Strategies For Black Carbon Controls in the Transportation Sector

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Bellagio Principles

- Design Programs & Policies That Reduce Conventional, Toxic, Noise and Greenhouse Emissions in Parallel
- Treat Vehicles and Fuels As A System
- New Vehicle Standards for Greenhouse Emissions & Conventional Pollutants Should Be Fuel Neutral
- Expect & Require Best Technologies and Fuels Worldwide – in Both Industrialized and Developing Countries
BC Emission Sources

top: diesel vehicles, agricultural burning
bottom: rural cook stove, brick kiln
In the United States, diesel engines particulate emissions have the strongest warming impact due to large BC and small OC emissions.

Open biomass burning particulate emissions have less certain net climate effects due to co-emissions of organic carbon.

The net climate impact of other black carbon sources is likely to be warming, but smaller than diesel, considering BC and OC emissions.
For the majority of the sampled weeks, night samples showed higher BC concentrations than day samples. This observation could be explained by the regulation, that lorries are only allowed to drive during night time in most parts of Beijing.
ELEMENTS OF A COMPREHENSIVE VEHICLE POLLUTION CONTROL STRATEGY

CLEAN VEHICLE TECHNOLOGY

APPROPRIATE MAINTENANCE

TRANSPORTATION & LAND USE PLANNING

CLEAN FUELS
The Solution Exists: Diesel Particulate Filters (DPFs)

- Removes 90+% BC, PM; also HC and CO
- Requires Ultralow Sulfur Diesel (ULSD)
Stringent Standards for New Vehicles Have Been Adopted by US EPA

**Tier 2 Light-duty (1999)**

**Tier 4 diesel (2004)**


**Nonroad**

**Locomotive/Marine**

**Common Aspects**--

- Systems approach—fuel change enables clean technologies
- Large environmental benefits
- Responsive to needs of States to meet air quality goals

**Highway**

**2008**
This figure is intended to illustrate the timeline for the final highway and nonroad diesel fuel sulfur control programs. It is not drawn to exact scale. Refer to 40 CFR Part 80 for specific program dates.
EPA Programs Are Cost-Effective

- Tier 2 Light-duty Highway
- 2007 Heavy-duty Highway
- Tier 4 Nonroad

Total Cost: $11 billion
Total Benefits: $175 billion

$ Billion Annually in 2030

Tier 2 Light-duty Highway
Tier 4 Nonroad
EU and US Light Duty Gasoline and Diesel Vehicle Standards

May/Will Include A Number Based PM Standard
Modern Diesel?
Black Carbon Reduces Diesel Benefit

CO2-only

CO2 + Black Carbon

Average CO2-equivalent Emissions, GWP20 (g/km)

Source: ICCT Analysis

Diesel Benefit

18%

2%

Fuel Type

Petrol

170 180 190 200 210

170 207

206 201

Diesel

Petrol

Source: ICCT Analysis
Emission Controls Enhance Diesel Benefit

- **Euro 3/4 Diesel without DPF vs Petrol**
  - Benefit: 2%

- **Diesel with DPF vs Petrol**
  - Benefit: 17%

Source: ICCT Analysis
U.S. vs. Europe Heavy-Duty Engine Transient Cycle Emission Standards

Euro VI to include particle number limit
Cumulative Emissions By Age – Diesel Trucks

Vehicle Age

Cumulative Emissions

PM
NOx
85% Less Diesel PM by 2020
(On- and Off-road Vehicles, Stationary Engines)

• New vehicle and engine standards (90% control)
• Low-sulfur (15 ppmw) diesel and alternative fuels
• Retrofits/re-powering with funding ($65M per year)
• International Diesel Retrofit Advisory Committee
• Anti-idling measures
• Enforcement programs

www.arb.ca.gov/diesel/dieselrrp.htm
Particulate Filters Being Applied To Various Types of Vehicles

Small tractor

Port equipment

Long haul heavy-duty truck

School bus

Earth mover
Fix It or Scrap It!!!!!
Trends in On Road Vehicle Black Carbon Emissions in Latin America

Normalized to 2000
Marine Black Carbon

Concerns with deposition on snow, especially Arctic

Control strategies

Technologies (e.g. diesel particulate filter)

Fuel switching (e.g., marine diesel oil)

Operations (e.g., speed control & emission control areas)
Thank You Very Much
ACTUAL FLEET AVERAGE GHG EMISSIONS DATA THROUGH MY2008 AND NEAREST TARGETS ENACTED OR PROPOSED THEREAFTER BY REGION

Solid dots and lines: actual data
Hollow dots and dashed lines: nearest targets enacted
Smaller hollow dots and dotted lines: proposed targets
Black Carbon Emissions By Road Vehicle Type
Base Case

Million Metric Tons

Motorcycles
Heavy Duty Diesel Truck
Medium Duty Gasoline Truck
Medium Duty Diesel Truck
Light Duty Diesel Vehicle
Light Duty Gasoline Vehicle