Colorado Clean Diesel Program: Protecting Children's Health and More

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Background: Most Diesel Buses Self-Pollute

- Tailpipe emissions come in through doors opening and closing at stops
- Crankcase emissions—burnt oil, etc. sweep in from under hood
- Majority of eligible buses are between model years 1990 – 2000, but we'll retrofit any younger than MY 2007
- Black carbon measured in buses can be 2x that found in an average light duty vehicle.

Background: Children's Exposure to Diesel Exhaust

- Diesel exhaust is a probable human carcinogen; can aggravate or induce asthma, other respiratory and neurological disease

- Children's developing lungs' smaller surface area, higher inhalation rate = greater exposure; potentially permanent damage to lung function.

  Early childhood: 20-40 breaths/min.

  Late childhood: 15-25 breaths/min.

  Adults: 12-18 breaths/min.

Gauderman Study (Lancet 2006, Vol 368)

- Children (n = 3677, ages 10-18) living in proximity to major road or freeway (500 meters) in 12 southern California communities (socio-economically diverse) showed substantial, likely permanent, lung function deficits compared to children living > 1500 meters from major road or freeway.
- Both gasoline and diesel exhaust contain many pollutants, including fine particulates (PM 2.5) and numerous carcinogenic compounds.

Background: Children's Exposure to Diesel Exhaust

- Exposures greatest inside school buses, but also at bus stops, other bus idling areas and in traffic (behind buses)

- Many children exposed for extended periods twice a day
  - 20 days per month
  - 9 months/year
  - 10 to 12 years
- 2 x 20 x 9 x 10 = 3600 exposures
- 2 x 20 x 9 x 12 = 4320 exposures

Background:
Pollution exposures aside, buses are safe

- School buses are highly visible, built to withstand great force, with padded seat fronts and backs; drivers specially trained

- A student traveling to school in a private vehicle is 96 x more likely to be involved in a fatal accident than when in a school bus. – *Transportation Research Board*

Goals of School Bus Retrofitting

- Reduce air toxics exposures to children and drivers inside buses; to communities from idling buses at neighborhood pickups, on school grounds, in traffic
- Reduce fuel usage via engine pre-heater technology (no need to idle to warm up the buses)
- Assist school districts that could not otherwise pursue such programs.

- *NOTE: CDPHE program is "statewide," outside of the Denver Metro Area. The Regional Air Quality Council retrofits buses in the DMA.*

Goals of Emission- and Idling- Reduction Technologies

- Engine pre-heaters greatly reduce need for idling; can save 1 gallon per bus per day of diesel fuel
  - ❖ 1 gal x 50 buses x 20 days x 9 mos x $2.67 = $24,030.

- Diesel oxidation catalysts (DOC) – certified to remove at least 20% of PM and 50% of HC

- Crankcase filtration (CCF) – certified to reduce PM 2.5 emissions (inclusive of many toxics) from under hood by upwards of 95% . We also provide first two replacement filters.

Average cost to retrofit a bus with all three: $4,000.
Replacement filters $50 each//500 hours.

Colorado Clean Diesel Program Benefits (Buses)

To date,(May 2010), retrofits at 20 school districts completed in Pueblo, Weld, Garfield, Rio Blanco counties.

- **Number of buses retrofitted: 450**
- **Number of students protected (65 x 450): 29,000**
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- **Annual fuel savings 89,100 gallons**
- **@ $3.00/gal. =$267,300.**

CCD Program Benefits: Measured in-cabin pollutant reductions

- PM 2.5 mass reduced by 56%
- Elemental carbon reduced by 85%
- Organic carbon reduced by 41%
- Formaldehyde reduced by 32%
- Hopanes (lube oil) reduced by 37%
- P-PAH (tailpipe) reduced by 50%
- Aliphatics (tailpipe) reduced by 43%

Little change for Acetaldehyde; acetone increased – likely a function of catalytic chemistry. Majority of toxins--and the more potent toxins--were reduced.

(CU School of Mechanical Engineering-Trenbath, Hannigan, Milford Paper published in *Atmospheric Environment.)*

CCD Program Benefits: Tailpipe emission reductions

- Reduce opportunity for bus "self-pollution" from tailpipe emissions and crankcase.
- School bus retrofits protect the health of bus riders and others near buses; *not* a regional ambient AQ strategy
- Protects "our future" Avoids healthcare costs.

Annual Reductions (tons per year) per 100 and per 700 buses

- MY 1995 buses per EPA Diesel Emission Quantifier (9/09)
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NOx	PM	HC	CO	CO2
4.2	0.43	2.36	8.76	139.36
29.4	3.01	16.52	61.32	975.5

CCD Quality Control

- Quality control assured by Mobile Sources Program engine/mechanical experts
- Inspect each piece of equipment after installation to ensure proper functioning
- Only then may contractor invoice.

Funding: Diesel Emission Reduction Act (DERA); American Response and Recovery Act (ARRA)

- CDPHE has received from EPA
  - $ 600,000 DERA for school bus retrofits in (2008)
  - $1.73 million ARRA/DERA for bus retrofits (2009)
  - $ 850,000 for ARRA OTR truck Retrofits (2009)
  - $ 235,294 DERA for bus retrofits (2010)

  $3.415 million

Currently funding retrofits in El Paso county. Next are: Gunnison, Dolores and La Plata school districts .

CCD Program Activities

- Apply for funds: Past and current funds will retrofit 700 buses and 180 long-haul trucks (APU's)
- Outreach to school districts includes presentation meetings, gathering fleet info
- Hired 4 contractors via RFP/bid process
- Pre-inspect and test buses
- Monitor contractor work via weekly conference calls and QA process
- Quarterly reports on each grant and SEP
- Train fleet managers regarding equipment.

CCD Program participants

- USEPA Region 8: Greg Davis, Kyle Olson, Michael Wenstrom
- CDE and School Districts around the State
- Contractors: Stewart-Stevenson; Instrument Sales, Service, MHC-Kenworth, Rush Truck Centers
- CDPHE: APCD Planning & Policy (Lisa) ; Mobile Sources Program (Garry Kaufman, Dave Moreau, Raymond Elick, Lonnie Shrewsbury); Fiscal and Purchasing groups
- CU: Boulder School of Mechanical Engineering
- Regional Air Quality Council: Steve McCannon, Kate Riegle