

The CMAQ Solution to Diesel Emissions:

How to Use CMAQ More Effectively

Emission Control Technology Association

Contents

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- Diesel retrofit industry/technology
- Diesel particulate problem
- CMAQ solution
- HOV provision

Summary Message

Retrofits are a Better Use of CMAQ

- Problems:
 - New PM_{2.5} nonattainment areas
 - 50% of PM_{2.5} from non-road sources
 - CMAQ sometimes used poorly
- Opportunities:
 - Retrofit technologies are highly effective in PM_{2.5} removal
 - Retrofits are more cost-effective than most CMAQ activities
 - Government funded highway projects in non-attainment areas represent an over-looked opportunity to address PM_{2.5} problem

Summary Message

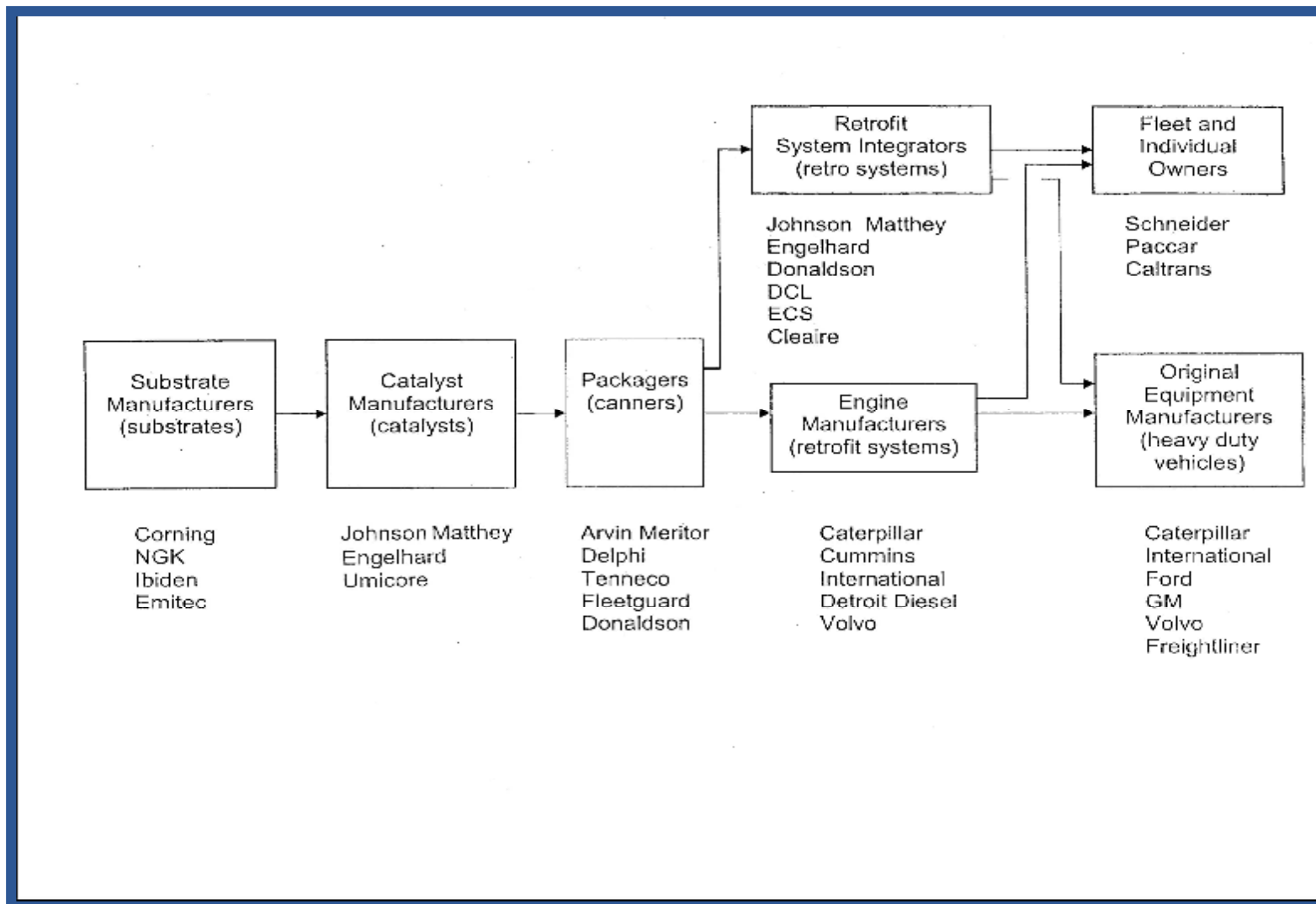
CMAQ Amendment Supported by Administration

“Addition to CMAQ Eligible Projects (section 1612 of S.1072): **We support section 1612(c) of S. 1072, which creates a new voluntary provision to allow CMAQ funding for and promote the adoption of diesel engine retrofit and anti-idling equipment for highway construction equipment**, but the provision must be amended to specify that these activities may receive emission reduction credit under the transportation conformity process. This section creates a voluntary program to reduce emissions from highway construction equipment in Clean Air Act non-attainment and maintenance areas. The program promotes the adoption of anti-idling equipment, diesel engine retrofit and other strategies determined appropriate by EPA and DOT. We support implementation of these strategies because of the substantial emission reductions that could occur through more rapid deployment of these technologies. Moreover, these control strategies are important tools for State and local governments as they work to meet the new NAAQS requirements for ozone and PM 2.5.”

Source: Statement of Administration Policy Agency Comments attachment on S.1072 and H.R.3550 as passed.

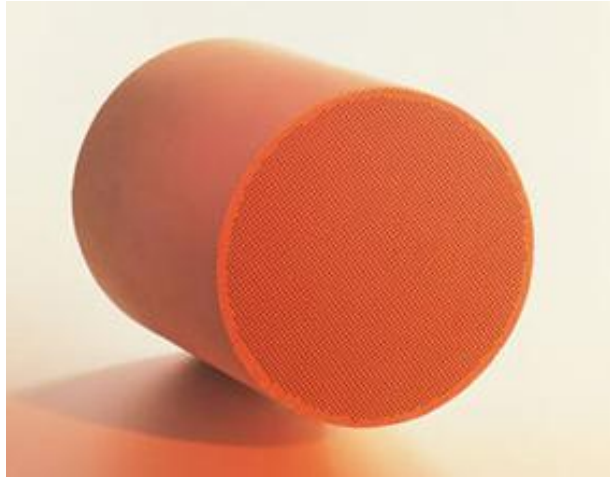
The Diesel Retrofit Industry and Technology

Diesel Retrofit Industry Structure



Diesel Particulate Filter Systems

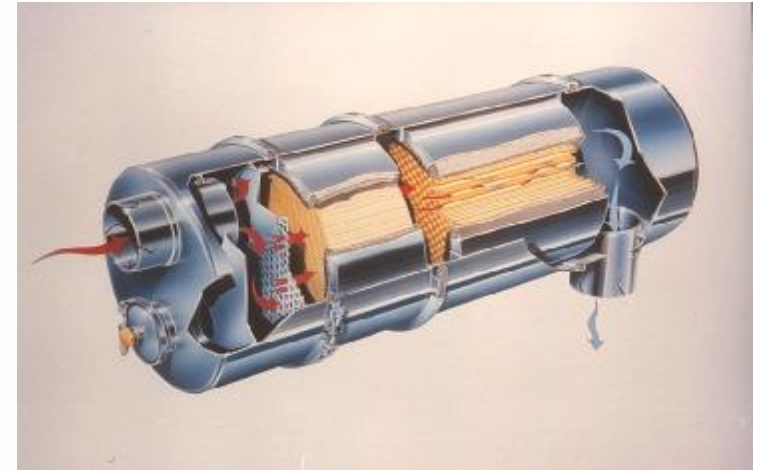
Components - ceramic, catalyst (depending), mat, can



Bare diesel particulate filter substrate. Depending on the technology, it is used as is, or with catalyst. Source: Corning

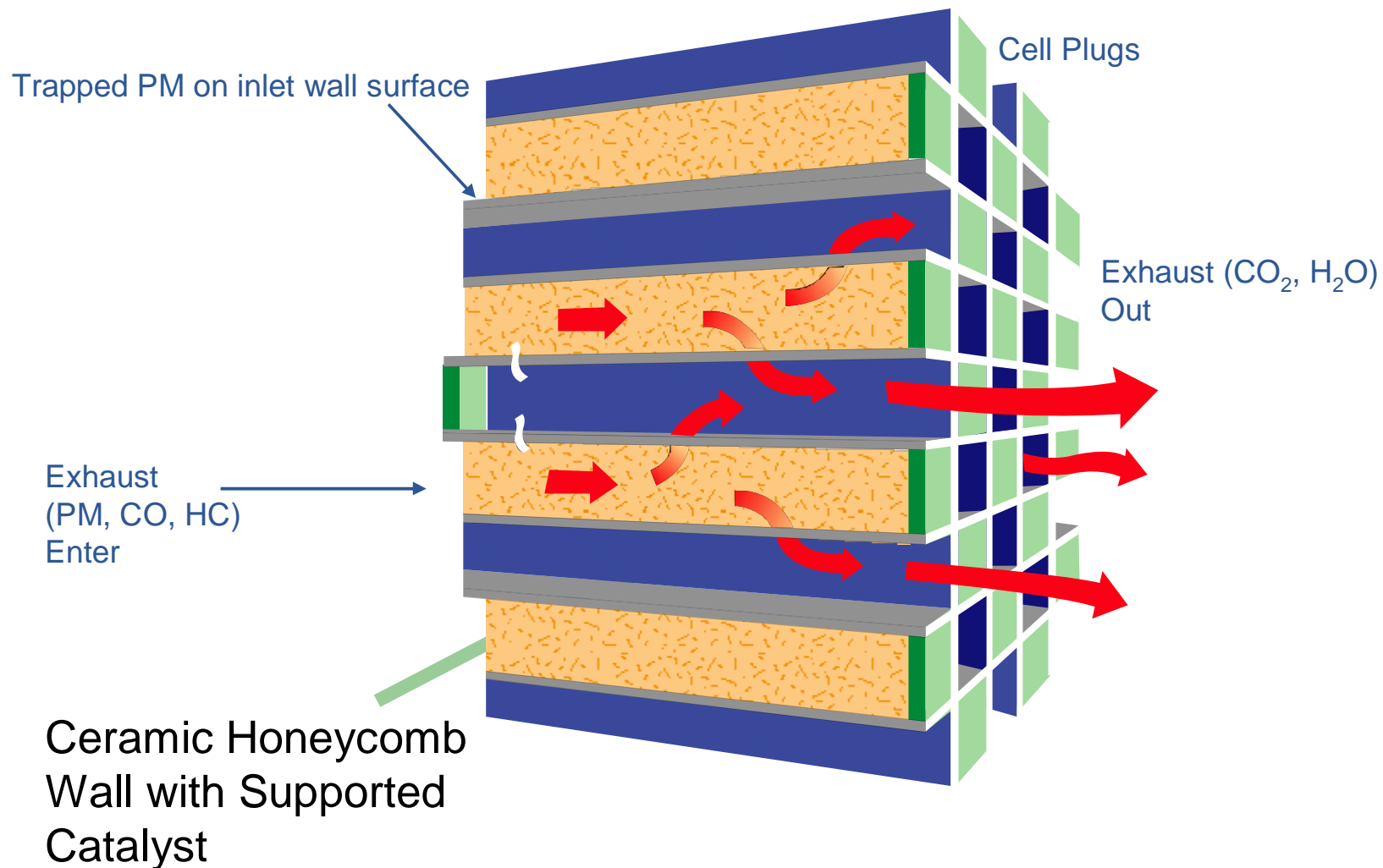


Filter is placed in a can with retaining rings to facilitate removal for ash cleaning. Source: Lubrizol - Canada



Canned systems can have DOCs (here), or NOx catalysts in the same can as the filter. Source: Johnson Matthey

How Diesel Particulate Filters Work



⁸ Note: NO_x is reduced by a separate system not shown here.

Seeing is Believing



Filter Inlet



Filter Outlet



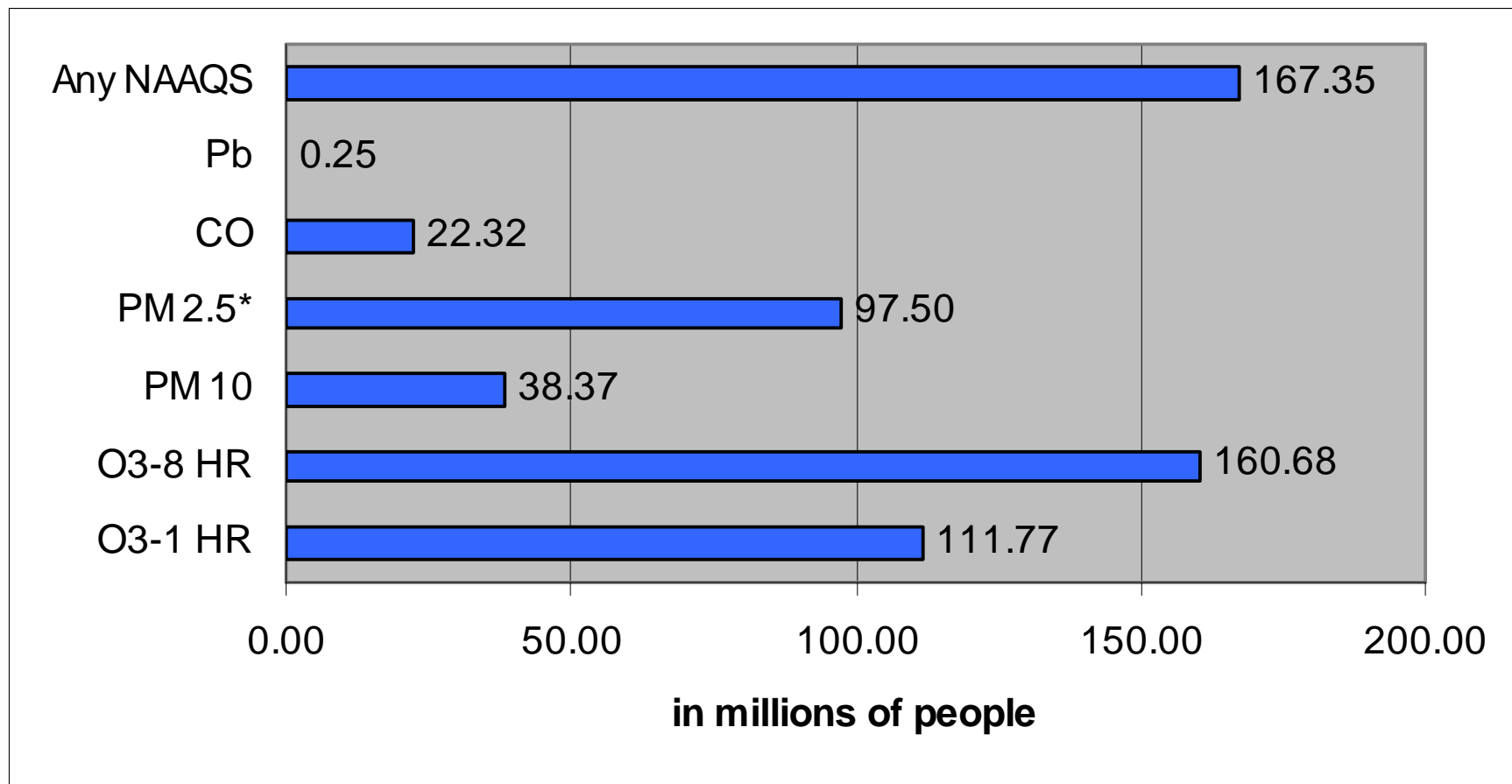
Filter Can Inlet Section



Filter Can Outlet Section

The Diesel Particulate Problem

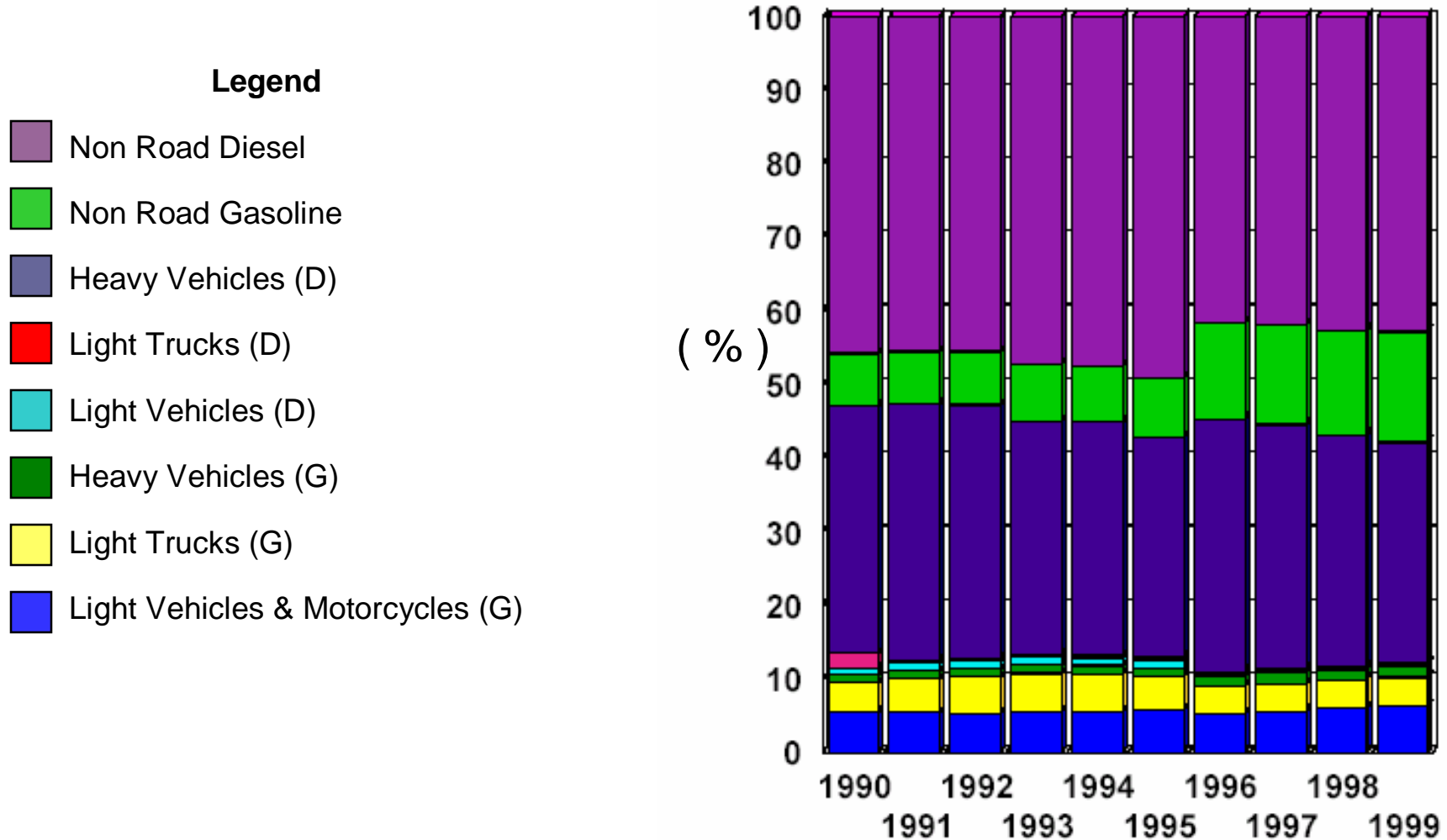
Population Living in Non-Attainment Counties *By Pollutant*



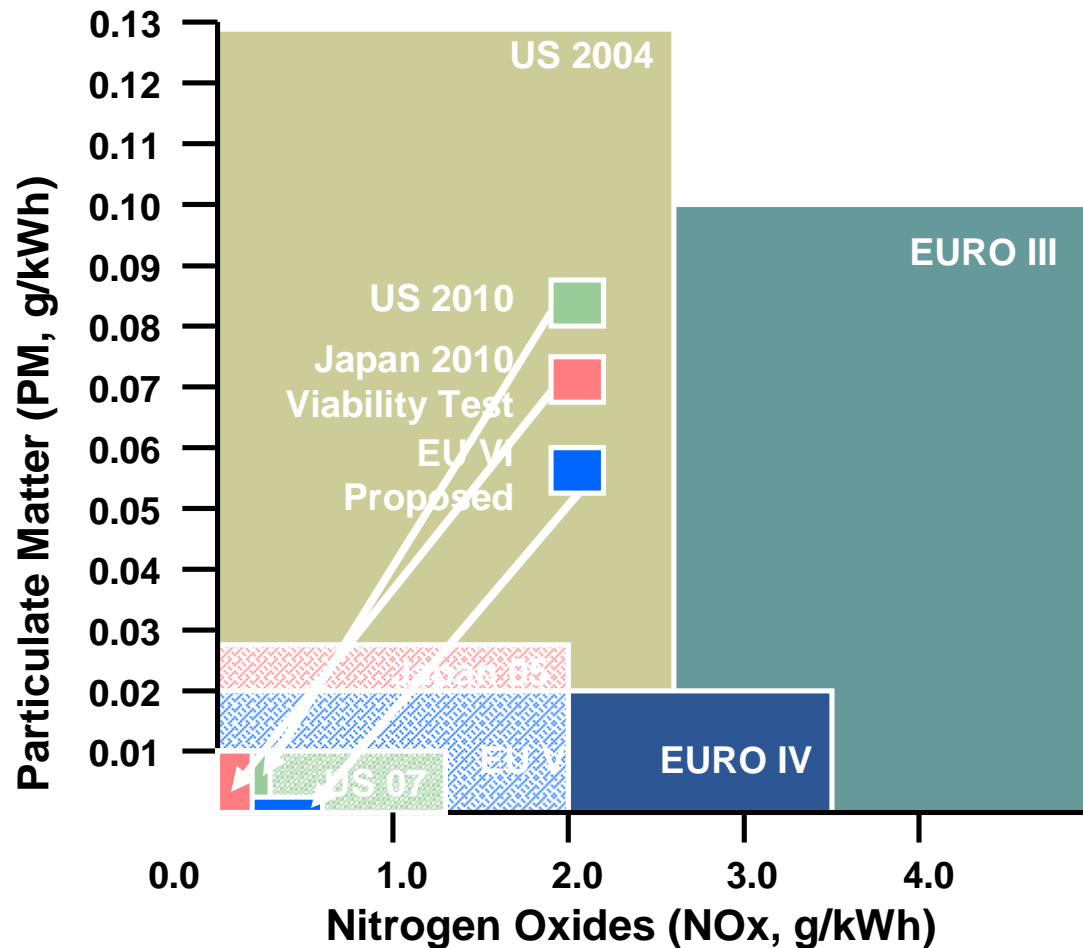
*PM 2.5 designations have not been finalized by EPA.

Source: EPA Air Data, November 2004

Non-Road Heavy Duty Diesel is 50% of the Mobile Source Problem



Global Regulatory Outlook



Current regulations on track:

- US 2007
- Euro IV (2005) and Euro V (2008)
- Japan 2005

Next wave is coming:

- US 2010 On-road
- US & EU HD Non-road
- Japan 2010
- EU VI HD (2010)

Proposed Asia-Pacific regulations tightening (2006-2010)

Tighter regulations are emerging worldwide

The CMAQ Solution

Key Issues

- Is there a better way to use CMAQ funds?
 - Answer: Yes. To reduce PM_{2.5} because it is by far the biggest health risk.
- If so, what is a better way to use CMAQ?
 - Answer: To finance diesel retrofits because they are the most cost-effective solution.

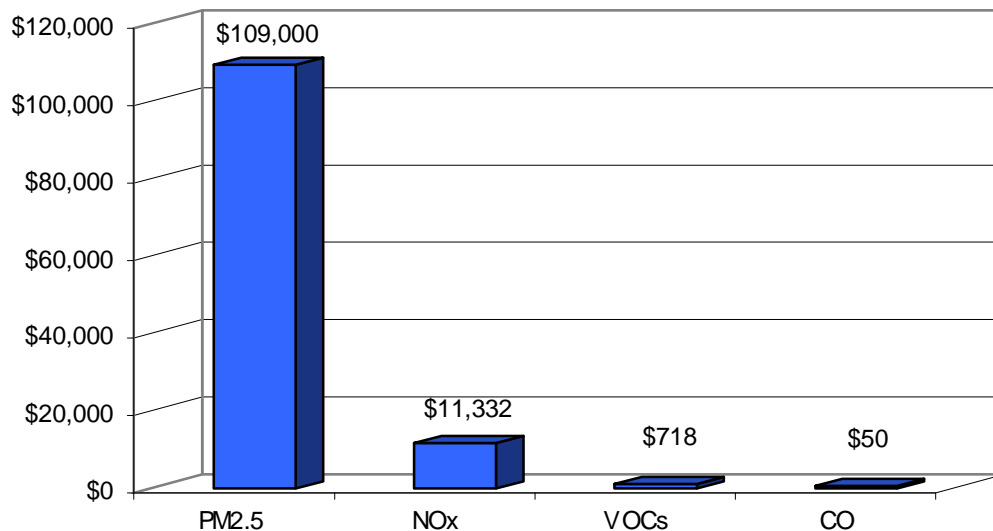
CMAQ & Air Quality

- CMAQ funds may be spent on air quality projects
- “The Administration believes that Congestion Mitigation and Air Quality Improvement Program (“CMAQ”) funding should only be used for projects that provide emissions reductions which contribute to maintenance or attainment of National Ambient Air Quality Standards under the Clean Air Act.” Source: Letter to Chairman Inhofe from Secretary Mineta, June 22, 2004.
- 23 USC § 149(b)(1) allows a state to allocate CMAQ funds for a transportation project or program:
 - if the project or program is for an area in the state that is or was designated as a nonattainment area for ozone, carbon monoxide, or particulate matter or,
 - if the project or program is likely to contribute to “(i) the attainment of a national ambient air quality standard; or (ii) the maintenance of a national ambient air quality standard in a maintenance area.”

CMAQ is Not Addressing the Most Dangerous Threat

Rebalancing CMAQ Toward PM_{2.5}

Health Costs per Ton, Urban Areas (Midpoint Estimate)



- Historically, CMAQ has been used primarily to reduce NO_x and ozone, not PM
- PM_{2.5} is the most dangerous threat to human health today
- Rebalancing CMAQ to PM_{2.5} particulate reduction would improve its effectiveness

Source: McCubbin and Delucchi (1999), “The Health Costs of Motor-Vehicle-Related Air Pollution,” *Journal of Transport Economics and Policy*, Sept.

Rebalancing CMAQ toward PM_{2.5}

National Academy of Science Agrees

- CMAQ 10-Year Review by National Academy of Science concluded:
 - “Much remains to be done to reduce diesel emissions, especially particulates, and this could well become a more important focus area for the CMAQ program.” (p. 74)
 - “Had data been available on particulate reductions..., the ranking of strategies focused on particulate emissions... would likely have shown more promising cost-effectiveness results [than current CMAQ projects].” (p. 131)

Source: *The CMAQ Improvement Program: Assessing 10 Years of Experience*, (2002).

CMAQ Cost Effectiveness is Also An Issue

Median cost per ton equivalent of air pollution removed

	Median Cost	Rank
Inspection and Maintenance	\$1,900	1
DIESEL RETROFITS	\$5,300	2
Regional Rideshares	\$7,400	3
Charges and Fees	\$10,300	4
Vanpool Programs	\$10,500	5
Misc. Travel Demand Management	\$12,500	6
Conventional Fuel Bus Replacement	\$16,100	7
Alternative-Fuel Vehicles	\$17,800	8
Traffic Signalization	\$20,100	9
Employer Trip Reduction	\$22,700	10
Conventional Service Upgrades	\$24,600	11
Park-and-Ride Lots	\$43,000	12
Modal Subsidies and Vouchers	\$46,600	13
New Transit Capital Systems/Vehicles	\$66,400	14
Bike/Pedestrian	\$84,100	15
Shuttles/Feeder/Paratransit	\$87,500	16
Freeway Management	\$102,400	17
Alternative-Fuel Busses	\$126,400	18
HOV Facilities	\$176,200	19
Telework	\$251,800	20

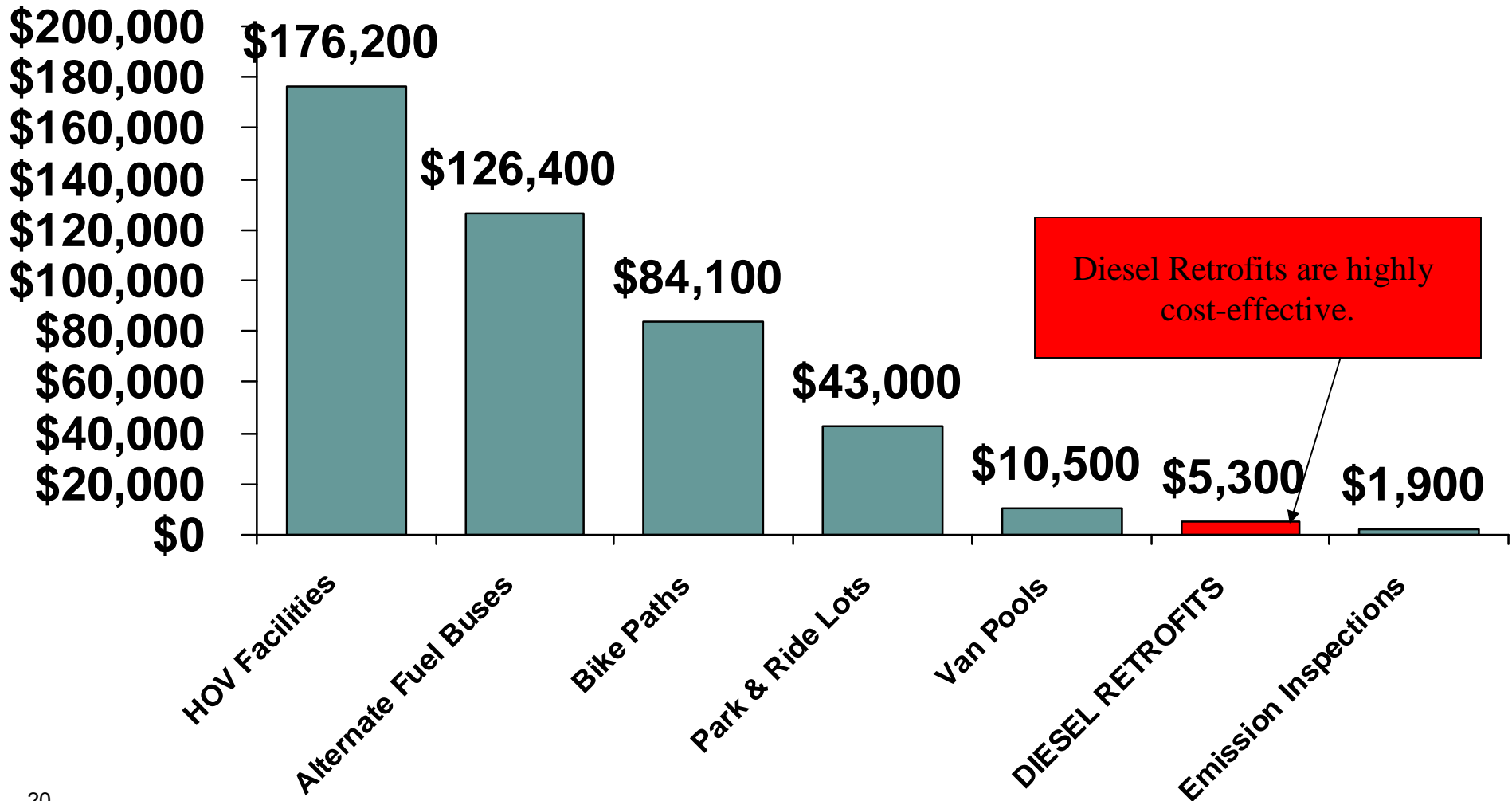
- National Research Council questioned CMAQ cost effectiveness
- Diesel retrofits is a better use of CMAQ because it is cost effective

Source: *The CMAQ Improvement Program: Assessing 10 Years of Experience*, (2002).

CMAQ Cost Effectiveness

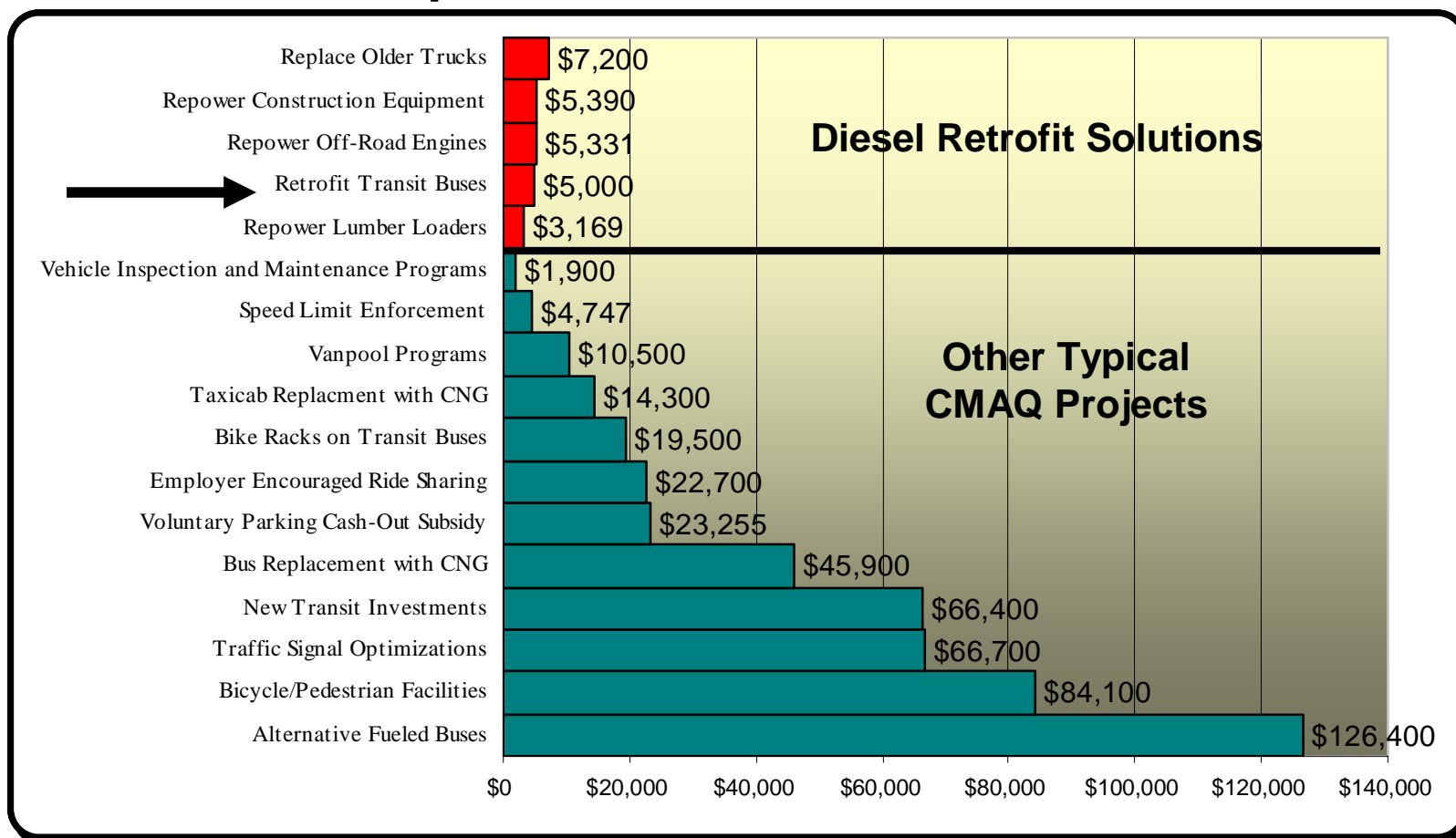
Diesel Retrofit a Better Use

Median cost per ton equivalent of air pollution removed



Diesel Technology Forum (“DTF”) Agrees DTF Says Diesel Retrofits are a Better Use of CMAQ

Dollars per ton of NOx reduction



Source: Diesel Technology Forum, “Clean Diesel Retrofit Tool Kit “ available at http://www.dieselforum.org/retrofit/why_bene.html#cost

Benefits of Retrofits

- Retrofitting diesel engines at construction sites operating in non-attainment areas is a highly cost-effective means of reducing emissions.
- Both on-road and non-road diesel engines used in construction, especially older and/or poorly maintained engines, are responsible for substantial emissions at these construction sites.
- A 175 horsepower bulldozer emits as much NO_x and PM as 26 new cars.*

* EPA, "EPA to Clean Up Diesel Emissions and Protect Public Health," April 17, 2003 *available at* <http://www.epa.gov/region02/news/2003/03035.htm>

The Big Dig Example

- The emission reduction benefits of retrofitting the construction equipment at the Central Artery Tunnel Project in Boston, MA was (in 2000)¹:
 - CO: 90 kg/day or 36 tons/ year
 - HC: 30 kg/day or 12 tons/year
 - PM10: 7.4 kg/day or 3 tons/year
- The Massachusetts Diesel Retrofit Program will reduce Central Artery construction emissions, particularly PM fine particulates, by approximately 200 tons over the next five years; an emission reduction equivalent to eliminating 96 million truck miles or removing **1,300 diesel-powered public buses** for a year. ²

1. Clean Air Fleets, "Off Road Diesel" available at <http://www.cleanairfleets.org/off-road.html>

2. Steven Lipman, "Massachusetts Diesel Retrofit Program: Executive Summary," August 2002 *available at* <http://www.mass.gov/dep/bwp/daqc/files/rfit823.doc>

CMAQ Amendment

- Last year's transportation bill included an amendment adopted unanimously to:
 - Get states to develop emission reduction strategies for construction projects located in non-attainment and maintenance areas
 - Direct EPA to develop voluntary guidelines for use by the states in developing their strategies with retrofits cited as one of the methods the states should consider
 - Make CMAQ funds available for states to use to finance emission reduction plans at their option

New CMAQ Provision

- Includes no new EPA authority
- Gives states total discretion
- Encourages cost-effective use of CMAQ funds
- Focuses on Federally funded construction projects
- Provides new SIP tools for new non-attainment areas
- Supported by Bush Administration

President Agrees

Administration Supports Diesel Retrofit Use for CMAQ

- “The Administration believes that Congestion Mitigation and Air Quality improvement Program (“CMAQ”) funding should only be used for projects that provide emissions reductions which contribute to the maintenance or attainment of National Ambient Air Quality Standards under the Clean Air Act.” (emphasis added)

Source: Letter to Chairman Inhofe from Secretary Mineta, June 22, 2004, p. 7

- “We support section 1612(c) of S.1072, which creates a new voluntary provision to allow CMAQ funding for and promote the adoption of diesel engine retrofit and anti-idling equipment for highway construction equipment... Moreover, these control strategies are important tools for State and local governments as they work to meet the new NAAQS requirements for ozone and PM_{2.5}.”

Source: Agency Comments on S.1072 and H.R.3550, as Passed, p.3

Annex of Supporting Analysis

Methodology for Comparing Cost Effectiveness of Diesel Retrofits to Other CMAQ Projects

- *The CMAQ Program: Assessing 10 Years Experience* (2002) by National Research Council estimates median cost effectiveness for 19 CMAQ strategies. Estimates are presented as “cost per ton equivalent removed from air,” with weights of 1 for VOCs, 4 for NO_x, but 0 for PM_{2.5}. Importantly, the study’s PM weight of 0 does not reflect PM’s health costs. Rather, as the study says, “PM_{2.5} is generally regarded as the pollutant with the most pernicious health consequences, though to date standards have not been promulgated for its regulation for both measurement and economic reasons.” (p. 295)
- Leading researchers, including McCubbin and Delucchi (1999), “The Health Costs of Motor-Vehicle-Related Air Pollution,” *Journal of Transport Economics and Policy*, find that a ton of PM_{2.5} causes \$109,000 of health damage in urban areas, compared with \$11,332 of damage from a ton of NO_x, and only \$718 of damage from a ton of VOCs.
- According to these estimates, even weighted NO_x should be considered more damaging than VOCs. That is, even though 0.25 ton (the 1:4 ratio above) of NO_x removed counts as the CMAQ equivalent of one ton of pollution removed, it has a higher health cost than VOCs (\$11,332 / 4 = \$2,883 for NO_x vs. \$718 for VOCs).
- Conservatively assume that all CMAQ projects remove the more damaging pollutant (NO_x). Thus a ton of PM_{2.5} reduction would be worth at least 9.45 tons of regular CMAQ reductions (\$109,000 for PM_{2.5} / \$11,332 for NO_x).
- Diesel retrofits are estimated to cost \$50,460 per ton of PM_{2.5} removed by the California Air Resources Board, “Staff Analysis of PM Emission Reductions and Cost-Effectiveness,” Sept. 6, 2002.
- Therefore diesel retrofits cost about \$5,340 per ton equivalent of air pollution removed (\$50,460 / 9.45), based upon conservative assumptions.
- If a less conservative and more realistic assumption is used – that CMAQ projects remove a mix of NO_x and VOCs – then the cost-effectiveness of diesel retrofits becomes substantially more favorable.

Diesel Retrofits for Off-Road Vehicles

Solution to a Growing Problem

- Particulate matter, especially PM_{2.5}, is now being viewed as the top air pollution problem
- Health costs of a ton of PM_{2.5} are estimated at 150 times the costs of a ton of hydrocarbons. (McCubbin and Delucchi, 1999)
- In urban areas, heavy duty diesel engines are responsible for 70% of PM pollution (California Air Resources Board)
 - On-road diesel: 1/3 of this (27% in CA)
 - Off-road diesel: 2/3 of this (66% in CA)

Diesel Retrofits

Benefits Greatly Exceed Costs

- California Air Resources Board diesel retrofits estimate
 - \$10-\$20 benefits for each \$1 cost (C. Witherspoon, June 3, 2004)
- U.S. EPA: Off-Road Diesel Rules estimate
 - \$24 benefits for each \$1 cost

Diesel Retrofits

Highly Cost Effective at Removing PM

- Proven Technology: DOCs and DPFs installed in nearly 2 million heavy duty diesel vehicles worldwide.
- In Europe, 36 million diesel passenger cars with DOCs, nearly 1 million with DPFs.
- Recommended as first best solution by
 - California Air Resources Board
 - National Resources Defense Council (DOCs for pre-1990 diesels, DPFs for post-1994 diesels)