Technology Overview

Aftermarket Diesel Emission Reduction Technologies

This handout provides a description of common retrofit technologies. EPA and CARB maintain lists of technologies that they have verified to reduce diesel emissions.

EPA-verified technologies are listed at: http://www.epa.gov/otaq/retrofit/retroverifiedlist.htm

CARB-verified technologies are listed at: http://www.arb.ca.gov/diesel/verdev/verifiedtechnologies/cvt.htm
Diesel Oxidation Catalyst (DOC)

- **What is it?**
  - Device that oxidize pollutants in the exhaust stream and can be packaged with mufflers

- **What does it do?**
  - Reduces PM (10-50%), HC 50%, CO 40%

- **Cost:** $500 - $2,000

- **Issues:**
  - Most widely used technology
  - No maintenance required
  - Lower PM reductions than DPF
  - Applicable to most engines and vehicles
  - Verified for dockside and construction equipment

\[
\text{Hydrocarbons} + \text{O}_2 = \text{CO}_2 + \text{H}_2\text{O} \\
\text{CO} + \frac{1}{2} \text{O}_2 = \text{CO}_2
\]
Diesel Particulate Filter (DPF)

• What is it?
  – Honeycomb or mesh devices placed within exhaust stream that physically trap and oxidize PM

• What does it do?
  – Reduces PM, HC, CO (+85%)

• Cost: $5,000 - $10,000

• Issues:
  – Must be used with ULSD
  – Passive filters require higher operating temp. (>250 C)
  – Periodic removal of unregenerated ash
Closed Crankcase Ventilation (CCV)

- **What is it?**
  - System that directs crankcase “blow-by” emissions to intake system for re-combustion. PM collected in filter.

- **What does it do?**
  - Reduces PM (10%), HC, CO

- **Cost:** $700

- **Issues:**
  - Likely used to meet 2007 requirements
  - Can be paired w/ DOC for greater reductions
Selective Catalyst Reduction (SCR)

What is it?
- System inject urea (or some form of ammonia) into the exhaust stream and react over a catalyst to reduce NOx emissions.

What does it do?
- Reduces PM (~25%), NOx (60-90%)

Cost: $10,500 - $50,000

Issues:
- Can be paired w/ DOC or DPF for greater reductions
- Requires on-board urea injection system
Lean NOx Catalyst (LNC)

• What is it?
  – Systems injects diesel fuel into the exhaust stream and then catalyzes the reaction to reduce pollution.

• What does it do?
  – Reduces NOx (25-40%)

• Cost: $5,000 - $10,000 (when combined w/ DPF)

• Issues:
  – Can be paired w/ DPF for greater reductions
  – Fuel economy penalty of 3-5%

\[ \{HC\} + NO_x = N_2 + CO_2 + H_2O \]
Exhaust Gas Recirculation (EGR)

• What is it?
  – Device recirculates a portion of engine exhaust back into the engine to cool peak combustion temperatures and thus reduce NOx

• What does it do?
  – Reduces NOx (40-50%) if paired with a DPF

• Cost: $13,000 - $15,000

• Issues:
  – Can be paired w/ DPF for greater reductions
  – Fuel economy penalty of 1-4%
EPA and CARB do not verify idle reduction technologies. Those that use a diesel engine (e.g., an auxiliary power unit) must meet EPA’s standards for that engine.
Automatic Shut-Down/Start-Up Systems

• What is it?
  – Automatic engine control microprocessor

• What does it do?
  – Starts and stops engine based on ambient temp, engine oil temp, battery voltage, or timer

• Cost: $1,000-$2,000

• Issues:
  – Drivers dislike having engine turn on and off while sleeping
Energy Recovery Systems

• What is it?
  – Small electric pump and control unit circulates warm coolant to cab heater

• What does it do?
  – Keeps cab interior warm after main engine shutdown

• Cost: $500

• Issues:
  – No AC; no electrical power; optimal for only 4.5 hrs
Direct Fired Heaters*

• **What is it?**
  - Small combustion flame to supply heat through a heat exchanger

• **What does it do?**
  - Heats cab and/or engine

• **Cost:** $1,000-$2,000

• **Issues:**
  - No AC; no electrical power

*Also called diesel-driven heaters*
Auxiliary Power Units

• What is it?
  – Small diesel powered combustion engine, ~10 hp, EPA certified non-road engines

• What does it do?
  – AC, heat and power for auxiliaries

• Cost: $5,000-$7,000

• Issues:
  – Weight*, maintenance, extra tax, costly

*Weight exemption language for APUs is included in the energy bill.
Truck Stop Electrification (Shore Power)

• **What is it?**
  – Inverter/charger & electric HVAC; connection to external electrical grid

• **What does it do?**
  – Provides power for HVAC and auxiliaries

• **Cost:** Inverter/Charge + electric HVAC ($4,000); external connection ($2,500/space)

• **Issues**
  – Requires modifications to truck, external connection not readily available

• **Major manufacturers:**
  Xantrex (see picture below), Dometic/Cab Comfort, Taylor, Phillips
Advanced TSE (Rental)

• **What is it?**
  - Electric HVAC system suspended above trucks

• **What does it do?**
  - Provides power for HVAC and auxiliaries; cable, telephone

• **Cost:** $15,000 per space (50 space min); $1.25-$1.50 hourly charge

• **Issues:**
  - Costly; available in only a few locations

• **Major Manufacturer:** IdleAire Technologies, Inc.