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>477</td>
<td>2,021</td>
<td>12,186</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,435</td>
<td>12,270</td>
<td>11,906</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5,751</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6,914</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6,548</td>
<td></td>
</tr>
</tbody>
</table>

* 913 DPFs sold into off-road applications, 556 in CA

DOCs and DPFs Form the Technology Base for Reducing PM Emissions from US 2007-10 & 2011 Interim Tier 4 On- and Off-Road Diesel Engines

- Significant experience base with LDD in Europe (> 6 M) & HDD retrofits (> 250 K)
- Crankcase Filters Provide Additional PM Control
- 2007 DPF Systems Feature Active & Passive Filter Regeneration
- Exhaust gas
- Diesel vapor
- Fuel Injection Unit
- Catalyzed DPF
- Heat
- DOC
- Alternator
- Turbo
- Air Filter
- cabins
US 2010 HD Engines Launched with DPF+SCR Systems

- Zeolite-based SCR with low NH\textsubscript{3} slip
- Achieves 0.2 g NO\textsubscript{x} 2010 EPA standard
- DEF usage of 1.5-2% of diesel fuel usage (10 gal. of DEF for about 5,000 miles)
- Up to 5% lower diesel fuel consumption
- Lower PM load on DPF

Source: Volvo Truck EPA 2010 Presentation

Clean Diesel Technology Challenges

- Ten years of progress, but still millions of legacy diesel engines operating across the U.S.
- Manufacturers continue to invest and expand the options available for reducing PM and NO\textsubscript{x} emissions from existing diesel engines.
- Incentives need to be expanded or re-invented to capture more of the health and climate change benefits of clean diesel technologies.
- Technology verification continues to be an expensive, slow process that could benefit from more resources at both ARB and EPA. More needs to be done to harmonize verification requirements between these agencies.