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Michigan Clean Fleet Conference

March 22, 2006

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Transportation Related Air Quality Issues

A Brief Introduction

The Environmental/Efficiency Challenge

Shanghai

Sao Paulo

Los Angeles

- 40% of urban pollution comes from transportation; commercial vehicles are the biggest contributor
- Almost all of these vehicles use conventional liquid fuels today
- General rule: more carbon = more emissions
- There has historically been an emissions/efficiency trade-off in going to low carbon fuels such as natural gas – but that is changing

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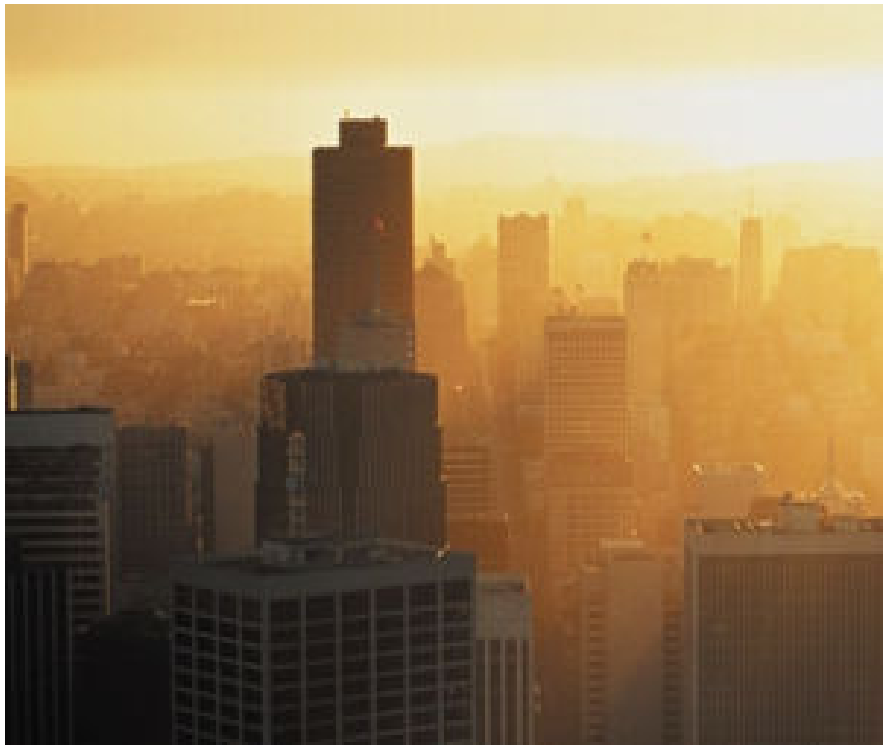
Ground Level Ozone Generation

- High temperature engine combustion produces NO_x
- Via complex reaction with sunlight NO_x leads to NO_2
- This Conversion leads to ground level ozone formation
- Reactive hydrocarbons can speed the conversion process
- Natural Gas hydrocarbons are less reactive then diesel
- In most urban areas lower NO_x will reduce ground level ozone



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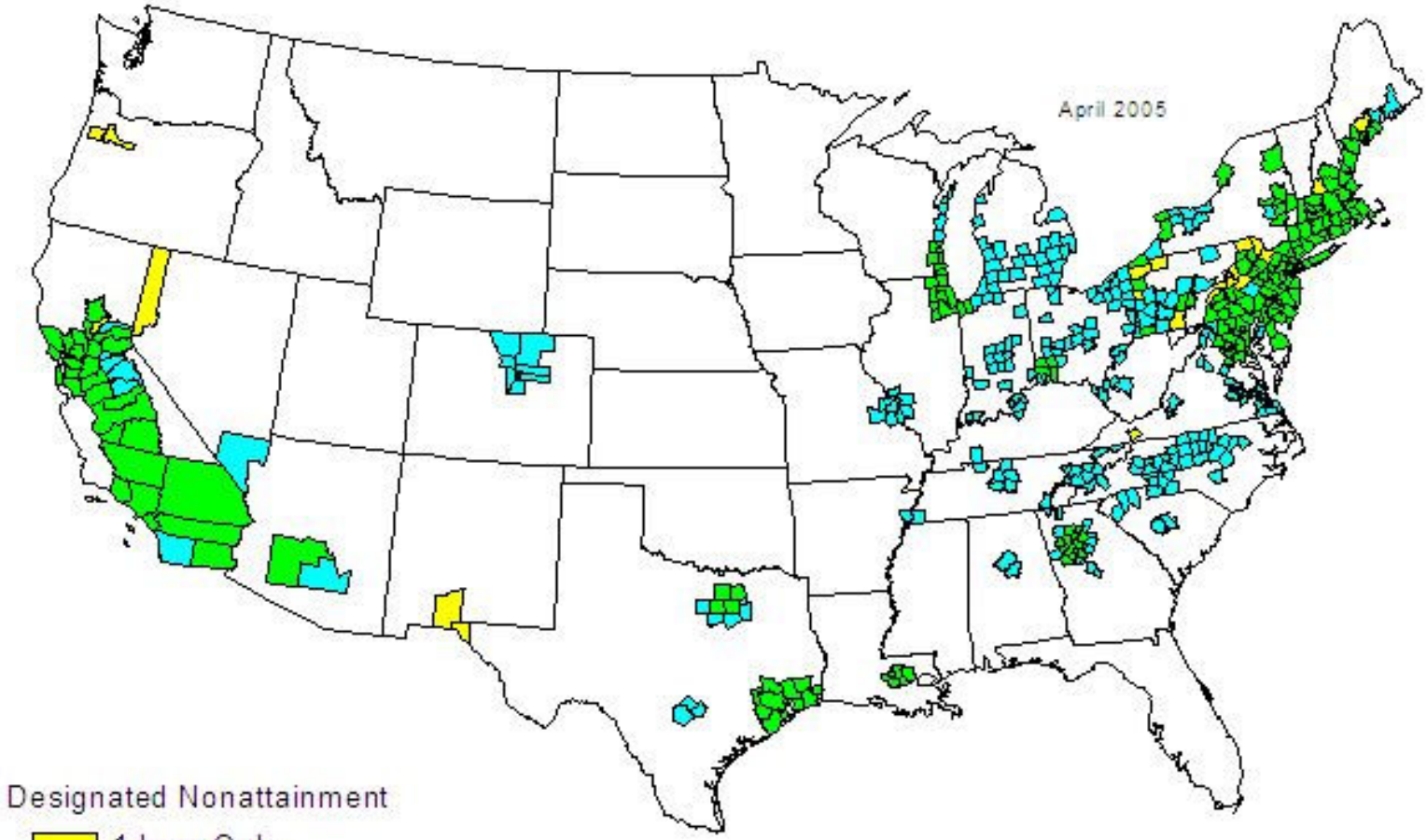
Counties Designated Nonattainment for the 1 and/or 8-hour Ozone Standard

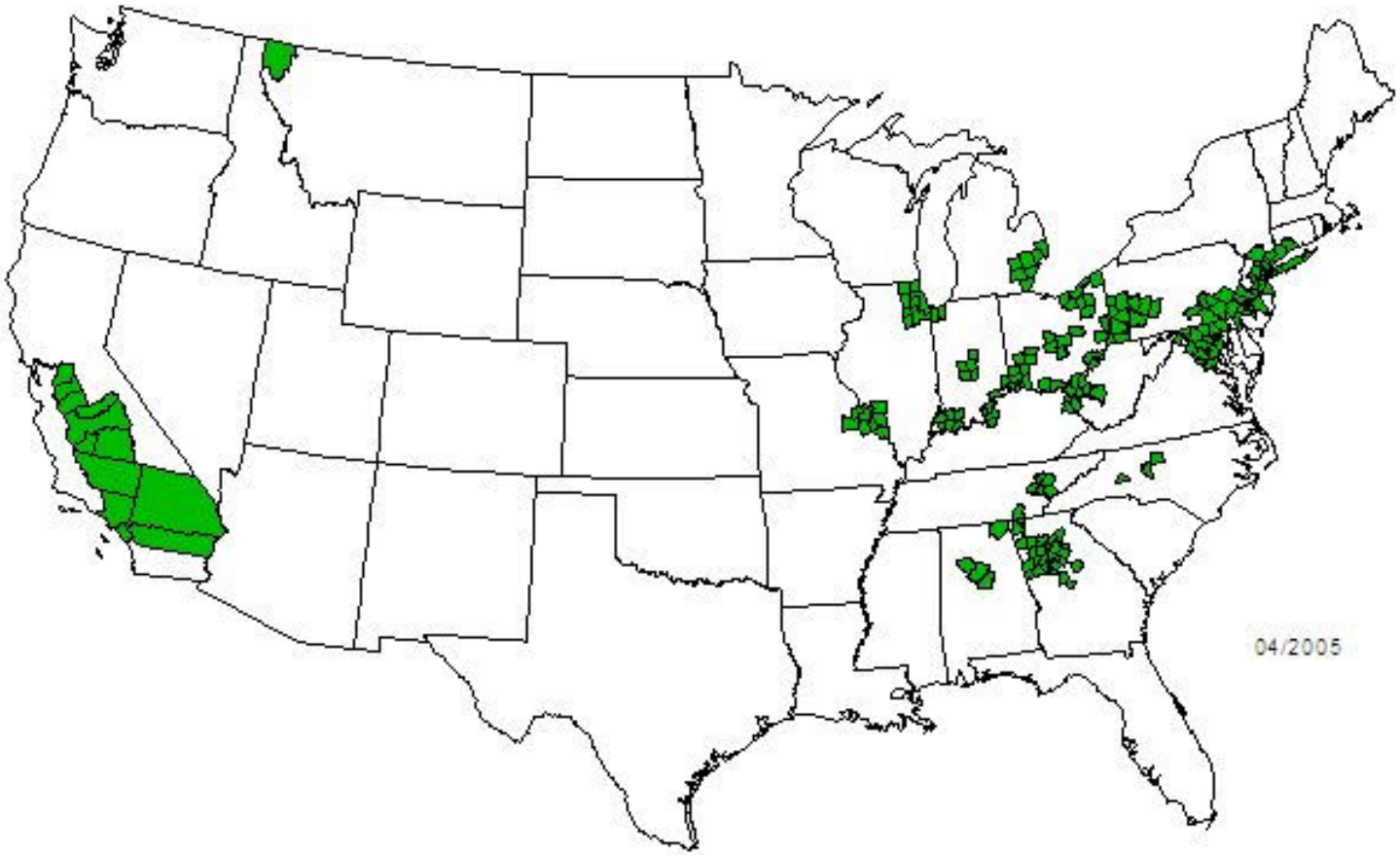


Designated Nonattainment

- 1-hour Only
- 1 and 8-hour
- 8-hour Only

Several counties have only a portion of their county designated nonattainment. These counties are represented as whole counties on this map.

Counties Designated Nonattainment for PM-2.5

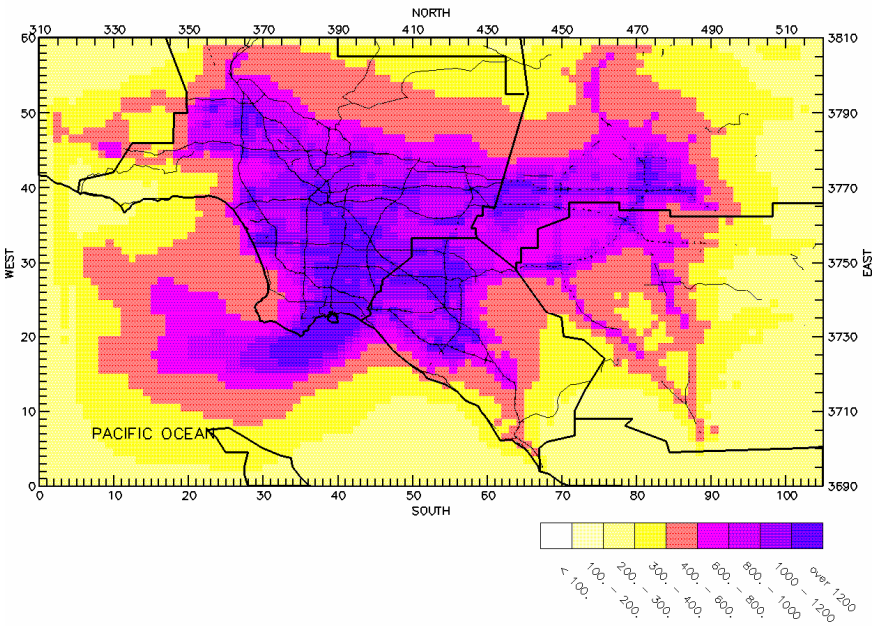


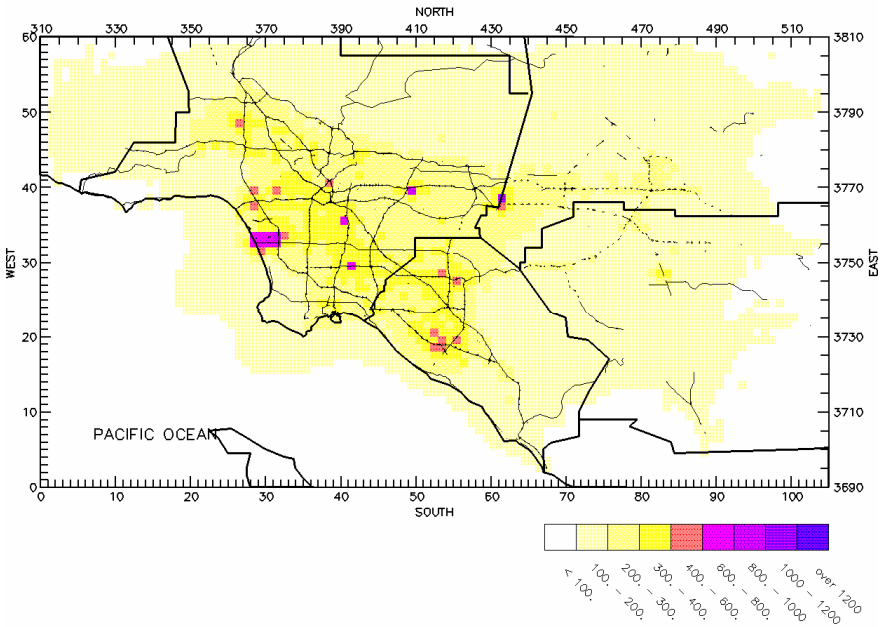
Particulate Matter Nonattainment Area Map

Partial counties are shown as whole counties

The Impact of Diesel Fuel Use

Los Angeles





Modeling health risk from air toxins:

Left: Current risk assessment with diesel

Right: Eliminate diesel sources

Source: South Coast Air Quality Management District, Los Angeles

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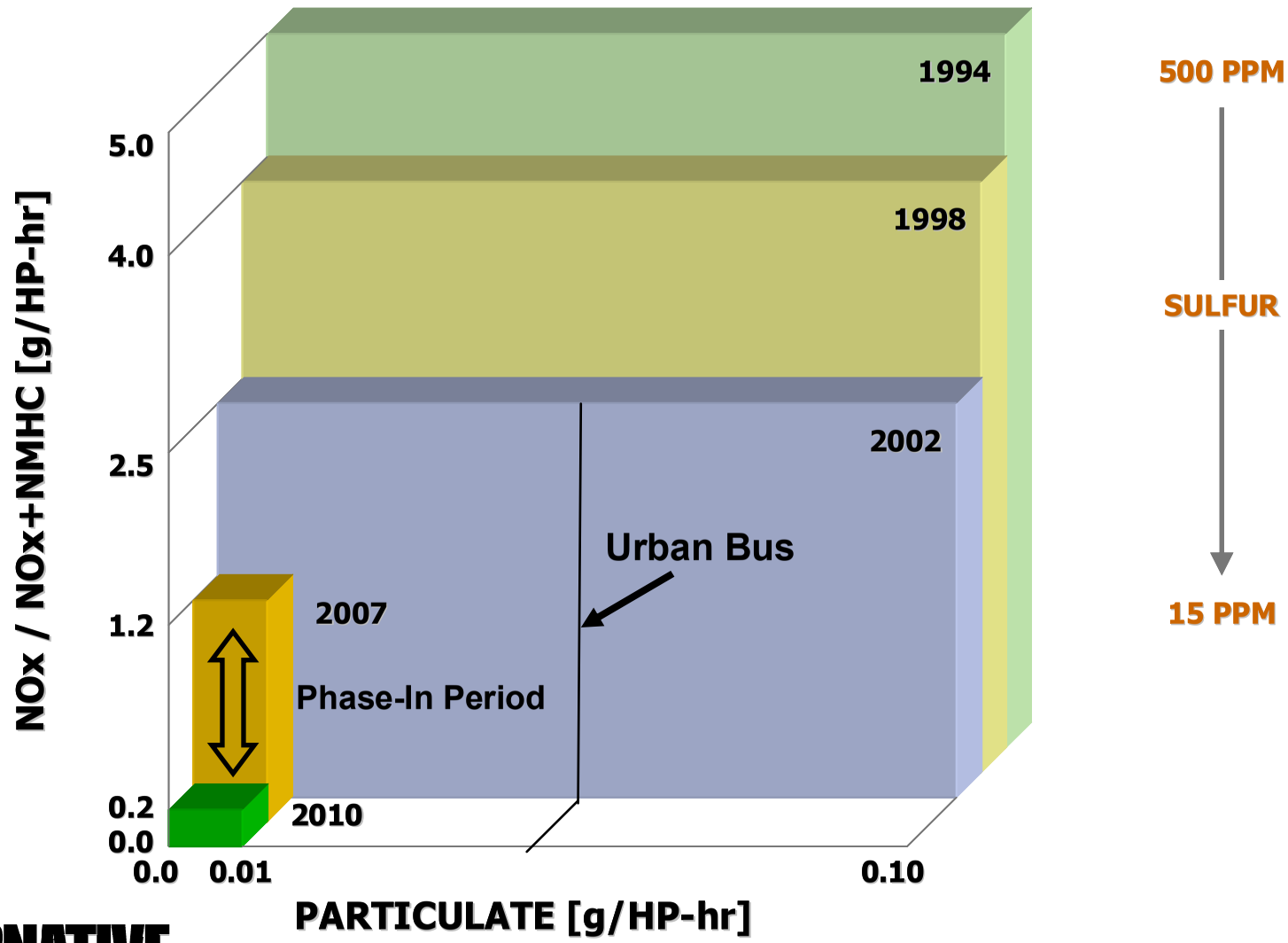
U.S. Emissions Standards Continue to Evolve



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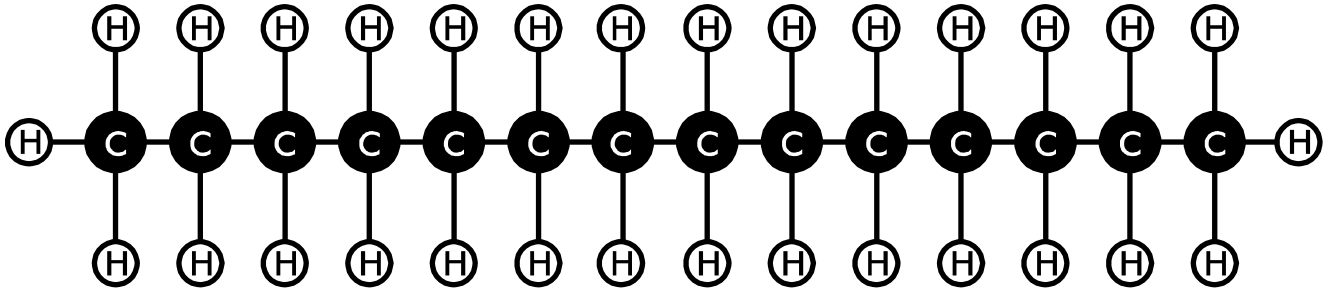
Diesel vs. Natural Gas

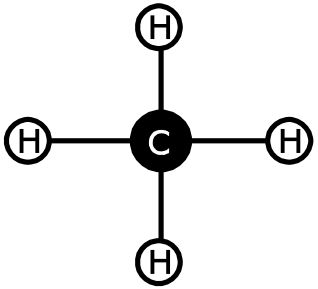
Diesel $C_{14}H_{30}$

Complex Hydro Carbon



Methane CH_4

Simplest Hydro Carbon



Highest hydrogen-to-carbon ratio of any hydrocarbon

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Diesel / NG Pathways to 2010

Diesel

- ULSD
- Diesel Particulate Filters
- CEGR (ISC/ISL)
- NOx Adsorber or SCR
- SCR more efficient but a liquid that will be regulated and taxed
- Crank Case Ventilation (CCV) potential in ’07
  - Sensor impact
- Lube Oil
  - Will require new, low ash oil
- New Oil Filters

Natural Gas

- CEGR
- TWC

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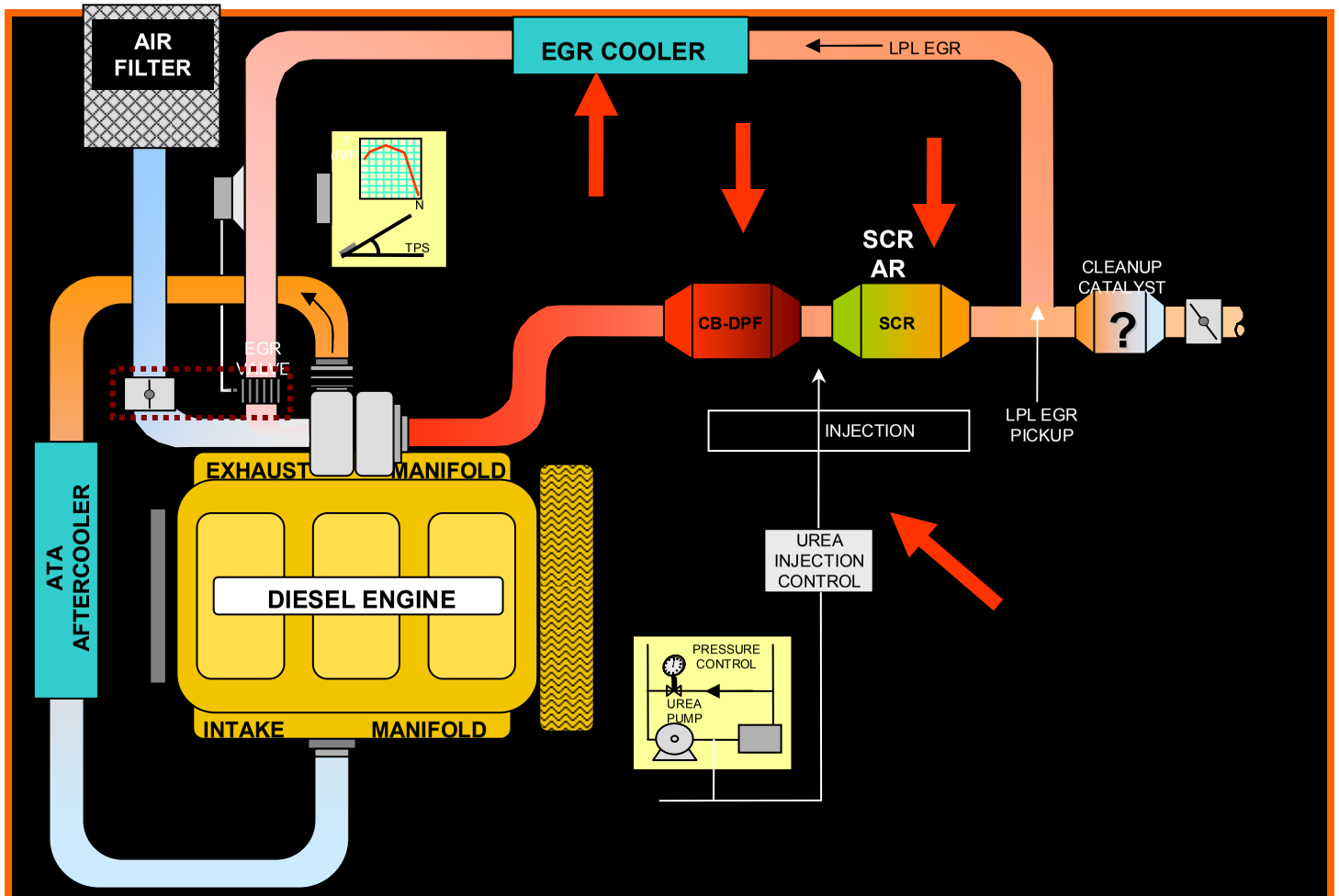
How Diesel Gets To 2010 Standards

The slide demonstrates a range of options of additional emissions reduction equipment that will be required for diesel engines to meet 2010 emission standards.



The emission control systems required for heavy duty trucks, will be the same for buses

Source: Southwest Research Institute (SWRI), presentation to American Trucking Association 5/14/2003

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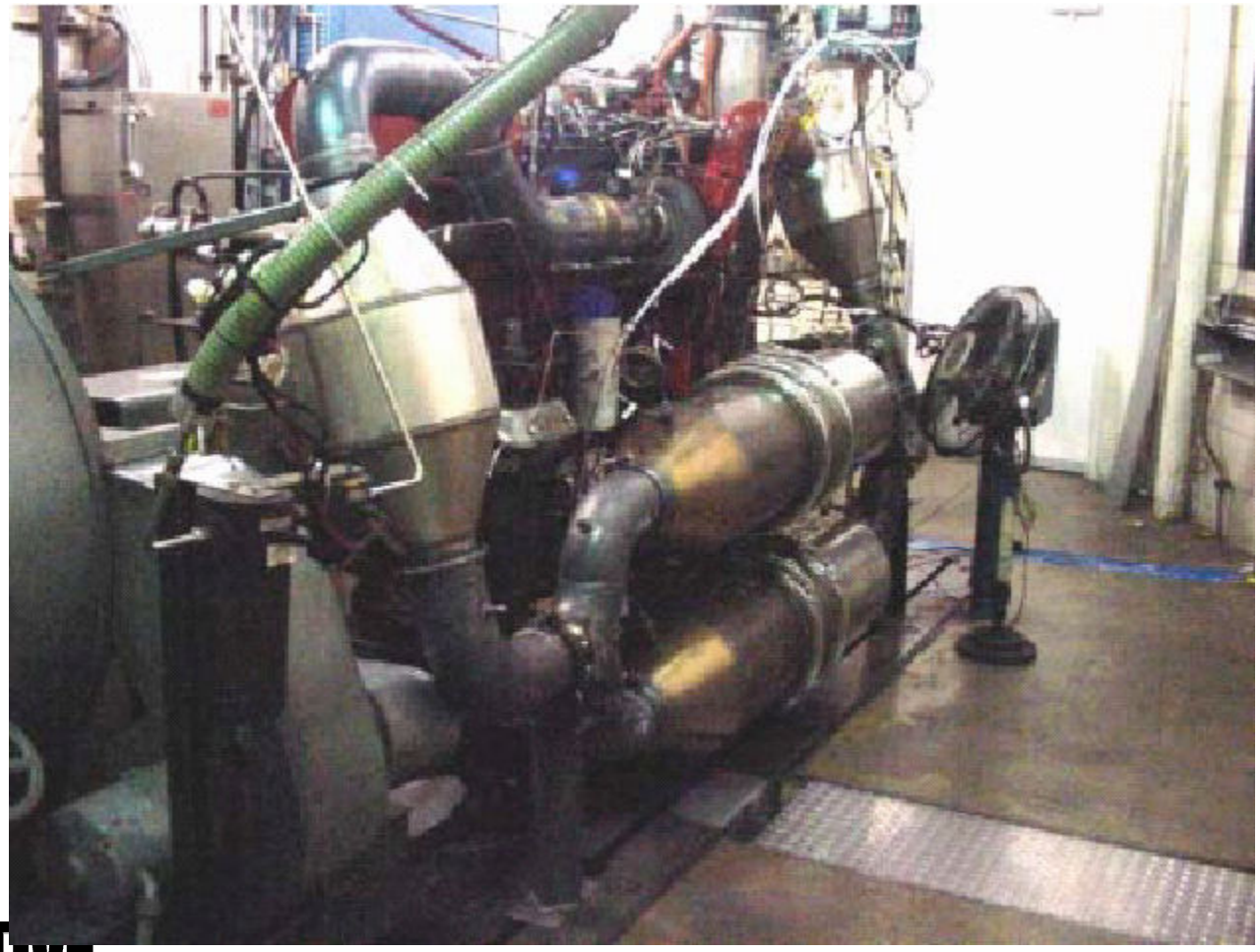
NOx Absorber/DPF System = Complex Aftertreatment



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Natural Gas Engine

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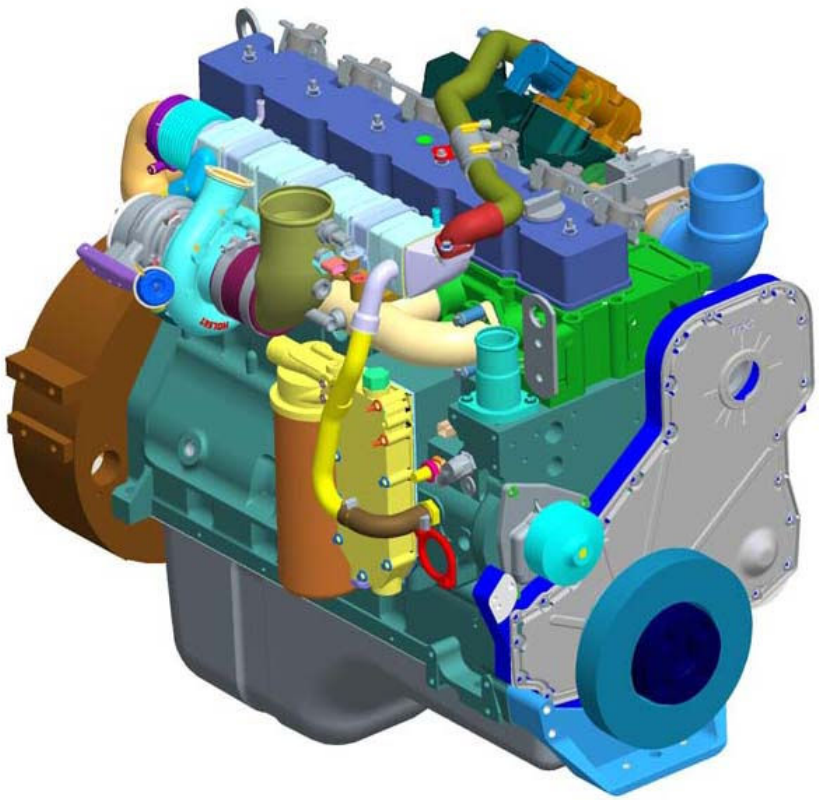
Next Generation Natural Gas Technology

Stoichiometric Featuring Cooled EGR



- Lowest emissions with use of simple passive TWC
- Higher efficiency with combustion enhancements
- 8.9 liter stoichiometric EGR engine with ratings 250- 320 hp
  - Improved clutch engagement torque
  - Higher efficiency/improved fuel economy
  - Reliability/Durability
  - Cummins diesel parts

0.2 NOx in 2007 vs. 1.2 Phase in Provision

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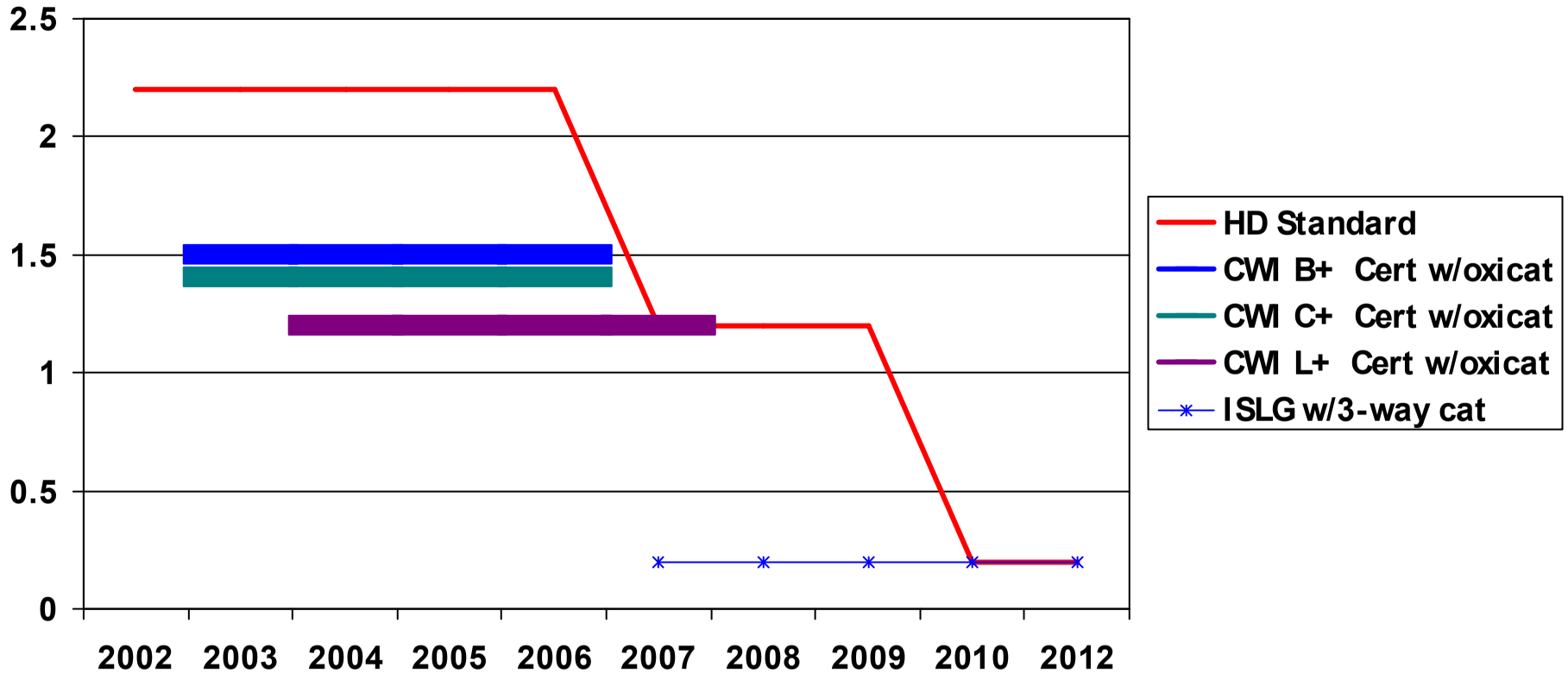
Natural Gas = 40% Lower NOx



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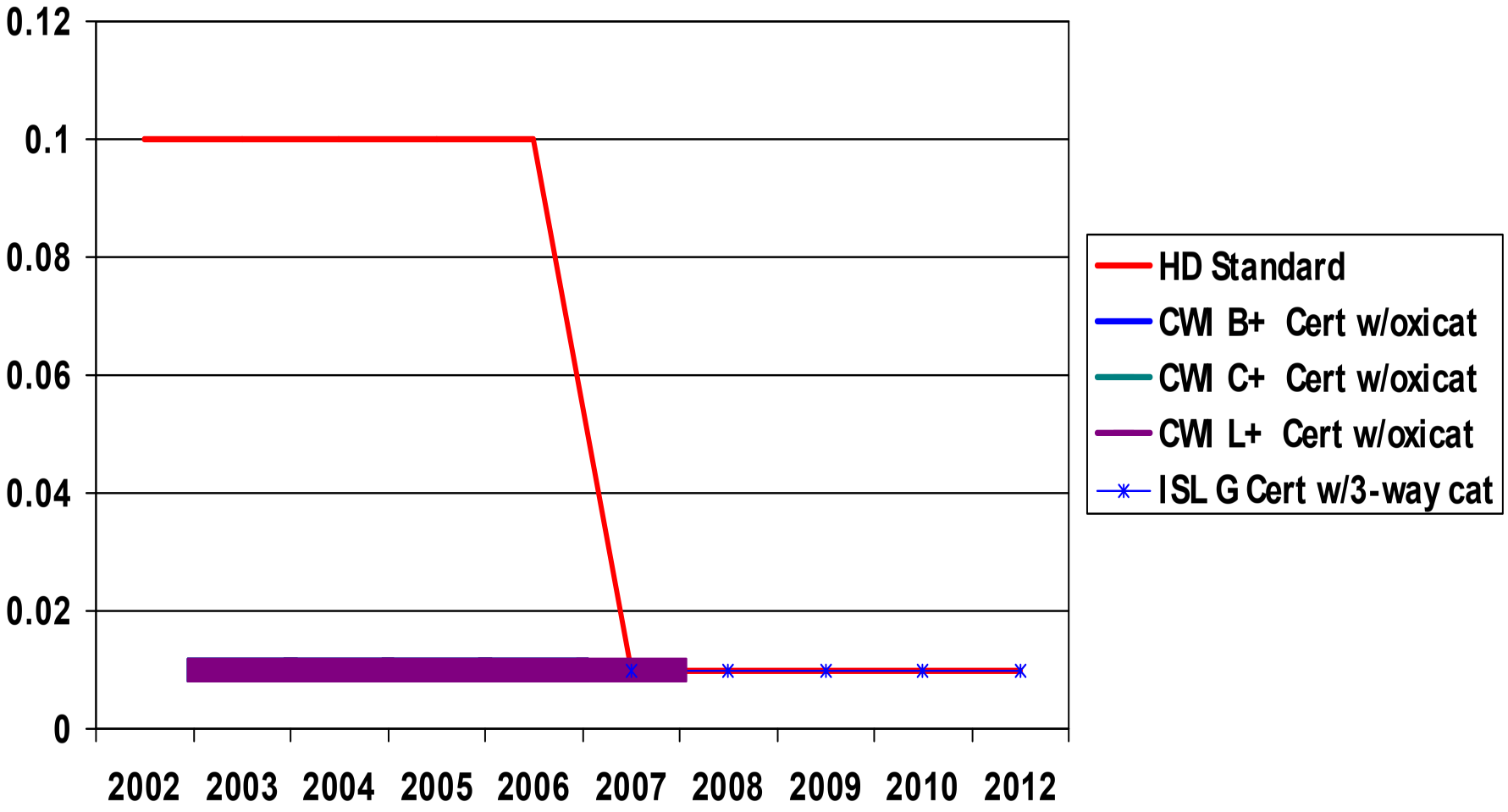
Natural Gas =95% Lower Particulate



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Products

Applications

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2007 North America Product Line

B Gas+
BLPG +

5.9 Liter

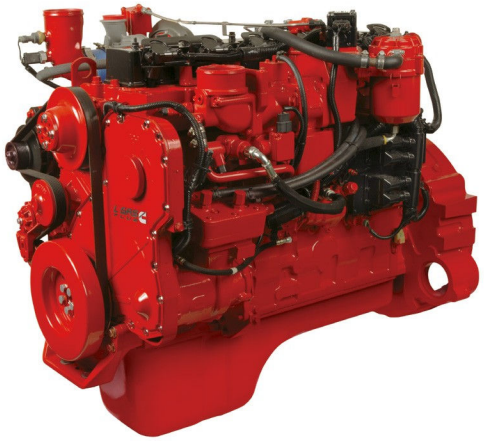
195–230 hp @ 2800 rpm

420–500 lb-ft @ 1600 rpm

CEGR added
Lower emissions
higher efficiency
Single platform
with full range of
ratings

No CEGR in 2007
Possible change
mid-08 with expected
decision mid-06

ISL-G



8.9 Liter

250-320 hp

660-1000 lb-ft

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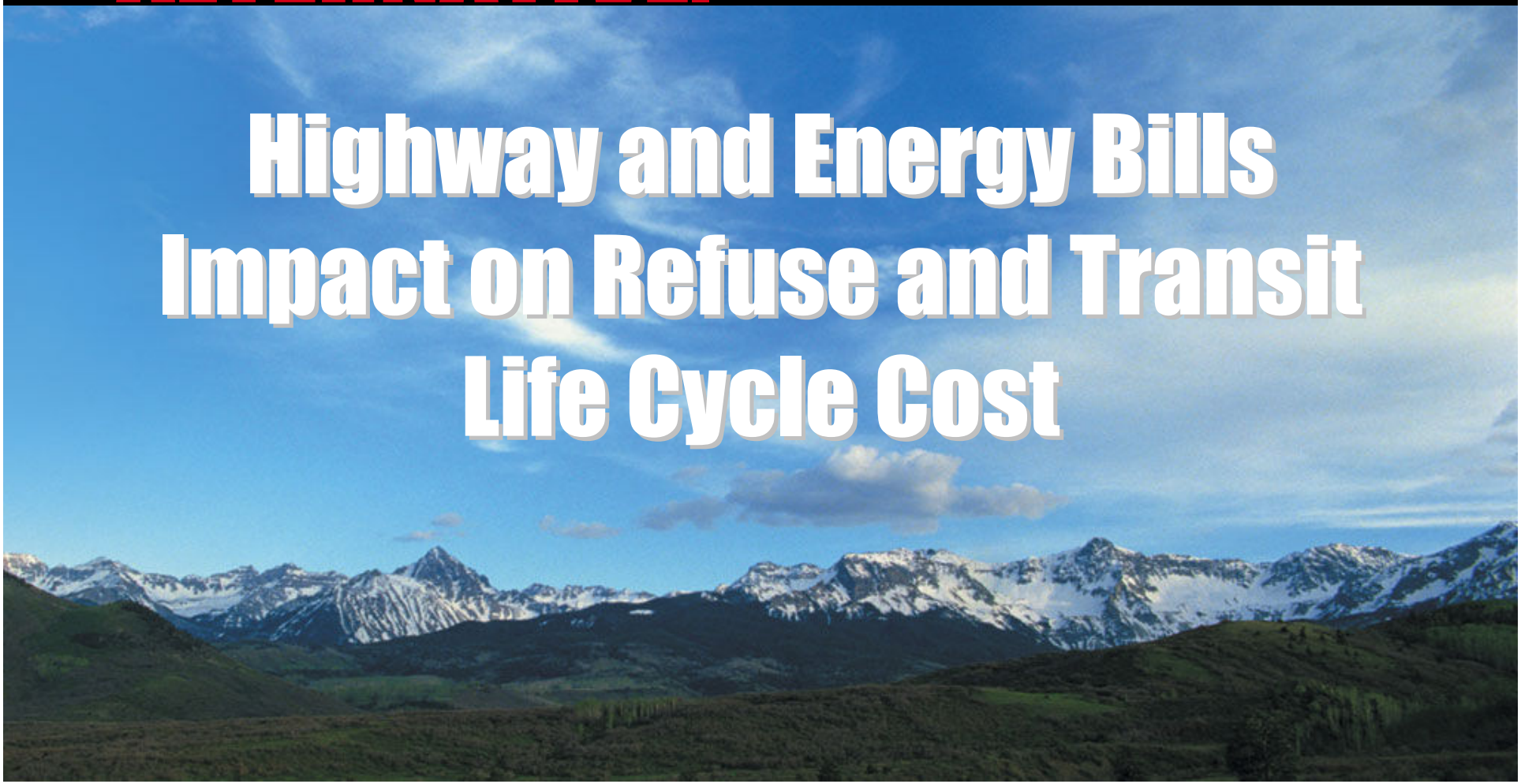
Highway and Energy Bills Impact on Refuse and Transit Life Cycle Cost



Highway/Energy Bill
Transit and Municipal Fleets

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Highway Bill*

	Old Tax	New Tax Oct 1, 2006	Tax Credit Oct 1, 2006	
CNG$ / DGE	0	0 Own Infrastructure	0.55	To Fleet
CNG$ / DGE	0	0 Don't Own Infrastructure	0.55	To Fuel Provider
LNG $/ DGE	0	0 All Infrastructure	0.85	To Fuel Provider

Energy Bill*

Up to $32,000 Vehicle Tax Credit	To OEM
Up to $30,000 Infrastructure Tax Credit	To Fleet

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* CWI's Interpretation Subject to IRS Rule Making

Highway/Energy Bill
Private Fleets

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Highway Bill*

	Old Tax	New Tax Oct 1, 2006	Net Tax Increase	Tax Credit	Net Benefit Oct 1, 2006	
CNG$ / DGE	0.067	0.203	0.136	0.55	0.419	To Fleet
			Own Infrastructure			
CNG$ / DGE	0.067	0.203	0.136	0.55	0.419	To Fuel Provider
			Don't Own Infrastructure			
LNG $/ DGE	0.202	0.413	0.211	0.85	0.639	To Fuel Provider
			All Infrastructure			

Energy Bill*

Up to $32,000 Vehicle Tax Credit	To Fleet
Up to $30,000 Infrastructure Tax Credit	To Fleet

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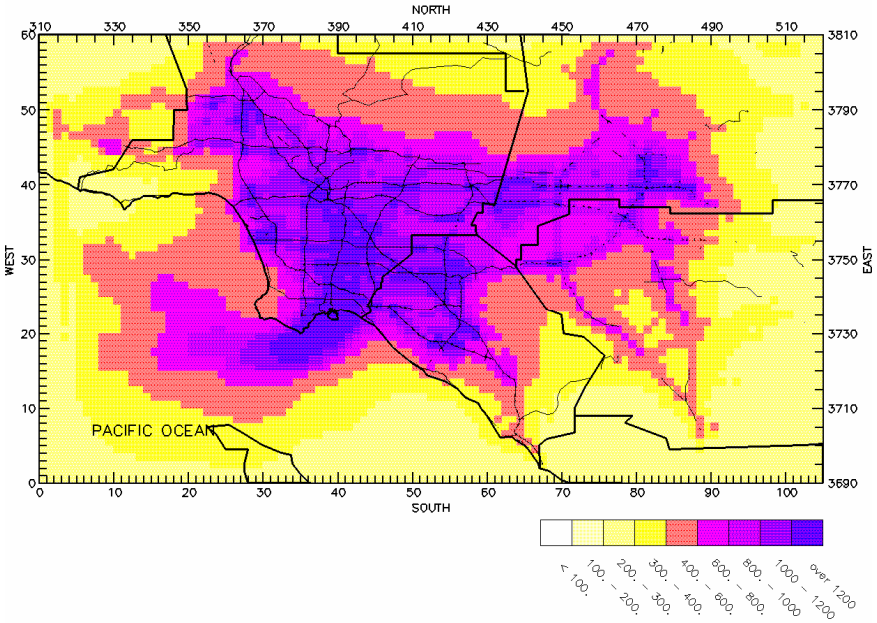
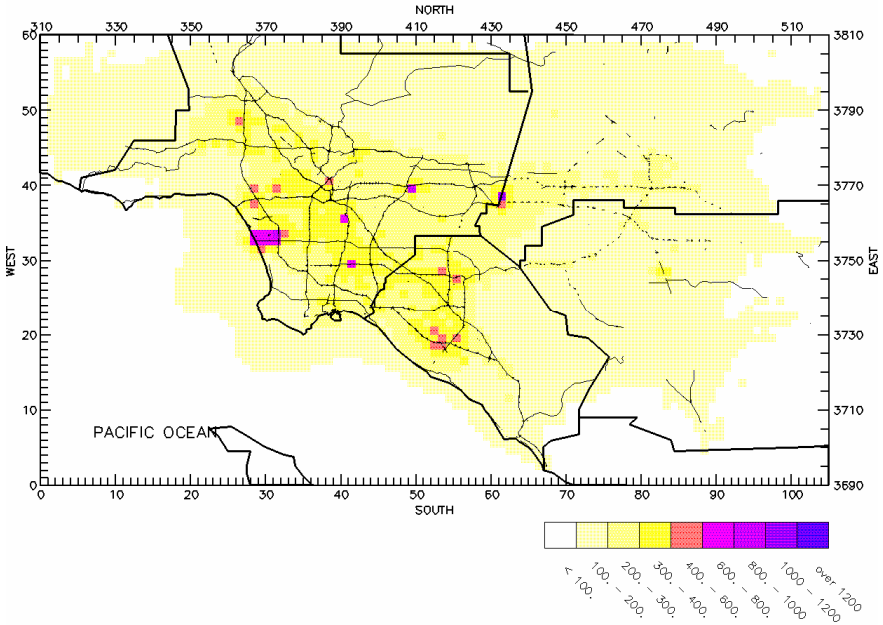
* CWI's Interpretation Subject to IRS Rule Making

The Choice is Clear

Los Angeles





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Cummins Westport Inc.
604 718-8100