

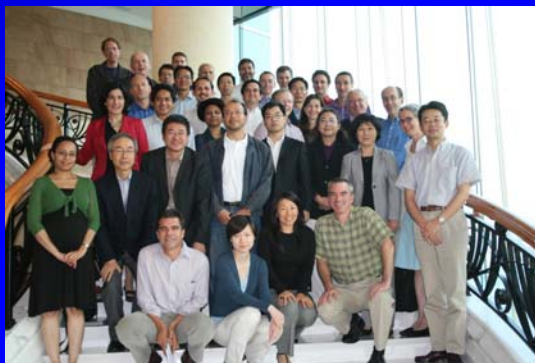
# ***World Overview of Cleaner Fuels and Vehicle Trends***

Conference on Cleaner Fuels and Vehicles  
For Eastern Europe, Caucasus and Central Asia  
24-25 January 2008  
Tbilisi, Georgia

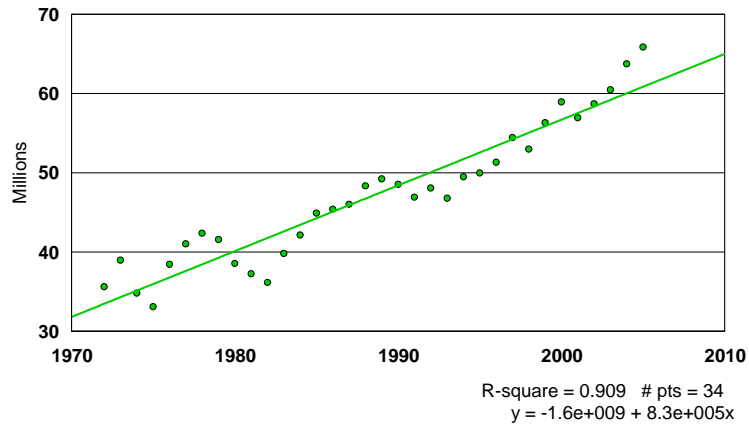
**Michael P. Walsh**  
International Motor Vehicle Consultant  
Chairman, Board of Directors,  
International Council on Clean Transportation

## **International Council on Clean Transportation**

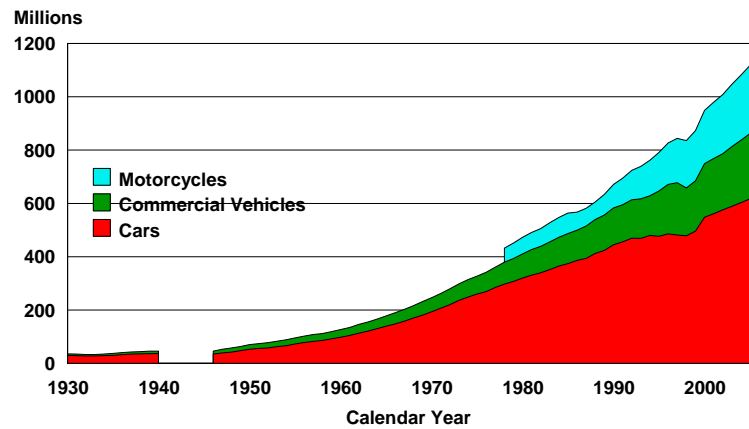
Goal of the ICCT is to dramatically reduce conventional pollutant and greenhouse gas emissions from personal, public and goods transportation in order to improve air quality and human health, and mitigate climate change.



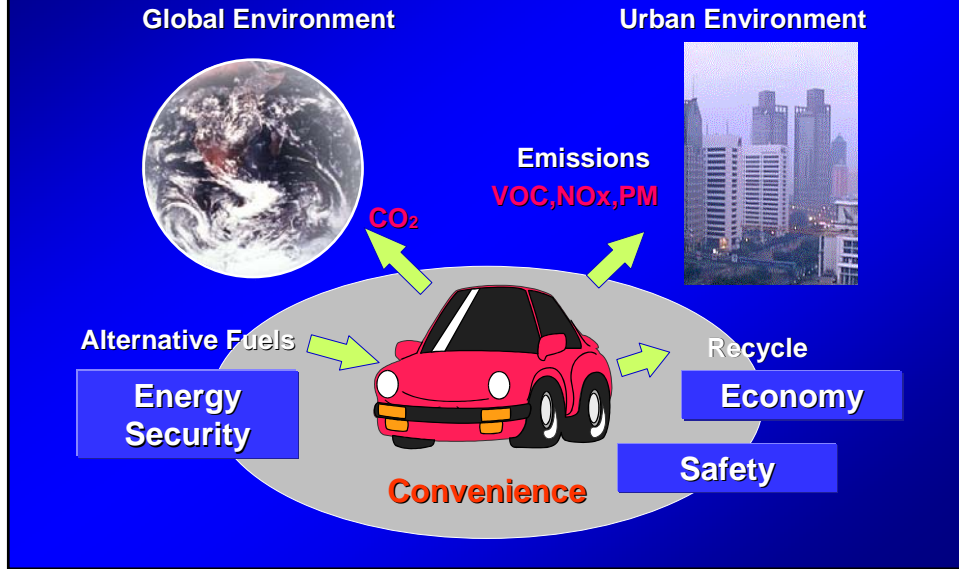
### Figure 6: Annual Production of Cars, Trucks and Buses



### Figure 5: World Motor Vehicle Population



# Automobiles and the Environment



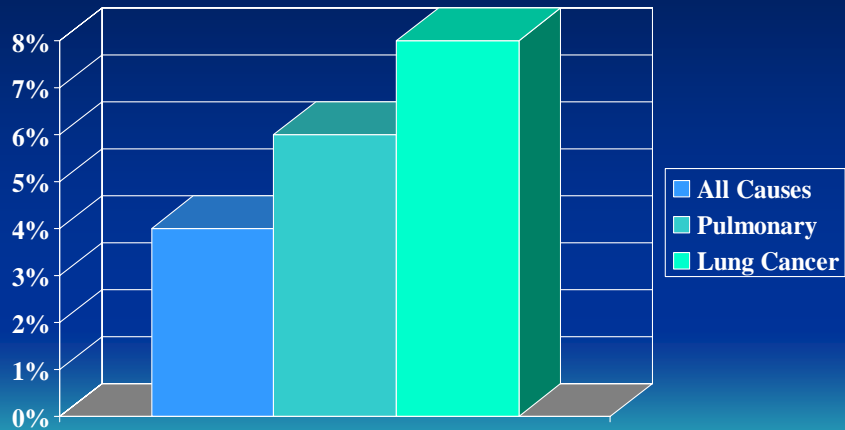
**China is Rapidly Moving From Coal Based Pollution To Motor Vehicle Related Pollution**

Shanghai November 2004

Beijing November 2004



# Increased Risk of Premature Mortality Due To $10\mu\text{g}/\text{m}^3$ $\text{PM}_{2.5}$



Journal of American Medical Association, March 2002

## •OZONE AND PM CAUSE SERIOUS ADVERSE HEALTH EFFECTS INCLUDING PREMATURE DEATH

**Particles larger than 10 microns:**  
Collect in throat, nose; eliminated by sneezing, coughing, nose blowing

**Particles less than 10 microns and larger than 2.5:**  
Settle in the windpipe

**Particles less than 2.5 microns:**  
Penetrate deeply into lungs, collecting in tiny air sacs where oxygen enters the bloodstream

**Ozone-damaged alveolar sac**

Ozone, a key component of smog, is known to exacerbate asthma and can induce lung inflammation and reduction of breathing capacity.

**Size of particulate matter (PM) you may find on your car.**

**Size of particulate matter you may find in your lungs, that can do the most damage to your respiratory system.**

Measurements in microns

Cross-section of a human hair

CLICK FOR DETAILED

## PM And Black Carbon Emissions Important For Both Urban Air Pollution and Global Climate Change

- WHO Estimates ~ 800,000 Premature Deaths Each Year From All Sources – Primarily Urban PM
- Black Carbon A Potent Greenhouse Pollutant- GWP Estimates Vary
  - Hansen et al – 2000 for 20 Year
  - Jacobsen 800-1200
  - Delucchi CEF ~ 4700

Most Scientists Conclude That Climate Change Is Already Underway

### Surface Melt on Greenland

Melt descending into a moulin, a vertical shaft carrying water to ice sheet base.

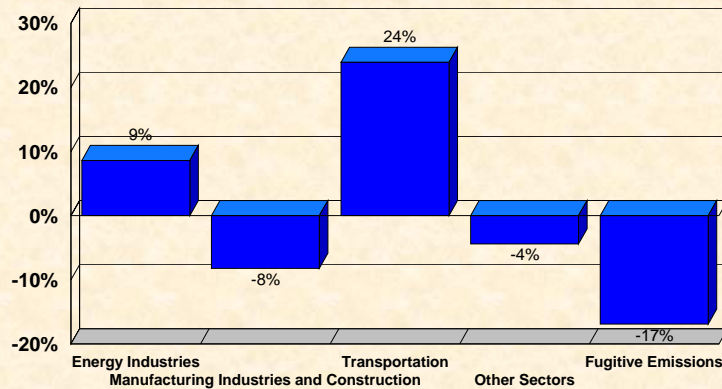


Source: Roger Braithwaite,  
University of Manchester (UK)

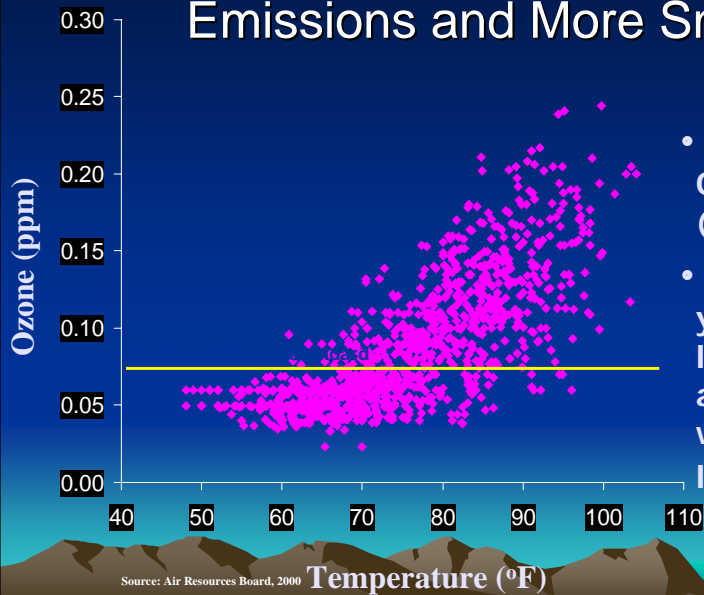
Transportation is Most Rapidly Growing Contributor!

## Annex 1 Party Greenhouse Gas Emissions in the Energy Sector

Change 1990-2004 (%)

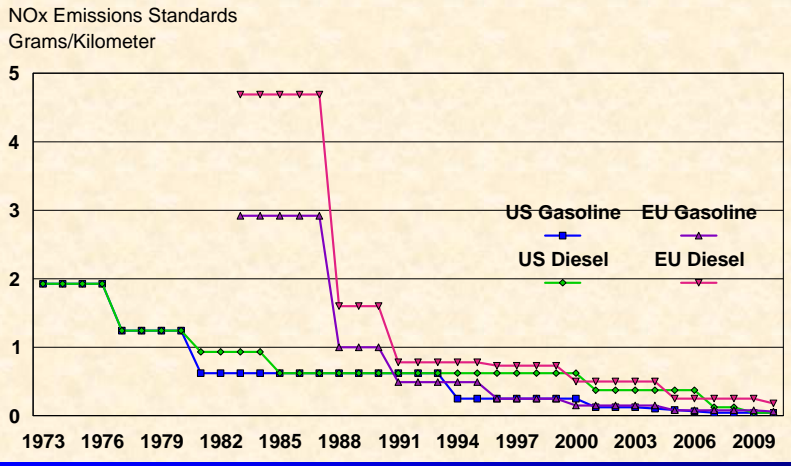


## Hotter Days Lead to Higher Emissions and More Smog



- Los Angeles Ozone Levels (1995-1998)
- 10 warmest years of the last century all occurred within the last 15 years.

# EU and US Passenger Car Exhaust Emissions Standards



## 1970 Car Vs. a 2007 Car in the US

	1970's Vehicle	1990's Vehicle	2007 Vehicle
CO2	700 gpm*	375 gpm	375 gpm
VOC	7.5 gpm	1.5 gpm	0.09 gpm
CO	88 gpm	19 gpm	4.2 gpm
NOx	3.5 gpm	1.6 gpm	0.07 gpm
Lead	0.22 gpm	0.00003 gpm	0.00003 gpm
Evap	11 gpm	0.9 gpm	0.03 gpm
In-use FE	12.7 mpg	23.7 mpg	23.7 mpg
Useful Life	50,000 miles	100,000 miles	120,000 miles**

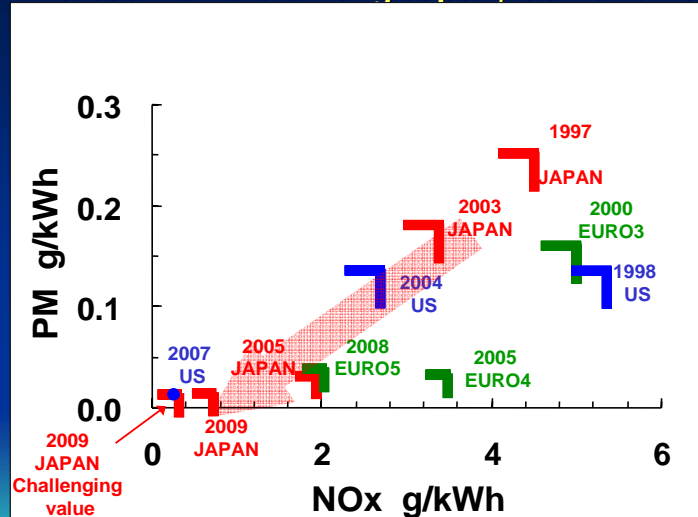
EU = 130  
By 2012

\* gpm = grams per mile

\*\* 120,000 miles = ~ 193,000 km



## Comparison of NOx and PM regulations for HD diesel vehicle among Japan, USA and Europe



ICCT Is Actively Encouraging Global Harmonization of HD Regulation To The Most Stringent Levels

## Bellagio Principles

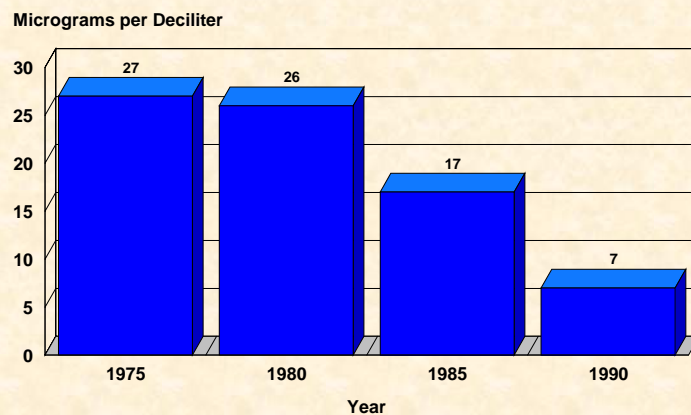
- Design Programs & Policies That Reduce Conventional, Toxic, Noise and Greenhouse Emissions in Parallel
- Treat Vehicles and Fuels As A System
- Expect & Require Best Technologies and Fuels Worldwide – in Both Industrialized and Developing Countries



## We Have Lots of Experience With Metallic Additives; Mostly Very Bad **The Experience With Lead**

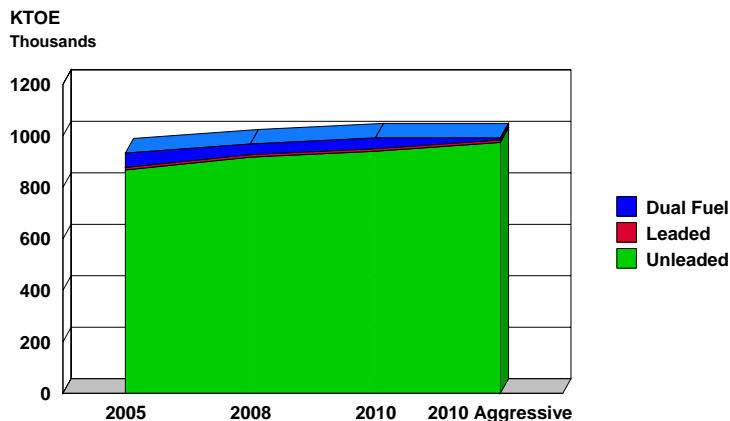
- Lowest Cost Octane Booster
- But Serious Health Impacts
  - Warning Signals Ignored or Suppressed for Over 50 Years
  - Still Marketed Today In Spite of Conclusive Proof of Toxicity to Children
- Destructive of Vehicle Pollution Controls

### Blood Lead Levels Considered Elevated



**Is Any Lead Acceptable From A Health Standpoint?**

## Global Distribution of On Road Unleaded Gasoline



18 Countries  
Remain; That's  
18 Too Many!

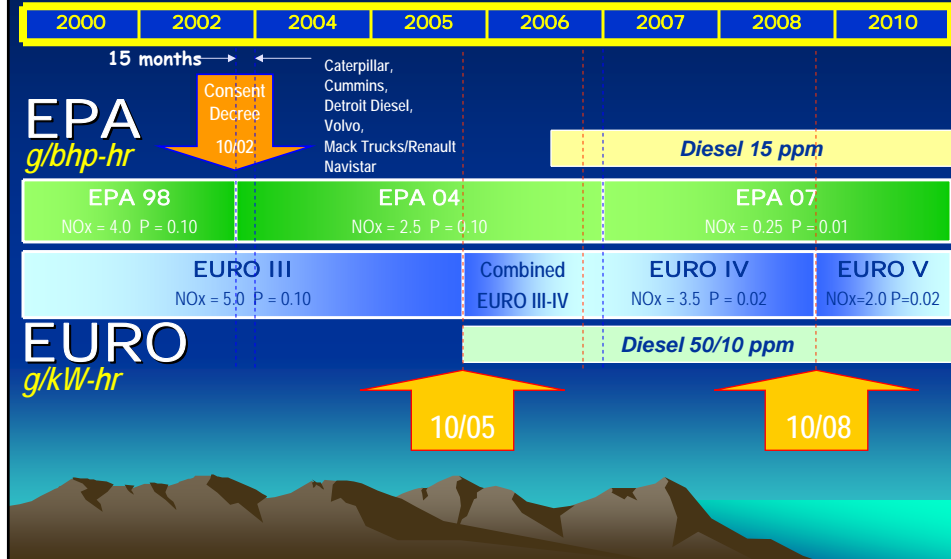
## What Other Fuel Changes Are Needed?

- Some changes are required for emissions performance of exhaust treatment emissions devices
 

Gasoline	Diesel
Very Low Sulphur : Exhaust Catalyst/particulate trap performance	
- Some changes are required for combustion related emission improvements
 

Gasoline	Diesel
Sulfur: SO <sub>2</sub> , HC, Nox, CO, Toxics	Sulfur: SO <sub>2</sub> , Nox, PM
RVP: HC, Toxics	Cetane: HC, CO, NO <sub>x</sub>
Benzene: Toxics	Density: PM, NO <sub>x</sub>
Aromatics: Toxics, Nox, HC	
Oxygenates: CO (older vehicles)	
Olefins: Reactivity, toxics	
Distillation: HC, NO <sub>x</sub>	

## Close Linkage Between Vehicle Emissions Standards and Fuel Sulfur Levels

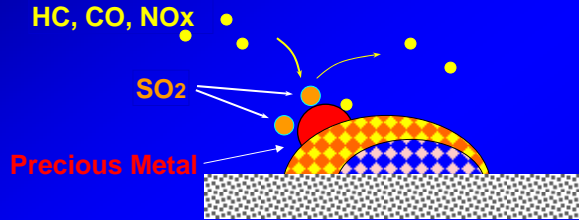


## Why Low Sulfur Fuel?

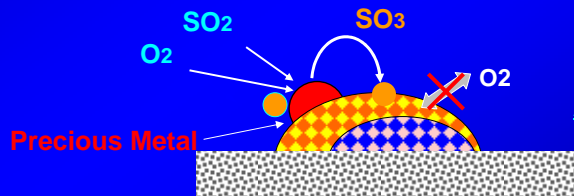
- Lowers Emissions From Existing Vehicles
  - SO<sub>2</sub> From All Vehicles
  - PM From Diesel Vehicles
  - CO, HC, NOx, Toxics From All Catalyst Vehicles
- Enables Advanced Technologies & Tight Standards For New Vehicles
- Enables Retrofit Technologies To Clean Up Existing Vehicles

# Sulfur Poisoning of Catalyst

## Poisoning of Precious Metal



## Poisoning of Washcoat



Lower O<sub>2</sub> Storage Ability

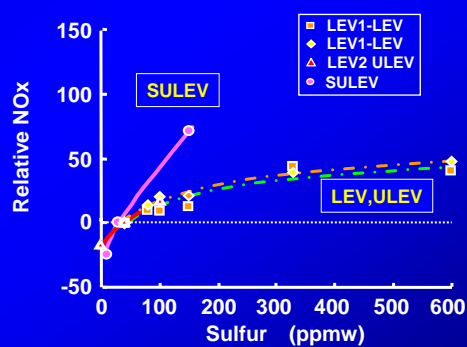
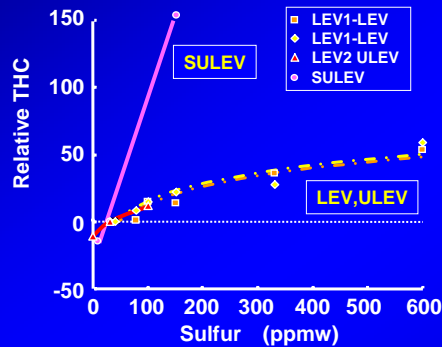
Cerium



Alumina



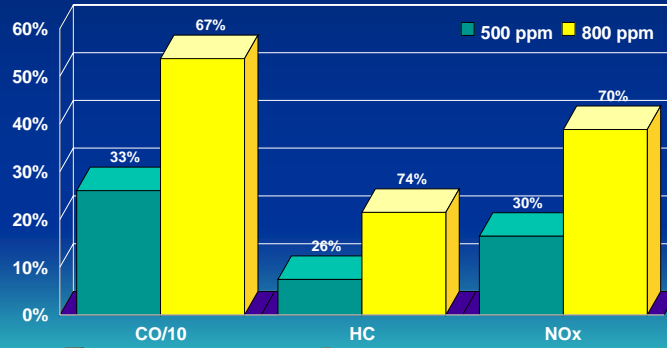
# Effects of Sulfur in Gasoline on Exhaust Emissions



SULEV : Super Ultra Low Emission Vehicle, ULEV : Ultra Low Emission Vehicle, LEV : Low Emission Vehicle

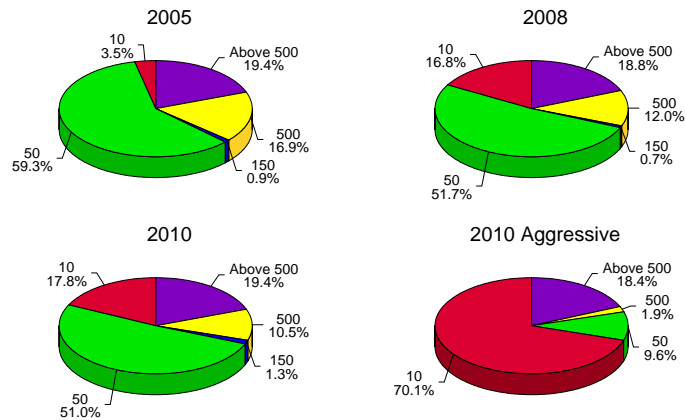
## Increase in In-Use Vehicle Emissions in Bangkok Due To Sulfur in Fuel (Gasoline)

Percent Increase  
Compared to 150 PPM Sulfur

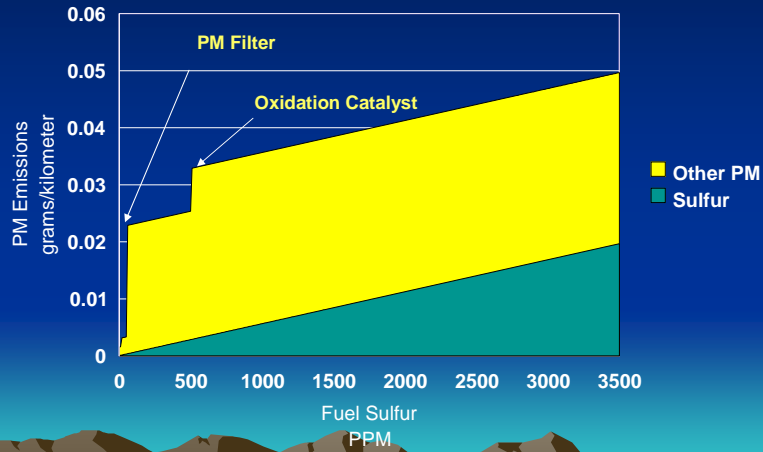


Impact on Vehicles Meeting EURO 3 Standards

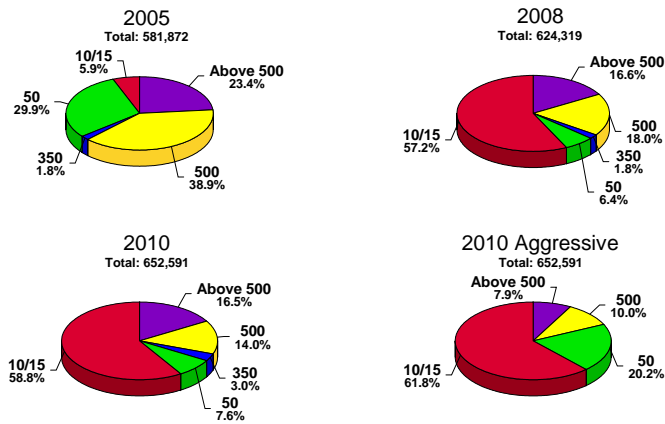
## Global Distribution of On Road Gasoline Sulfur Content (PPM)



# Linkage Between Fuel Sulfur and PM Emissions



# Global Distribution of On Road Diesel Fuel Sulfur Content (PPM)



In Addition To Cleaning Up Fuels

**BE VERY CAREFUL WHAT  
YOU ADD!**

**The Same Company That Gave Us  
Lead Has Come Up With A New Gift  
MMT**

- Lowest cost lead alternative, octane response less than lead.
- 10-20% of the MMT derived manganese from the fuel is emitted from the tailpipe- the majority remains within the engine, catalyst and exhaust system
- Most major auto-makers recommend against using MMT, advising that any damage caused by MMT not covered by the warranty
- Because of Growing Concerns Regarding Adverse Health Effects of Manganese & Possible Damage to Advanced Pollution Controls, Very little MMT is Used in OECD Countries and it is Banned in India & Brazil

## Health Effects Institute Statement (December 2005)

- There is a large body of evidence that
  - under certain circumstances, manganese can accumulate in the brain,
  - chronic exposure can cause irreversible neurotoxic damage over a lifetime of exposure,
  - manganese may cause neurobehavioral effects at relatively low doses, and
  - these effects follow inhalation of manganese-containing particles.

HEI's Comments on the Afton Rebuttal; HEI is Much More Credible Than Afton.

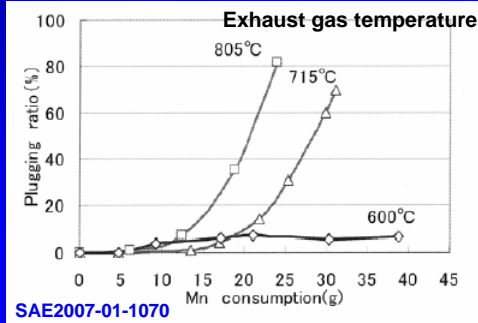
## Health Concerns With MMT Lead to the Brescia Declaration

- Scientific Committee on Neurotoxicology and Psychophysiology and the Scientific Committee on the Toxicology of Metals of the International Commission on Occupational Health (ICOH) convened an International Workshop; Scientists and physicians from 27 nations participated.
- Conclusions:
  - Exposures of pregnant women and young children to manganese need to be reduced to prevent subclinical neurotoxicity.
  - In children, evidence from two recent epidemiological studies suggests that exposure to manganese in early life causes subclinical developmental neurotoxicity.
  - The addition of organic manganese compounds to gasoline should be halted immediately in all nations.
  - New data raise grave concerns about the likelihood that addition of manganese to gasoline could cause widespread developmental toxicity similar to that caused by the worldwide addition of tetraalkyllead to gasoline.

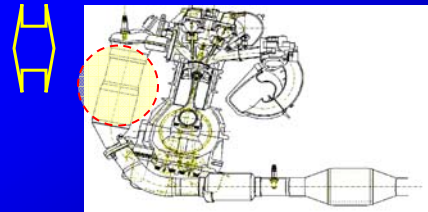
These Doctors Are Much More Credible Than Afton!

# Effects of Manganese Based-Gasoline Additive on Catalyst Performance (1)

Effects of Mn concentration and Ex. Gas temp. on Catalyst Plugging

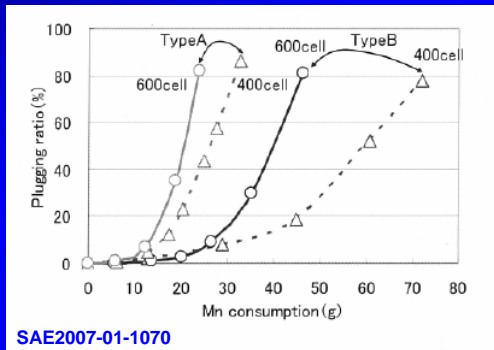


Close Coupled Catalyst  
Quick warm-up  
Higher Temperature

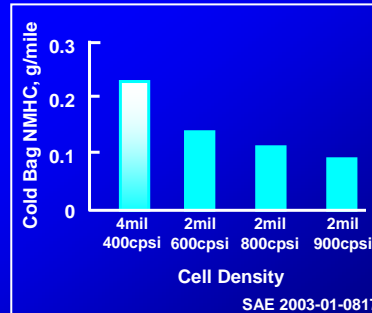


# Effects of Manganese Based-Gasoline Additive on Catalyst Performance (2)

Effects of Mn concentration and Cell Density on Catalyst Plugging



High Cell Density



## Conclusions

- The health impacts of vehicles are very significant and without aggressive action are likely growing.
- Stringent vehicle emissions standards are spreading around the world and combined with clean low sulfur fuels are a major step towards improving air quality and reducing health impacts.
- Vehicle standards will not be as effective without equally stringent fuel quality standards.
- Even in economic terms, the benefits of clean vehicles and fuels will far outweigh the costs.
- Don't replace the octane benefit from lead additives with other metallic additives which pose similar risks.

## Costs & Benefits of Clean Fuels and Vehicles

