

Clean Air Act 101

Module 2

Mobile Source

Controls/Strategies

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Subchapter 2 of the CAA and Title II of the 1990 CAA Amendments

This Part of the CAA is Implemented by EPA

- Given the movement of vehicles and the network of fuel pipelines across the country, the regulation of vehicles and equipment, emissions standards, and fuels is done almost entirely at the Federal level.
- EPA's motor vehicle testing laboratory is located in Ann Arbor, Michigan.

Sec. 209 – State Vehicle and Engine Standards

- This section of the CAA specifies what states may require and what States are prohibited from requiring of new motor vehicles and engines and nonroad vehicles and engines.
- There are provisions for granting waivers of prohibitions at Sections 209(b) and 209(e) to California. Such waivers require EPA to go through notice and comment.

Sec. 209 – State Vehicle and Engine Standards

continued

- If California is granted a waiver, sections 177 and 209(e) allow other states to promulgate standards identical to California.
- In no event may any State standards be less stringent than the otherwise applicable Federal standards.

A Brief History of Vehicle Emissions & Controls

Milestones In Vehicle Emissions Control Technology

1964 - California requires control systems on 1966+ cars

1966 - Congress requires controls on all 1968+ cars

1970 - Clean Air Act calls for 90% cut in auto emissions

1971 - Evaporative emissions standards required for the first time

1972 - EGR valves appear on cars for the first time

1974 - CAFE program is phased-in, starting with 1975 cars

1975 - Catalytic converters are first used (w/ unleaded gasoline)

Milestones In Vehicle Emissions Control Technology

continued

1975 - Cars must meet 0.41g/mi HC & 3.4 g/mi CO standards

1976 - Cars must meet 0.4 g/mi NO_x standard (note: this was revised in 1977)

1977 - Congress delays implementation of HC, CO, and NO_x standards, at the request of auto makers (until MY 1980 - 81)

1981 - 3-way catalysts & on-board computers & oxygen sensors appear in most new cars

1983 - I/M programs are required in 64 cities, to address the problem of malfunctioning emissions control systems

Milestones In Vehicle Emissions Control Technology

continued

- 1985** - EPA adopts standards for 1991 diesel-powered trucks and buses
- 1990** - EPA imposes limits on diesel fuel sulfur content, to help trucks meet tough, new emissions standards.
- 1991** - EPA tightens tailpipe standards for HC and NO_x for the 1994 model year, per the 1990 CAA (i.e., Tier I standards)
- 1992** - EPA establishes cold-temperature (20 deg F) CO standards
- 1998** - EPA, auto makers, and states agree to voluntarily set stricter National LEV standards for MY1999 (in the OTR), and the 2001 model year (rest of nation)

Milestones In Vehicle Emissions Control Technology

continued

- 1996** - On-board diagnostics II required on all Federal cars
- 1999** - EPA moves to promulgate stricter light-duty standards for HC, CO, and NO_x beginning MY 2004 (i.e., Tier II)
- 2000** - EPA promulgates stricter standards for heavy-duty diesel engines for NO_x and PM for MY 2007
- 2007** - Requirement (as part of 2007 Mobile Sources Air Toxics Rule, EPA issued the first-ever cold-temperature hydrocarbon standard (20 degrees F), and also a standard for the benzene content of gasoline.

Helping States Achieve the NAAQS

- Despite our successes, air pollution remains a public health problem.
- A new vehicle today is up to 95% percent cleaner than a new vehicle in 1970.
- By 2020, mobile sources are still projected to account for up to 50% of the NO_x emissions, and substantial hydrocarbon and PM emissions.

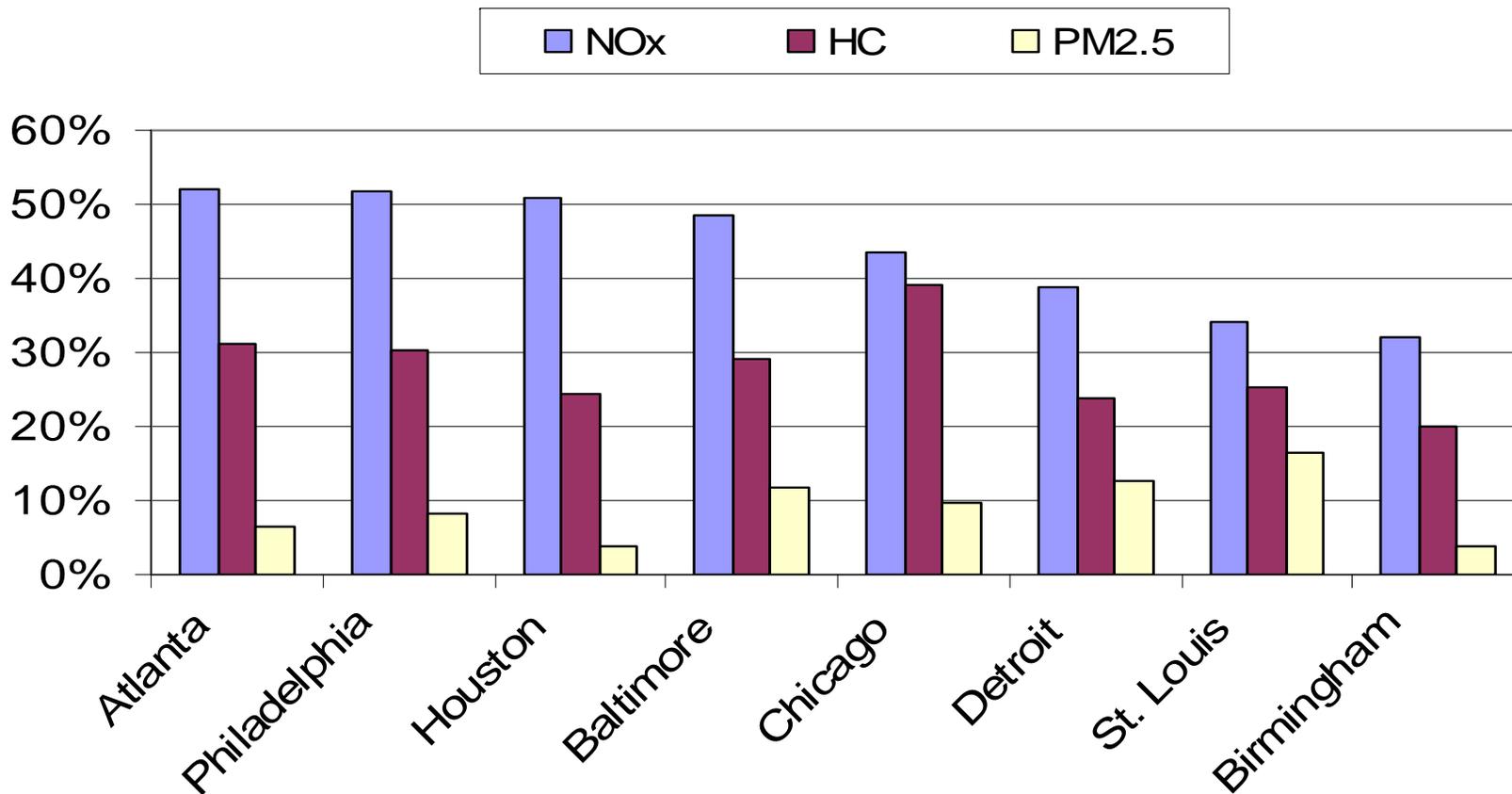
Helping States Achieve the NAAQS

continued

- Even with the control strategies “in the pipeline,” mobile sources will continue to significantly contribute to air pollution problems in many parts of the country.
- EPA is continually evaluating the potential for new mobile source measures – for both vehicles and fuels - that could help States as they work to achieve new NAAQS standards.

Projected 2020 Mobile Source Contribution for Select Cities

Projected Mobile Source Contribution in 2020



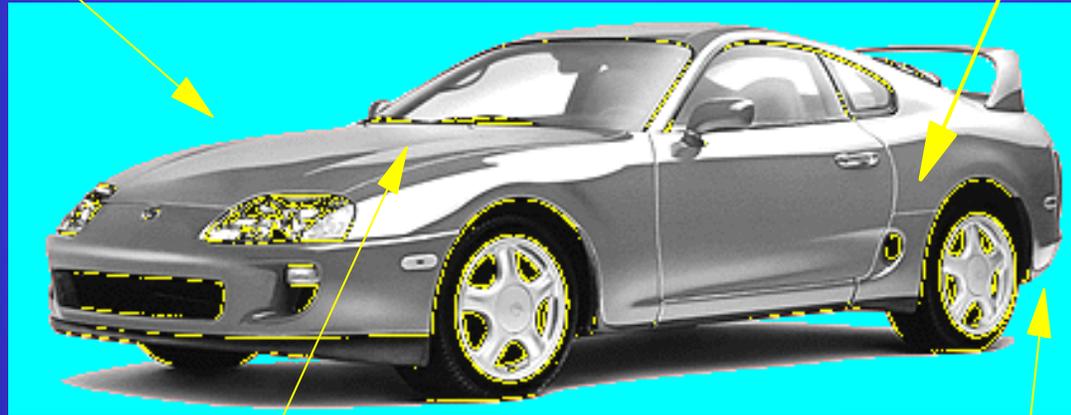
Sources of Vehicle Emissions

Crankcase Losses:

"blow-by" - gases past combustion chamber

Refueling Losses:

displaced refueling vapors + spillage



Evaporative Emissions:

fuel evaporative during running, hot soak, and diurnal conditions

Exhaust Emissions:

nitrogen + steam + CO₂ + pollutants (unburned HC, CO, PM, and toxics)

Refueling & Vapor Recovery

- Stage II controls on gasoline pumps are currently required in serious and above ozone nonattainment areas and in the Ozone Transport Region.
- After consultation with DOT on safety issues, in 1996 EPA promulgated the requirements for “onboard refueling vapor recovery (ORVR) controls”.
- When ORVR is found to be in widespread use, Stage II would no longer be required pursuant to the terms of the widespread use finding.

Overview of EPA's Passenger Vehicle Standards Programs

Tier I Emissions Standards Background

- 1990 CAA required EPA to promulgate new emissions standards for 1994-and-newer model year passenger cars and trucks
- Phased-in between 1994 to 1996
 - compliance based on each manufacturer's sales
 - 1994 - 40% ; 1995 - 80% ; 1996 - 100%
- Useful life for vehicles extended from 50,000 to 100,000 miles
 - separate interim and full useful life emissions standards were established (50,000/100,000 mile standards)

Tier 2 Emissions Standards Background/Overview

- Milestones include the first combined use of gasoline formulation control & engine standards control, and for first time light trucks & cars (& all fuel types) meet the same standards
- Different phase in timetable for cars, trucks & fuel
- By 2009, vehicles are 77-95% cleaner than Tier 1
- Gasoline fuel sulfur content capped at 30 ppm, beginning 2006

Tier 2 Program Benefits

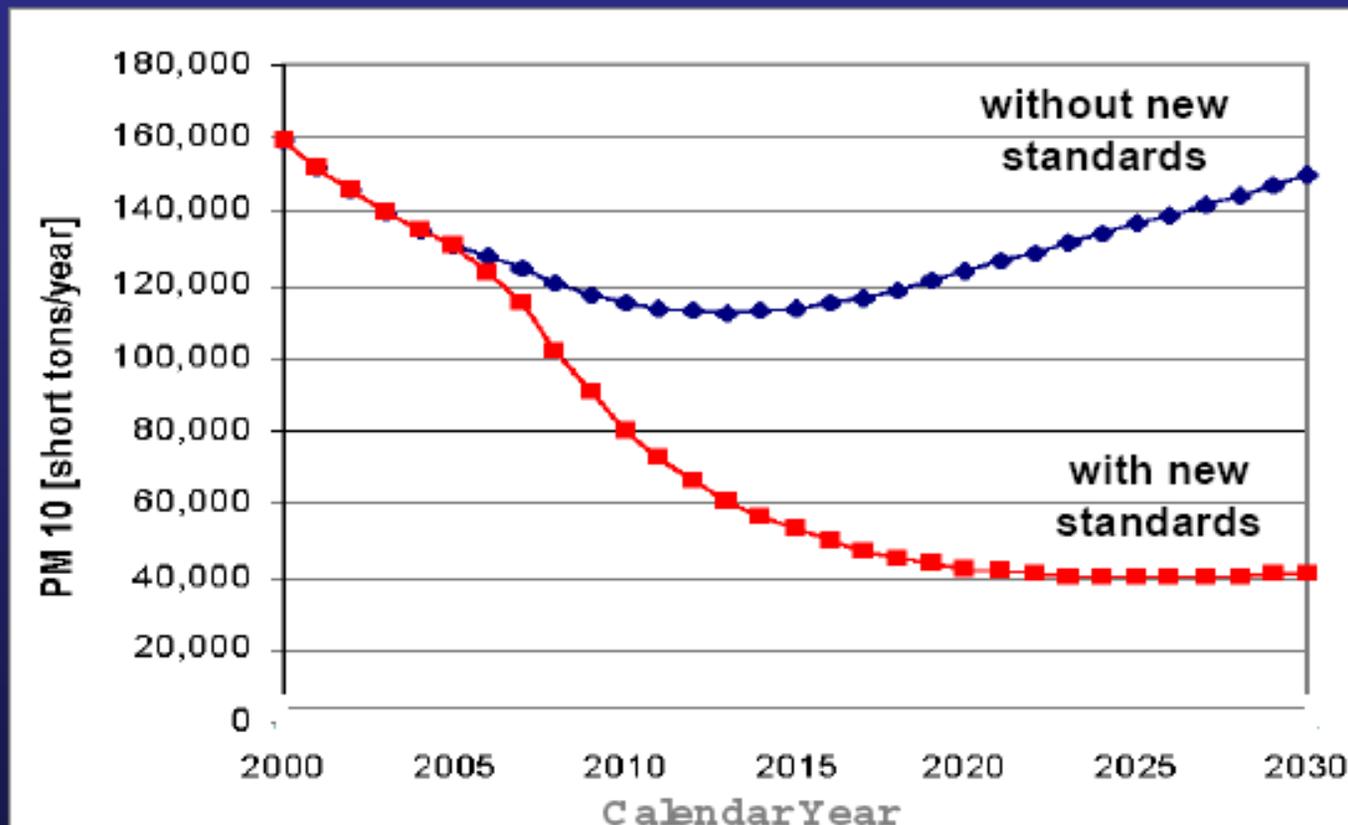
- Fleet turnover for full phase-in estimated by 2030, reducing vehicle NOx emissions by 74%
 - 2 million tpy by 2020, 3 million tpy by 2030
 - When fully implemented, equivalent to taking 164 million cars off the road
- By 2030, will prevent 4,300 deaths and more than 10,000 cases of chronic bronchitis, & tens of thousands of respiratory ailments a year.
- Industry cost of ~\$5.3 billion, with environmental benefits of \$25.2 billion.

EPA's Clean Diesel Standards

- Background
 - Diesel trucks and buses emit 28% of total NO_x and 20% of total PM in the US
 - Diesel has been implicated in increased risk of lung cancer and respiratory disease
 - US EPA labels diesel exhaust as a likely human carcinogen
 - PM & NO_x contribute to asthma and other cardio-respiratory health problems

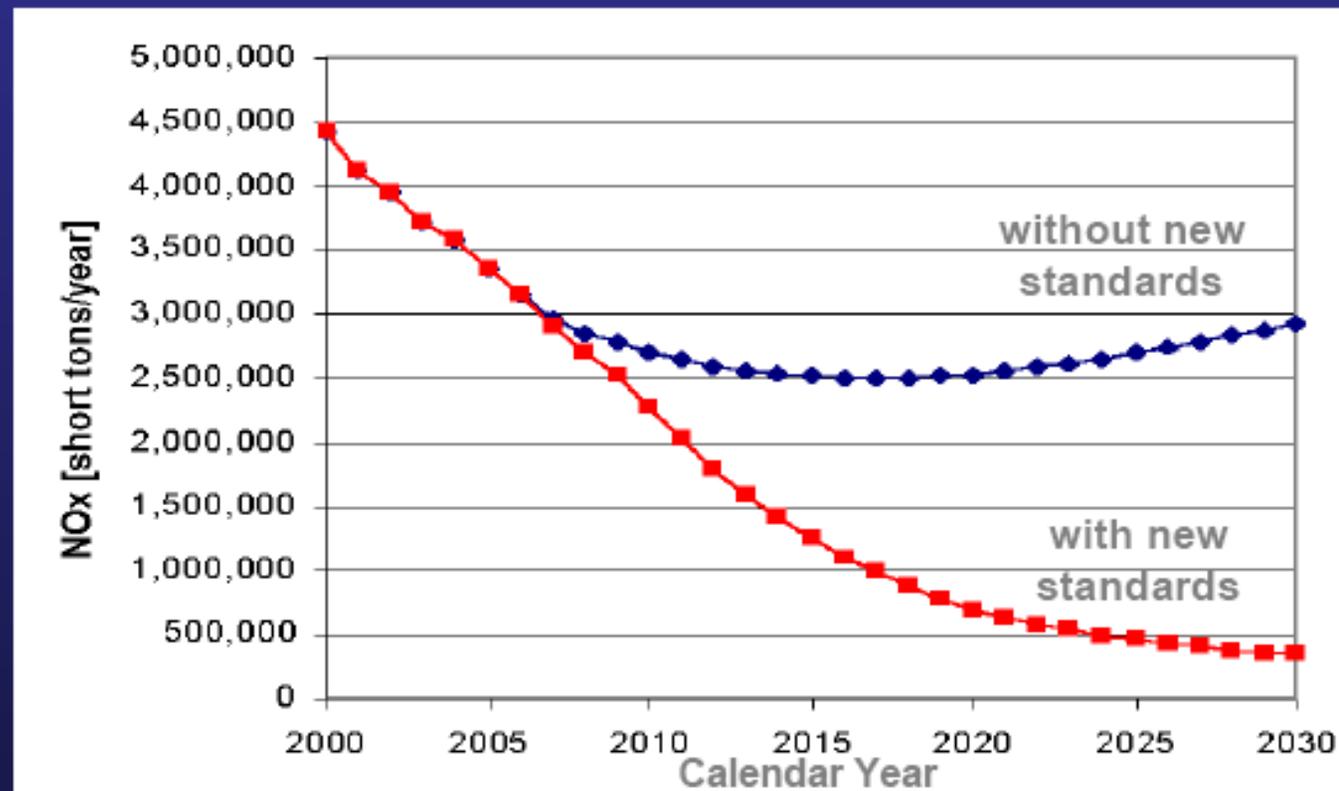
HD Highway Diesel Rule PM Benefits

Nationwide Heavy-Duty PM Emissions



HD Highway Diesel Rule NOx Benefits

Nationwide Heavy-Duty NOx Emissions



Benefits of the HD Highway Diesel Rule

continued

- Compliance costs
 - Estimated at \$1200 - \$1900 per engine
 - 4 - 5 cents per gallon fuel,
(partially off-set by maintenance savings of ~
1 cent per gallon)
 - Total costs are \$4.3 billion/year

Benefits of the HD Highway Diesel Rule

continued

- Health benefits -- The program will prevent annually
 - Over 8,300 premature deaths
 - Over 750,000 respiratory illnesses
 - 1.5 million lost work days
 - 2.6 million tons of NO_x; 110,000 tons of PM; and 17,000 tons of toxic pollutants
- Monetized benefits: \$70.3 billion/year

Nonroad Emissions Standards & Fuels

Nonroad Vehicles and Equipment

Engine Categories

- Diesel Boats & Ships
 - (commercial ships, recreational craft, etc.)
- Gasoline Boats & Personal Watercraft
 - (recreational boats, personal watercraft, etc.)
- Nonroad Diesel Program
 - (farm, construction, mining, etc.)

Nonroad Vehicles and Equipment

continued

- Forklifts, Generators, & Compressors
 - (forklifts, generators, etc.)
- Lawn & Garden Equipment
 - (lawn mowers, leaf blowers, chainsaws, etc.)
- Locomotives
- Snowmobiles, Dirt Bikes & ATVs
 - (snowmobiles, dirt bikes, all-terrain vehicles, etc.)

Milestones in Nonroad Engine Standards

- **1994** – The nonroad engine rule that regulated nonroad diesel engines used in nonroad construction, agricultural and other applications for the first time.
- **1995** – The nonroad engine rule that regulated small spark-ignition engines (such as lawnmowers) for the first time.

Milestones in Nonroad Engine Standards

continued

- 1997 - Locomotive Rule Sets emission standards for nitrogen oxides (NO_x), hydrocarbons, carbon monoxide, particulate matter, and smoke for newly manufactured and re-manufactured diesel-powered locomotives and locomotive engines.

Milestones in Nonroad Engine Standards

continued

- **1998** - Tier 2 and 3 Nonroad Diesel Rule sets emissions standards for new nonroad diesel engines.
- **1999** - Commercial Marine Diesel Rule reduces nitrogen oxides and particulate matter emissions from new large marine diesel engines.

Milestones in Nonroad Engine Standards

continued

- 2002 – Large spark-ignition engines and recreational vehicles regulated for the first time.
- 2003 - Ocean-Going Vessel Rule Sets emissions standards for new marine diesel engines on U.S. flagged ocean-going vessels.
- 2004 - Clean Air Nonroad Diesel Rule

Milestones in Nonroad Engine Standards

continued

- The Clean Air Nonroad Diesel Rule sets standards that will dramatically reduce emissions by over 90 percent from nonroad diesel equipment, and
- Dramatically reduces sulfur levels by 99 percent from current levels in nonroad diesel fuel starting in 2007.
- This step will apply to most nonroad diesel fuel in 2010 and to fuel used in locomotives and marine vessels in 2012.

Milestones in Nonroad Engine Standards

continued

- Locomotive and Marine Diesel Standards require the same technologies as on-highway and non-road diesel engines:
 - Reduces PM by 90 percent and NOx by 80 percent for newly-built locomotives and marine diesel engines
 - Tightens standards for existing locomotives and large marine diesel engines when they are remanufactured
 - New engine standards phase-in beginning in 2009

Nonroad HD Diesel Rule Tier 4

- Analogous to 2007 HD Diesel Highway Rule, in that standards and diesel fuel sulfur controls work in combination (90% NOx & PM reduction)
- To meet emission standards, engine makers to rely upon advanced emission controls similar to those used to meet the HD Diesel Highway Rule.
- Exhaust emissions will decrease by more than 90 percent (phased in between 2008 - 2014)

Nonroad HD Diesel Rule Tier 4

continued

- Nonroad diesel accounts for 47% of diesel PM emissions & 25% of NOx emissions from mobile sources, nationwide
- Off-road diesel sulfur limit of 15 ppm (Oct 2007)
 - Represents 99% reduction from 3000 ppm baseline

Nonroad HD Diesel Rule Tier 4

continued

- By 2030, will annually prevent 12,000 premature deaths, 8,900 hospitalizations, one million work days lost, 15,000 heart attacks, 6,000 asthma emergency room visits, 280,000 respiratory cases in children, etc.
- Health benefits of \$80 billion annually, at \$2 billion annual cost.

Aircraft

- Aircraft are covered/treated separately.
- The Aircraft Engines Rule amends standards for NO_x emissions from new aircraft and new aircraft engines beginning in 2005.
- Applies to new commercial aircraft, including small regional jets, single-aisle aircraft, twin aisle aircraft, and 747s and larger aircraft.

The Legacy Fleet National Clean Diesel Campaign

- There are about 11 million existing, high-polluting diesel engines not subject to our new standards.
- Focus on Key Sectors: School buses, marine ports, construction, agriculture, freight
- Promoting retrofitting, early replacement, and idle reduction
 - In FY-08 national grants funded 14,000 retrofits which reduced NOx emissions by 46,000 tons and PM emissions by 2,200 tons.

The Legacy Fleet National Clean Diesel Campaign

continued

- Program activities:
 - Technology verification
 - Technical and policy analysis
 - Coalitions and outreach
 - Innovative funding for projects
 - Federal grants, loans and tax incentives

Clean Diesel Funding

- FY 2008 awarded \$ 49.2 M
- FY 2009 under Recovery Act Awarded \$ 300 M
 - 160 Grants
 - Preliminary projected results
 - 33,000 engines, vehicles, vessels
 - 5,000 tons PM
 - 120,000 tons NOx
 - 850,000 tons CO2
 - \$1.2B - \$2.8B in health benefits

Clean Diesel Funding

continued

- Fiscal Years 2009 & 2010 awarded in May-July
\$120M
- Almost 400 applications requesting about
\$600 Million
- Offering matching funds
over \$1 Billion

Clean Air Act Gasoline Regulatory Programs

A Quick Overview of CAA Fuel Formulation Programs

PRE-1990 PROGRAMS

- Lead Phase-Down late 70's – 1996
- Phase I Volatility Controls 1989
- Phase II Volatility Controls 1992

1990 CAA / 1995 Energy Policy Act Programs in Place

- Oxygenated Fuels 1992
- Low-Sulfur Diesel Fuel 1993
- RFG Phase I / Phase II 1995/2000
- Low-Sulfur Gasoline (30 ppm) 2004
- Low-Sulfur Highway Diesel (15 ppm) 2006
- Boutique Fuels Rule (limits # state fuels as of 2004) 2006
- Low-Sulfur Nonroad Diesel 2007
- Renewable Fuel Standard (2.78-7.5 billion gallons) 2007-2012
- Low-Sulfur Nonroad Diesel (15 ppm) 2010
/Locomotive Marine (15 ppm) 2012

Renewable Fuel Standards Impacts & Benefits

- Petroleum consumption to be reduced by 2.0 - 3.9 billion gallons by 2012
 - 0.8% to 1.6% otherwise used for transportation
- CO₂ reduced by 13.1 million metric tons
- CO vehicle emissions reduced by 0.9% to 2.5%
- Benzene reduced by 1.8% to 4%

RFS Impacts & Benefits

continued

- Combined VOC+NOx increase of 41,000 to 83,000 tons per year (varying by region)
 - no emissions change for areas using ethanol already
 - new areas +4%-5% NOx & +6%-7% VOC
- Gas production costs to increase 0.5-1.1 cents per gallon
 - excise tax credit for ethanol will offset costs for a savings of 0.4 to 0.7 cents per gallon.

Sec. 211-Regulation of Fuels

- This section of the CAA provides EPA the authority to regulate motor vehicle fuels and fuel additives (including nonroad).
- Provides EPA the authority to prohibit the sale of motor vehicle fuels and fuel additives except under certain circumstances.
- Prohibits States (or any part of a State) from requiring a fuel or fuel additive that differs from what EPA has determined necessary.

Sec. 211(c) Waivers

- States may request and EPA may grant waivers to allow the sale of a fuel different than the otherwise required Federal fuel.
 - e.g., low RVP gasoline
- EPA must conduct rulemaking to grant such a 211(c)(4)(C) waiver.

Sec. 211(c) Waivers

continued

- State must demonstrate that the fuel is a necessary requirement of a SIP to attain a NAAQS and that no other measure would bring more timely attainment.
- The 2005 Energy Policy Act further limits EPA's ability to approve state fuel rules.

CAA Fuel Program Success Stories

- Fuel composition changes have provided great air quality benefits
- Oxy fuels were so successful, many cities were finally able to attain/maintain the CO NAAQS (often keeping the program as a contingency measure)
- RFG Phase I/II achieved more benefits in practice than CAA requires

CAA Fuel Program Success Stories

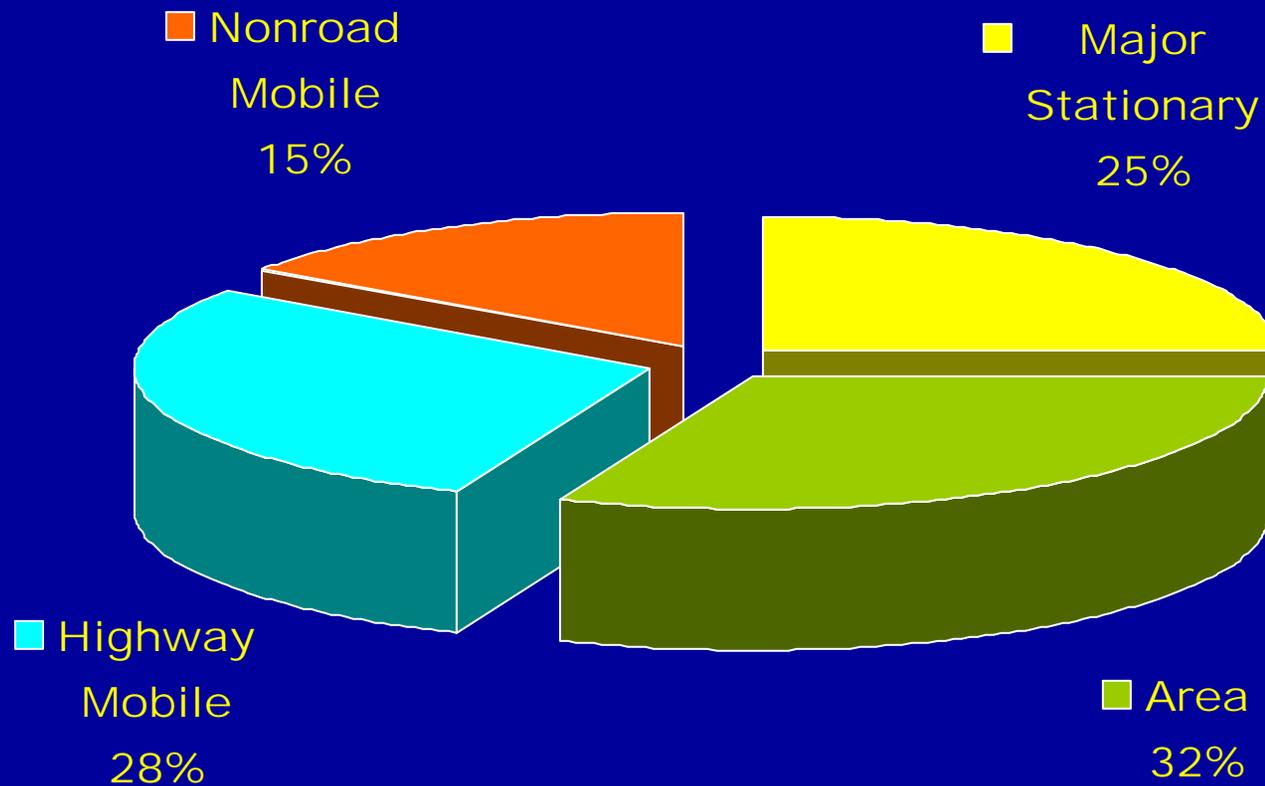
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- Low-sulfur diesel fuel blazed the way for cleaner diesel vehicles and equipment (HD Highway/Off-road rules).
- Low-sulfur gasoline allowed for cleaner light-duty standard (Tier 2).
- State “boutique” fuels allowed for low-cost, state-adopted programs where RFG could not be adopted.

AIR TOXICS FROM MOBILE SOURCES

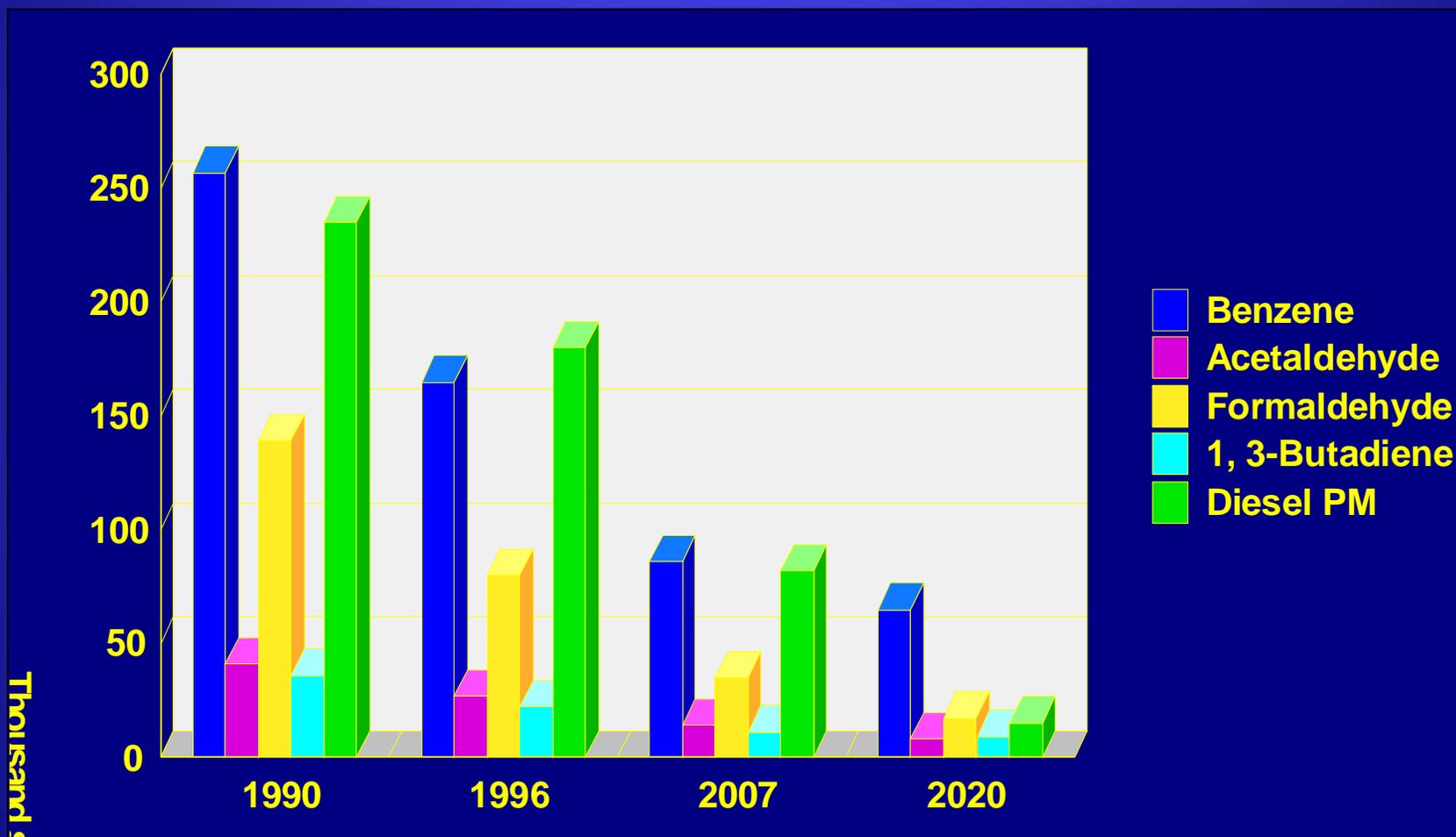
How Much Do Mobile Sources Contribute to Air Toxic Emissions?

1999 National Toxics Inventory (Does not include diesel PM)



Projected National Emissions of Selected Mobile Source Air Toxics

(after Tier 2 and Heavy-Duty Diesel 2007 Highway Controls)



2001 Mobile Source Air Toxics Rule (MSAT)

- Section 202(I) of the Clean Air Act requires EPA to set standards to control hazardous air pollutants from motor vehicles, motor vehicle fuels, or both.
- EPA published a rule under this authority in March 2001 that established toxics emissions performance standards for gasoline refiners and committed to additional rulemaking to evaluate the need for and feasibility of additional controls.

February 2007 MSAT

- MSAT revised to significantly lower emissions of benzene and the other air toxics in three ways:
- (1) by lowering benzene content in gasoline;
- (2) by reducing exhaust emissions from passenger vehicles operated at cold temperatures (under 75 degrees); and
- (3) by reducing emissions that evaporate from, and permeate through, portable fuel containers.

Inspection & Maintenance Programs

Inspection & Maintenance

- Under Title I of the CAA, an I/M program required for certain nonattainment areas as a mandatory Part D SIP element.
- States required to have I/M programs adopted state regulations and submitted them to EPA for approval into their State Implementation plans (SIPs).

Inspection & Maintenance

- Original (1970s) I/M tests were designed for old technology cars where idle tests were representative (didn't check evaporative emissions)
- 1981+ model cars use computers to adjust fuel mix over full range of operating modes (idle testing less representative, but still used)
- 1996+ model cars equipped with advanced on-board diagnostics (OBD) for easier repairs at lower thresholds (need OBD check)

Inspection & Maintenance

Given the substantial penetration of on-board diagnostics (OBD) vehicles into the fleet, most I/M programs will meet program requirements by OBD testing on 1996 and newer vehicles.

Resources for State and Local Agencies

- EPA's State Resources website:
<http://www.epa.gov/otaq/stateresources/index.htm> includes links to:
 - Guidance documents, models and calculators for quantifying emissions reductions from a wide range of mobile source measures
 - Regulations for on-road and non-road sources
 - Clean Diesel State and Local Tool Kit
 - Information on various funding sources
- EPA's MOVES website:
<http://www.epa.gov/otaq/models/moves/index.htm> includes links to:
 - The MOVES 2010 software to be downloaded
 - Instructions for downloading and installing the model
 - Technical and Policy Guidance on using the model
 - A users guide for the model

END OF MODULE 2
Clean Air Act 101