# MOBILE SOURCE PARTICULATE AND SEMI-VOLATILE ORGANIC CARBON AMBIENT MODELING

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# Review Potential Individual Adjustments to MOBILE6

- Current modeling air quality has consistently under predicted the organic carbon particulate measured at ambient monitors
- Likely future emission factors improvements in air quality modeling scenarios
  - Light-duty gasoline vehicle (LDV): PM adjustments reflecting multi-sponsored test data in Kansas City
  - Light-duty gasoline vehicle (LDV): Remote sensing study comparisons for high emitters sensitivity analysis
  - Heavy-duty diesel vehicles (HDDV): in-use testing and realistic testing cycles
- Inclusion of semi-volatile hydrocarbons

# Kansas City Study Light-duty Gasoline Vehicle PM Emissions

- Adjustments to MOBILE6 LDGV and LDGT PM emissions at 72°F

LDGV – Passenger vehicles

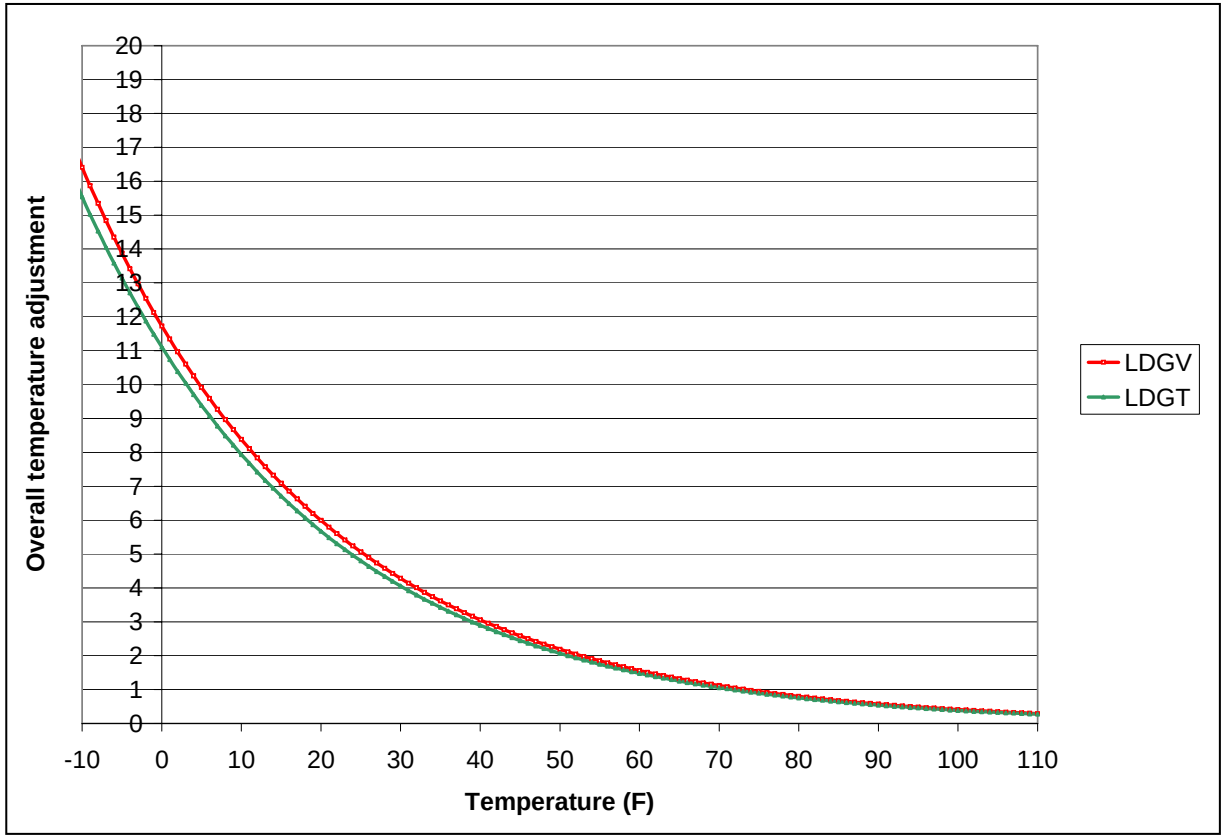
| MDYgroup | DRI Adj. | Chicago | Cincinnati | Detroit | Milwaukee | LADCO Average | NYC |
|---|---|---|---|---|---|---|---|
| 1981-1990 | **4.36** | 6.1% | 7.0% | 10.1% | 7.2% | | 10.3% |
| 1991-1995 | **1.82** | 15.8% | 18.3% | 15.5% | 18.5% | | 22.0% |
| 1996+ | **0.54** | 78.1% | 74.7% | 74.4% | 74.3% | | 67.6% |
| Average Adj. | | **0.97** | **1.04** | **1.12** | **1.05** | **1.044** | **1.21** |

LDGV – Trucks

| MDYgroup | DRI Adj. | Chicago | Cincinnati | Detroit | Milwaukee | LADCO Average | NYC |
|---|---|---|---|---|---|---|---|
| 1981-1990 | **2.01** | 5.8% | 8.3% | 7.0% | 21.0% | | 10.6% |
| 1991-1995 | **2.02** | 12.3% | 15.6% | 7.9% | 13.8% | | 12.2% |
| 1996+ | **0.68** | 81.9% | 76.1% | 85.1% | 65.2% | | 77.3% |
| Average Adj. | | **0.92** | **1.00** | **0.88** | **1.15** | **0.988** | **0.99** |

# Light-duty Temperature Adjustment

- Very significant temperature adjustment outlined by EPA (Ed Nam 2008)

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# High Emitter Analysis
# SEMCOG RSD and Atlanta CAFE RSD

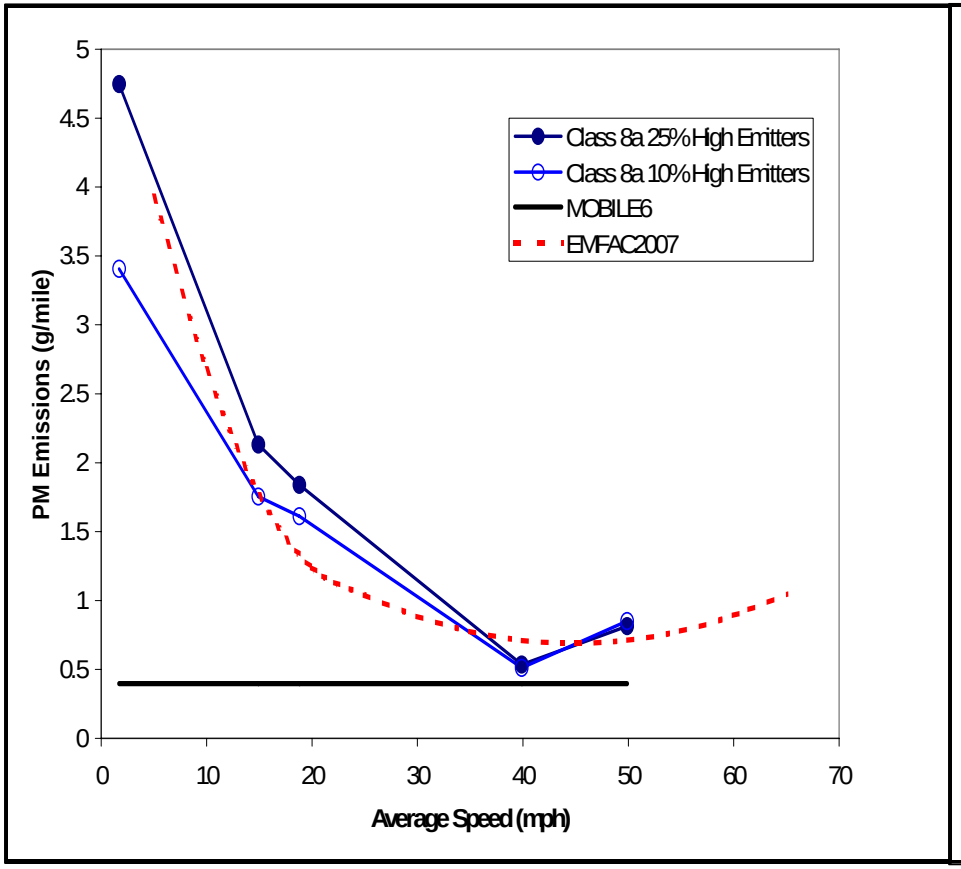
- Results from ENVIRON study funded by EPRI
- Used RSD data for:
  - Atlanta: Continuous Atlanta Fleet Evaluation (CAFÉ), Release 18.
  - Detroit: ESP and McClintock: *2007 High Emitter Remote Sensing Project*

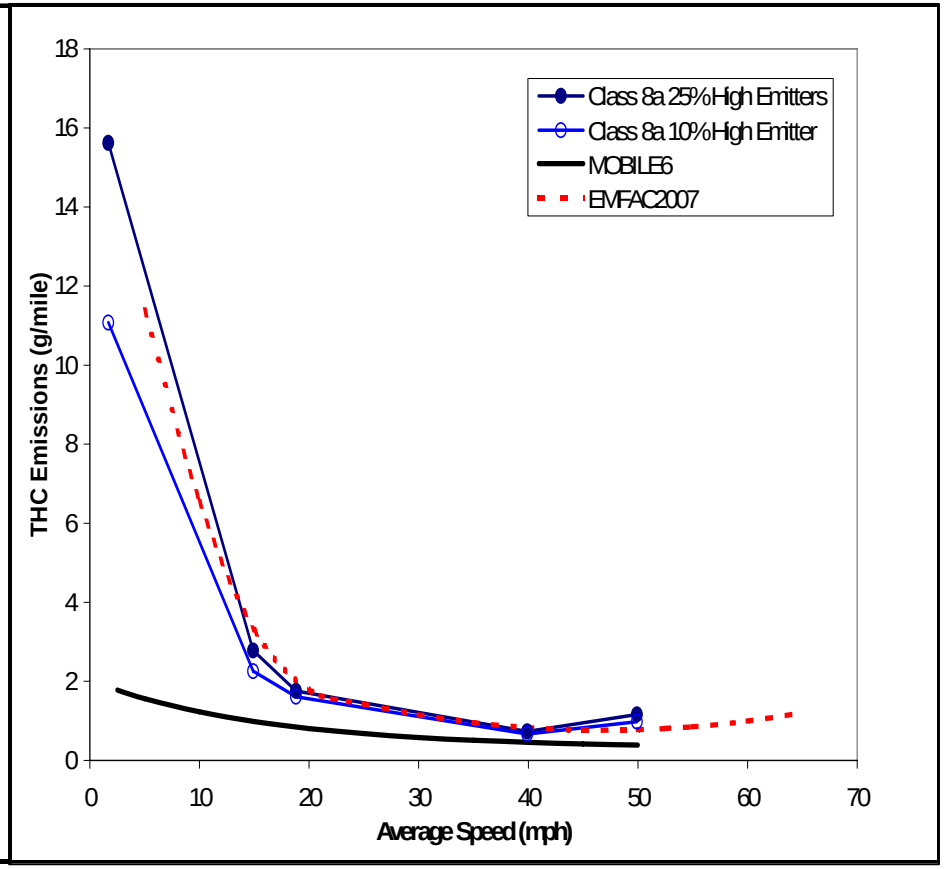
| Area | Running Exhaust Emission Factor Adjustments | | | |
|---|---|---|---|---|
| | LDGV | LDGT | LDGT1 | LDGT2 |
| **HC** | | | | |
| Detroit – SEMCOG (CY 2007) | +32% | -8% | - | - |
| Atlanta - CAFE (CY 2006) | +26% | - | +24% | +21% |
| **CO** | | | | |
| Detroit SEMCOG (CY 2007) | -61% | -46% | - | - |
| Atlanta – CAFE (CY 2006) | -46% | - | -36% | -35% |
| **NOx** | | | | |
| Detroit SEMCOG (CY 2007) | -22% | -54% | - | - |
| Atlanta – CAFE (CY 2006) | +68% | - | +88% | +83% |

# HDDV Approach

- Results from ENVIRON study funded by EPRI
- Vehicle types (normal and high)
  - High emitters (two types)
    - Snap-idle opacity failures
    - Others receiving repair based on mechanical review
- Test Cycles (ARB cycles and one other)
  - Creep3, Transient3, Cruise3, HHDDT short
  - Test D (simulated FTP cycle)
- Data Sources
  - West Virginia (CRC) Report E-55/59
  - Colorado School of Mines (EPA and other sponsors)
  - University of California Riverside
- Sample Size (mostly Class 8a (33k – 60k lbs. GVWR)

# Comparison with MOBILE6 and EMFAC2007 for HDDV

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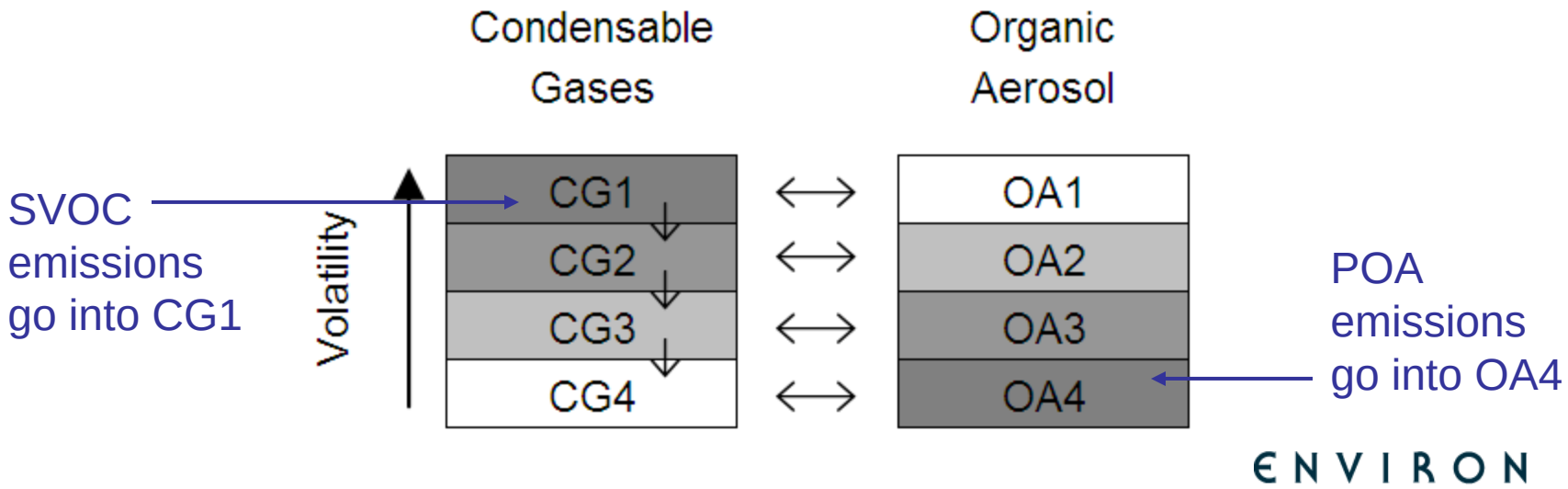
# Inclusion of Semi-Volatile Organic Carbon (SVOC)

- SVOC are missing from the speciation and perhaps in the emission estimates (~2 to 4% of TOG Emissions)
  - By weight are primarily C11 and C12 alkyl-benzenes and methyl-naphthalenes; minority sources have higher molecular weights
  - Not in the historic speciation profiles
  - These may adsorb or otherwise not be measured for light-duty gasoline vehicles as THC with the cold FID
- Mobile source SVOC usually ignored in PM modeling
  - CMU has added “IVOCs” to PMCAMx modeling
  - Intermediate species that after oxidation might condense
- These SVOCs are too volatile to condense under typical ambient conditions
  - Chemical aging rapidly lowers their volatility
  - The CMU “volatility basis set” methodology deals with aging and volatility

# Introduction of Mobile Source Emissions into Volatility Basis Set (VBS)

- Pairs of condensable gas (CG) and organic aerosol (OA) exists in thermodynamic phase-equilibrium according to a partitioning coefficient
- Chemical oxidation (aging) converts more volatile CGs to less volatile CGs
- Example VBS with four volatility levels:

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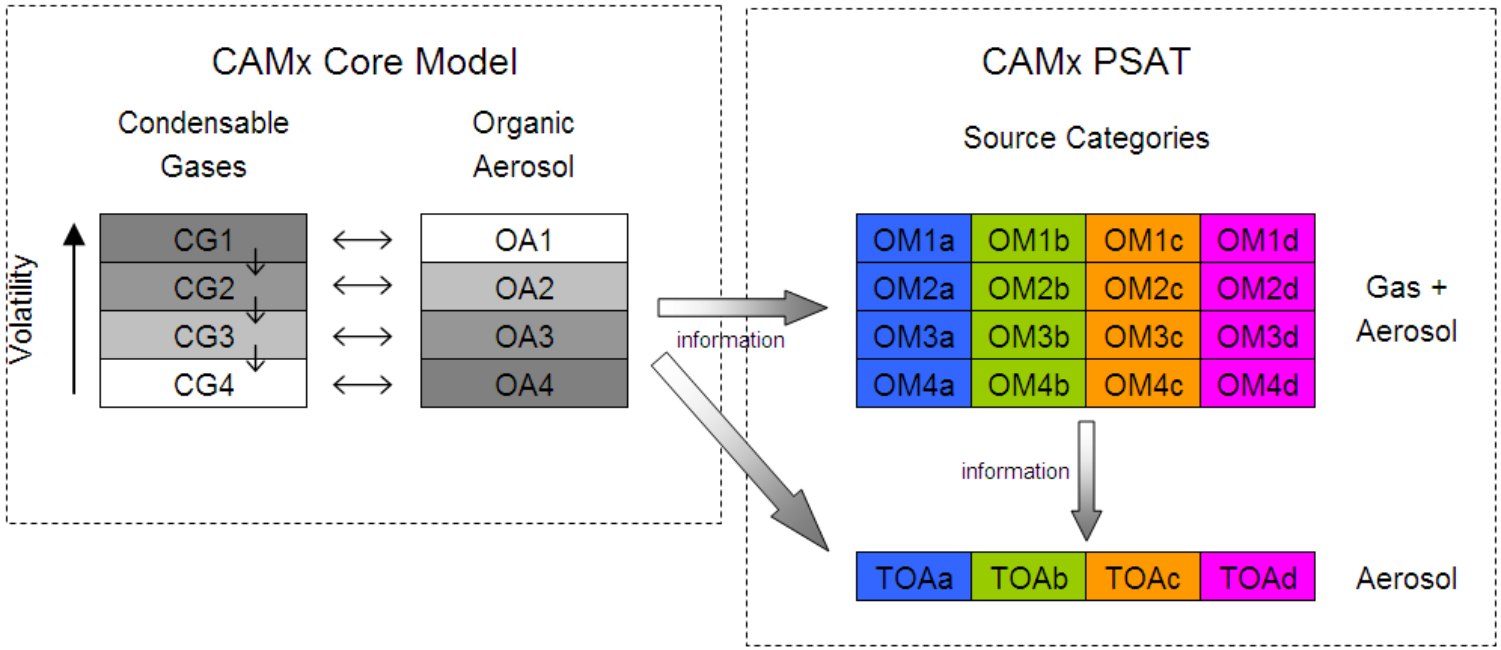
# Source Apportionment with the VBS

- CAMx PM source apportionment technology (PSAT)
  - can be used to separate the source contributions, e.g., gasoline vs. diesel vehicles
  - Figure shows PSAT methodology for apportioning four source category contributions (a-d) within a volatility basis set with four volatility levels (1-4)



# Modeling Plan

- MOBILE6 adjustments
  - LGV (mostly temperature adjustments especially important for winter conditions)
  - HDDV (speed adjustments)
  - Sensitivity for LGV high emitters
- SVOC inclusion (mass and chemistry)
- Comparison of modeled and monitor data