



Environmental Standards for Vehicles in the U.S. and Their Impact on BC Emissions



Teresa Kuklinski, U.S. EPA
Transport and Clean Air Seminar
Moscow, Russia
December 2013

Multiple Drivers for Reducing Diesel Emissions



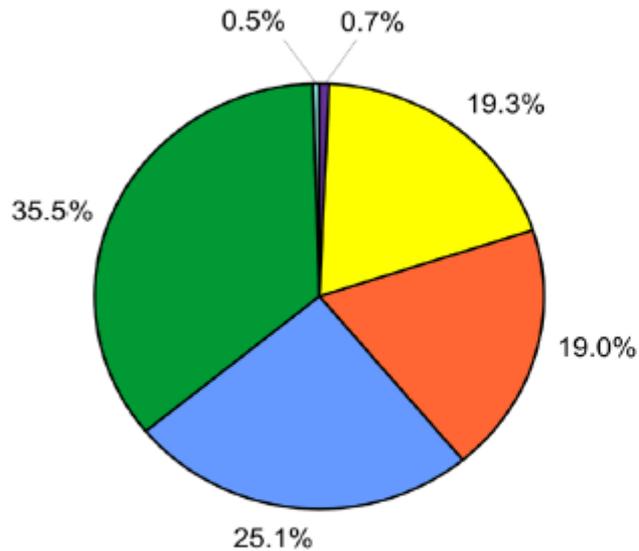
- Mobile sources account for about 19% of global black carbon (BC) emissions
- In the U.S. mobile sources account for the majority of US elemental carbon emissions, at about 52%
 - Diesels are responsible for 90% of the mobile emissions (2005 inventory)
- Current US regulations for new engines are projected to significantly reduce elemental carbon by 2030



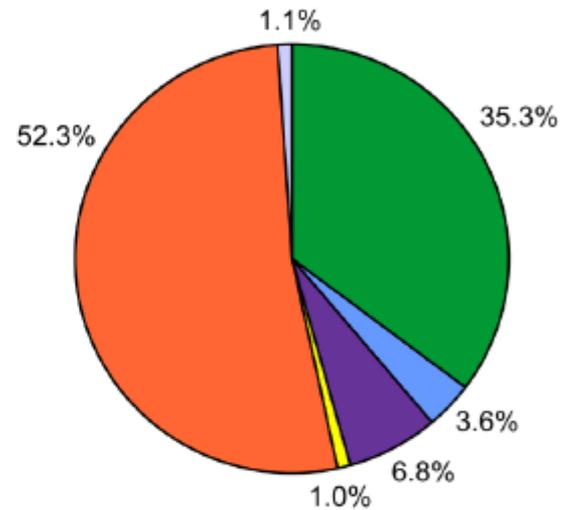
Black Carbon Inventories – EPA Report to Congress 2012



Global BC Emissions, 2000 (7,600 Gg)



U.S. BC Emissions in 2005 (0.64 Million Tons)

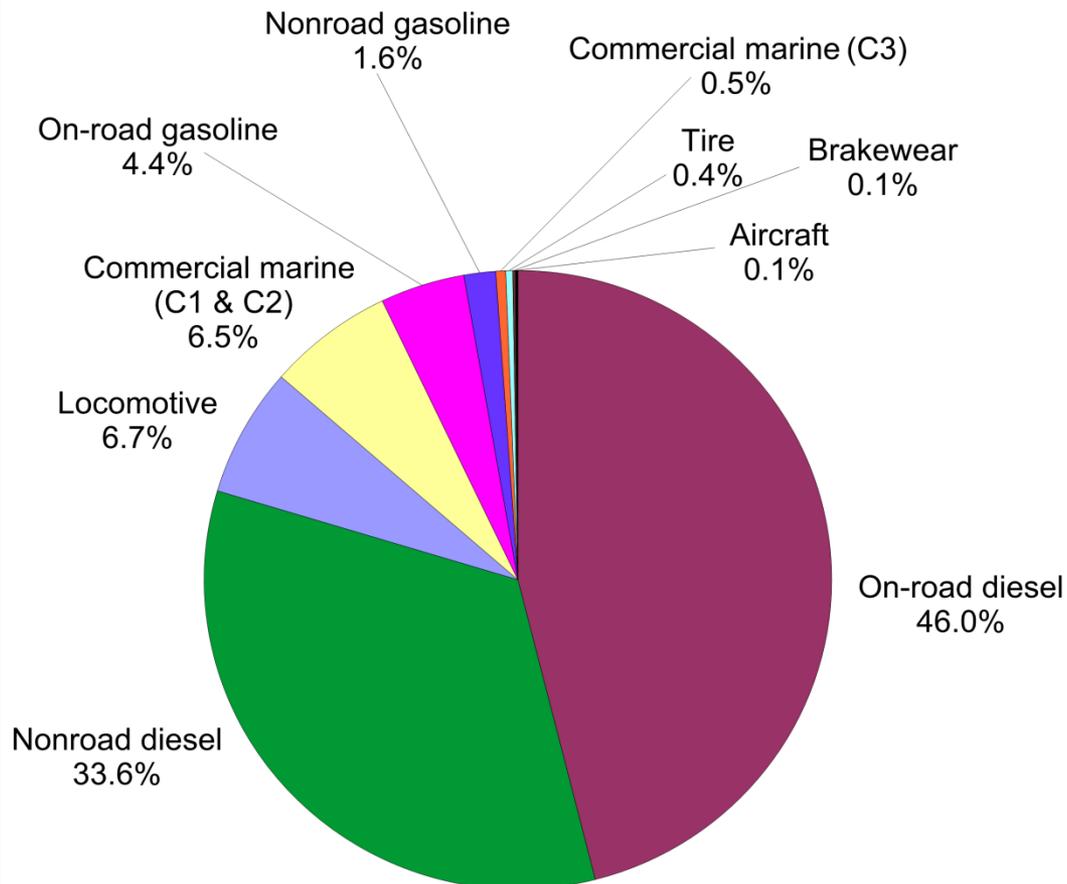


- Open Biomass Burning (Includes Wildfires)
- Transport
- Energy/Power
- Domestic/Residential
- Industry
- Other

Mobile Sources



- Year 2005
- U.S. mobile source BC comes mainly from diesels
- Gasoline exhaust is a smaller source of BC



Ways to reduce PM emissions



- Oxidize organic gas-phase components (i.e. oxidize HCs)
 - Diesel Oxidation Catalyst (DOC)
 - No reduction or slightly reduces soot portion of PM
- Filter out solid components (soot and ash)
 - Diesel Particulate Filter (DPF)
 - Soot must be burned off (regenerated)
- Reduce diesel sulfur content (reduce sulfate/SO_x)
 - Lowers both directly emitted PM and secondary PM
- Recirculate crankcase vapor to combustion chamber; Closed crankcase ventilation
- Upgrade engine to cleaner standards

The “Systems Approach” to Standard Setting



- Treat vehicles and fuels as one system - regulate fuel sulfur and vehicle emissions at same time.
- Sulfur reduction is necessary for the most advanced emission controls
 - Diesel Particulate Filters and Lean NOx traps
 - Advanced catalysts for spark ignition engines
- Sulfur reduction yields immediate benefit from entire fleet
- U.S. Gasoline, 30 ppm avg; 80 ppm max
 - Tier 3 proposal will reduce to 10 ppm average
- U.S. Diesel, 15 ppm max

Reducing BC from Mobile Sources

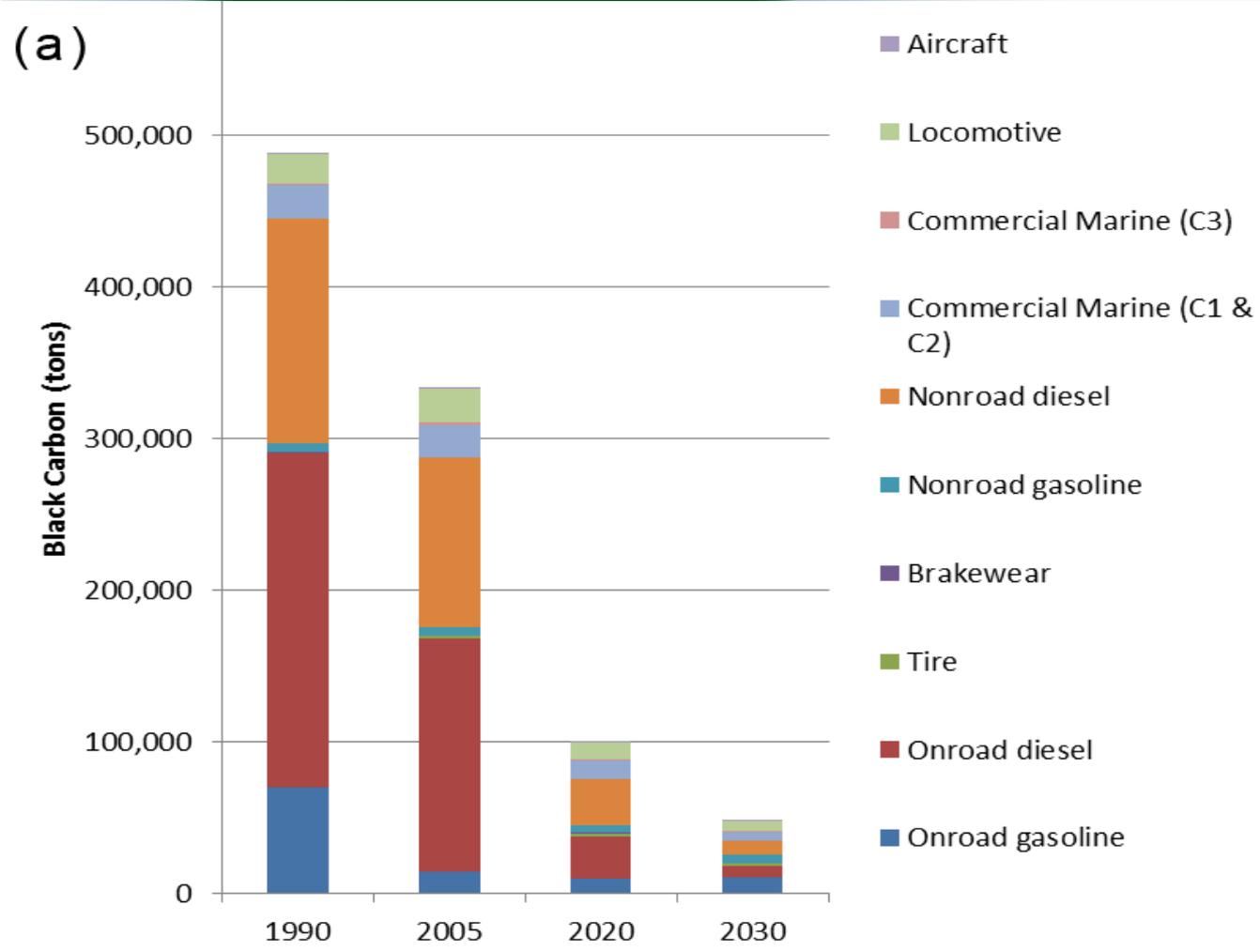


- BC emissions from U.S. mobile diesel engines controlled via
 - **Emissions standards** for new engines, including requirements resulting in use of diesel particulate filters (DPFs) in conjunction with ultra low sulfur diesel fuel
 - Standards are for PM and are “technology forcing.”
 - Diesel particulate filters to be used on
 - On road diesels (trucks, passenger cars)
 - Nonroad diesels (such as construction and agricultural equipment)
 - Locomotives
 - Commercial marine (categories 1 and 2) using distillate fuel
 - **Retrofit programs** for in-use mobile diesel engines, such as EPA’s National Clean Diesel Campaign and the SmartWay Transport Partnership Program.



- 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 (DPF) preferentially reduce BC
 - DPFs require ultra low sulfur diesel fuel (less than 15 ppm versus ~ 500 ppm)
 - Earlier diesel PM standards also reduced BC
- Similar standards for nonroad diesels started in 2012
 - Exhaust emissions from these engines will decrease by more than 90 percent.
- 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\$). Tremendous health benefits.
- Similar diesel controls being phased in internationally
- Gasoline PM is also reduced in future years

Projected Decline in BC Emissions from Mobile Sources



- Total U.S. mobile source BC emissions are projected to decline by 86% by 2030 due to regulations already promulgated.

Emissions from U.S. Mobile Sources

Mobile Source Emissions Reductions 1990-2030



<u>BLACK (ELEMENTAL) CARBON</u>	1990	2005	2020	2030	1990--->2005	2005--->2030
Onroad gasoline	69,629	14,510	9,538	10,027	-79%	-31%
Onroad diesel	219,958	153,477	28,175	7,615	-30%	-95%
Tire	809	1,198	1,435	1,720	48%	44%
Brakewear	290	475	569	682	64%	44%
Nonroad gasoline	5,420	5,444	4,702	5,174	0%	-5%
Nonroad diesel	148,537	112,058	31,254	9,356	-25%	-92%
Commercial Marine (C1 & C2)	22,122	21,652	11,595	5,440	-2%	-75%
Commercial Marine (C3)	1,262	1,681	864	1,306	33%	-22%
Locomotive	19,317	22,495	11,349	5,684	16%	-75%
Aircraft*	283	410	457	553	45%	35%
Total	487,628	333,400	99,940	47,557	-32%	-86%



- The tightest standards on new diesel engines can not clean up the existing fleet
- Goal: reduce emissions from the legacy fleet of millions of diesel engines
- National Clean Diesel Campaign components:
 - Diesel Emissions Reduction Program (DERA): Install exhaust control devices
 - SmartWay Transport Program: Promote fuel saving technologies; less fuel = emissions reductions



More information

- Teresa Kuklinski
US EPA International Program Manager
Phone: 202-564-0246
Email: Kuklinski.Teresa@epa.gov