Regulatory and Voluntary Efforts in Addressing Particulate Matter and Black Carbon in the U.S

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Kimber Scavo

EPA's Revisions to the Air Quality Standards for Particle Pollution

- On December 14, 2012 ,consistent w**ith the requirements of the Clean Air Act and the latest science, EPA revised one of the National Ambient Air Quality Standards (NAAQS) for fine particulate matter, also known as $PM_{2.5}$, to improve public health protection.**

- EPA strengthened the annual health standard for $PM_{2.5}$ to 12.0 micrograms per cubic meter ($\mu g/m^3$) . The existing annual $PM_{2.5}$ standard of 15.0 $\mu g/m^3$ was set in 1997.
  - An extensive body of scientific evidence shows that exposure to fine particle pollution can cause premature death and adverse cardiovascular effects, including increased hospital admissions and emergency department visits for heart attacks and strokes. Respiratory effects including asthma attacks.
  - An area will meet the standard if the three-year average of its annual average $PM_{2.5}$ concentration is less than or equal to 12.0 $\mu g/m^3$ at each monitor.

Existing Federal and State Rules Will Help Reduce Particle Pollution

- Federal rules designed to reduce PM, ground-level ozone, and acid rain, along with rules that will reduce particles as a co-benefit of reducing toxic emissions, will help most areas of the country meet the updated annual $PM_{2.5}$ standard by 2020. These federal programs include:
  - Mercury and Air Toxics Standards;
  - Mobile Source Standards: The Light-Duty Vehicle Tier 2 Rule, the Heavy Duty Diesel Rule, the Clean Air Nonroad Diesel Rule, NOx Emission Standard for New Commercial Aircraft Engines, Emissions Standards for Locomotives and Marine Compression-Ignition Engines, Control of Emissions for Nonroad Spark Ignition Engines and Equipment, Emissions Reductions from Oceangoing Vessels;
  - Regional Haze Regulations and Guidelines for Best Available Retrofit Technology Determinations;
  - Rules to reduce the regional transport of air pollution;
  - Emissions Standards for Reciprocating Internal Combustion Engines ; and
  - Amended New Source Performance Standards and Emissions Guidelines for Hospital/Medical/Infectious Waste Incinerators.
- On-the-books state programs include rules on power plants or industrial facilities and wood smoke reduction programs.

Mitigating BC: Key Considerations

- Available control technologies can reduce BC, generally by improving combustion and/or controlling direct $PM_{2.5}$ emissions from sources.
- Some combustion sources emit more BC than others, and reductions in emissions from BC-rich sources have the greatest likelihood of providing climate benefits. Reducing emissions affecting the Arctic and other ice and snow-covered regions may be particularly beneficial.
- Some state and local areas in the U.S. have already identified control measures aimed at direct $PM_{2.5}$ as particularly effective strategies for meeting air quality goals.
- Average public health benefits of reducing directly emitted $PM_{2.5}$ in the U.S. are estimated to range from $290,000 to $1.2 million per ton $PM_{2.5}$ in 2030.
- Though the costs vary, many reductions can be achieved at reasonable costs. Controls applied to reduce BC will help reduce total $PM_{2.5}$ and other co-pollutants.

BC Mitigation Opportunities in the U.S.

- U.S. BC emissions have declined more than 70% since the early 1900s (due to controls on industrial and mobile sources, improvements in technology and broader deployment of cleaner fuels such as natural gas).

- The U.S. will achieve substantial BC emissions reductions by 2030, largely due to controls on new mobile diesel engines.
  - Diesel retrofit programs for in-use mobile sources are a valuable complement to new engine standards for reducing emissions.
  - Controlling new sources with diesel particulate filters and ultra low sulfur diesel fuel.

- Other U.S. source categories have more limited mitigation potential due to smaller remaining emissions in these categories, or limits on the availability of effective BC control strategies:
  - Stationary sources
  - **Residential wood combustion**
  - Open biomass burning

Addressing Residential Wood Smoke in the U.S.

- Helps areas attain the PM2.5 health standards
- Supports community-based air toxics program
- Supports indoor air quality program efforts
- Residential wood combustion is 13% (345,000 tons) of total PM2.5 direct emissions
  - ~More than all of the PM2.5:
    - US petroleum refineries
    - Cement manufactures
    - Pulp and paper plants combined.
- Residential wood combustion is about 3% of the domestic BC inventory
- Nationally, residential wood combustion accounts for:
  - ~62% of the 7-polycyclic aromatic hydrocarbons (PAH), which are probable human carcinogens
  - ~24% of area source cancer risk (2005 NATA)
  - ~15% of respiratory risk (2005 NATA)

EPA's Residential Wood Smoke Initiative: Voluntary & Regulatory Components

- **Wood Burning Appliance Changeout/Retrofit Campaigns**
- **Hydronic Heater & Fireplace Partnership Program**
- **Burn Wise Education Campaign/Wood Moisture**
- **Wood Heater New Source Performance Standard**

What's a Wood Stove Changeout Campaign?

- **Education and incentive-based (cash rebates) effort to encourage owners of old, inefficient woodstoves to replace or "changeout" their stove with a cleaner burning appliance like:**
  - **Gas stoves**
  - **Wood pellet or corn stoves**
  - **EPA-Certified wood stoves**
  - **Gas furnaces, heat pumps**

- **Partnership with hearth industry and others to market and support program, e.g., additional discounts**

Benefits of Changing Out Old Inefficient Wood Stoves:

- **Reduces fine particles and toxic air pollution by 70%**
- **Reduces indoor PM2.5 emissions by 50% - 70%**
- **Each old wood stove replaced is equal to eliminating the PM2.5 emissions from five old diesel buses**
- **As a control technology, changeouts are cost-effective at only $3000 per ton of particulate matter**

***Education and outreach is critical for proper operation and emission reductions**

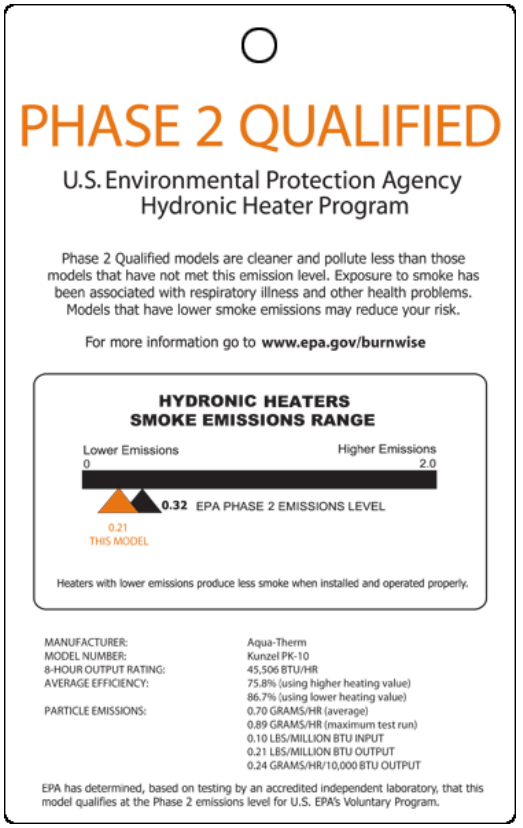
Progress to date

- **50 communities implemented woodstove changeouts**
- **24,000+ old stoves and fireplaces changed out/retrofitted**
- **370 tons of PM2.5 reduced/year from changeouts**
- **63 tons of toxic air pollutants reduced per year**
- **Providing approximately $135 to $329 million in estimated annual health benefits.**

EPA Hydronic Heater Program

- Launched in 2007, 70 percent cleaner models qualified for EPA Label (Phase 1). In Phase 2, up to 90 percent cleaner than older unqualified units.

- Models must be tested by an EPA-accredited laboratory
  - More than 37 EPA-qualified models
  - 10,000 EPA-qualified units have been sold
  - Avoiding approximately 6,100 tons of PM2.5 emissions each year after 2010


PHASE 2 QUALIFIED

U.S. Environmental Protection Agency
Hydronic Heater Program

Phase 2 Qualified models are cleaner and pollute less than those models that have not met this emission level. Exposure to smoke has been associated with respiratory illness and other health problems. Models that have lower smoke emissions may reduce your risk.

For more information go to **www.epa.gov/burnwise**

HYDRONIC HEATERS SMOKE EMISSIONS RANGE

Lower Emissions 0 — Higher Emissions 2.0

0.32 EPA PHASE 2 EMISSIONS LEVEL

0.21 THIS MODEL

Heaters with lower emissions produce less smoke when installed and operated properly.

MANUFACTURER:	Aqua-Therm
MODEL NUMBER:	Kunzel PK-10
8-HOUR OUTPUT RATING:	45,506 BTU/HR
AVERAGE EFFICIENCY:	75.8% (using higher heating value) 86.7% (using lower heating value)
PARTICLE EMISSIONS:	0.70 GRAMS/HR (average) 0.89 GRAMS/HR (maximum test run) 0.10 LBS/MILLION BTU INPUT 0.21 LBS/MILLION BTU OUTPUT 0.24 GRAMS/HR/10,000 BTU OUTPUT

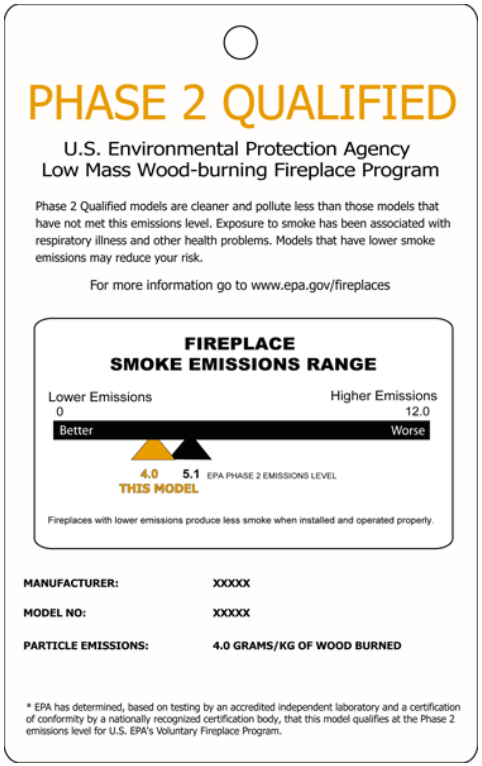
EPA has determined, based on testing by an accredited independent laboratory, that this model qualifies at the Phase 2 emissions level for U.S. EPA's Voluntary Program.

EPA Fireplace Program

- **Launched in 2009, 70 percent cleaner models qualified for EPA Label (Phase 2).**

- **Models must be tested by an EPA-accredited laboratory. Includes masonry and builder-box models.**

- **Manufacturers include text in each qualifying owner's manual on proper operation and maintenance of the fireplace including how and what to burn.**



Burn Wise Education Campaign:
www.epa.gov/burnwise

Residential Wood Heaters NSPS Draft Proposal

- On February 26, 1988, EPA published the original new source performance standard for residential wood heaters.
- In 1995, Washington State tightened their emission limits.
- EPA conducted numerous stakeholder outreach activities and prepared the technical and economic information necessary for a draft proposal.
- Our proposal is anticipated to address wood stoves, hydronic heaters, forced-air furnaces, and masonry heaters and better reflect current best systems of emission reduction. It is also likely to add emission limits for new appliances that were not regulated in 1988, such as outdoor wood boilers and single-burn-rate stoves.
- The monetized health benefits far exceed the costs.
- Proposed rulemaking: 2013
  - 90-day public comment period
- Final rulemaking: 2014

Two-Step Approach

- Anticipated Two-Step Approach *(the following slides address our anticipated current approach that has not been proposed yet by EPA)*
  - The states feel strongly about the need for stringent stepped standards as they strive to attain and maintain the national ambient air quality standards.
  - EPA plans to take comment on a longer compliance schedule.

Wood Stoves

Approach under consideration for Wood Stove NSPS Proposal

Tightest state standard (Washington State) upon promulgation

- **Step 1**:

- **Step 2: "Best Systems" emission level five years after promulgation**

Hydronic Heaters

Approach under consideration for Hydronic Heater NSPS Proposal

- **Step 1: Partnership Program Phase 2 level upon promulgation**
  - 36 hydronic heater models (27 cordwood and 9 pellet models) built by 17 U.S. manufacturers have already been qualified at this level.
- **Step 2: "Best Systems" five years after promulgation**

Forced-air Furnaces

Approach under consideration for Forced-air Furnaces NSPS Proposal

- **Step 1: CSA B415 level upon promulgation**
  - The two primary U.S. manufacturers of forced-air furnaces both have models that can meet Step 1 already. Other manufacturers are conducting tests now.
- **Step 2: "Best Systems" five years after promulgation**

Masonry Heaters

Compliance Requirements being considered for Masonry Heater NSPS Proposal:

- **Level equivalent to Hydronic Heaters upon promulgation except for small volume manufacturers.**
  - Based on data submitted by the Masonry Heater Association, over 10 models already achieve this level.
  - Many other models are expected to use a computer simulation to show that their design would be expected to achieve the NSPS level without conducting further testing.
- **For small volume manufacturers (less then 15 total units per year), compliance deadline would be 5 years after promulgation**
  - Most masonry heater manufacturers are very small businesses that produce less than 12 heaters per year.

Thank You!
APPENDICES

NAAQS for Particle Pollution: More Information

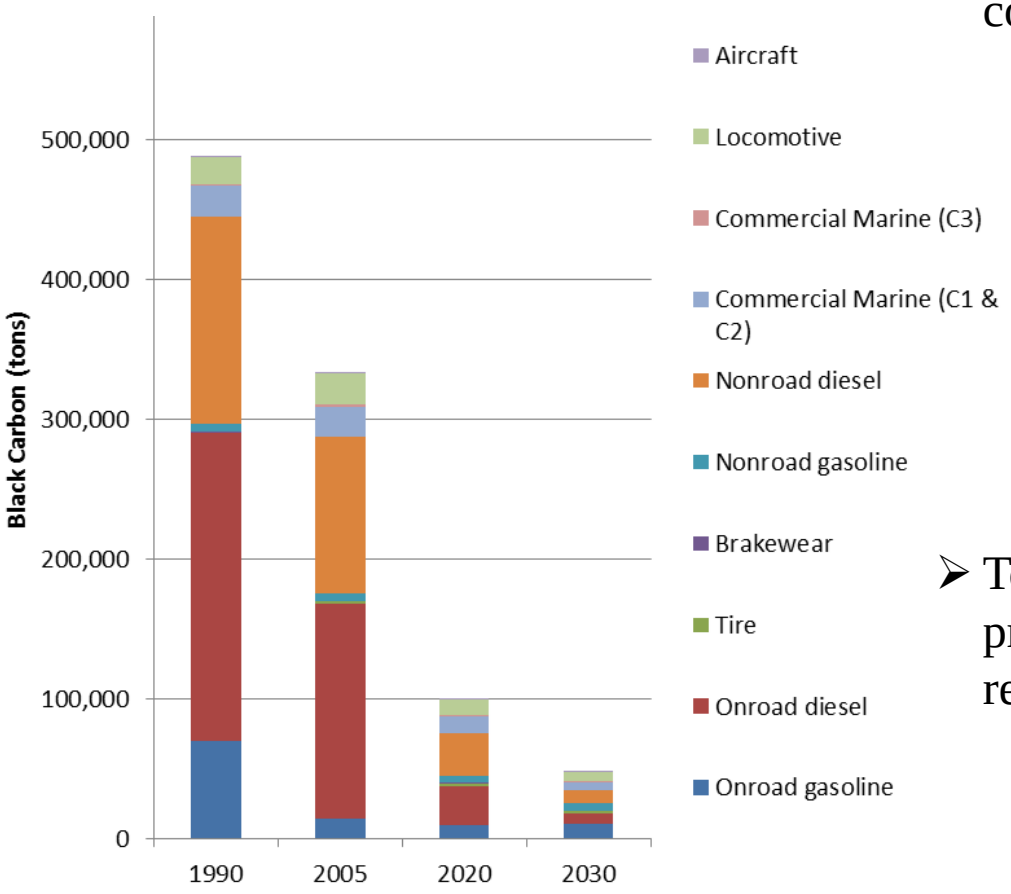
- In addition to revising the **annual** $PM_{2.5}$ standard to 12.0 µg/m^3, EPA is retaining the **daily** $PM_{2.5}$ health standard of 35 µg/m^3 set in 2006.
  - Decisions consistent with the independent Clean Air Scientific Advisory Committee's support for an annual standard in the range of 11-13 µg/m^3 in conjunction with a daily standard no less stringent than 35 µg/m^3.
- Retaining the existing secondary standards for $PM_{2.5}$ to address PM-related effects on public welfare such as visibility impairment, ecological effects, damage to materials, and climate impacts.
- Retaining the existing standards for coarse particles (PM_{10}). These standards were issued in 1987.
- Received more than 230,000 public comments.
- **A large body of scientific evidence supports the new $PM_{2.5}$ standard.**
  - EPA examined thousands of studies as part of this review.
  - New evidence includes more than 300 new epidemiological studies, many of which report adverse health effects even in areas that meet the 2006 $PM_{2.5}$ standards.

PM Standards Have Changed Over Time

EPA has regulated particulates since 1971

- **1971:** EPA set standards covering all sizes of airborne particles, including dirt and other larger particles -- known as a "total suspended particulate, TSP"
- **1987:** EPA changed the standards to focus on particles 10 micrometers in diameter and smaller (PM_{10})
  - Particles larger than 10 micrometers don't generally get past your nose
  - EPA set both 24-hour and annual PM_{10} standards at that time
- **1997:** EPA decided the fine and coarse fractions of PM_{10} should be considered separately
  - Added new indicator to focus on fine particles – $PM_{2.5}$; set initial annual and 24-hour $PM_{2.5}$ standards
  - Retained PM_{10} standards to provide protection for coarse particles (particles between 10 and 2.5 micrometers or $PM_{10-2.5}$)
- **2006:** EPA maintained standards for both fine and coarse particles
  - *Fine particles*: Revised level of 24-hour $PM_{2.5}$ standard (65 to 35 $\mu g/m^3$) and retained level of annual $PM_{2.5}$ standard (15 $\mu g/m^3$)
  - *Coarse particles:* retained 24-hour PM_{10} standard and revoked annual PM_{10} standard

U.S. Mobile Sources



Emissions from U.S. Mobile Sources

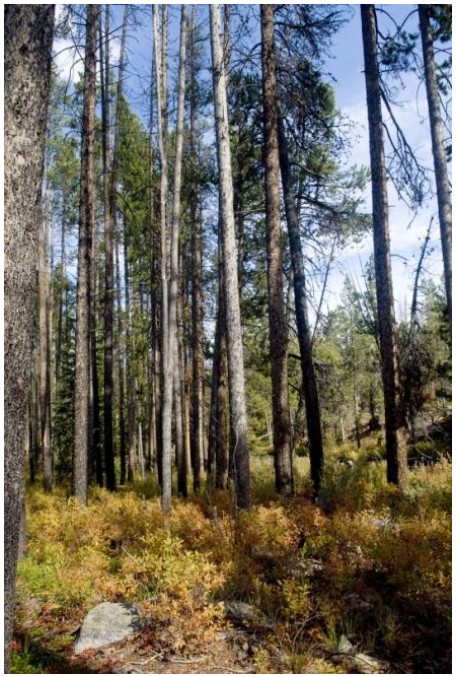
- BC emissions from U.S. mobile diesel engines controlled via:
  - Emissions standards for new engines, including requirements resulting in use of diesel particulate filters (DPFs) in conjunction with ultra low sulfur diesel fuel.
  - Retrofit programs for in-use mobile diesel engines, such as EPA's National Clean Diesel Campaign and the SmartWay Transport Partnership Program.
- Total U.S. mobile source BC emissions are projected to decline by 86% by 2030 due to regulations already promulgated.
  - EPA has estimated the cost of controlling $PM_{2.5}$ from new diesel engines at ~ $14,000/ton (2010$).

U.S. Stationary Sources

- Controls on industrial sources, combined with improvements in technology and broader deployment of cleaner fuels such as natural gas, have helped reduce U.S. BC emissions more than 70% since the early 1900s.
- Regulations limiting direct PM emissions (including BC) affect more than 40 categories of industrial sources, including coke ovens, cement plants, industrial boilers, and stationary diesel engines.
- Available control technologies and strategies include:
  - Use of cleaner fuels.
  - Direct $PM_{2.5}$ reduction technologies (e.g. fabric filters (baghouses), electrostatic precipitators (ESPs), and diesel particulate filters (DPFs)).
  - The control technologies range in cost-effectiveness from \$48/ton $PM_{2.5}$ to \$685/ton $PM_{2.5}$ (2010\$) or more, depending on the source category. However, they also may involve tens of millions in initial capital costs.

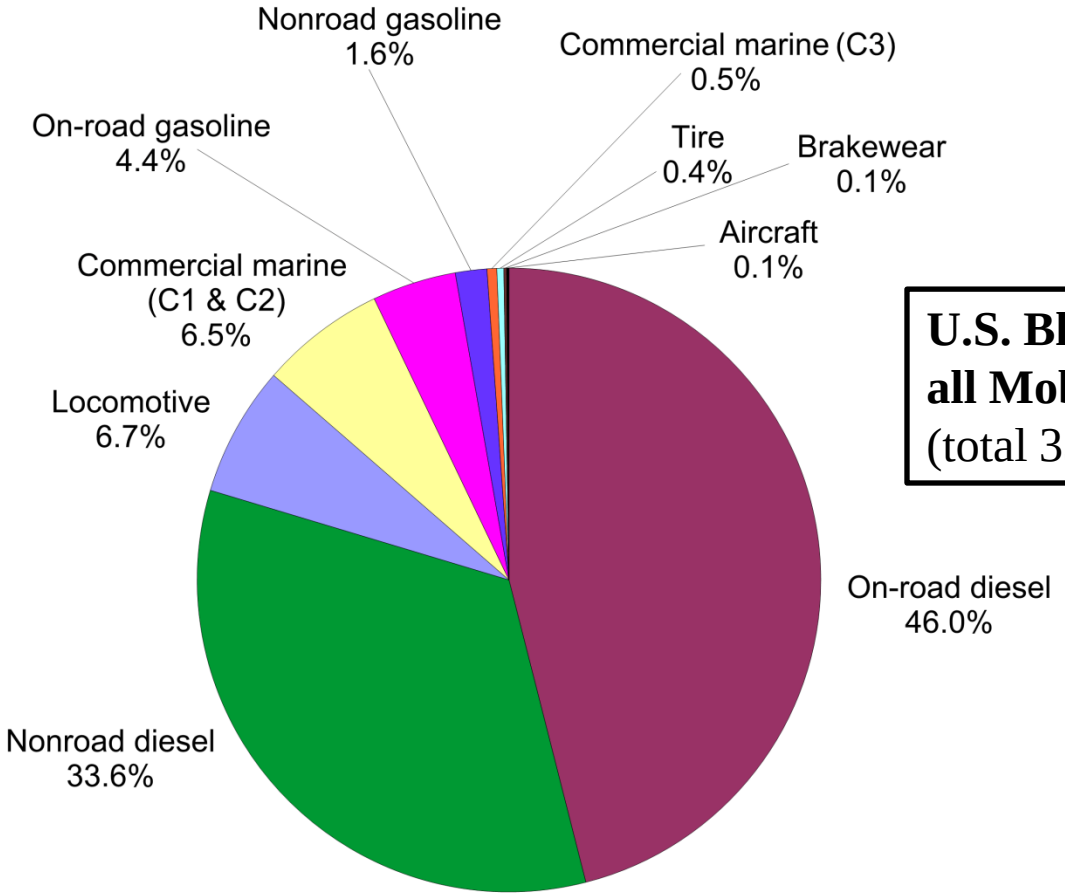
Open Biomass Burning

- Open biomass burning is the largest source of BC emissions globally, and these emissions have been tied to reduced snow and ice albedo in the Arctic.
  - A large percentage of these emissions are due to wildfire (e.g., U.S. Alaskan fires).
  - Total organic carbon (OC) emissions (which may be cooling) are seven times higher than total BC emissions from this sector.
- $PM_{2.5}$ emissions reductions techniques (e.g., smoke management programs) may help reduce BC emissions.
- Appropriate mitigation measures depend on the timing and location of burning, resource management objectives, vegetation type, and available resources.
- Expanded wildfire prevention efforts may help to reduce BC emissions worldwide.



Mobile Sources

- U.S. mobile source BC comes mainly from diesels
- Gasoline exhaust is a smaller source of BC



U.S. Black Carbon Emissions from all Mobile Source Categories, 2005 (total 333,400 tons)

Reducing BC from Mobile Sources

- BC emissions from U.S. mobile diesel engines controlled via:
  - **Emissions standards** for new engines, including requirements resulting in use of diesel particulate filters (DPFs) in conjunction with ultra low sulfur diesel fuel.
    - Standards are for PM and are "technology forcing."
    - Reductions estimated from emissions models used in regulatory packages
      - On road BC, OC, PM inventory from MOVES
      - Nonroad BC inventory from PM for NONROAD model
      - Locomotive, commercial marine, and aircraft emissions estimated separately from models
  - **Retrofit programs** for in-use mobile diesel engines, such as EPA's National Clean Diesel Campaign and the SmartWay Transport Partnership Program.
- EPA presently has minimal standards for gasoline PM; however, EPA VOC/other standards do reduce gasoline PM.
- EPA has recently proposed tighter tailpipe standards on motor vehicles and limits on sulfur in gasoline.

U.S. EPA Diesel Standards

- On road diesel PM standards – 2007 model year
  - 99% reduction in diesel PM for 2012 diesel truck compared to a 1970 pre-control diesel truck
  - On road diesel PM and BC reduced by 91% and 95% respectively from 2005-2030
  - Diesel particulate filters preferentially reduce BC
  - Earlier diesel PM standards also reduced BC
  - Fleet turnover needed to achieve full PM/BC reductions
- Similar standards for nonroad diesels started in 2012
- Similar standards for locomotives and commercial marine (categories 1 and 2 but not ocean going)
- EPA has estimated the cost of controlling $PM_{2.5}$ from new diesel engines at ~ $14,000/ton (2010$).
- Similar diesel controls being phased in internationally; but there is still much work to be done, in particular, in areas without access to low-sulfur diesel.
- Gasoline PM is also reduced in future years.