

# Implications of MOVES on Mobile Source Air Toxic Emission Estimates

**Midwest Transportation Air Quality Summit  
Grafton, Illinois**

**Michael Claggett**  
FHWA Resource Center

# Overview

## National Emission Trends

- DraftMOVES2009 versus MOBILE6.2 Comparisons

## Variability of Emission Factors with Vehicle Speed

- DraftMOVES2009 versus MOBILE6.2 Comparisons
- DraftMOVES2009 versus Emfac2007 Comparisons

## Variability of Emission Factors with Vehicle Congestion

## Project-Level Emission Trends

- DraftMOVES2009 versus MOBILE6.2 Comparisons

# Priority Mobile Source Air Toxics

**Acrolein**

**Benzene**

**1,3-Butadiene**

**Diesel Particulate Matter plus**

**Diesel Exhaust Organic Gases**

**Formaldehyde**

**Naphthalene**

**Polycyclic Organic Matter**

## Polycyclic Organic Matter

**Benzo[b]fluoranthene**

**Benz[a]anthracene**

**Indeno(1,2,3-c,d)pyrene**

**Benzo[k]fluoranthene**

**Chrysene**

**Benzo[a]pyrene**

**Dibenz(a,h)anthracene**

**Anthracene**

**Pyrene**

**Benzo(g,h,i)perylene**

**Fluoranthene**

**Acenaphthylene**

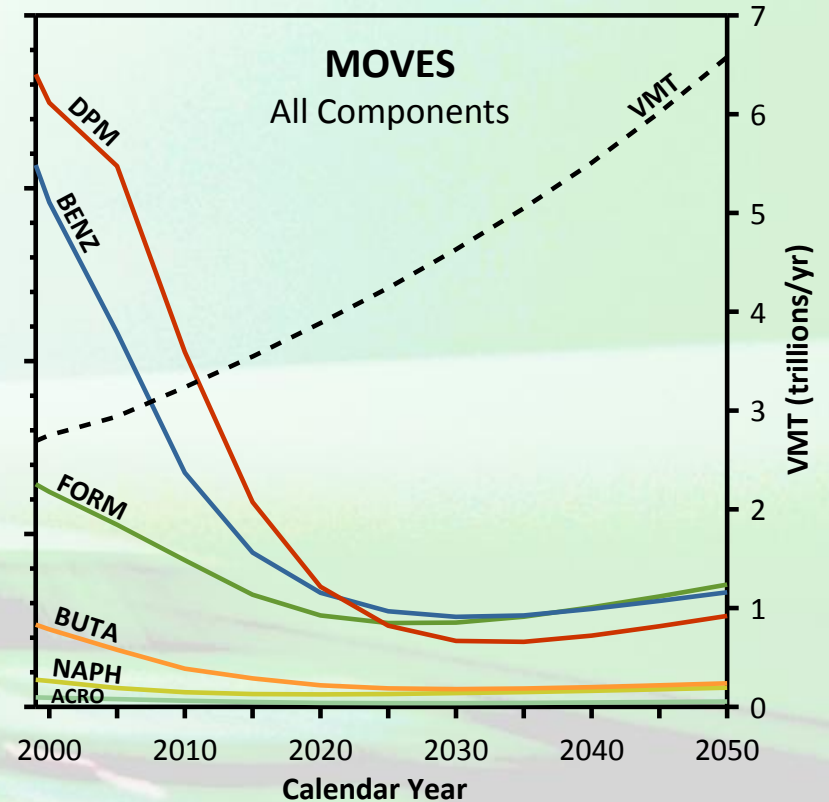
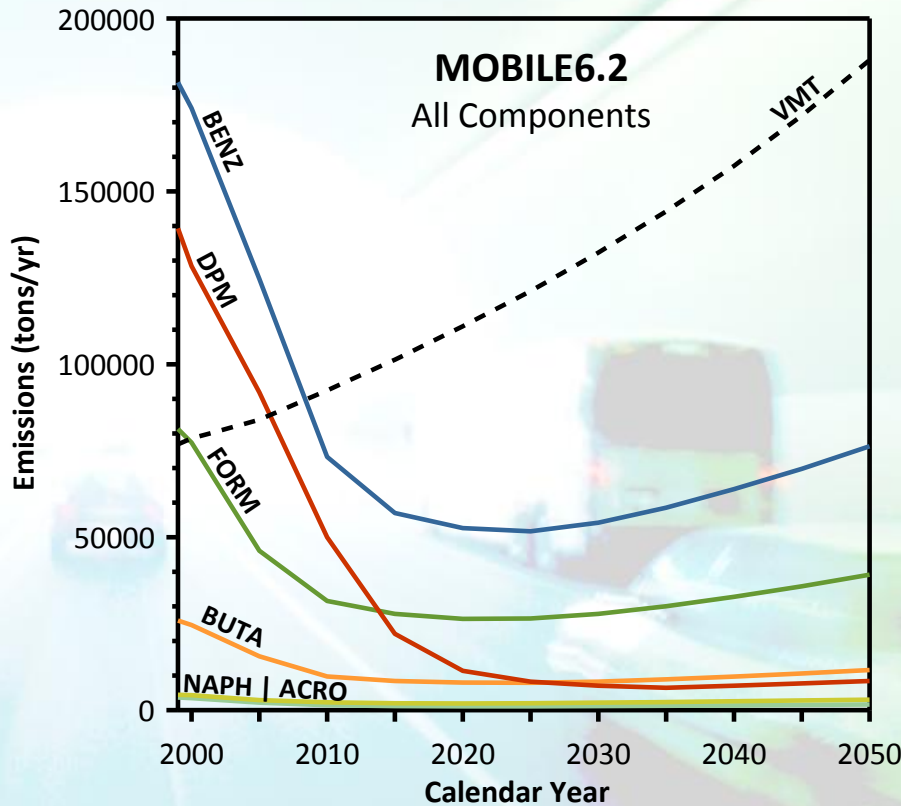
**Phenanthrene**

**Fluorene**

**Acenaphthene**

# National MSAT Emissions Trends

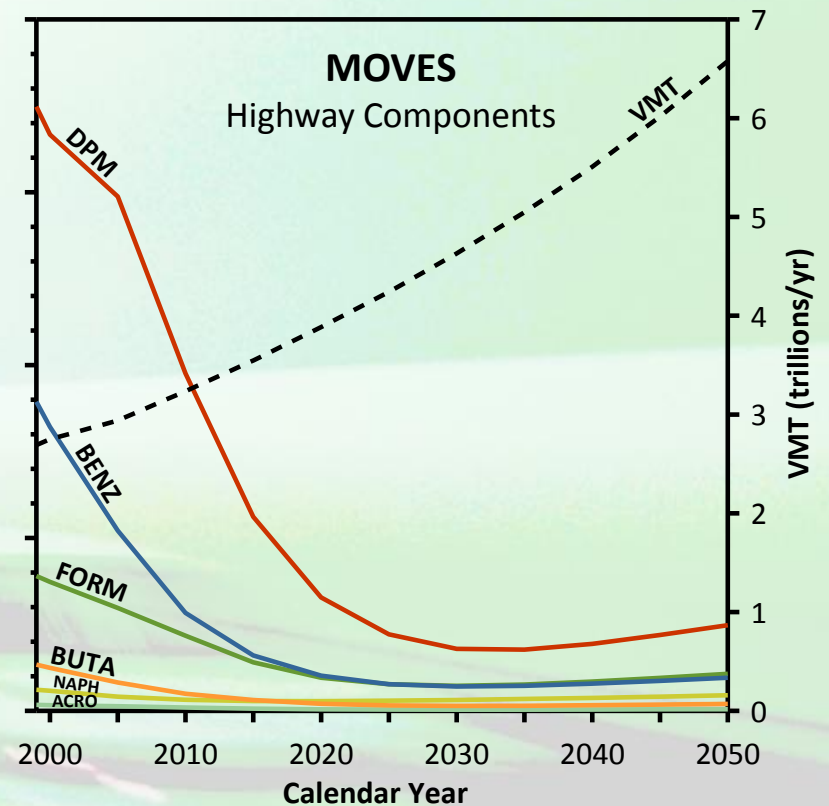
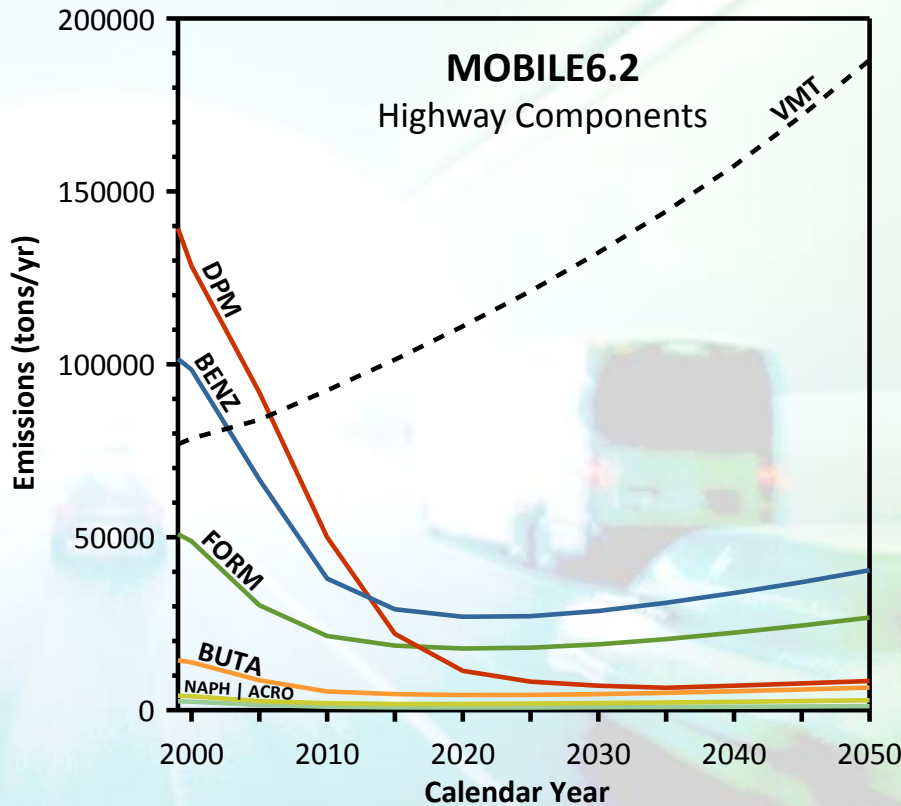
NOTE: Annual Emissions of Polycyclic Organic Matter are projected to be 561 tons/yr for 1999 decreasing to 373 tons/yr for 2050 based on MOBILE6.2 projections



- DPM - Diesel PM
- FORM - Formaldehyde
- NAPH - Naphthalene
- BENZ - Benzene
- BUTA - 1,3-Butadiene
- ACRO - Acrolein
- - - VMT - Vehicle-Miles Traveled

# National MSAT Emissions Trends

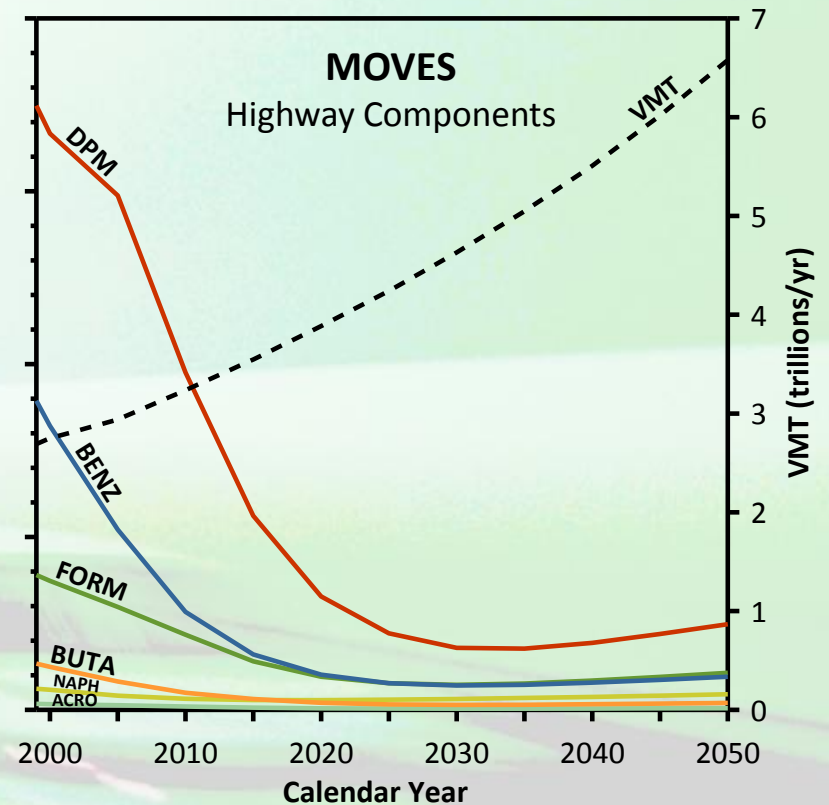
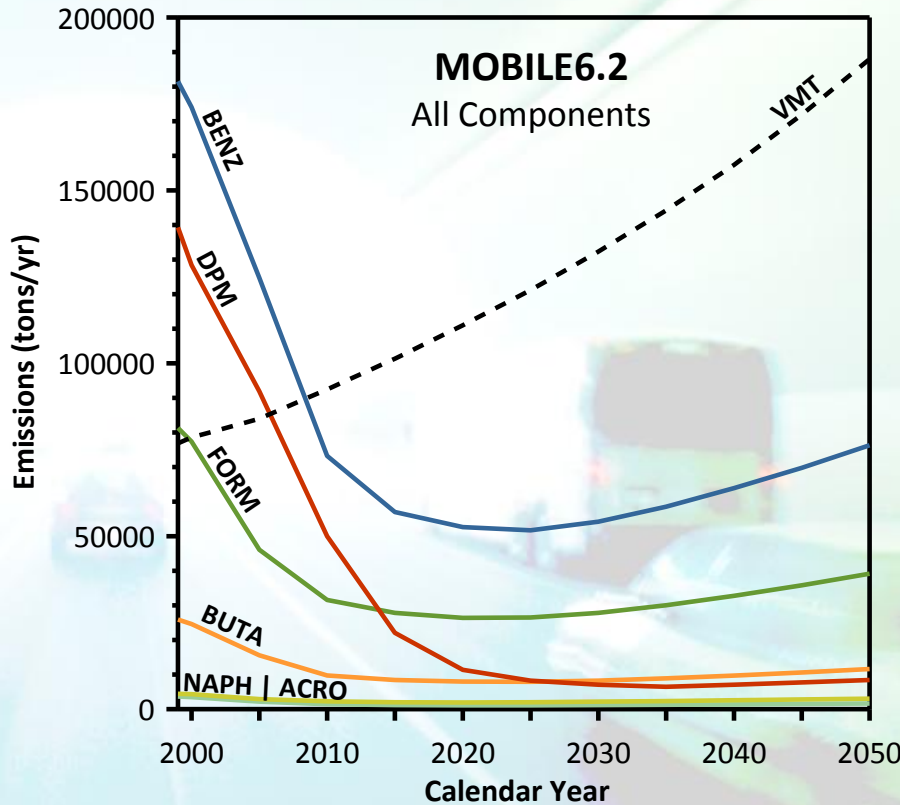
NOTE: Annual Emissions of Polycyclic Organic Matter are projected to be 561 tons/yr for 1999 decreasing to 373 tons/yr for 2050 based on MOBILE6.2 projections



- DPM - Diesel PM
- BENZ - Benzene
- FORM - Formaldehyde
- BUTA - 1,3-Butadiene
- NAPH - Naphthalene
- ACRO - Acrolein
- - - VMT - Vehicle-Miles Traveled

# National MSAT Emissions Trends

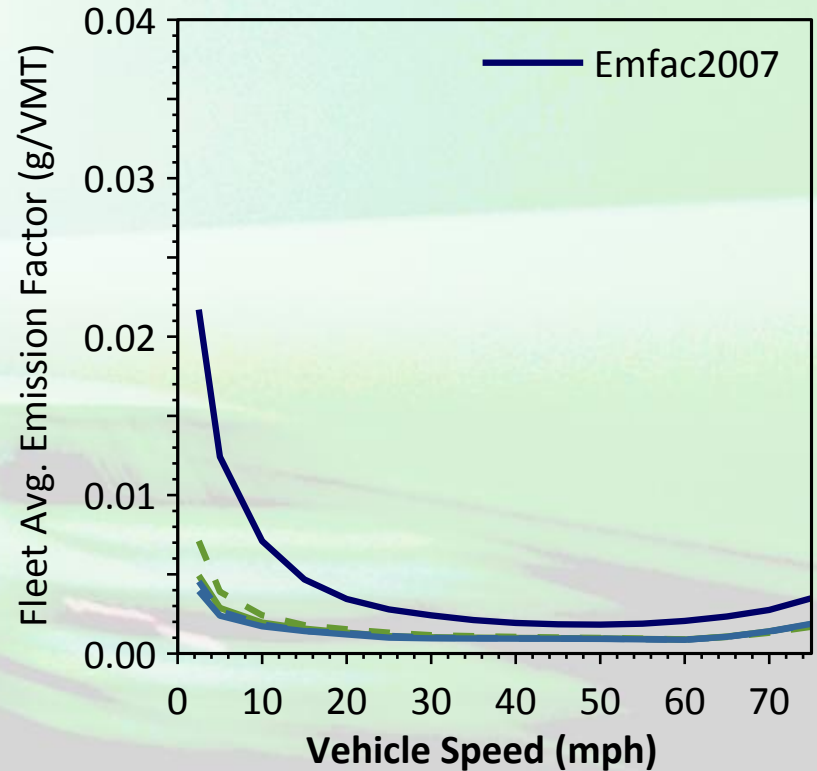
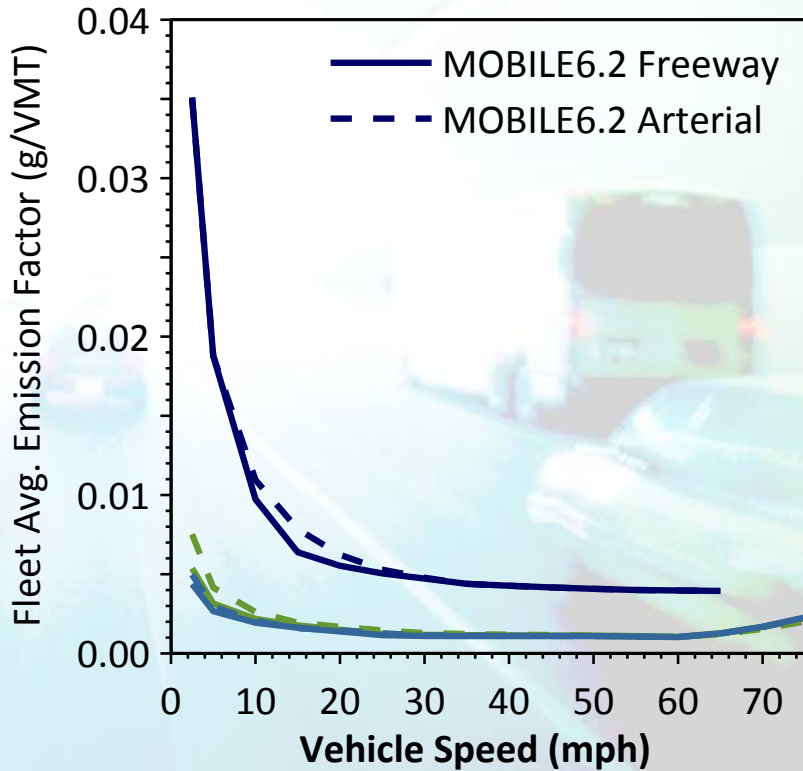
NOTE: Annual Emissions of Polycyclic Organic Matter are projected to be 561 tons/yr for 1999 decreasing to 373 tons/yr for 2050 based on MOBILE6.2 projections



- DPM - Diesel PM
- FORM - Formaldehyde
- NAPH - Naphthalene
- BENZ - Benzene
- BUTA - 1,3-Butadiene
- ACRO - Acrolein
- - - VMT - Vehicle-Miles Traveled

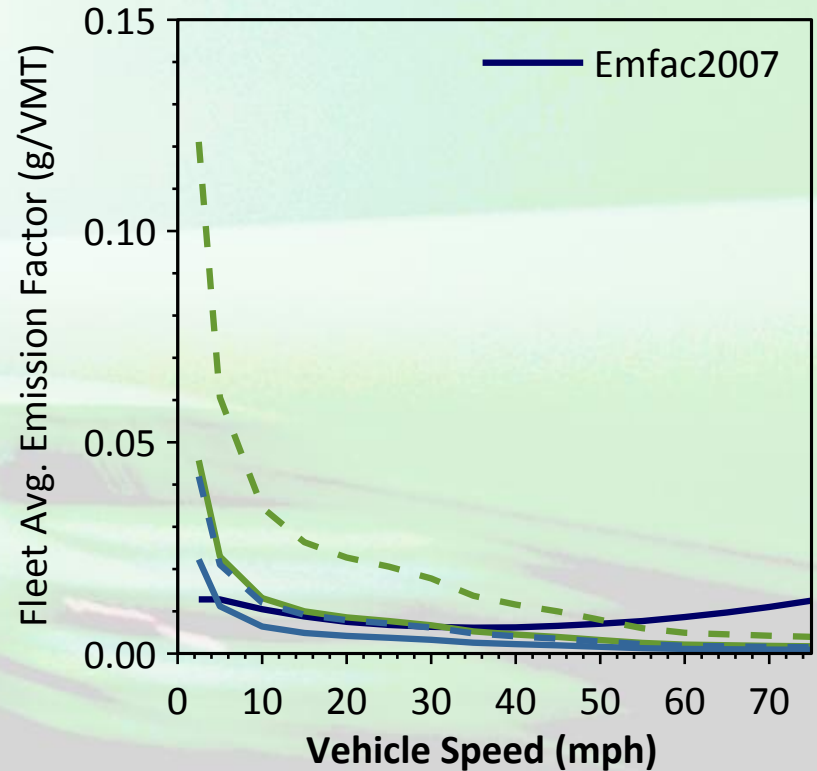
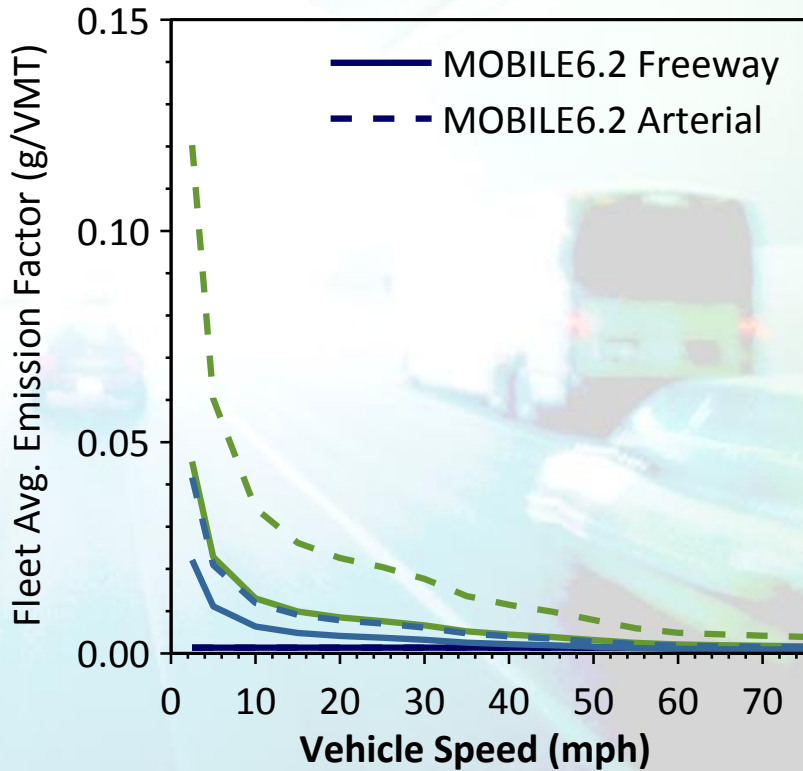
# Variability of Emission Factors with Speed – Benzene – 2030

- MOVES Urban Unrestricted
- - - MOVES Urban Restricted
- MOVES Rural Unrestricted
- - - MOVES Rural Restricted



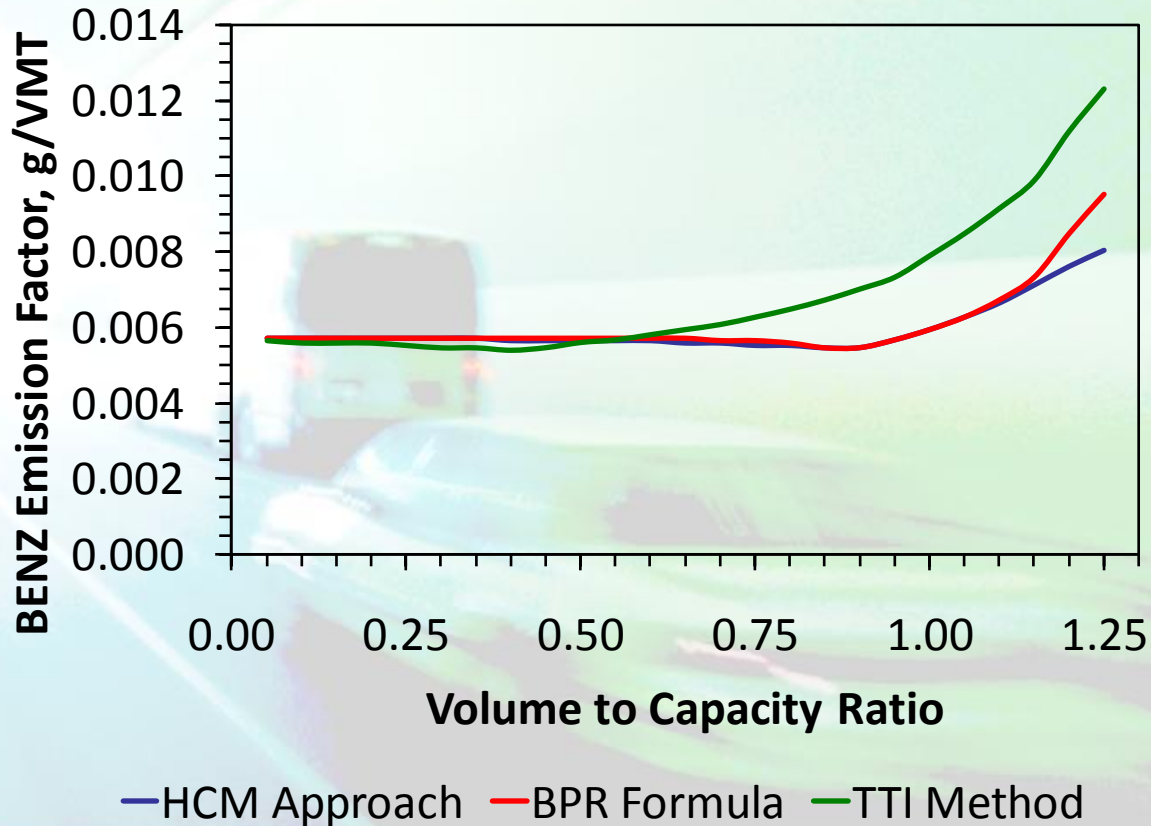
# Variability of Emission Factors with Speed – Diesel PM – 2030

- MOVES Urban Unrestricted
- - - MOVES Urban Restricted
- MOVES Rural Unrestricted
- - - MOVES Rural Restricted



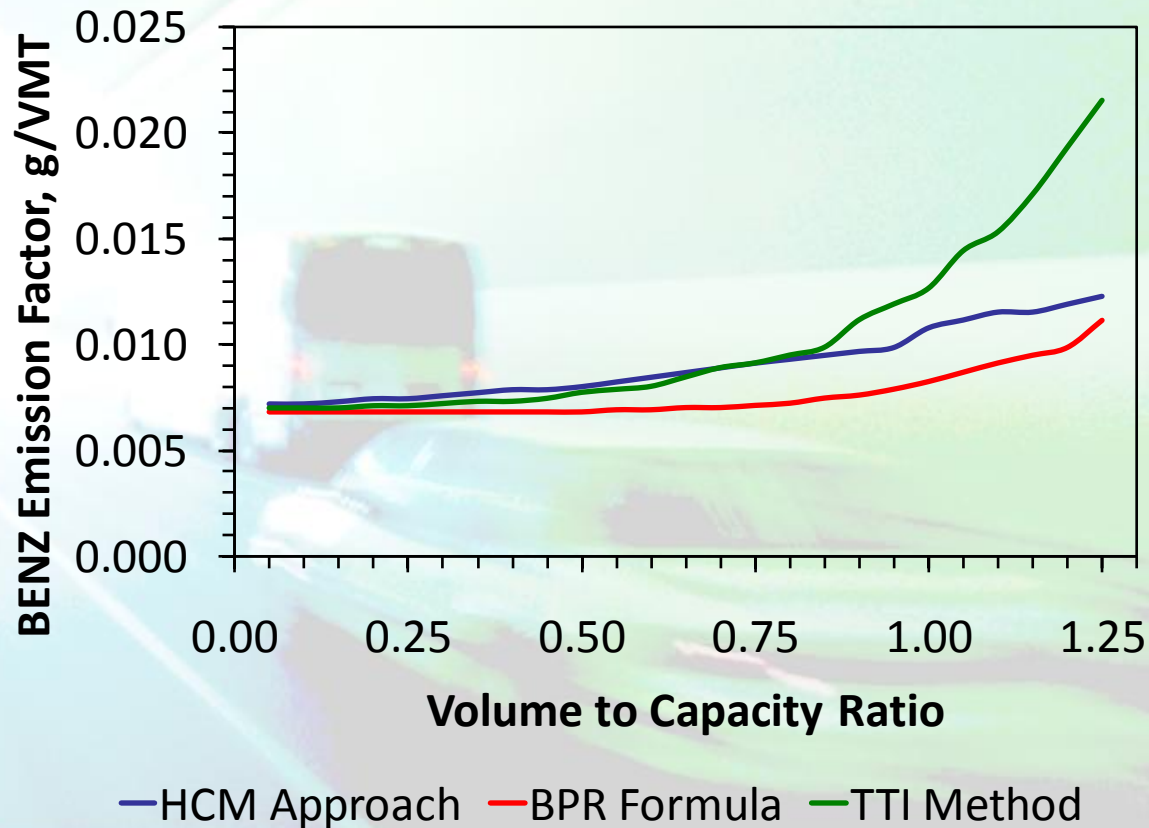
# Variability of Emission Factors with Congestion – Benzene – 2010

## Congestion Mitigation – Urban Restricted Access



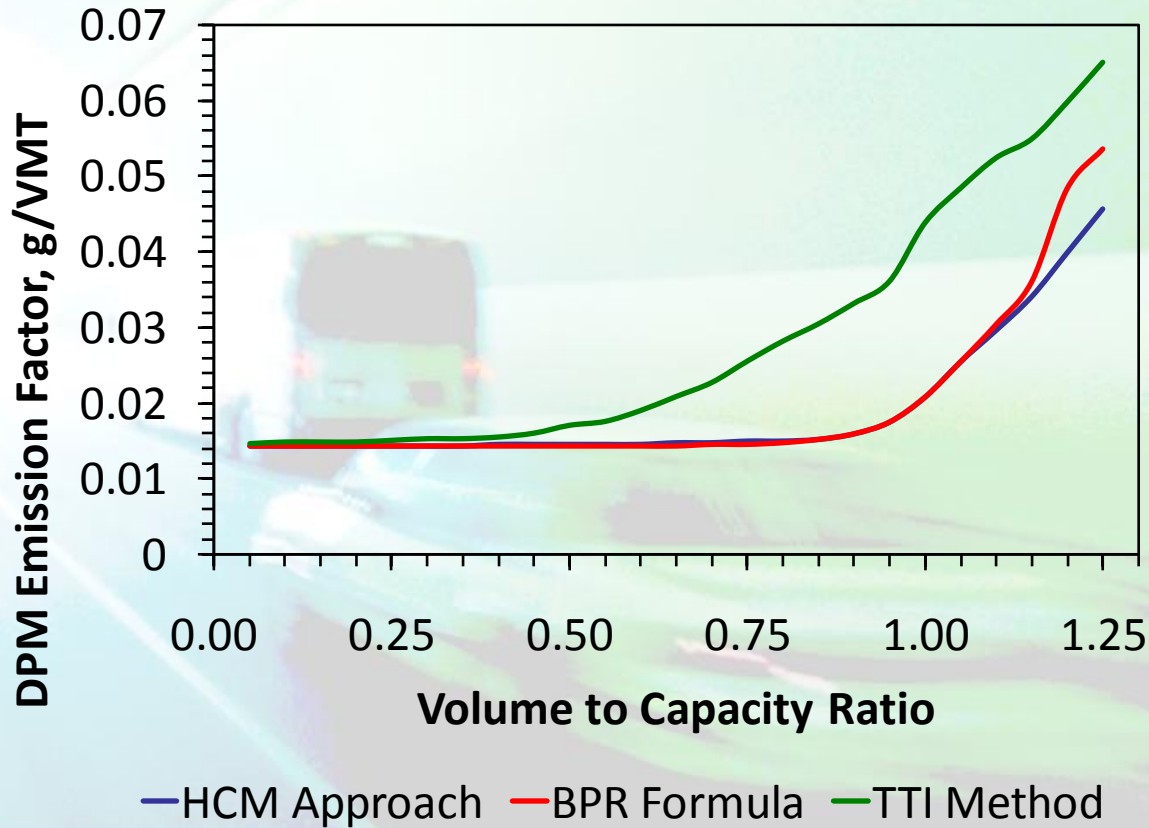
# Variability of Emission Factors with Congestion – Benzene – 2010

## Congestion Mitigation – Urban Unrestricted Access



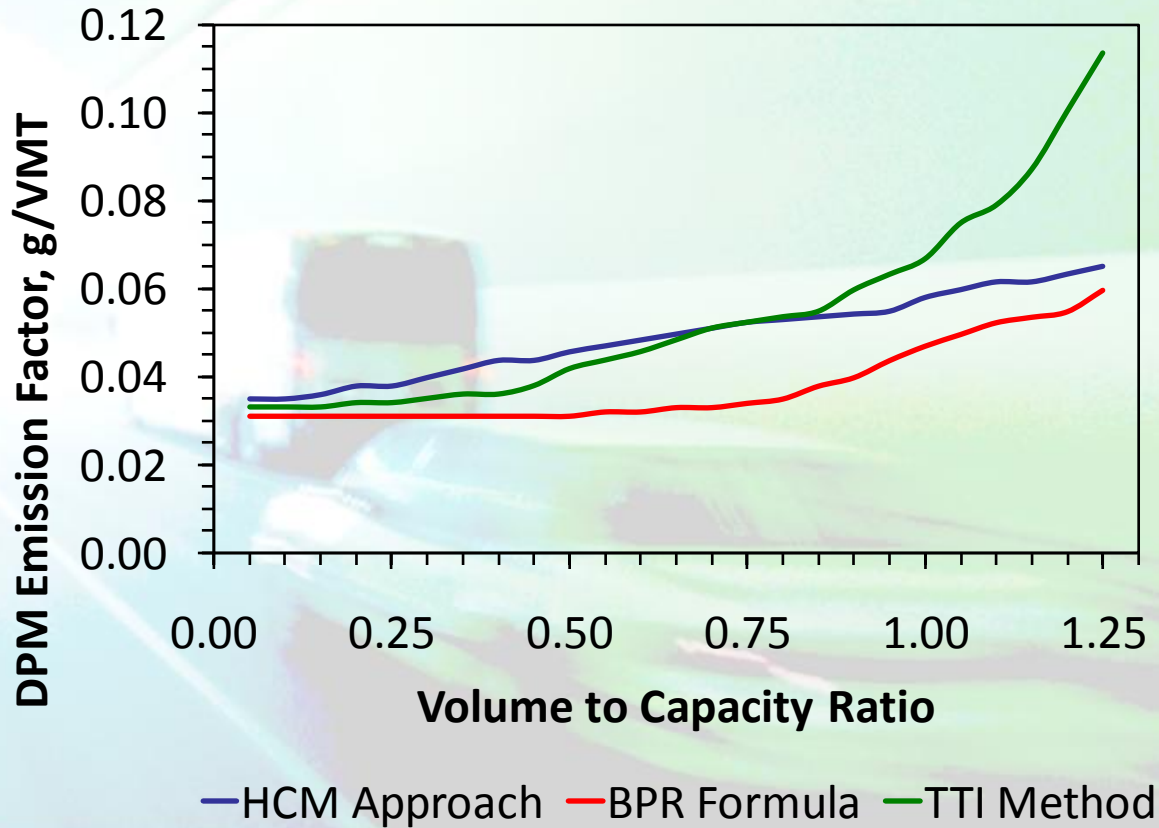
# Variability of Emission Factors with Congestion – Diesel PM – 2010

## Congestion Mitigation – Urban Restricted Access

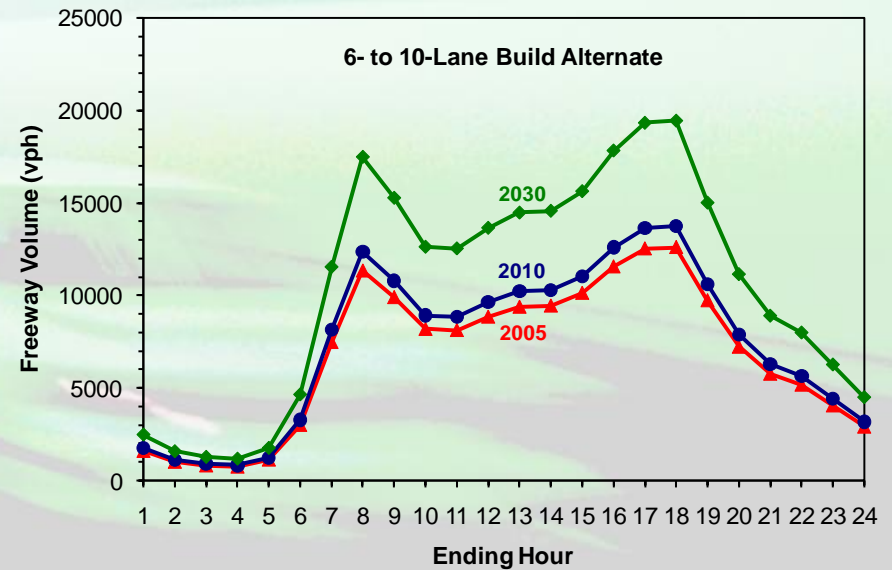
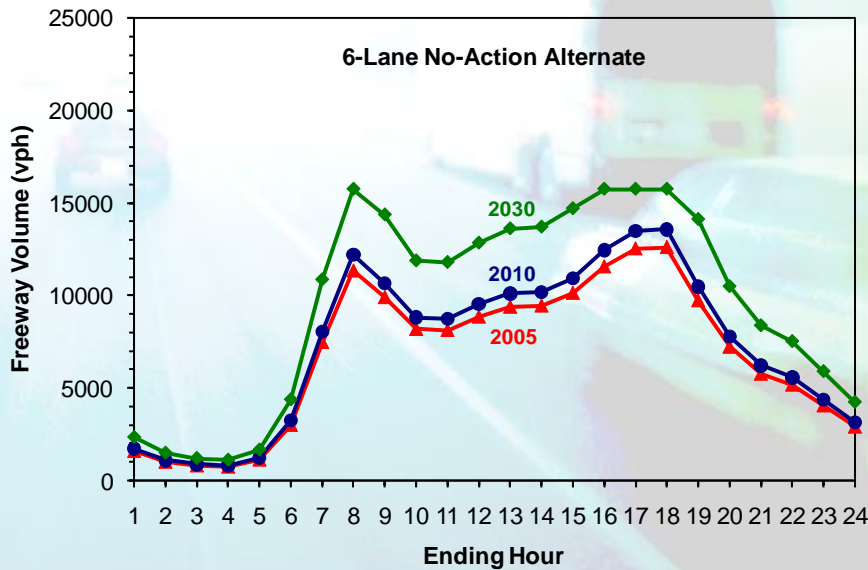
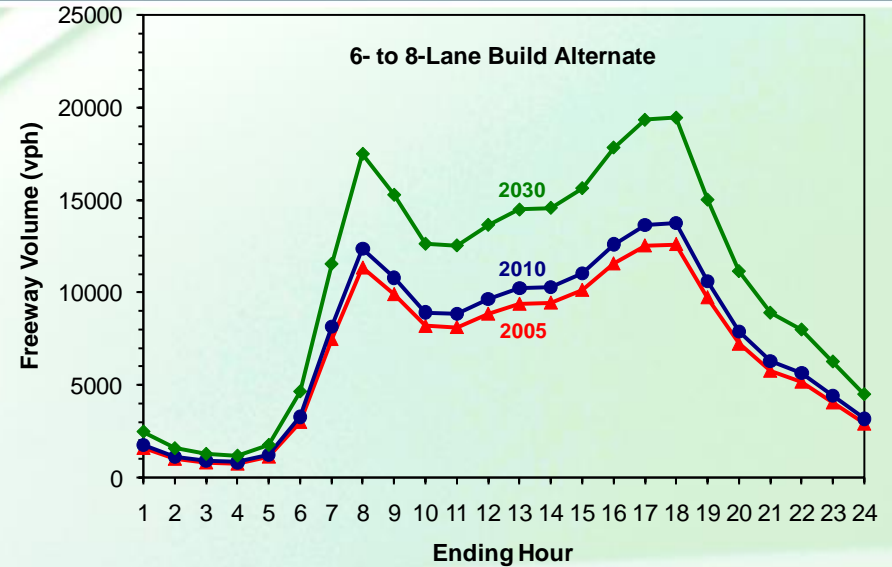


# Variability of Emission Factors with Congestion – Diesel PM – 2010

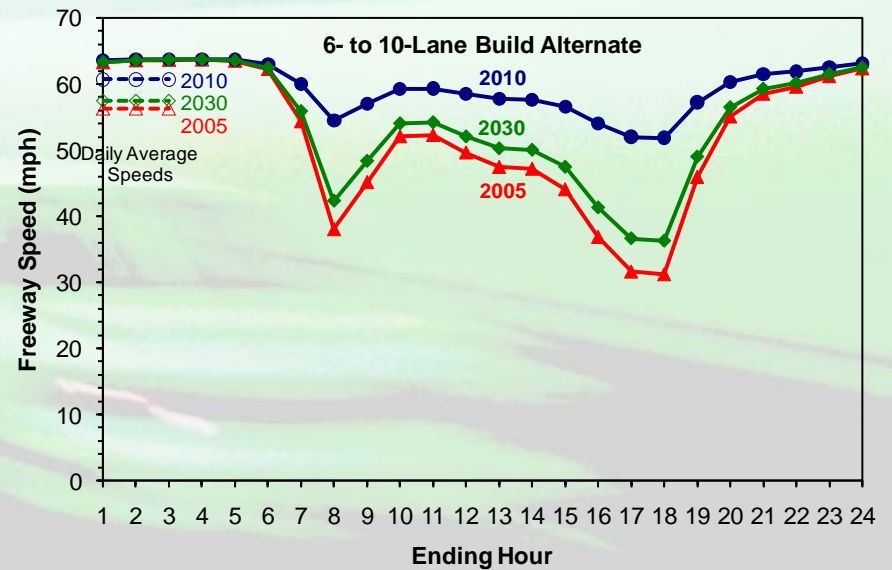
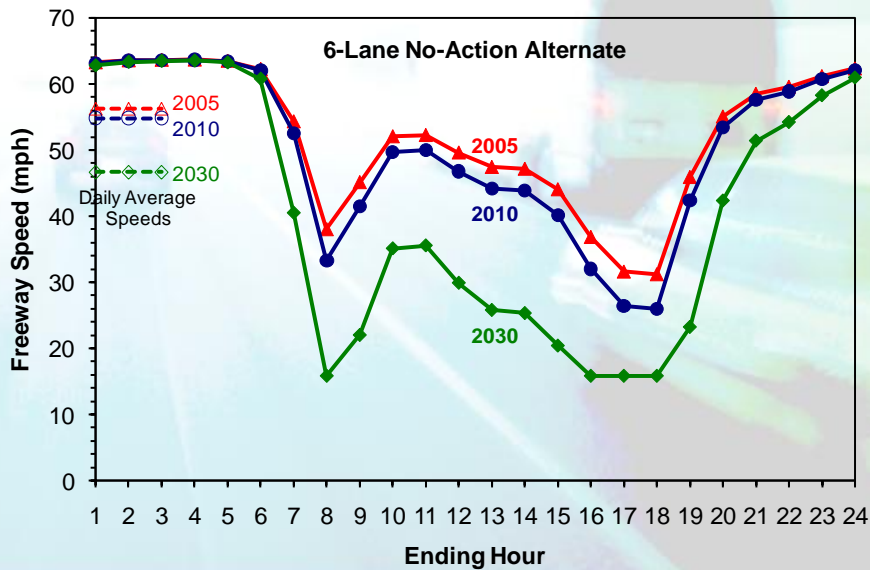
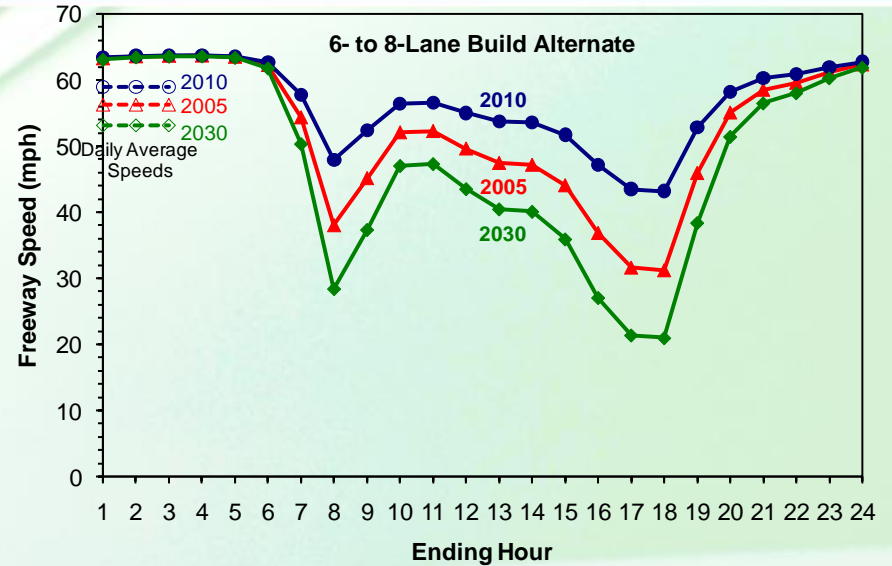
## Congestion Mitigation – Urban Unrestricted Access



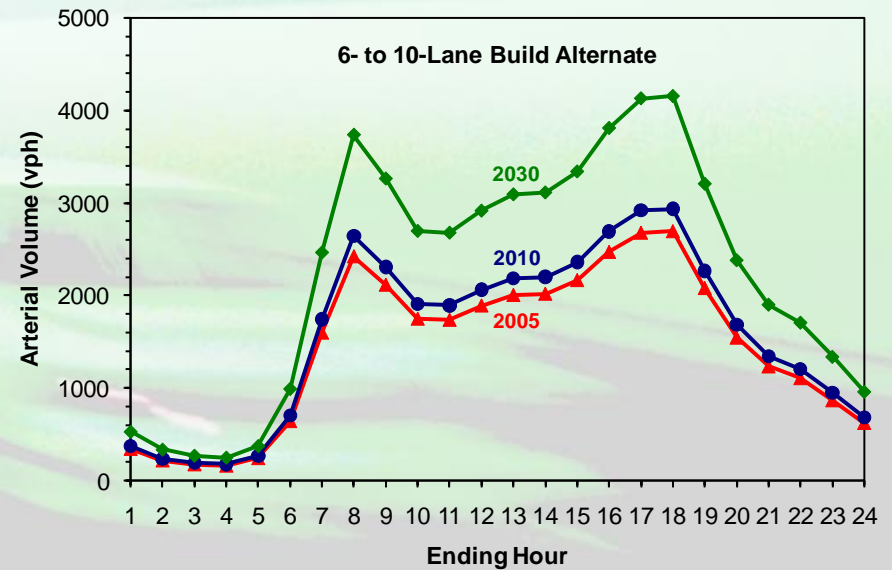
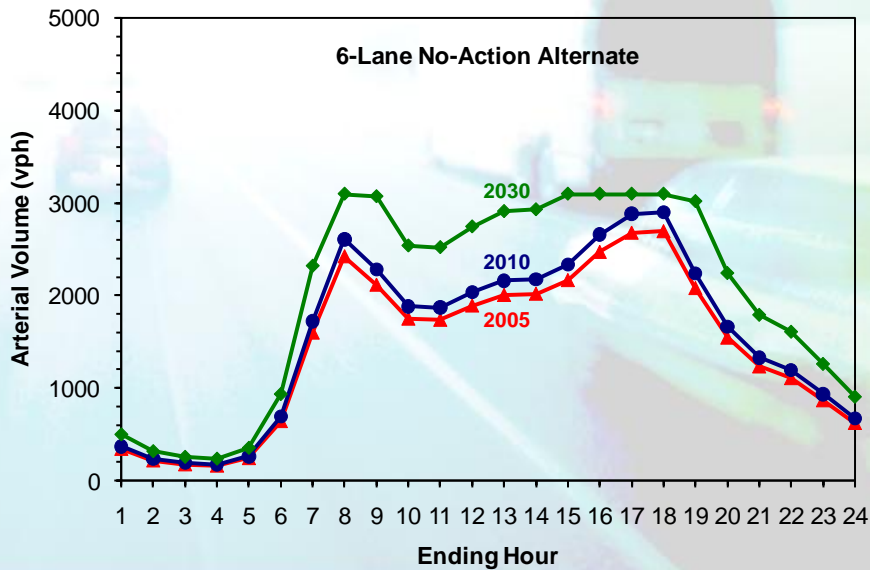
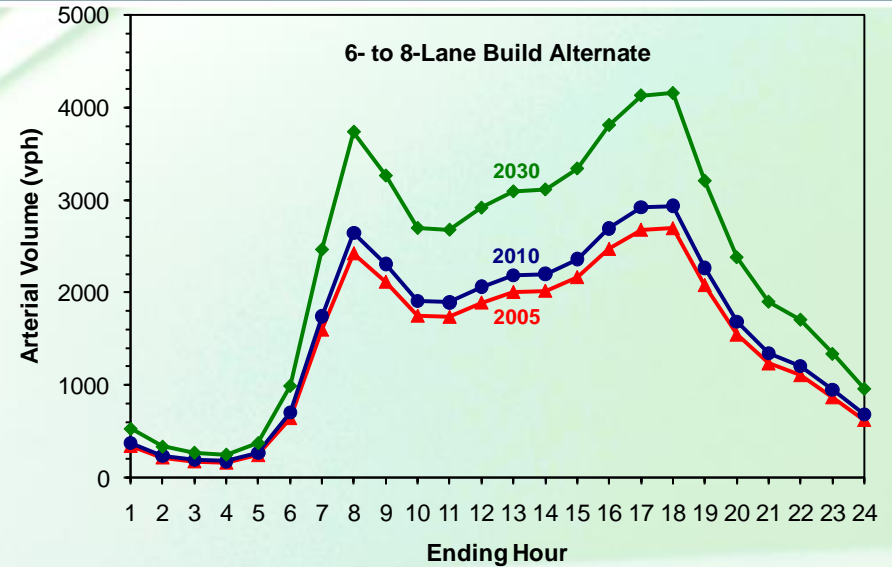
# Freeway Hourly Traffic Volumes



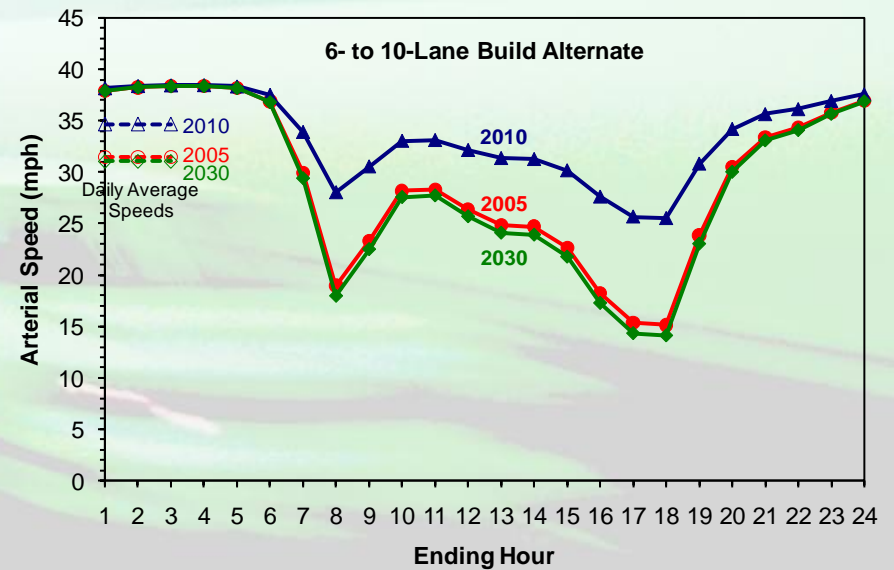
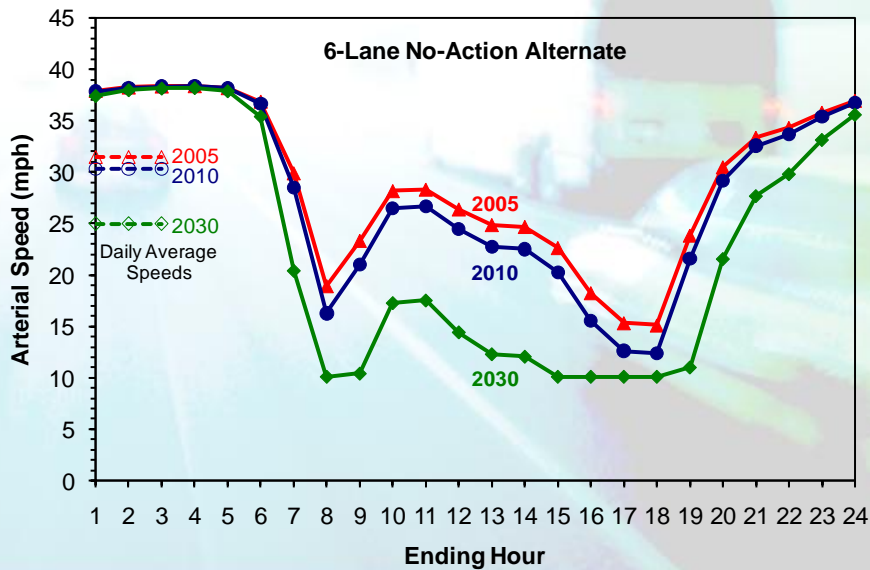
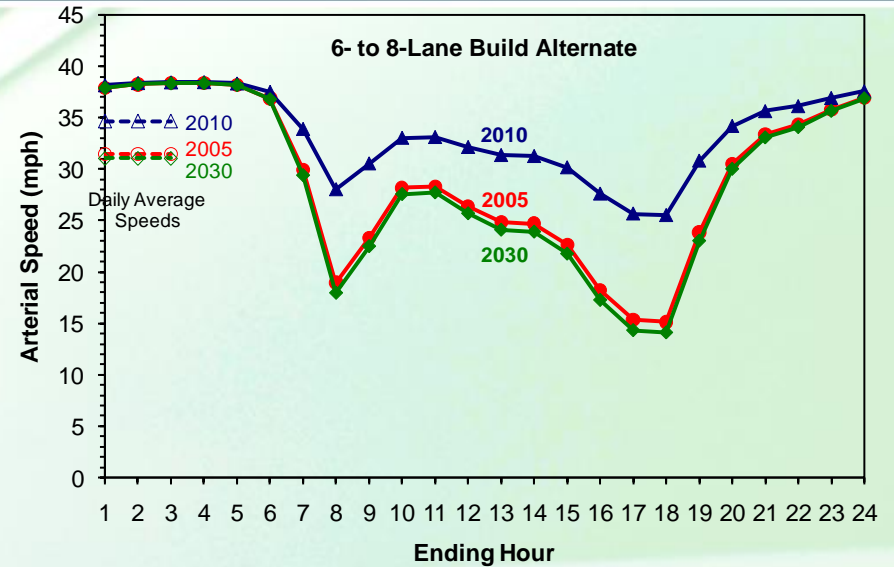
# Freeway Hourly Traffic Speeds



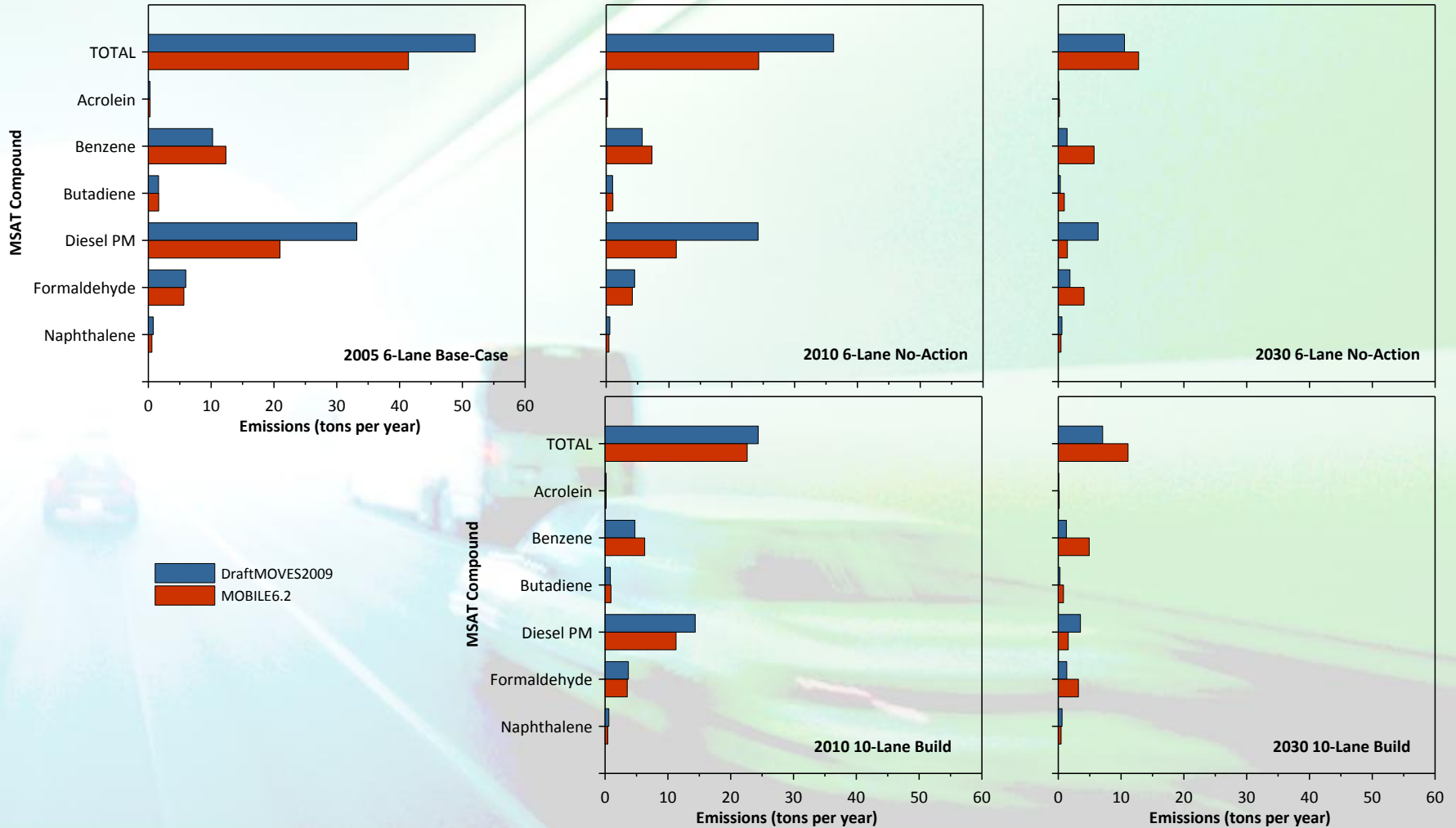
# Arterial Hourly Traffic Volumes



# Arterial Hourly Traffic Speeds



# Project-Level MSAT Emissions Trends

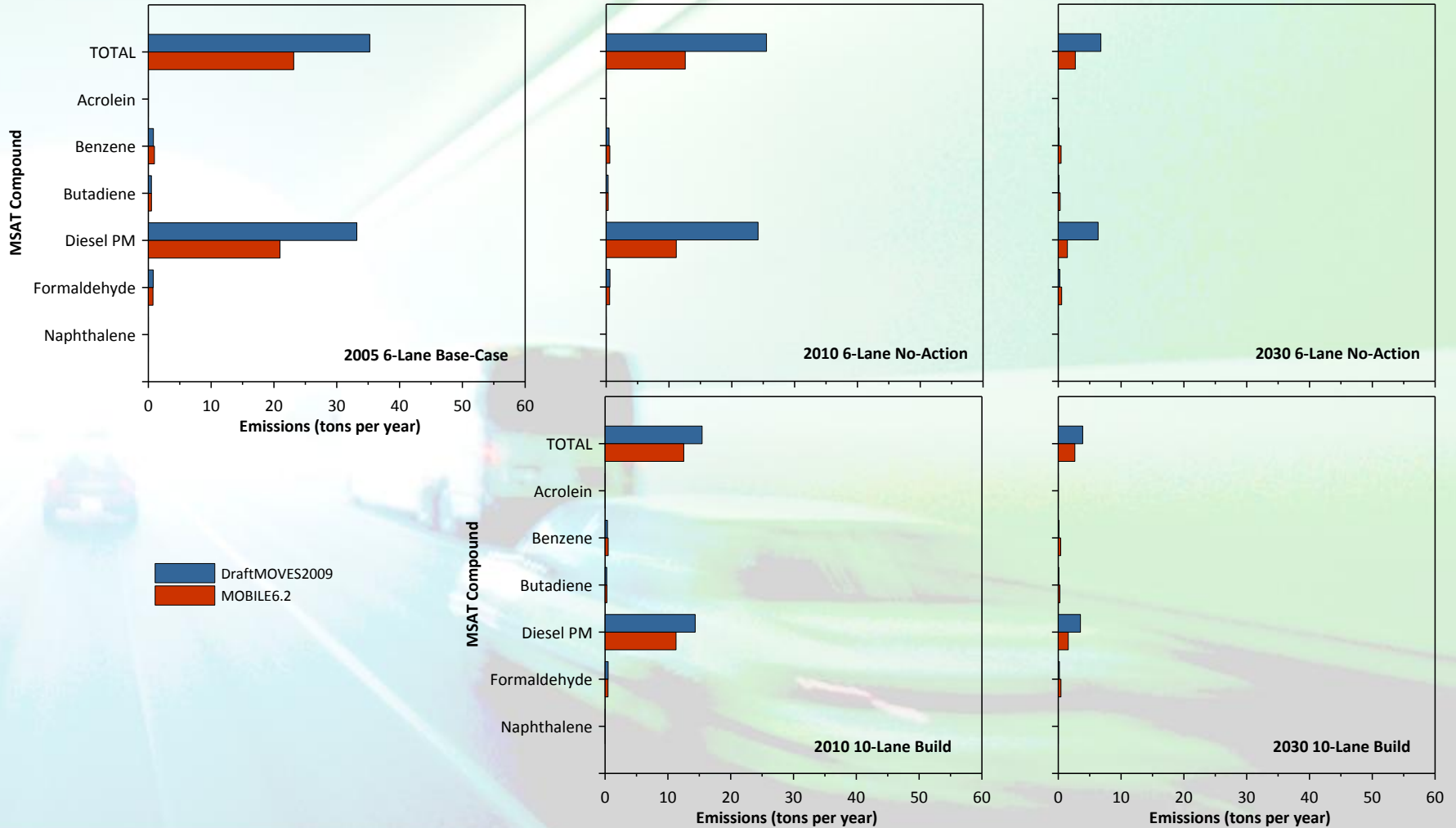


## Relative Toxicity of Priority MSATs

Compound	Unit Risk ( $\times 10^{-6}$ per $\mu\text{g}/\text{m}^3$ )	Equivalent Risk to 1 ton DPM
Acrolein	0	0
Benzene	2.2 – 7.8	13 – 4,500
1,3-Butadiene	30	3.3 – 330
Diesel PM	100 – 10,000 *	1
Formaldehyde	13	7.7 – 770
Naphthalene	0	0

\* According to EPA (<http://www.epa.gov/risk/basicinformation.htm#g>), “a consideration of numerous uncertainties and assumptions also indicates that lower risk is possible and zero risk cannot be ruled out. These risk findings are only general indicators of the potential significance of the lung cancer hazard and should not be viewed as a definitive quantitative characterization of risk or be used to estimate an exposure-specific population impact, i.e., estimating numbers of cancer deaths”.

# Project-Level MSAT Emissions Trends (as DPMe)



# Implications of MOVES

## National Emission Trends

- Diesel PM emissions are considerably more prominent

## Variability of Emission Factors with Vehicle Speed

- Significantly lower benzene emission factors in the future for all speeds
- Much higher diesel PM emission factors, especially for lower speeds

# Implications of MOVES

## Variability of Emission Factors with Vehicle Congestion

- Mitigating congestion on highways where traffic volumes exceed capacity lowers benzene and diesel PM emission factors

## Project-Level Emission Trends

- Lower estimates of total MSAT emissions in the future
- Higher proportion of diesel PM
- Congestion mitigation has a greater effect in lowering total MSAT emissions