OTT
Office of Heavy Vehicle Technologies

# OHVT's Study of Comparative Toxicity of Engine Emissions – Sources, Samples, and Participants

**Douglas R. Lawson, NREL**
National Renewable Energy Laboratory
1617 Cole Boulevard, Golden, CO 80401
303.275.4429
doug_lawson@nrel.gov

NREL
CENTER FOR TRANSPORTATION TECHNOLOGIES AND SYSTEMS

# Comparative Toxicity Study

## Program Objective

- Conduct comparative toxicity studies of gasoline and diesel PM and SVOC exhaust samples

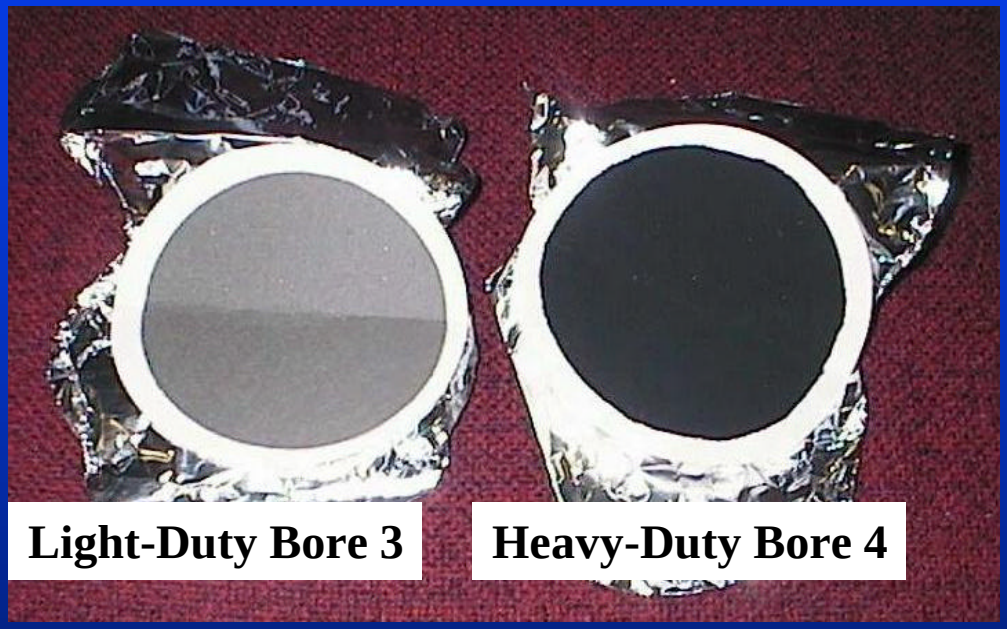
## Tasks

- Collect on-road and dynamometer gasoline and diesel vehicle PM and semi-volatile (SVOC) exhaust samples from new and in-use vehicles
- Perform detailed chemical analyses on fuels and collected PM and SVOC samples

# Comparative Toxicity Study

- Subcontractors are Desert Research Institute, Southwest Research Institute, University of Dayton Research Institute, Lovelace Respiratory Research Institute, NIOSH, ORNL; pilot studies completed in April 1999
- 2 Phases for collection of gas and diesel exhaust
  - Dynamometer testing to acquire 4 gr PM and associated semi-volatile compounds (SVOC); completed in June 2000
  - Ft. McHenry (Baltimore) Tunnel study testing to acquire 4 gr PM and associated semi-volatile compounds (SVOC); completed Sept. 1999
- 14 samples selected by NREL and sent to Lovelace for comparative toxicity testing between gas and diesel emissions
- Selected samples sent to NIOSH for genotoxicity testing
- Gasoline and diesel PM and SVOC dynamometer samples have been collected at SwRI and sent to ORNL for morphological analyses

# Ft. McHenry Tunnel $PM_{2.5}$ Samples Pilot Study – Collected April 1999




Ft. McHenry tunnel contains four bores, two in each direction. Of the two in each direction, HDVs can only go through one (Northbound-bore 4), allowing relatively good segregation of light-duty/heavy-duty samples. Heavy-duty bore includes some LDVs, but HDVs dominate.

# Comparative Toxicity Study

## Samples for Testing

- **Dynamometer Samples at 72 °F (PM and SVOC):**

  1) Ave. gasoline vehicles
  2) Black Smoker gasoline vehicle
  3) White Smoker gasoline vehicle
  4) Current technology diesel vehicles
  5) High emitter diesel vehicle
  6) New technology gasoline vehicles
  7) New technology diesel vehicle

- **Dynamometer Samples at 72 °F (SVOC only):**

  8) Ave. gasoline vehicles (same as #1)
  9) Current technology diesel vehicles (same as #4)

- **Dynamometer Samples at 30 °F (PM and SVOC):**

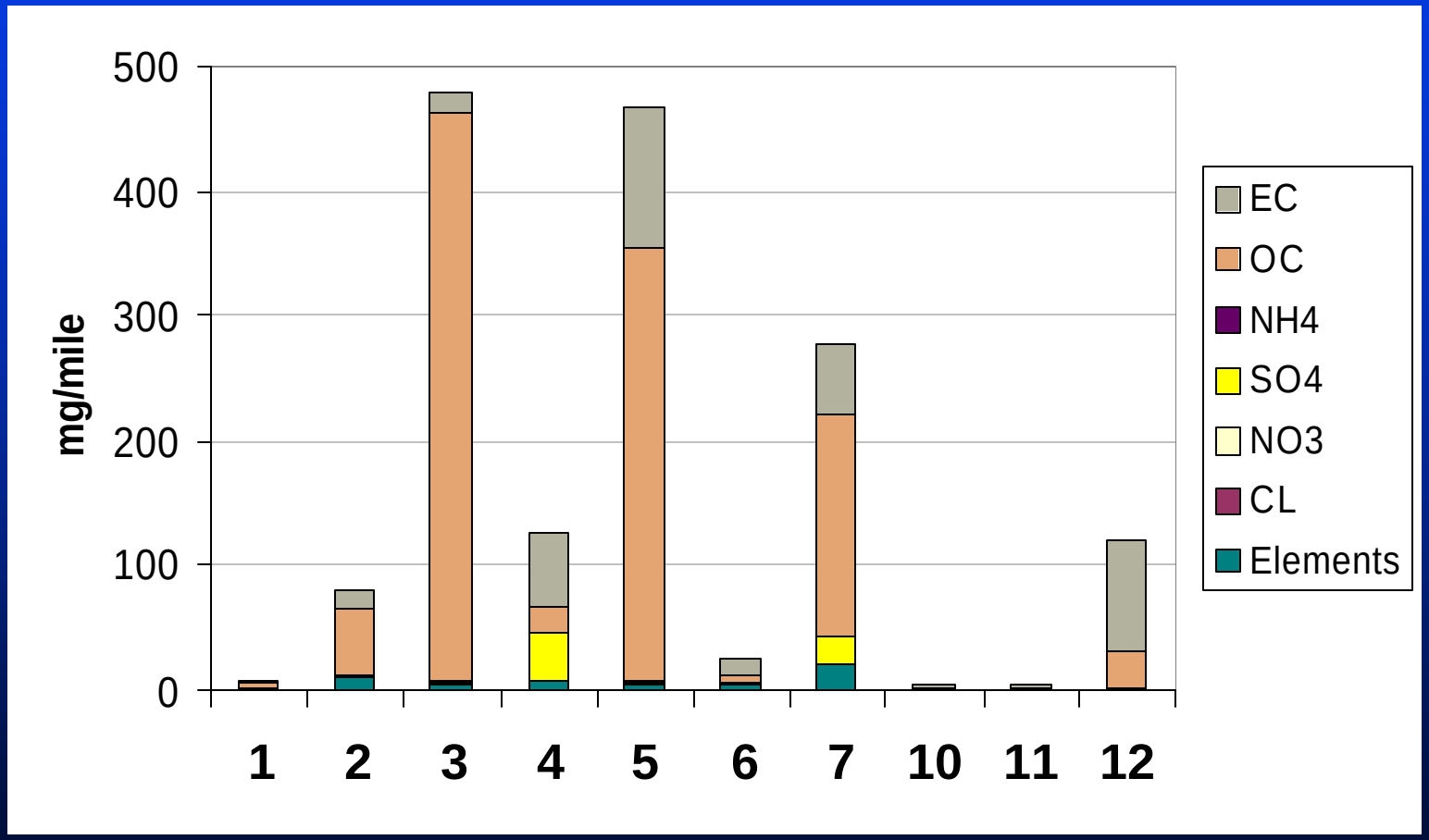
  10) Ave. gasoline vehicles (same as #1)
  11) Current technology diesel vehicles (same as #4)

- **Samples from Fort McHenry Tunnel (PM and SVOC):**

  12) “Diesel” fleet sample plus “background” sample
  13) “Gasoline” fleet sample plus “background” sample

# Comparative Toxicity Study – UDC Emission Rates

## PM Emission Rate Summary (from in-line CVS filters)

| Vehicle Category | Test Vehicles | Odometer, miles | Total PM Emission Rate, mg/mi | |
|---|---|---|---|---|
| | | | ~72ºF | ~30ºF |
| Average SI Vehicles | 96 Mazda Millenia<br>95 Ford Explorer<br>82 Nissan Maxima<br>94 GMC Pickup<br>93 Mercury Sable | 35,162<br>76,733<br>190,203<br>68,325<br>70,786 | 11 | 35 |
| SI Black Smoker | 76 Ford F-150 Pickup | 199,499 | 67 | |
| SI White Smoker | 90 Mitsubishi Montero | 184,583 | 770 | |
| Current Technology CI Vehicles | 99 Dodge Ram 250 Pickup<br>98 Mercedes Benz E300<br>00 BW Beetle TDI | 37,242<br>47,762<br>7,495 | 144 | 389 |
| CI High Emitter | 91 Dodge Ram 2500 Pickup | 35,455 | 483 | |
| New Technology SI Vehicle (NLEV) | 99 Ford Windstar | 5,140 | 3.3 | |
| New Technology SI Vehicle (ULEV) | 99 Honda Accord | 4,715 | 3.3 | |
| New Technology CI Vehicle | 99 Mercedes Benz C220 | 6,250 | 122 | |

# Comparative Toxicity Study – UDC Emission Rates