

# Regional Air Quality Council

2010 Engine Standards Workshop

8/26/09



# Discussion

- U.S. EPA 2010 Emission Strategy
- Mack Hybrid
- Mack Natural Gas



# US '10 Emissions Regulation

“ NO<sub>x</sub> “

## Nitrogen Oxides

**U.S. EPA limit**

**US '07 = 1.2 g / bhp-hr**

**US '10 = .2 g / bhp-hr**

**83 % reduction**

**With SCR, we meet that standard.**



# SCR Animation



[www.Macktrucks.com](http://www.Macktrucks.com)



# SCR System

## Supplemental Catalytic Reduction

- 3 major components
  - SCR module
  - DEF Tank
  - DEF Injector

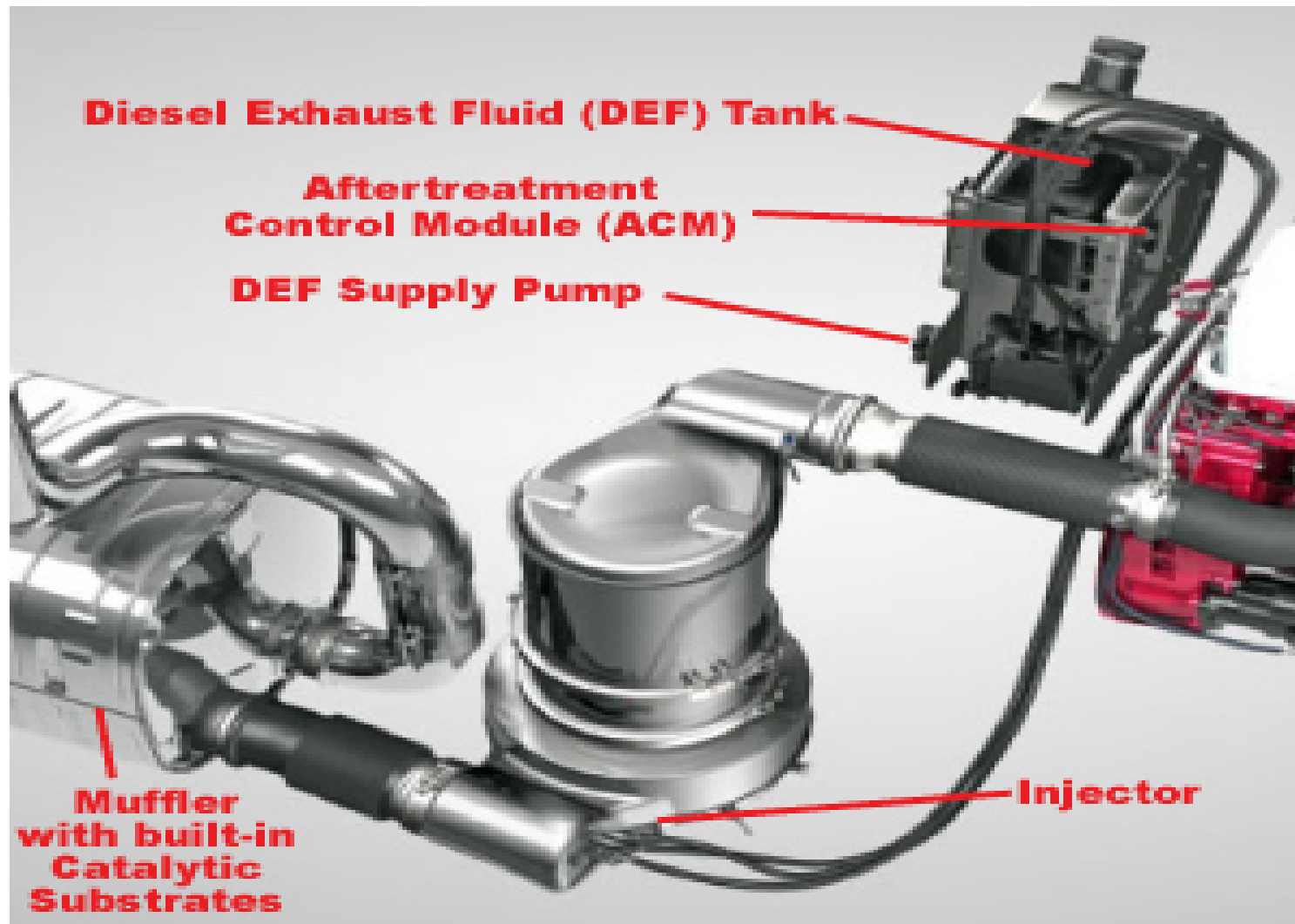


# US EPA 2010



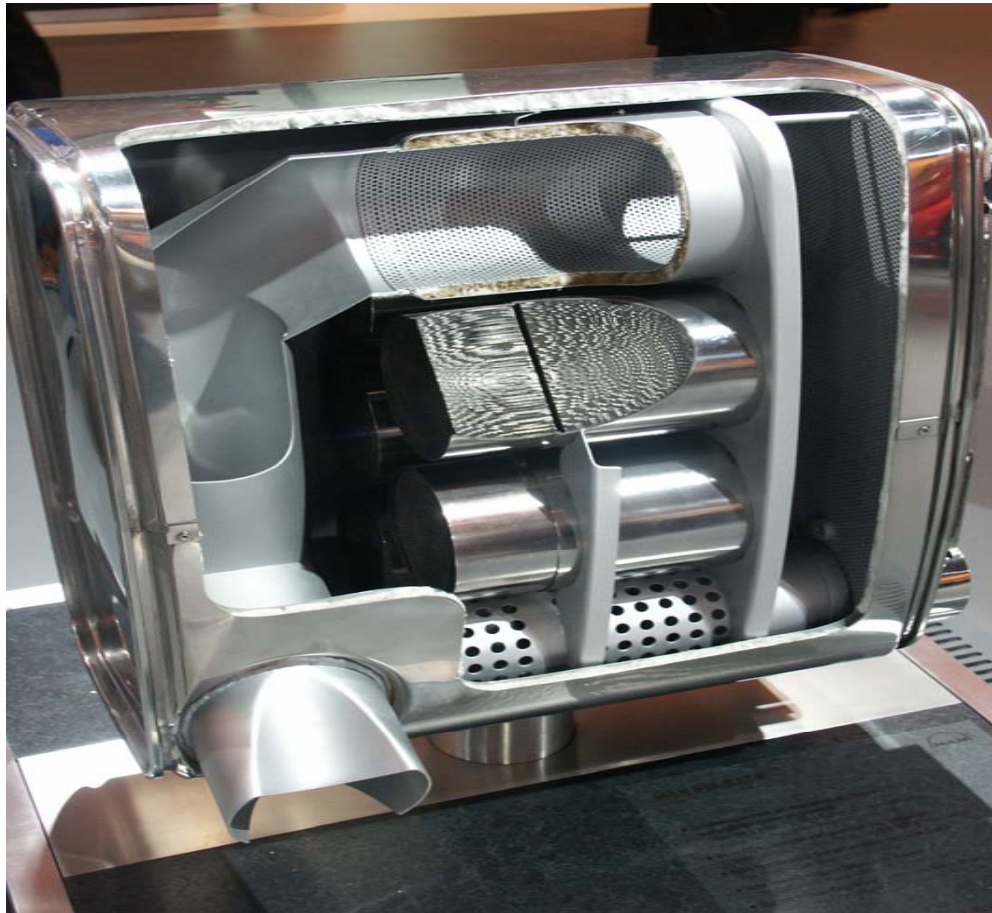


# MACK SCR SET-UP



# SCR Module

**Iron  
Zeolite**



**Zero  
Maintenance**





**6 - 12 - 18 gallon options**  
**7 % volume expansion space**

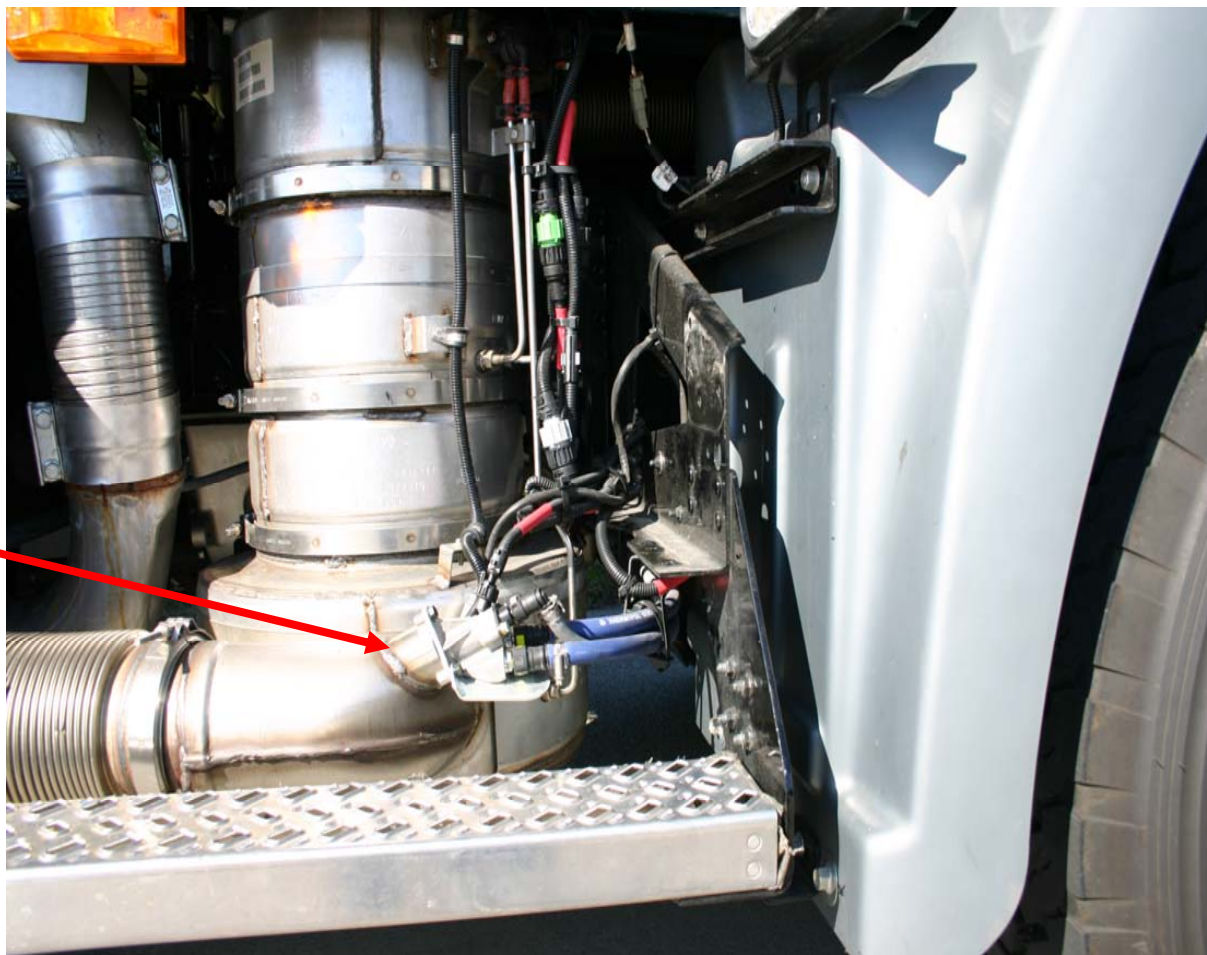


# DEF In-Tank Heater





# DEF Injector



# Diesel Exhaust Fluid

DEF is the reactant for the SCR system

32.5% urea

67.5% deionized water

Natural Gas is the raw material

Cracking process produces ammonia

Mixed with carbon dioxide

Optimum storage conditions:

between 86 deg F and 40 deg F

Under these conditions shelf life is > 1 year

DEF is corrosive to metals- hence the plastic tank

**Freeze point is 11 deg F above Zero**



# DEF Storage

Hottest Temperature on Record (EVER) in Phoenix Arizona: 122 °F

- DEF stored 24 hours a day at 122°F will have a shelf life of 1 month

Daily Mean Temperature in Arizona in July: 95 °F

- DEF stored 24 hours a day at 95°F will have a shelf life of 9 months

DEF stored 24 hours a day at 78°F will have a shelf life of nearly 3 years

**Freezing and re-freezing** has no detrimental effect on DEF



# DEF Range

**DEF tank = 18 US gallons**

**Dosing rate = 3%**

**Fuel Economy = 6.0 MPG**

**2800 to 3640 miles per tank of DEF.**

**Here is another example:**

- **Annual miles for truck = 120,000 miles**
- **Average MPG for truck = 6 mpg**
- **120,000 miles / 6 mpg = 20,000 gallons diesel fuel per year**
- **DEF usage @ 2% of fuel consumption = 400 gallons of DEF / year**
- **400 gallons / 18 gallon tank = 22 DEF fill-ups / year**
- **50 to 1 ratio of Diesel fuel to Urea**

The EPA mandates twice the fuel fill capacity

100 gallon total fuel capacity requires a minimum 6 gallon DEF tank



# UREA / DEF

TerraCair is the preferred supplier for factory fill at Mack Trucks.  
We have it available today!

TERRA's North American manufacturing can supply up to 2.2 million tons of AUS 32. This represents only 50% of current capacity.

Distribution networks are being built to ensure reliable, competitive product supply.



## Key DEF Market Drivers

### Heavy / Medium Duty

- Mack Volvo\*
- Detroit Diesel Daimler Truck\*
- Paccar\*
- Isuzu
- Hino
- Cummins

\* Represent 80% of diesel vehicle production

### Light Duty

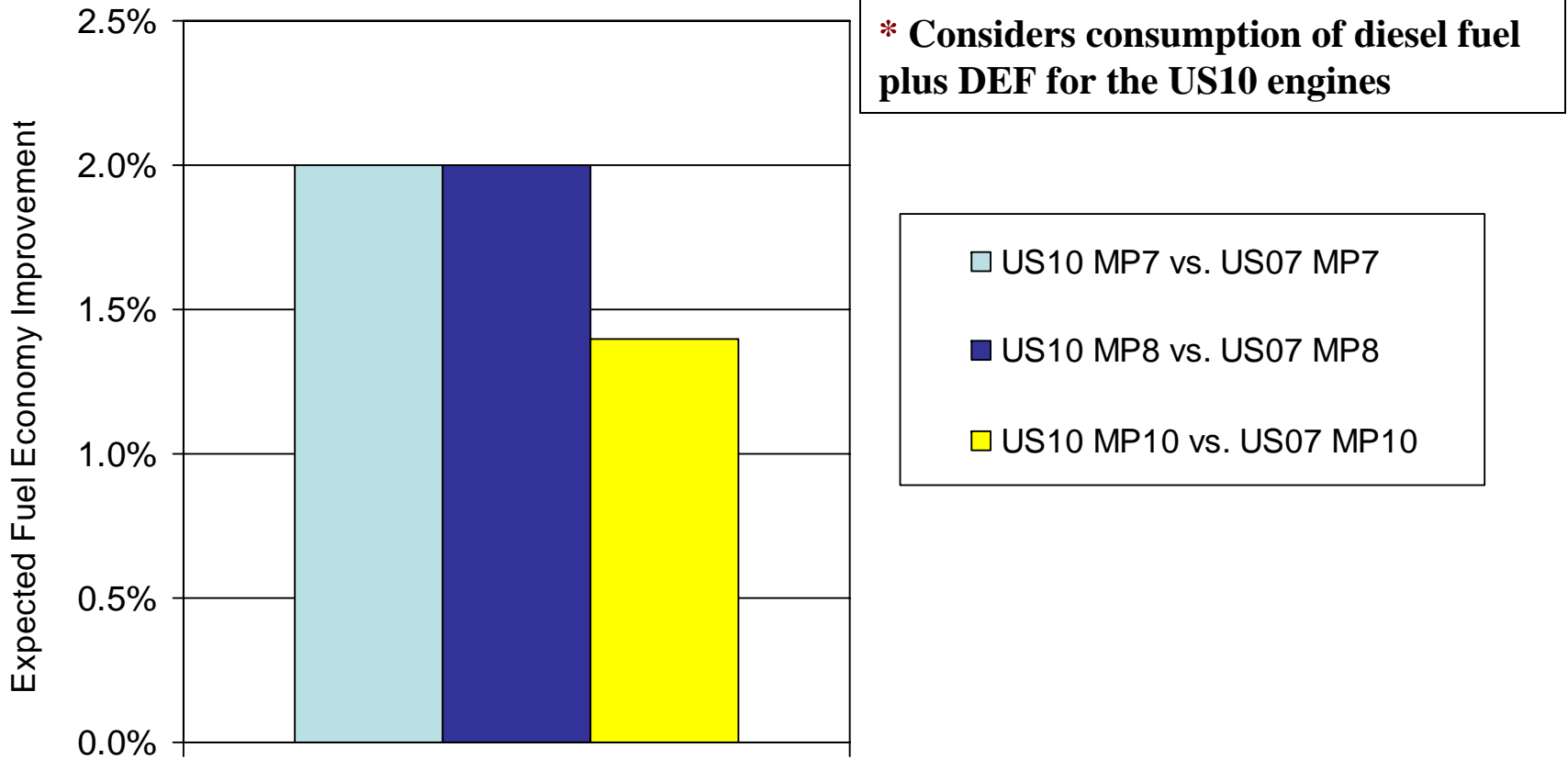
- Ford\*
- GM\*
- Chrysler\*
- VW
- BMW
- Mercedes
- Audi
- Toyota
- Nissan



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# Fuel Economy US-10 vs. US-07 MP Engines



# Diesel Electric Hybrid

MACKTERRAPRO LOW ENTRY — HYBRID ELECTRIC



## MACK® HYBRID TECHNOLOGY

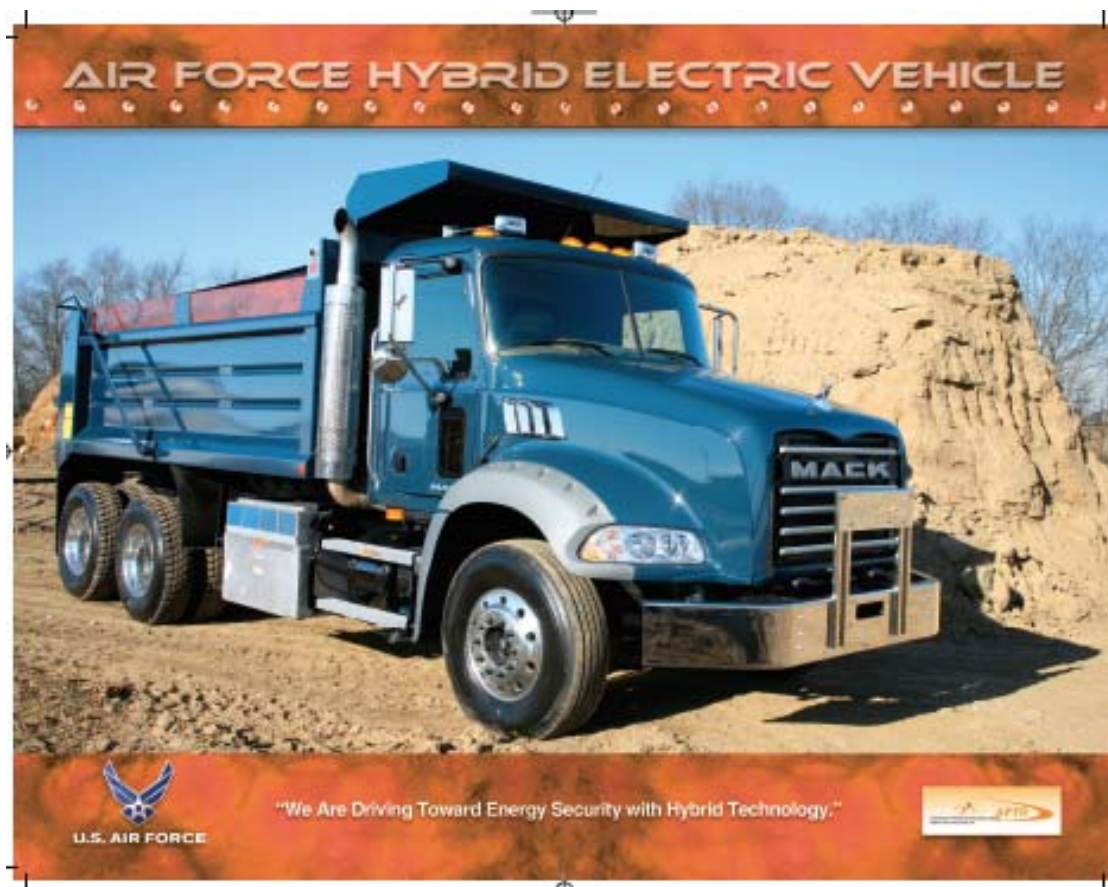
- REDUCED COST OF OPERATION
- IMPROVED FUEL EFFICIENCY
- EXTENDED SERVICE BRAKE LIFE
- REDUCED NOISE EMISSIONS
- REDUCED EXHAUST EMISSIONS
- ENHANCED PERFORMANCE
- MORE AVAILABLE HORSEPOWER



MACKTERRAPRO LOW ENTRY — HYBRID ELECTRIC



# Diesel Electric Hybrid



# CNG / LNG

MACK TERRAPRO — NATURAL GAS

**THE TRUCK OF CHOICE FOR TRASH COLLECTION**  
NOW AVAILABLE WITH NATURAL GAS

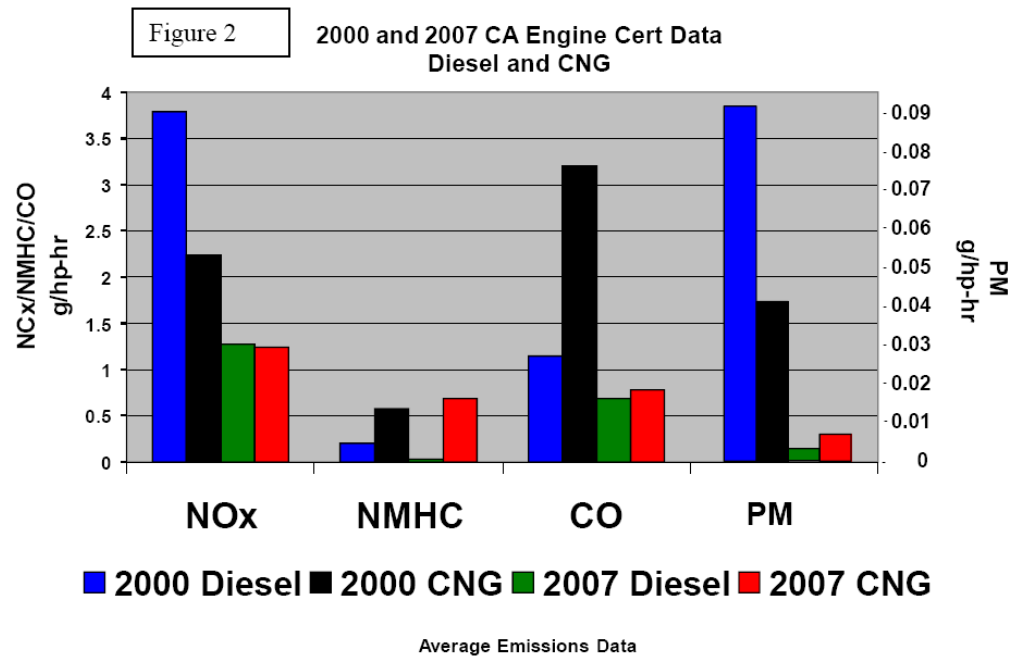


#### NATURAL GAS ENGINES

- LOWER GREENHOUSE (CO<sub>2</sub>) EMISSIONS
- REDUCE DEPENDENCY ON FOREIGN OIL
- LESSEN A TRUCK'S CARBON FOOTPRINT
- DELIVER OUTSTANDING HORSEPOWER
- PROVIDE EXCEPTIONAL TORQUE
- USE LESS EXPENSIVE FUEL



# Diesel / Natural Gas Emissions



**Figure 2: Notes:**

1. NOx- oxides of nitrogen emissions;
2. NMHC= Non Methane Hydrocarbon emissions;
3. PM= Particulate matter
4. CO= Carbon Monoxide Emissions
5. Units are grams per brake-horsepower hour
6. Average Emissions Data shown for all certified HD engine families

Source: California Air Resources Board; 2007 Heavy duty engine emissions average certification data  
<http://www.arb.ca.gov/msprog/onroad/cert/mdehdhdv/2007/2007.php>

Biomethane = Land fill / waste wood / manure / Algae



# MACK TRUCKS

- **Mack has meet the challenging new emissions and is ready to help you meet the challenges of your business!**





THANK YOU