

# 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.

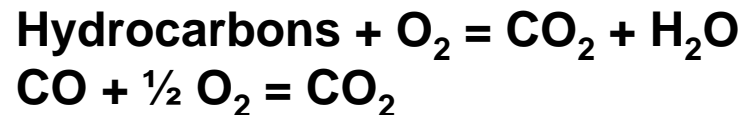
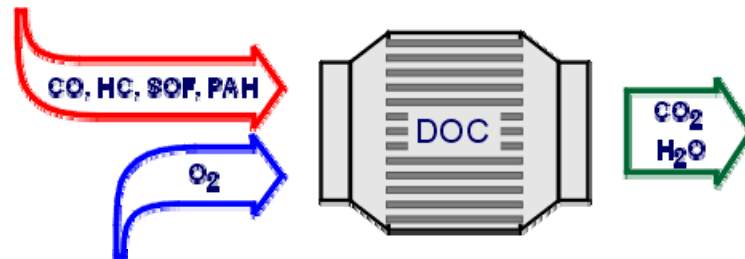
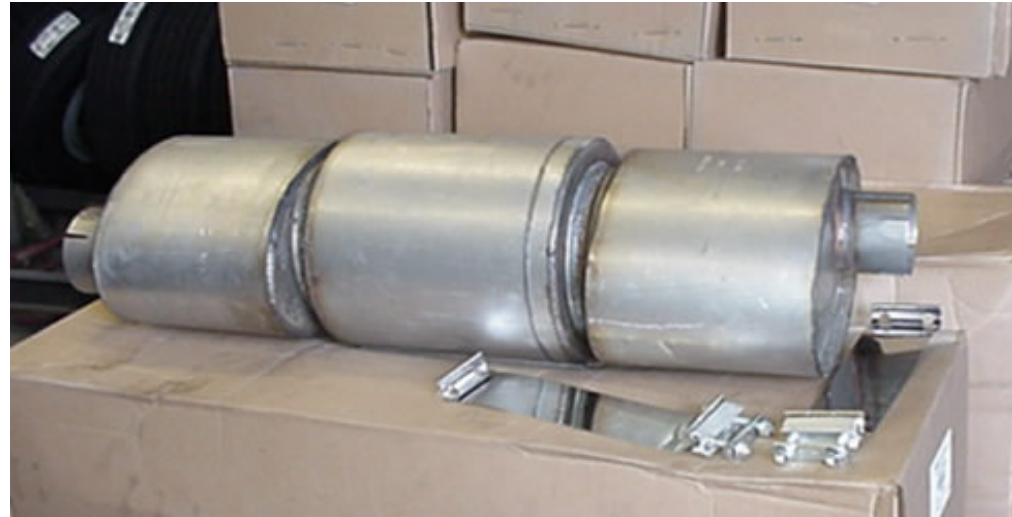
EPA-verified technologies are listed at: <http://www.epa.gov/otaq/retrofit/retroverifiedlist.htm>

CARB-verified technologies are listed at:

<http://www.arb.ca.gov/diesel/verdev/verifiedtechnologies/cvt.htm>

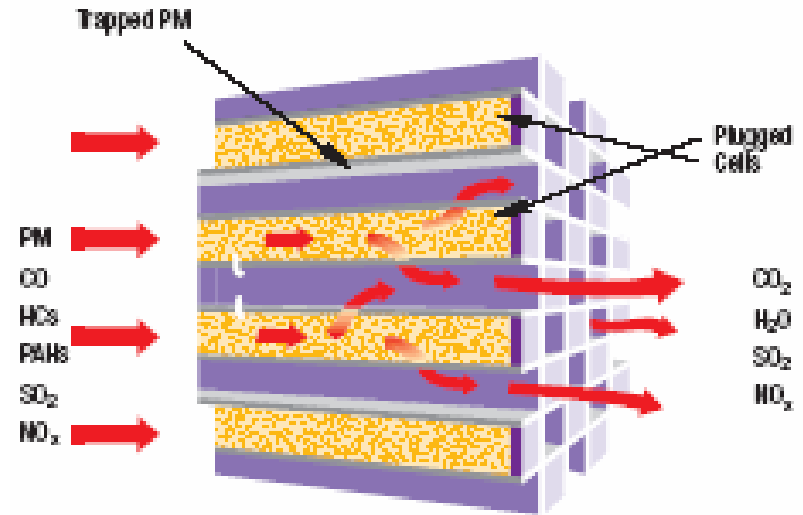
# Diesel Oxidation Catalyst (DOC)

- 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



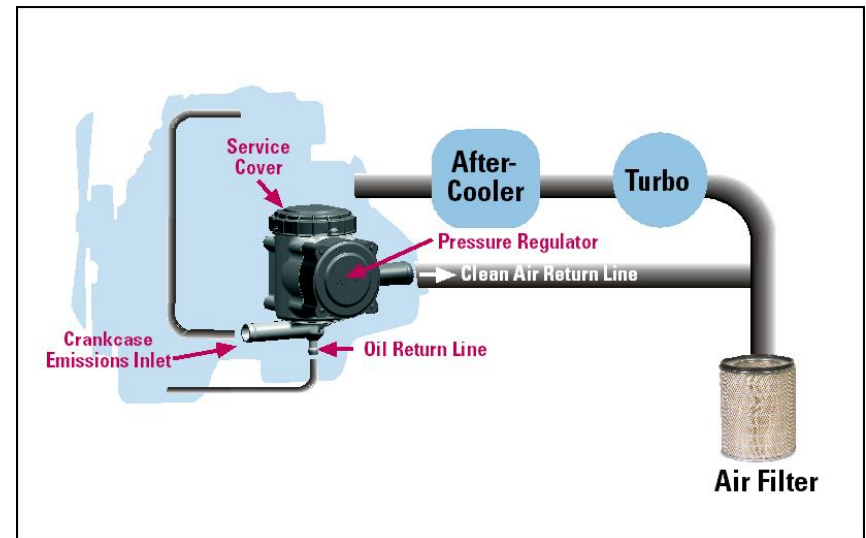
# Diesel Particulate Filter (DPF)

- 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

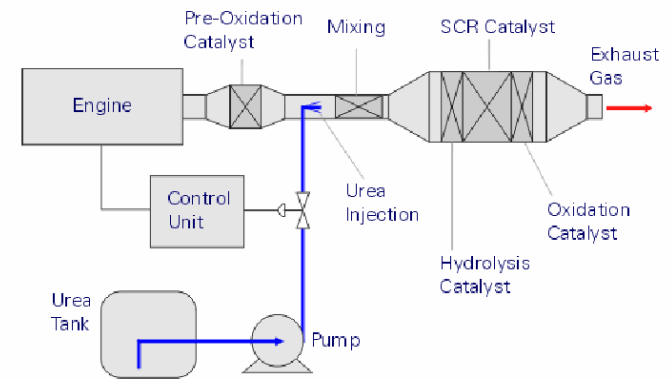


Figure 7. Open Loop Urea SCR System for Mobile Diesel Engines



# 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%

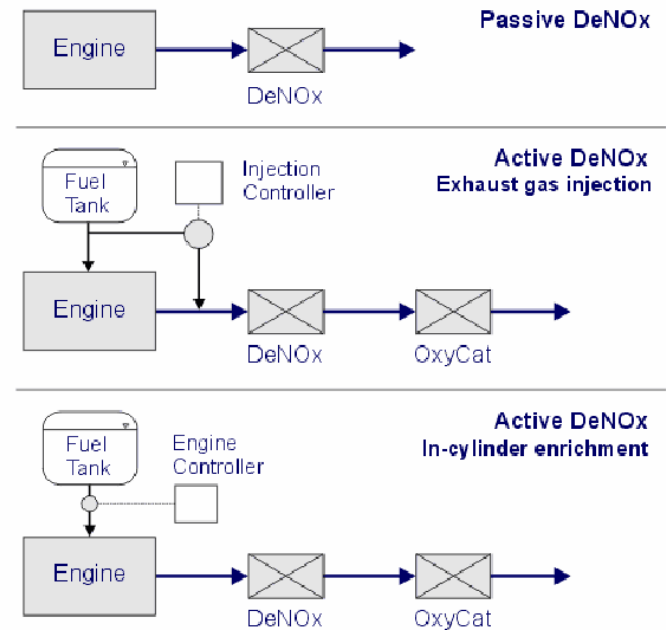
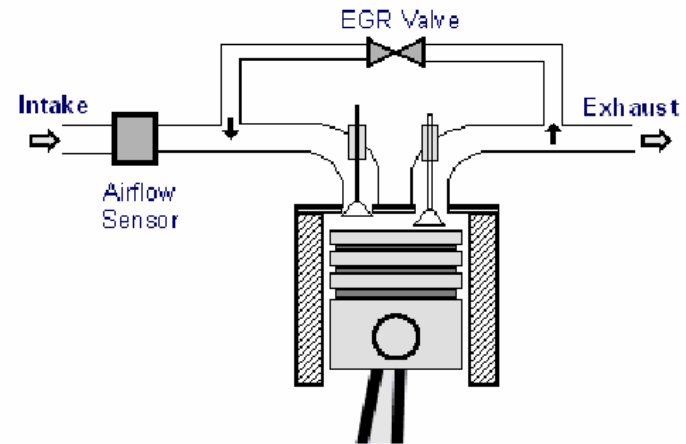


Figure 1. DeNOx Catalyst Configurations



# 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 NO<sub>x</sub>
- What does it do?
  - Reduces NO<sub>x</sub> (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%



# Technology Overview

## Idle Reduction Technologies

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

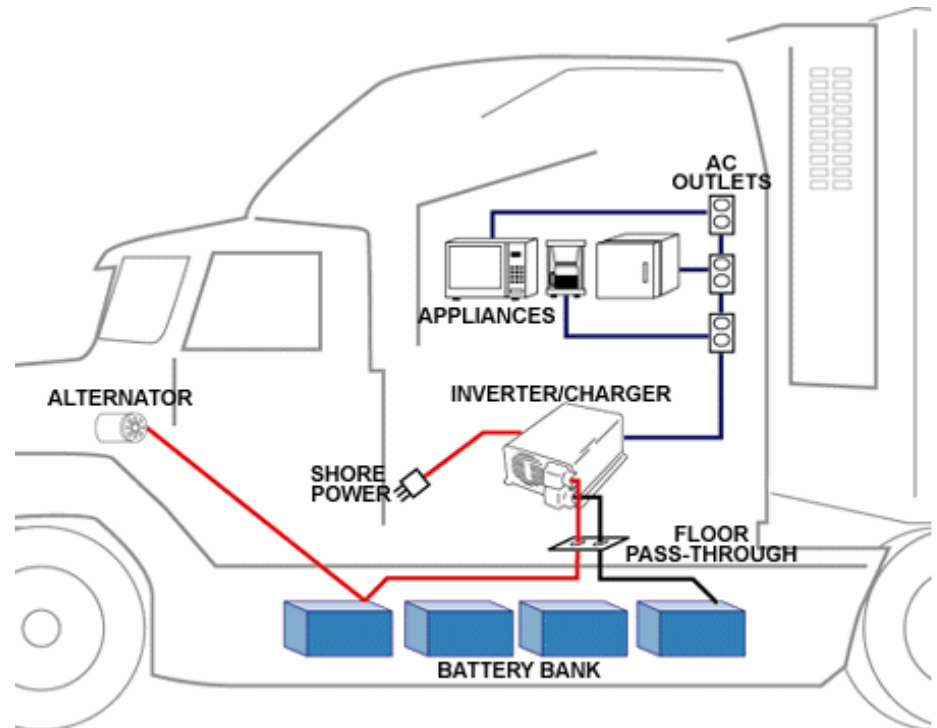


\*Weight exemption language for APUs is included in the energy bill.

# 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.

