On-road Mobile Source Emission Inventory Development for the Central Regional Air Planning Association (CENRAP)

Presented by

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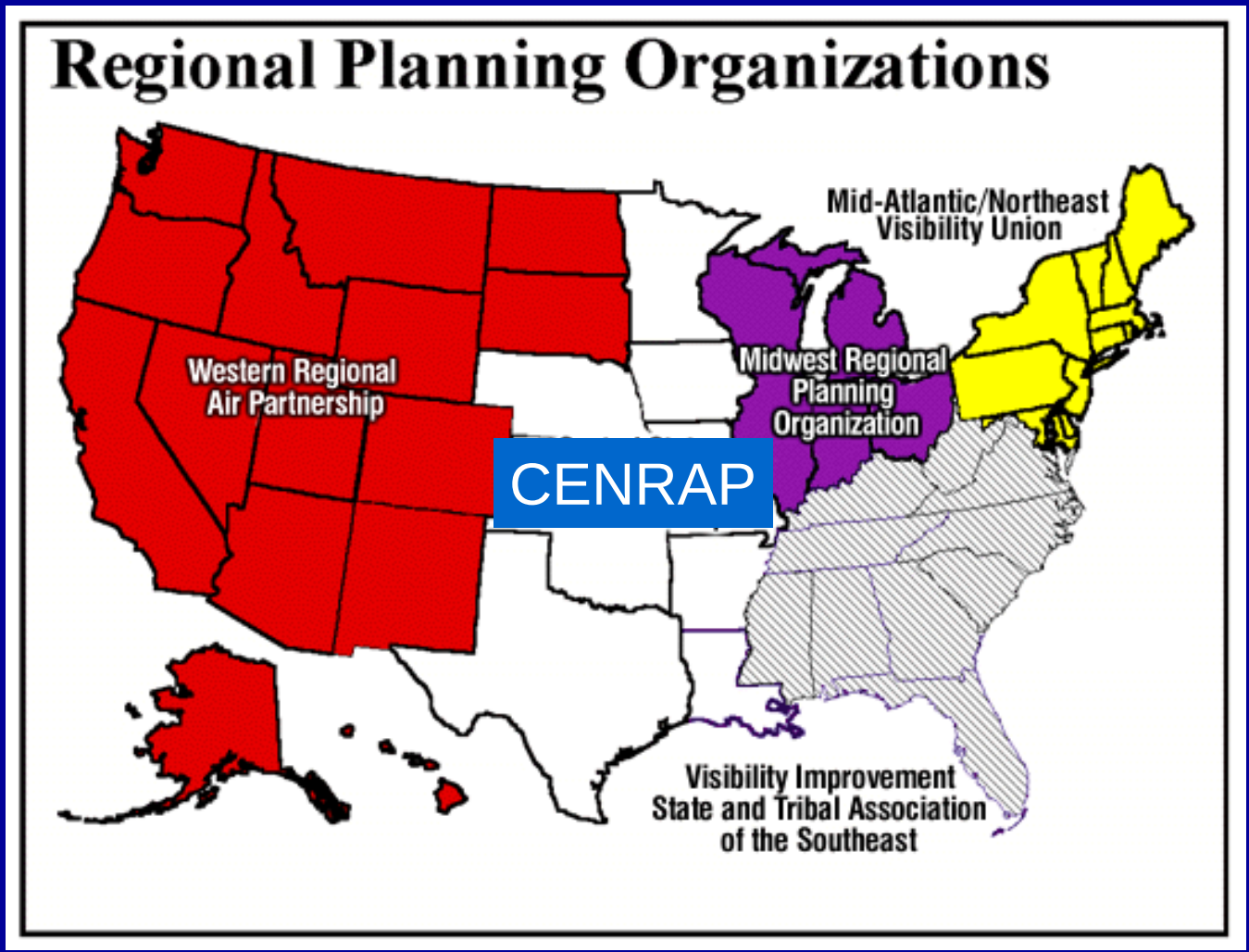
Objectives

Develop emission inventories of criteria pollutants for on-road mobile sources that are suitable for photochemical modeling and consistent with EPA guidance.

- Develop county-level emission inventories on the basis of bottom-up activity data.
- Prepare county-level emissions modeling inputs suitable for running MOBILE6 within SMOKE.
- Generate annualized emission inventories of criteria pollutants for 2002 (NIF3.0 format).

CENRAP Region



Source: http://www.epa.gov/air/visibility/regional.html

MOBILE6 Inputs

Various inputs affect emission inventories of on-road mobile sources moderately to significantly.

- VMT (activity data)
- Distributions of VMT (by facility type, vehicle type, and time of day)
- Speed
- Fuel characteristics
- Regulatory controls
- Fleet characteristics (registration distributions and fuel fractions)
- Temperature
- Altitude
- Air conditioning
- Hot and cold soaks
- Mileage accumulation rates
- Humidity

Methods—VMT and Speeds (1 of 3)

Highest priority was assigned to areas with large VMT or population near Class I areas.

Local data were acquired for non-attainment areas.

- Houston/Galveston, TX
- Beaumont/Port Arthur, TX
- El Paso, TX
- Dallas-Ft. Worth, TX
- Baton Rouge, LA

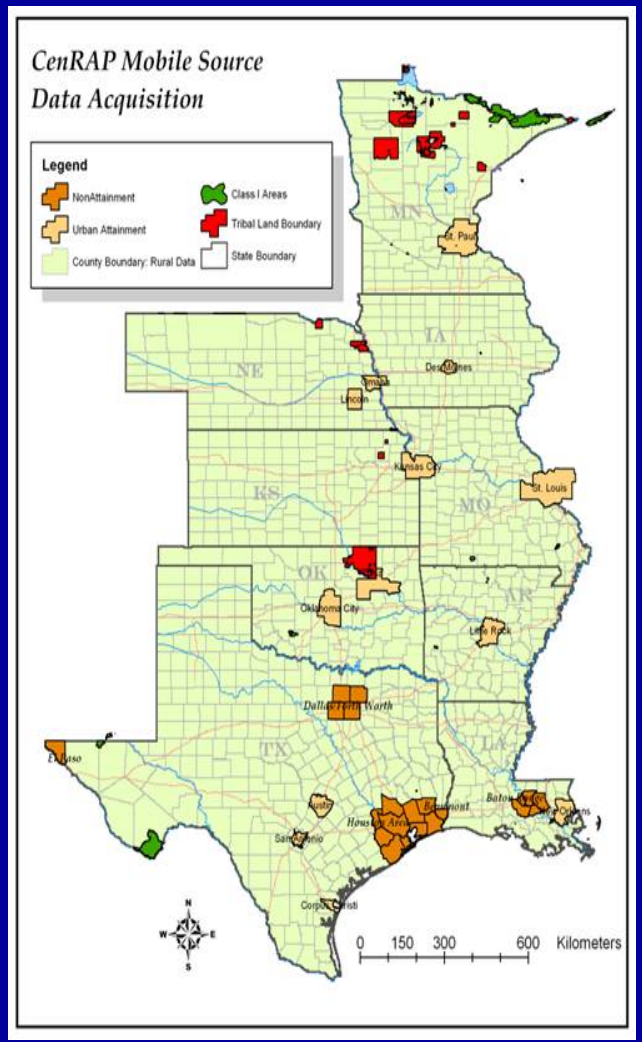
Methods—VMT and Speeds (2 of 3)

Local data were acquired for urban attainment areas.

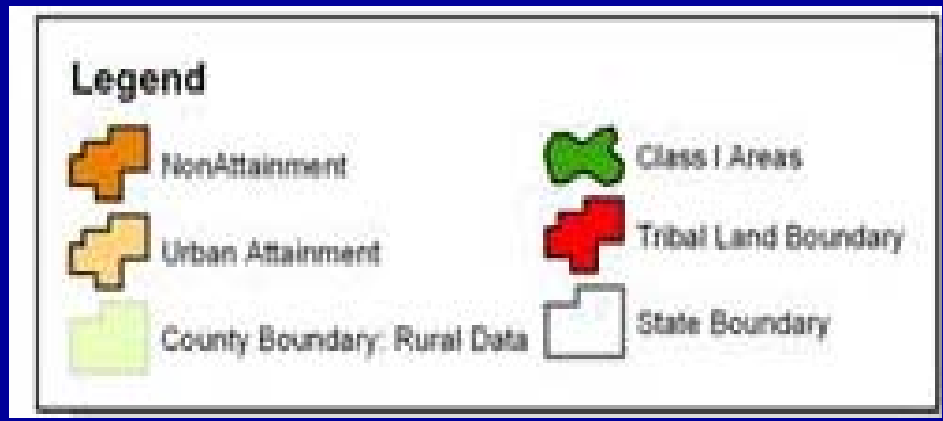
- New Orleans, LA
- St. Louis, MO
- Kansas City, MO-KS
- Lincoln, NE

A combination of local data and MOBILE 6 defaults were developed for all other areas, which were mostly small urban and rural.

Data Acquisition Areas



- Nonattainment areas
- Urban attainment areas near Class I areas
- Other areas



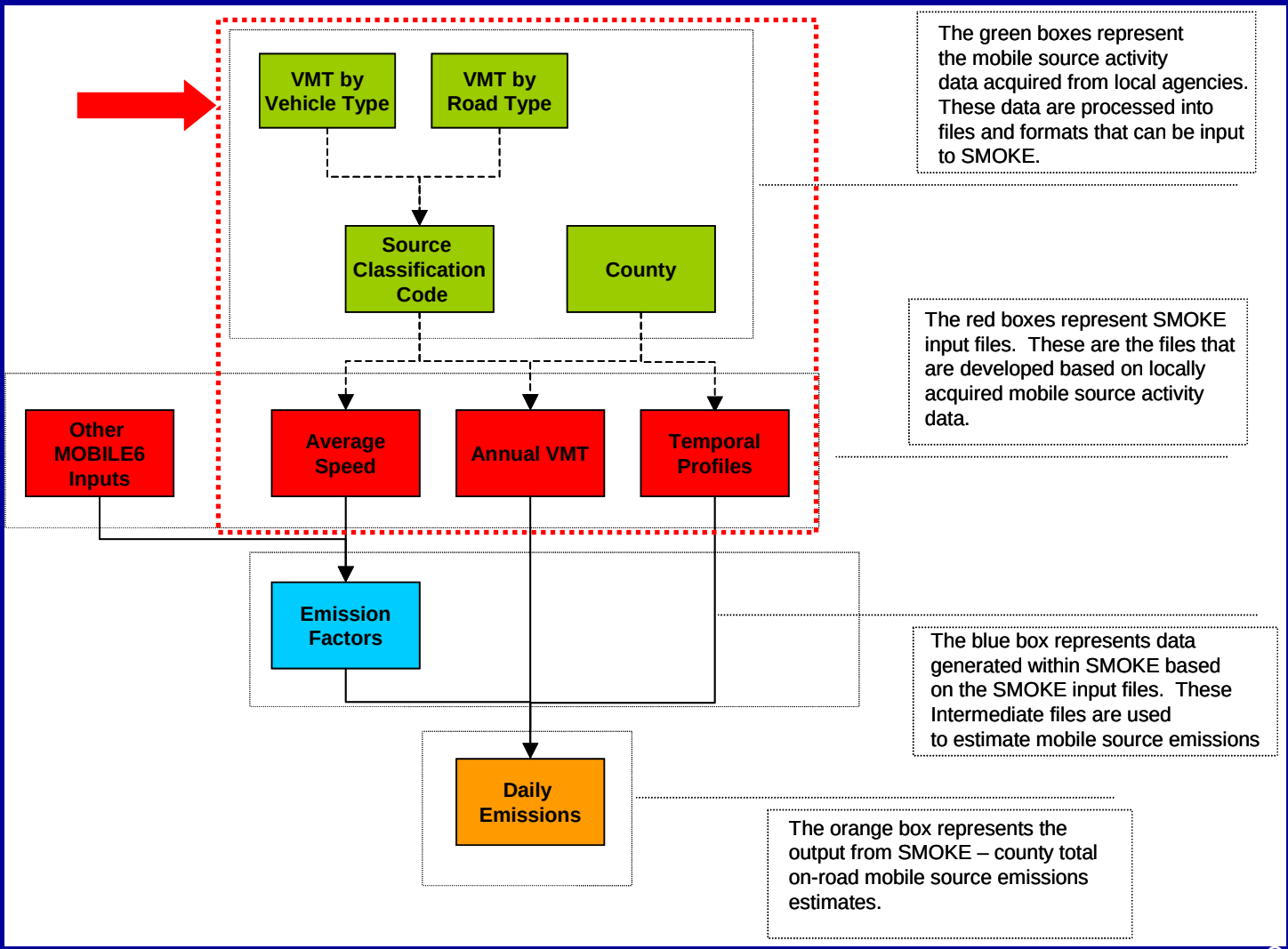
Methods—VMT and Speeds (3 of 3)

Acquired Data

SMOKE Inputs

Emission Factors

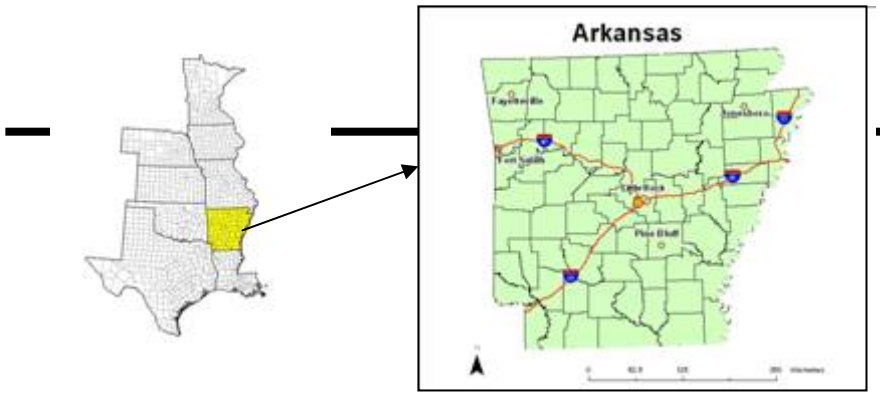
County-level Emissions



Data Summary Sheet: Arkansas

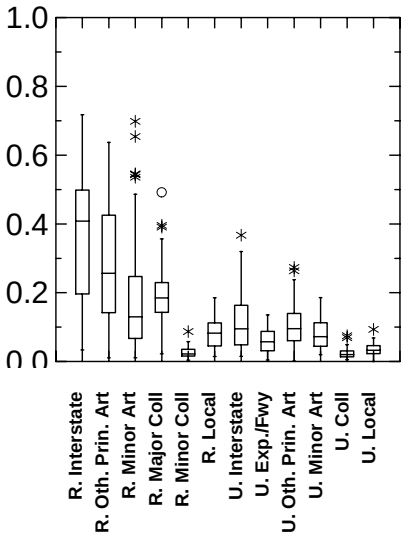
Data Source: [1] **Arkansas Dept. of Transportation & Highways**

[2] **Default Data**

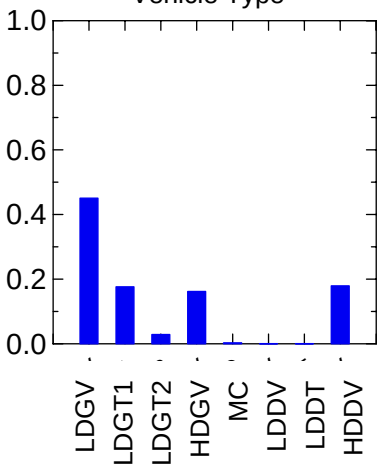


2002 Countywide VMT [1]

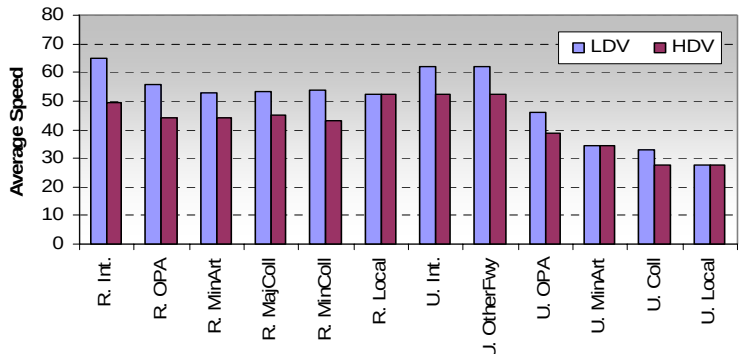
VMT Distribution by Road Type [1]



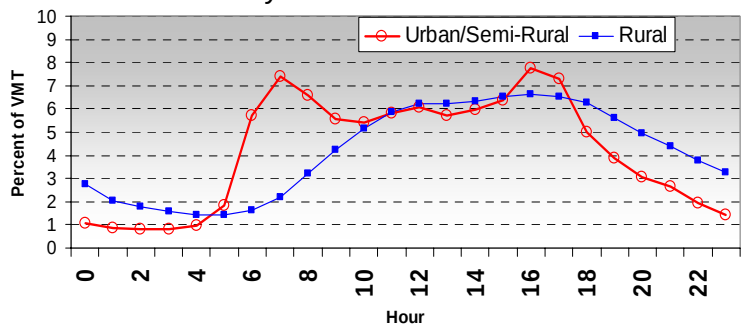
VMT Distribution by Vehicle Type [1]



Average Speed by Road Type [2]



Weekday VMT Diurnal Distribution [2]



Methods—Fleets (1 of 2)

Inputs were developed at the county level.

- Registration distributions
  - Fractions of vehicles in each of 25 age groups
  - Separate distributions for each of 16 vehicle classes
- Fuel fractions
  - Fractions of diesel and/or natural gas vehicles in each age group and vehicle class

Methods—Fleets (2 of 2)

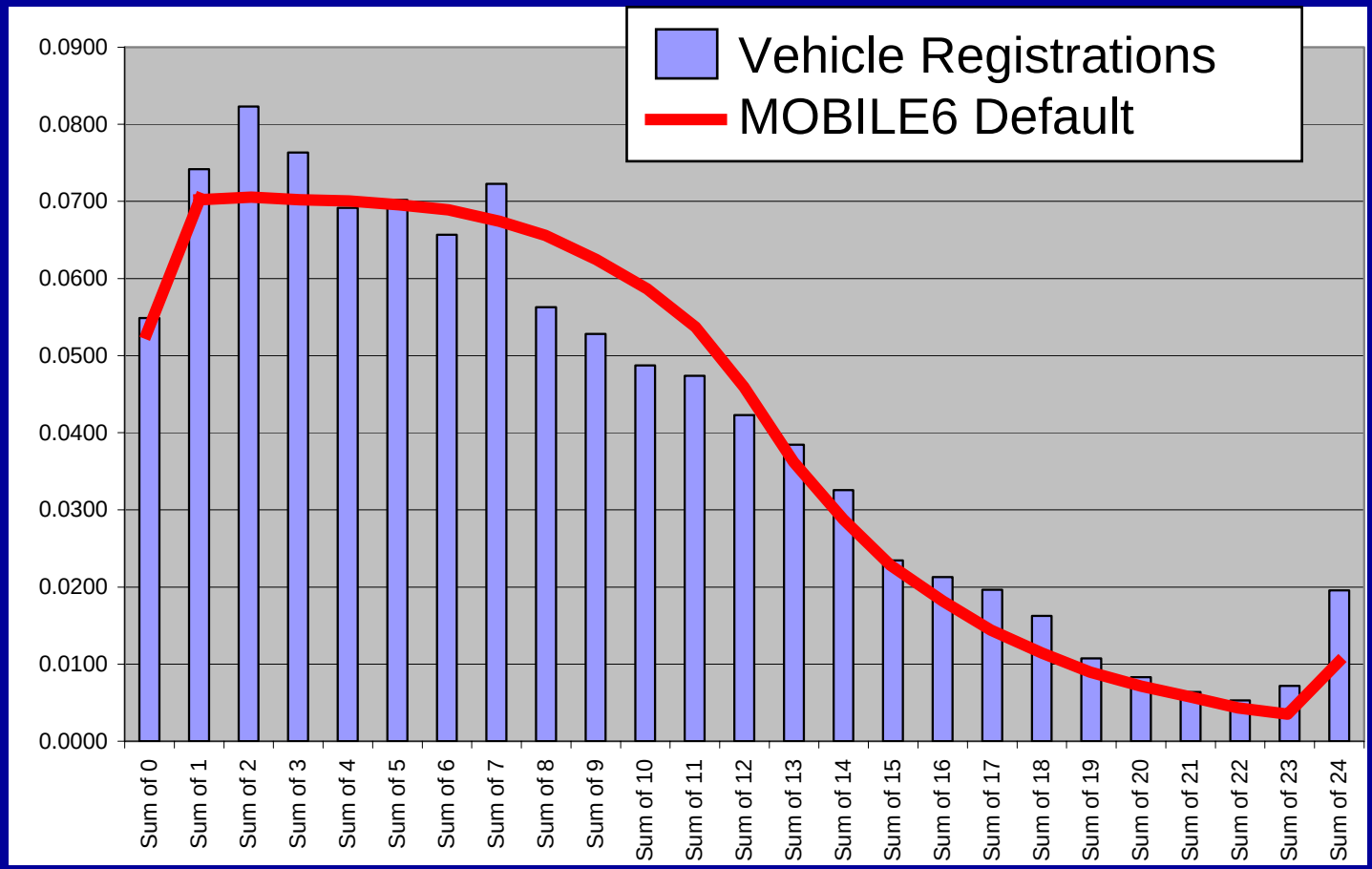
Inputs were based on records of vehicle identification numbers (VINs).

VINs were acquired from state departments of motor vehicles (DMVs) and decoded.

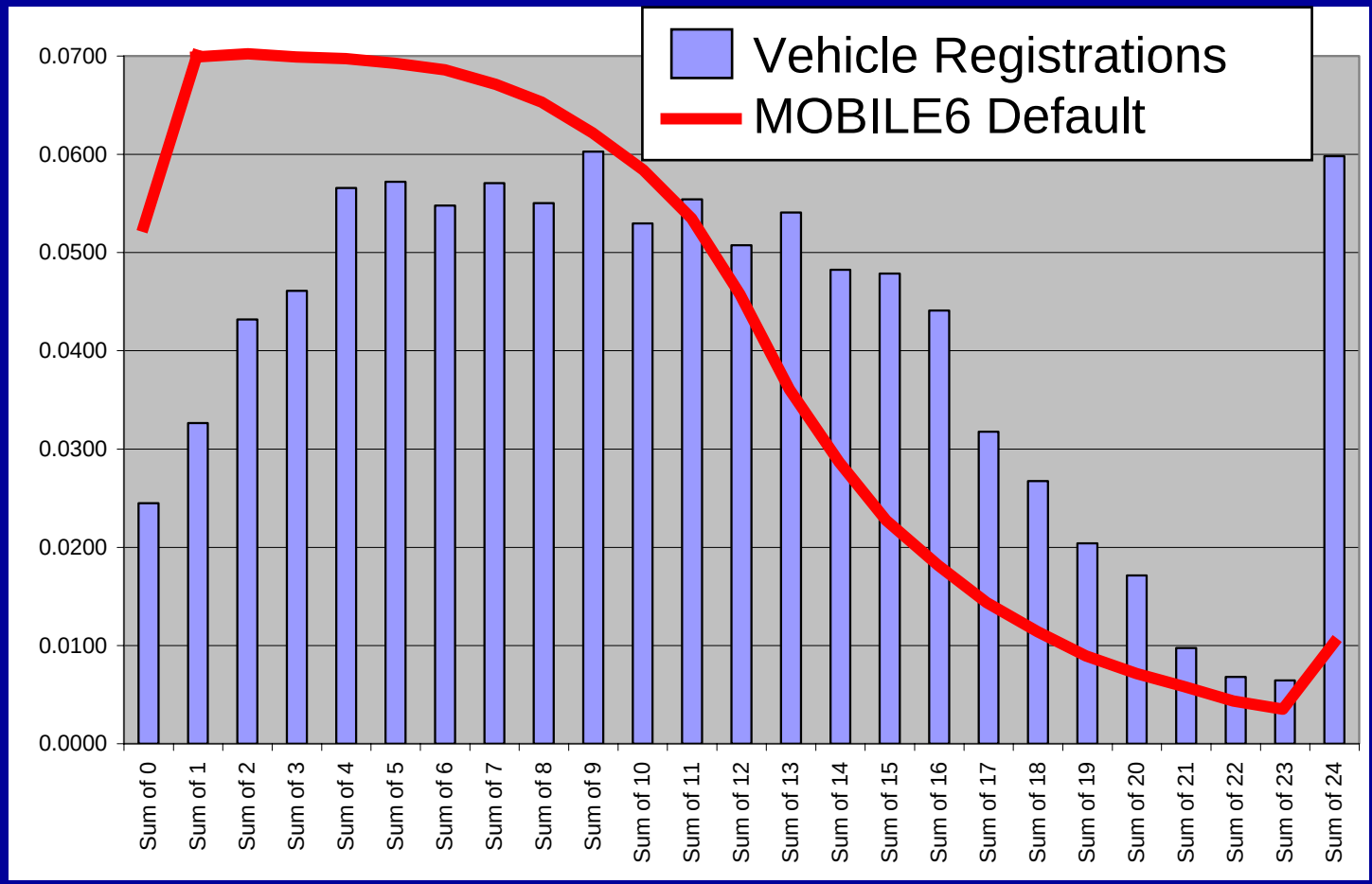
Two states were exceptions.

- Texas provided its own county-level fleet distributions.
- Arkansas is developing its own distributions through a state-funded project.

Example Results—Louisiana



Example Results—Another CENRAP State



Fuels and Controls

Fuels characteristics were acquired.

- Gasoline volatility
- Gasoline oxygenate content
- Sulfur content (gasoline and diesel)

Regulatory controls exist in a few non-attainment areas: St. Louis, Baton Rouge, and a few cities in Texas.

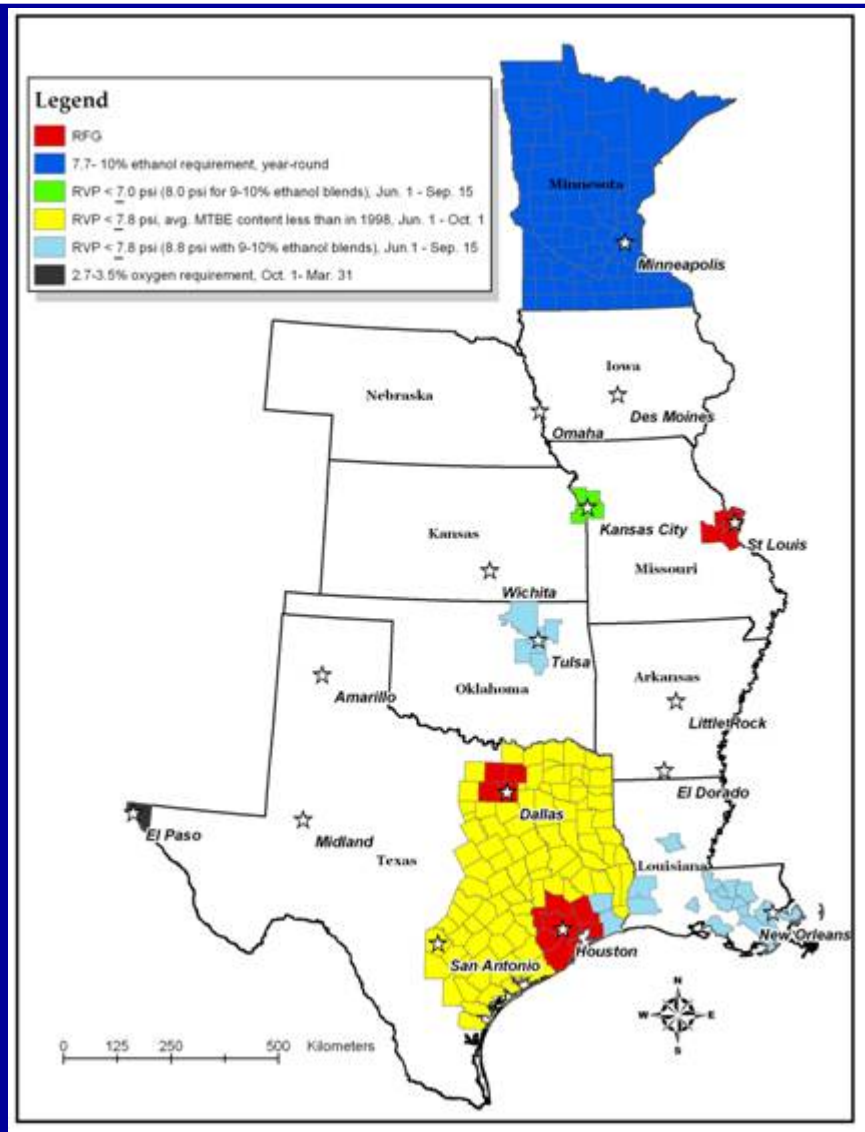
- Anti-tampering programs
- I&M programs
- Stage II refueling controls

Starting Points for Fuels

MOBILE6 explicitly models areas that use federal reformulated gasoline (RFG).

Data were acquired from Northrop Grumman (NG).

- Data are available for many areas of CENRAP.
- However, NG's data do not cover every area and are not always representative of an entire state.



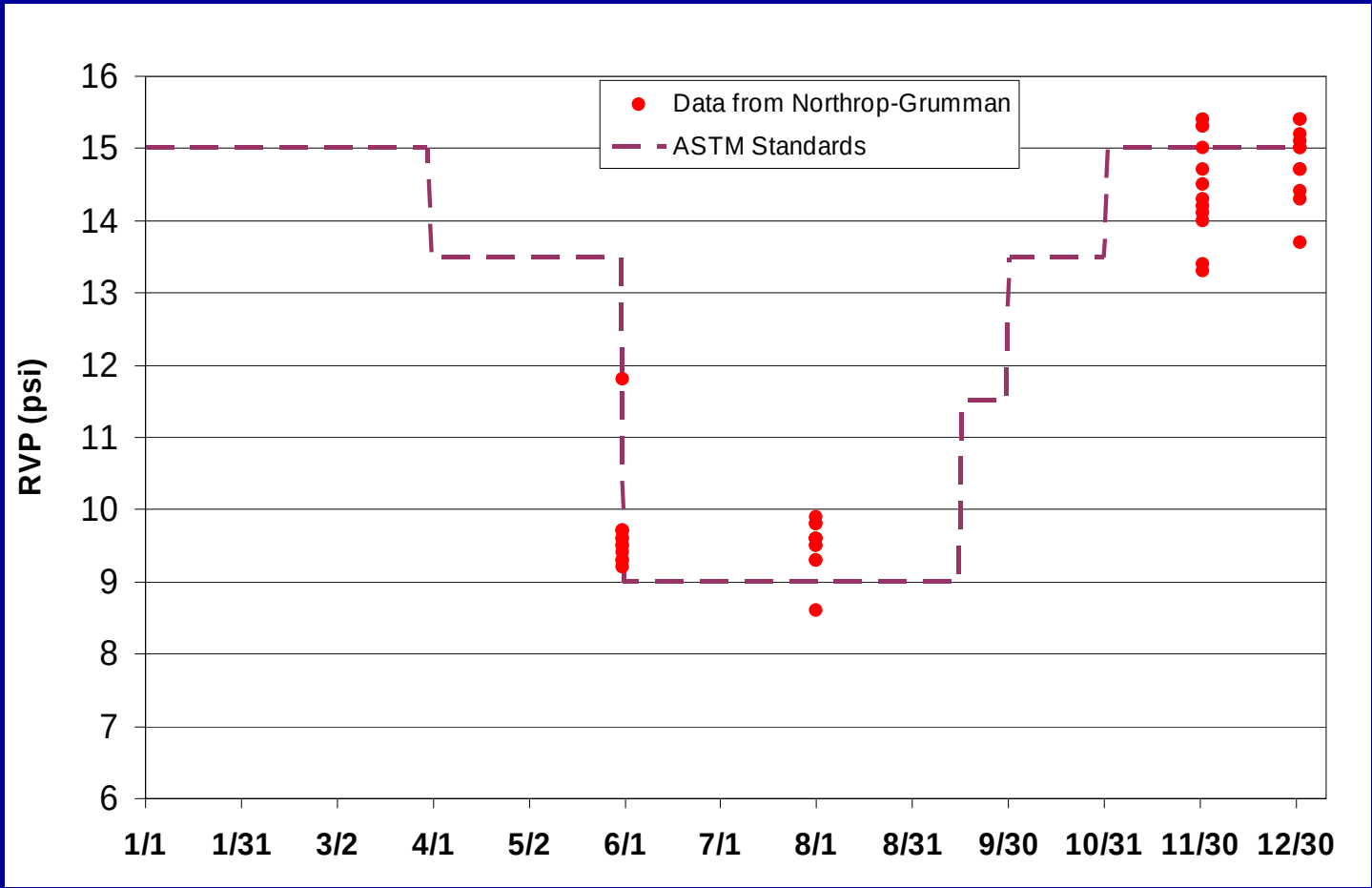
Results: Fuels (1 of 6)

Fuel Volatility

- NG's data are often used and are assumed to be representative of all gasolines.
- However, fuel volatility data are available for summer and winter only and for limited sampling locations.
- Additionally, interpolations are based on ASTM standards.

Results: Fuels (2 of 6)

Example results for fuel volatility: Twin Cities, MN



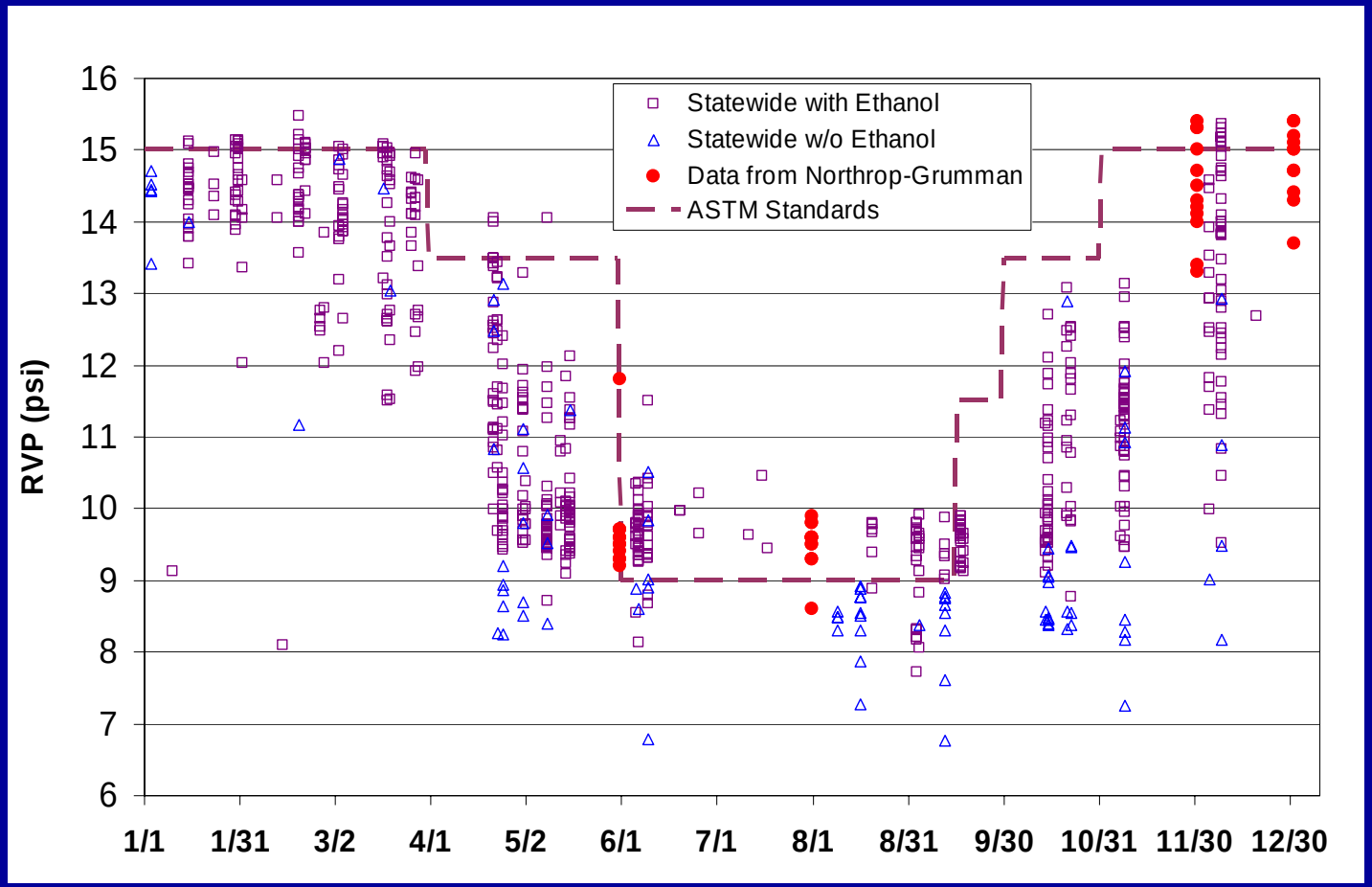
Results: Fuels (3 of 6)

Fuel volatility data were improved by acquiring information from state departments of agriculture.

- Spring and fall observations deviated significantly from the ASTM interpolation.
- Requirements for regular-grade fuels did not necessarily apply to all other grades of fuel.

Results: Fuels (4 of 6)

Example results for fuel volatility: Minnesota



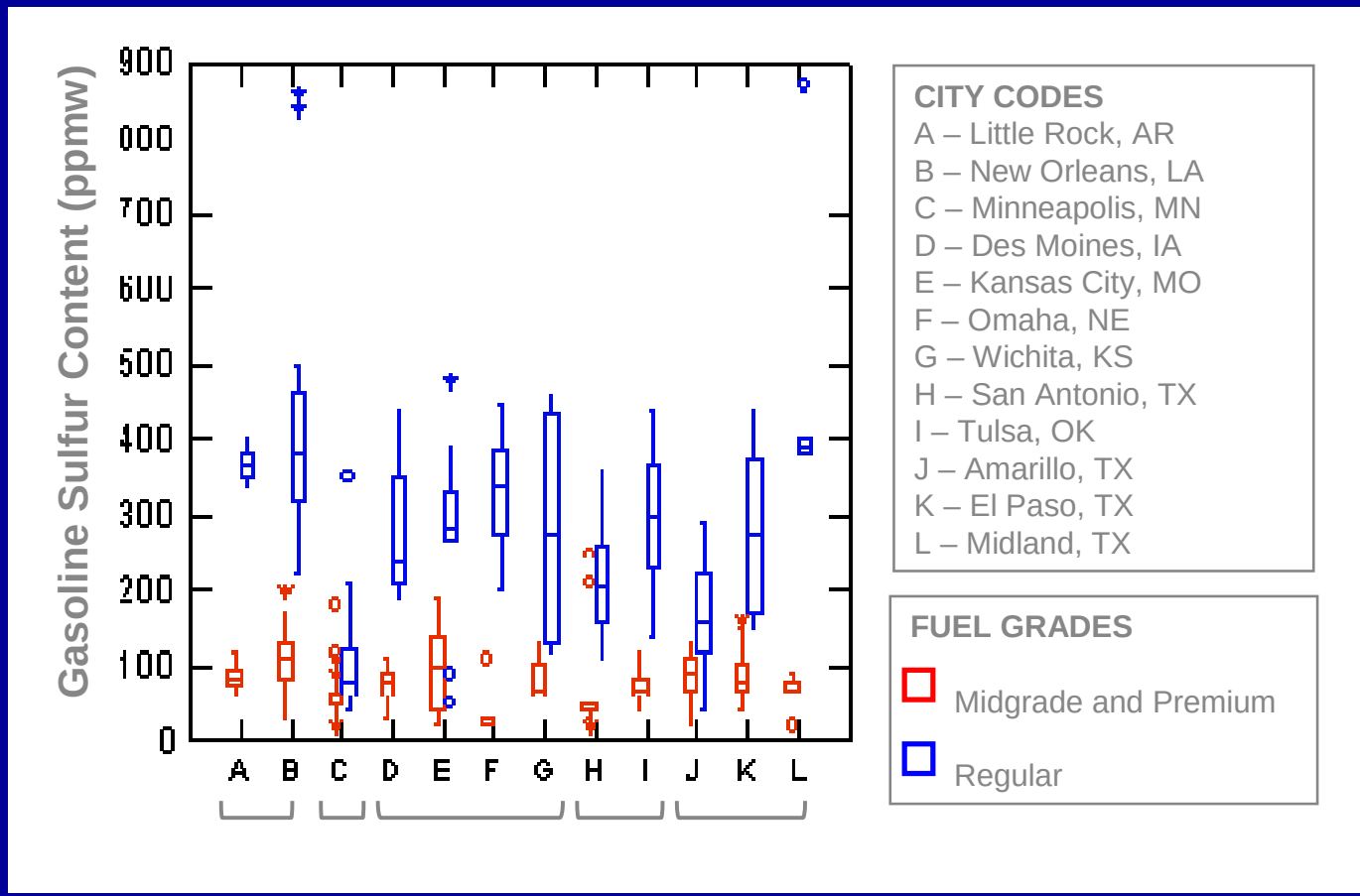
Results: Fuels (5 of 6)

Sulfur content directly affects SO_2 and sulfate PM emissions, and indirectly affects CO, NO_x, and VOC emissions due to its damaging effects on catalysts.

- For non-RFG, MOBILE6 defaults are 279 ppmw (average) and 1000 ppmw (max).
- Observations for regular-grade gasoline are comparable to defaults.
- Observations for mid- and premium-grade gasoline are significantly lower than defaults.
- About 75% of gasoline sold nationally is regular-grade, and 25% is medium- or premium-grade.

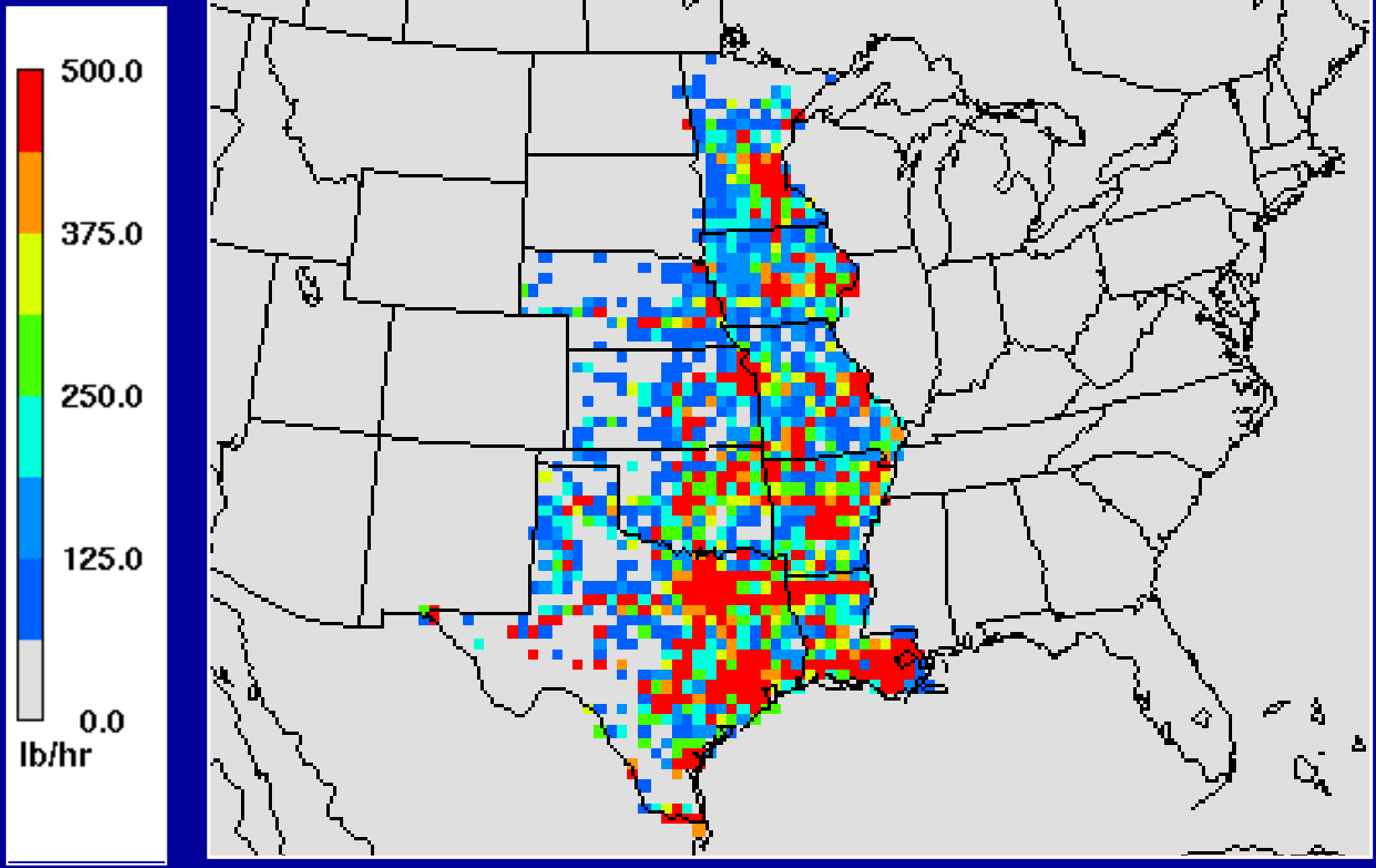
Results: Fuels (6 of 6)

Sulfur content: weighted averages for each district.



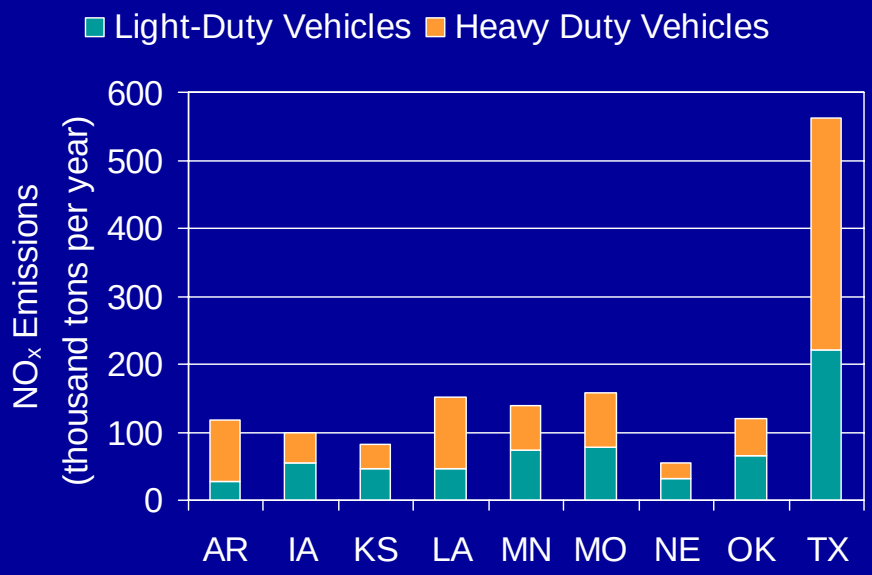
Brackets on the x-axis indicate cities in similar districts of the petroleum pipeline distribution chain.

Results: NO_x Emissions, July 10, 2002

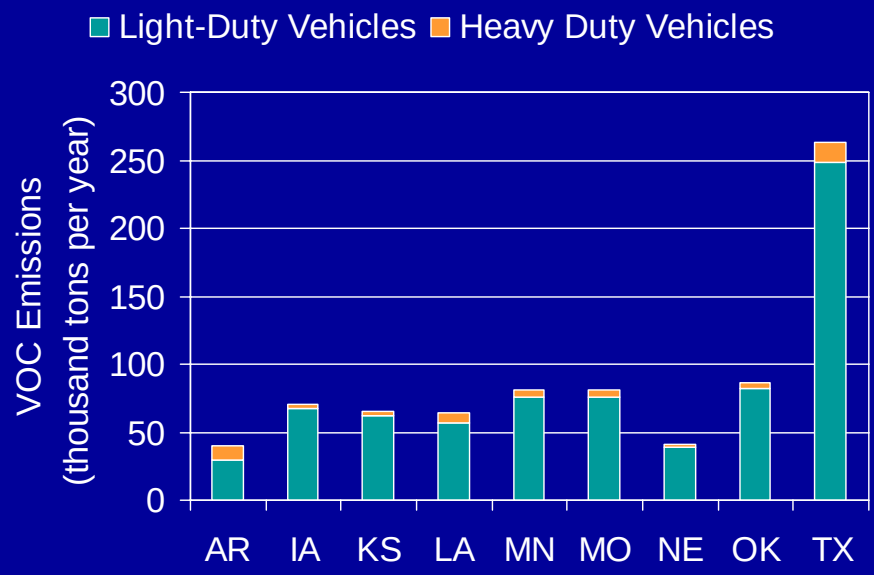


Emissions by Vehicle Type

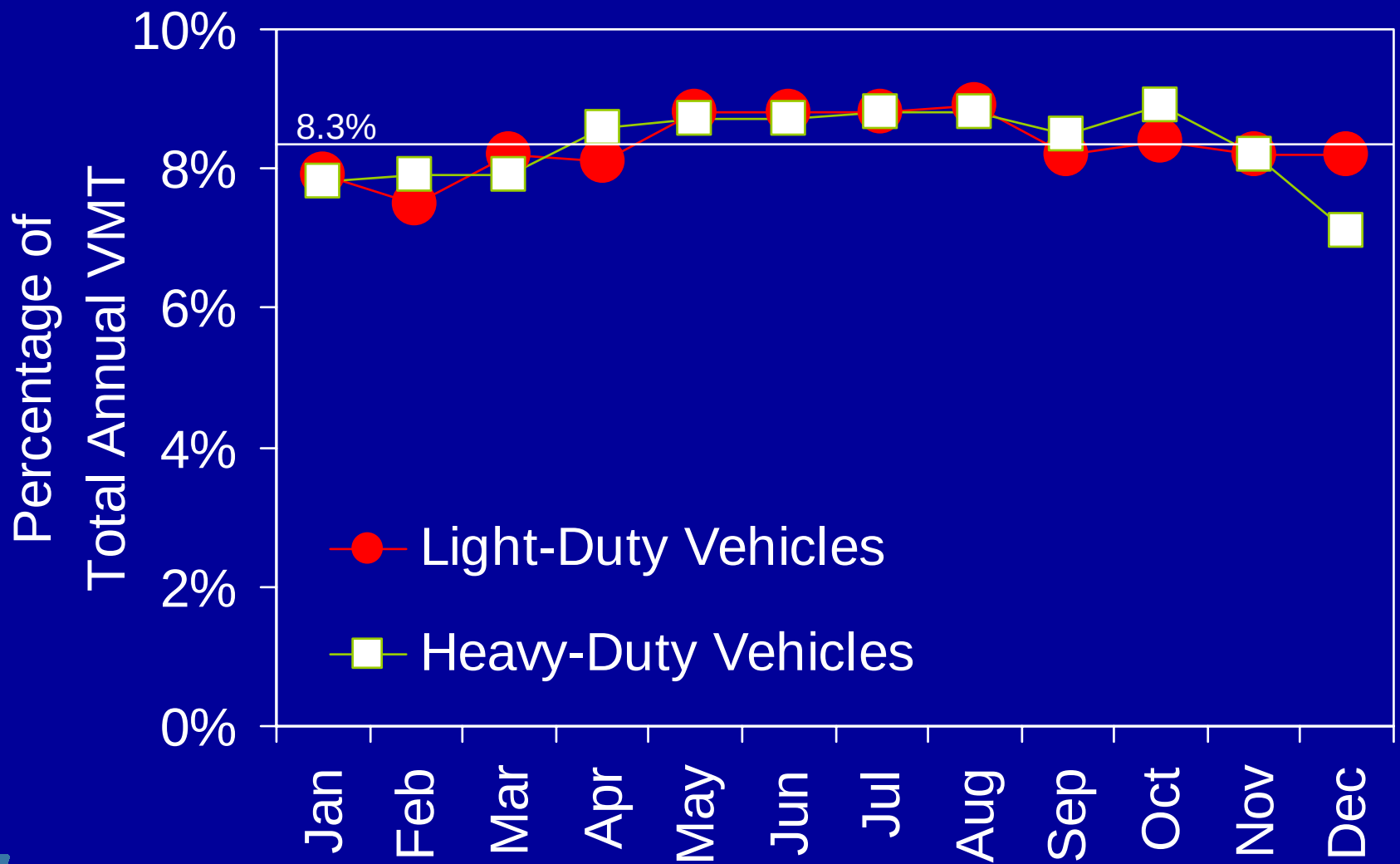
NOx



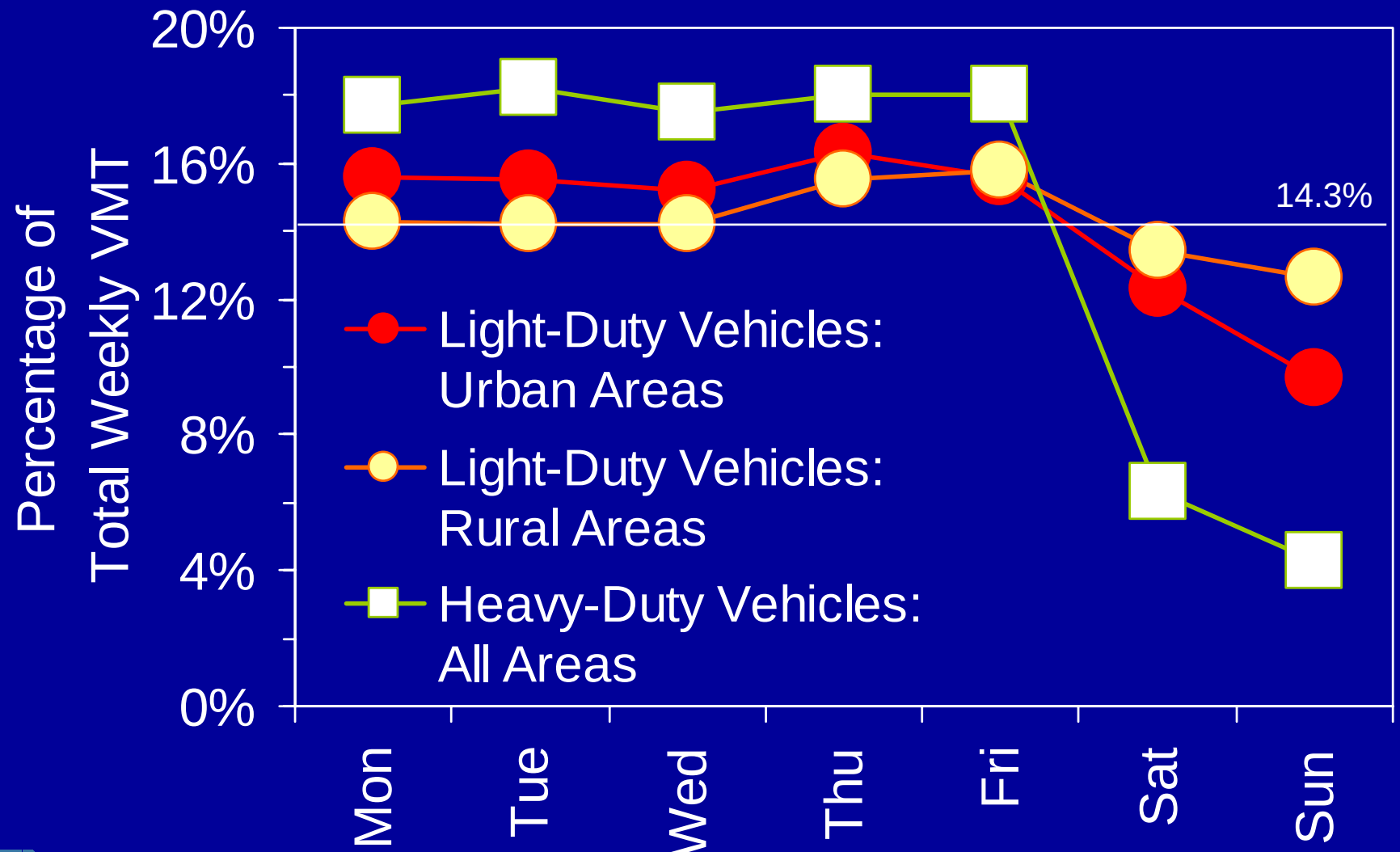
VOC



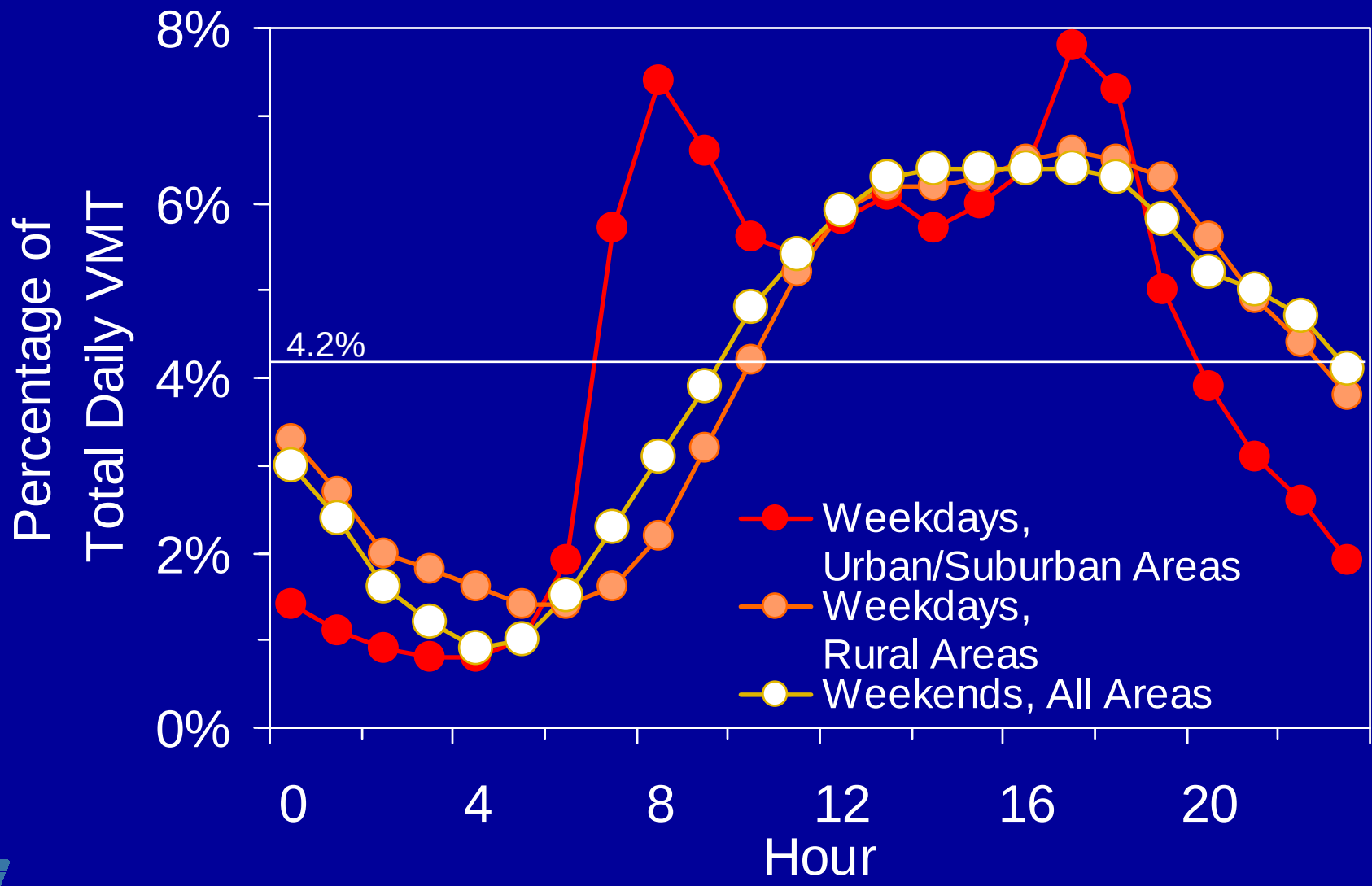
Monthly Pattern



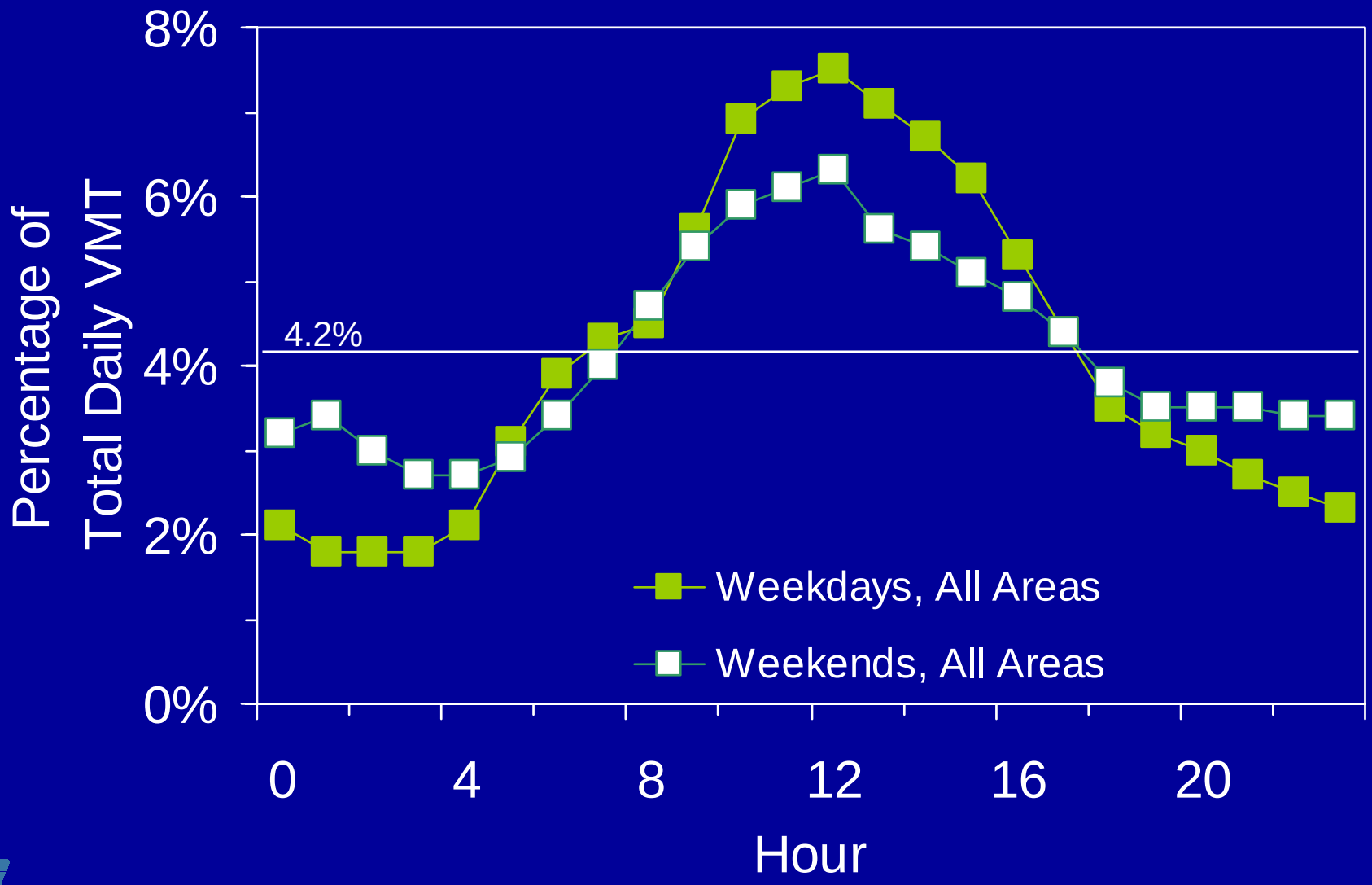
Weekly Patterns



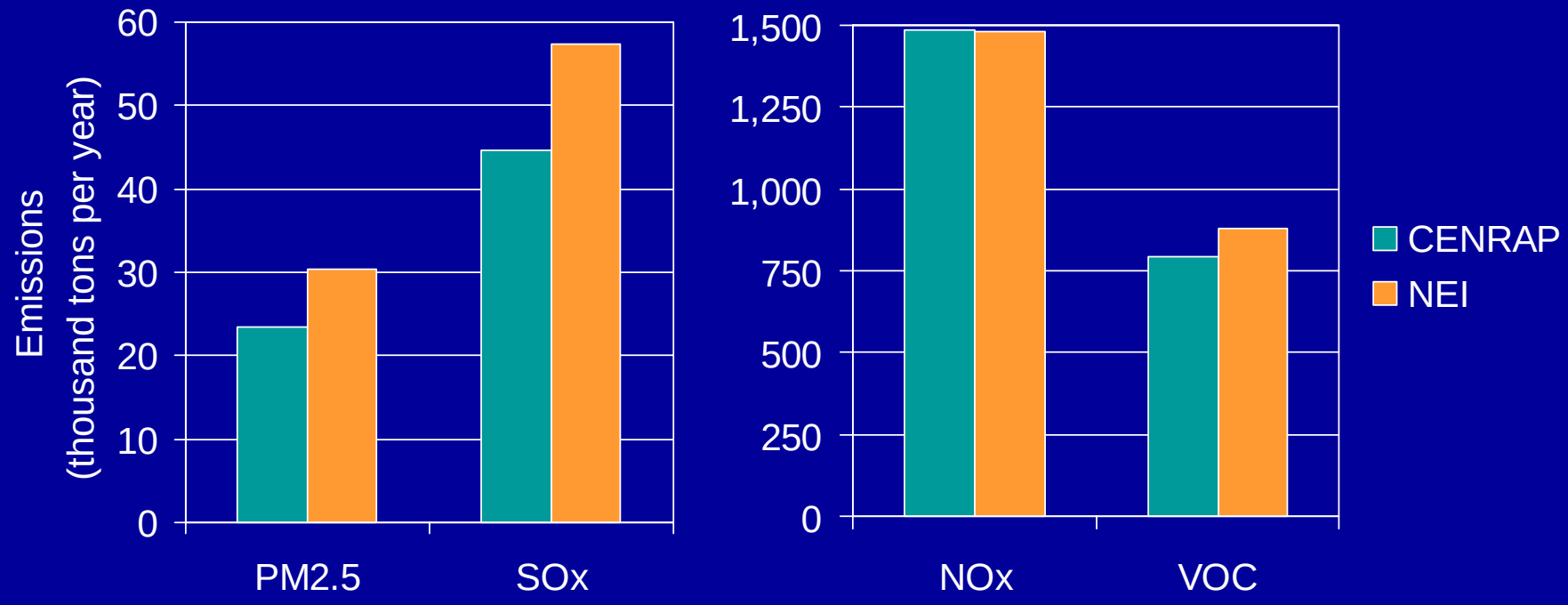
Diurnal Patterns—Light-Duty Vehicles



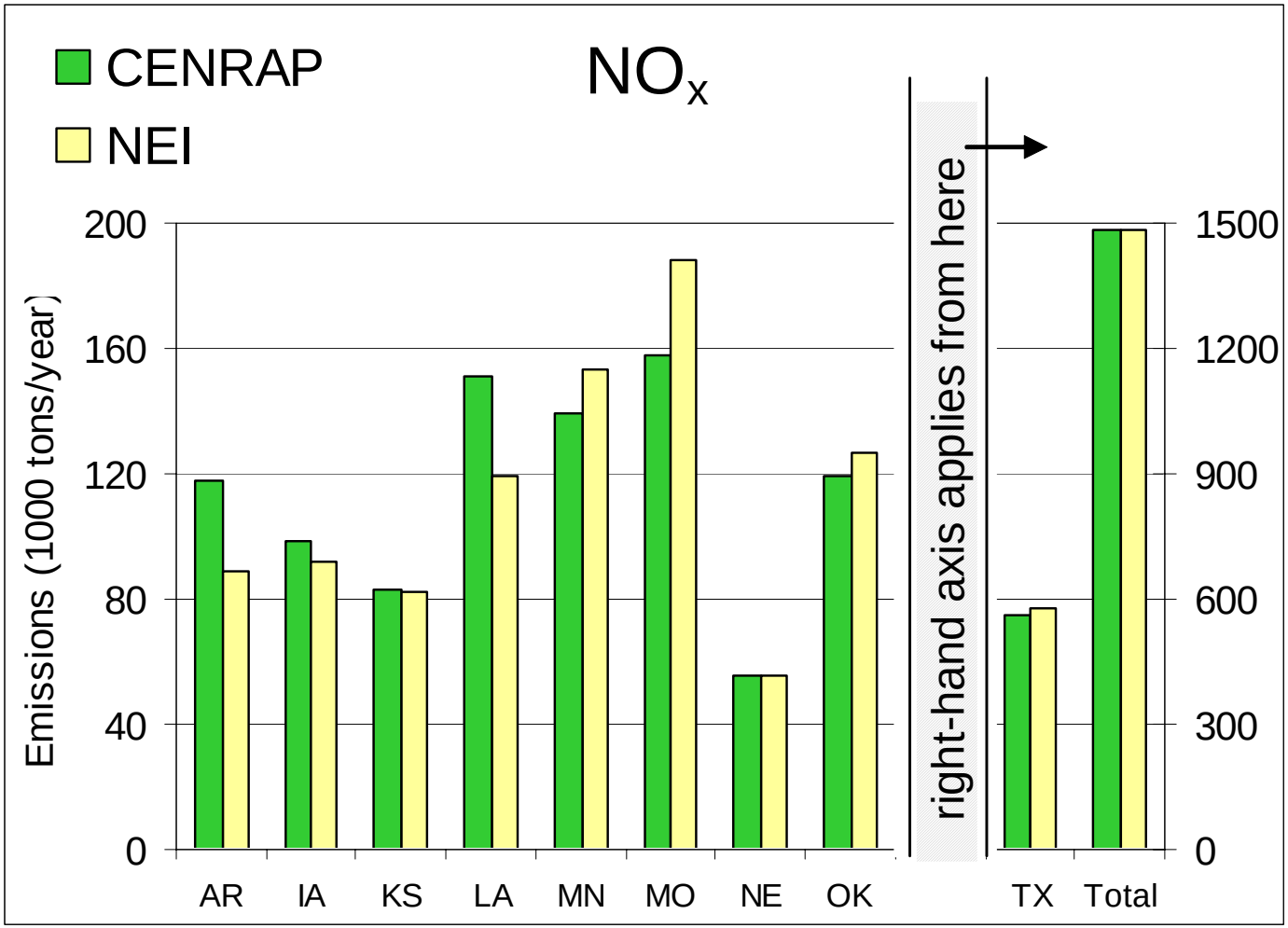
Diurnal Patterns—Heavy-Duty Vehicles



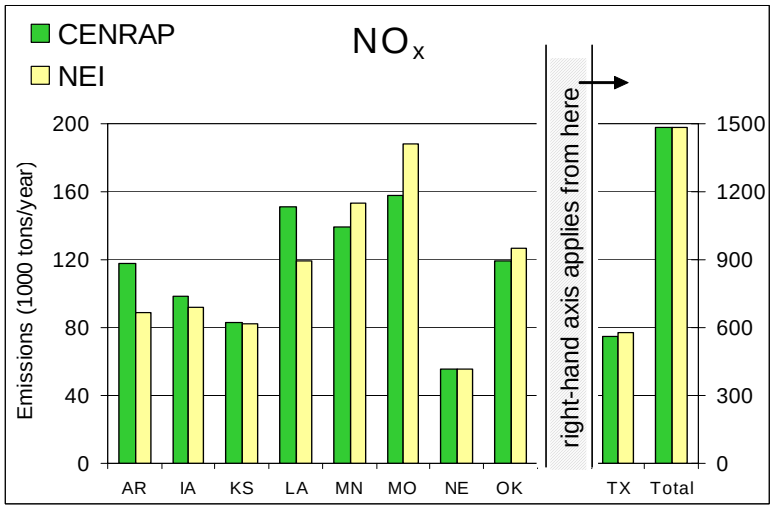
Comparison with the Draft 2002 NEI (1 of 3)

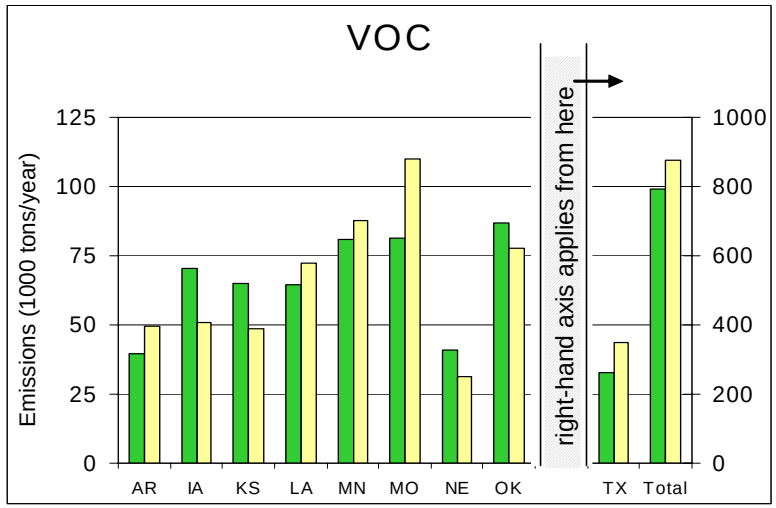


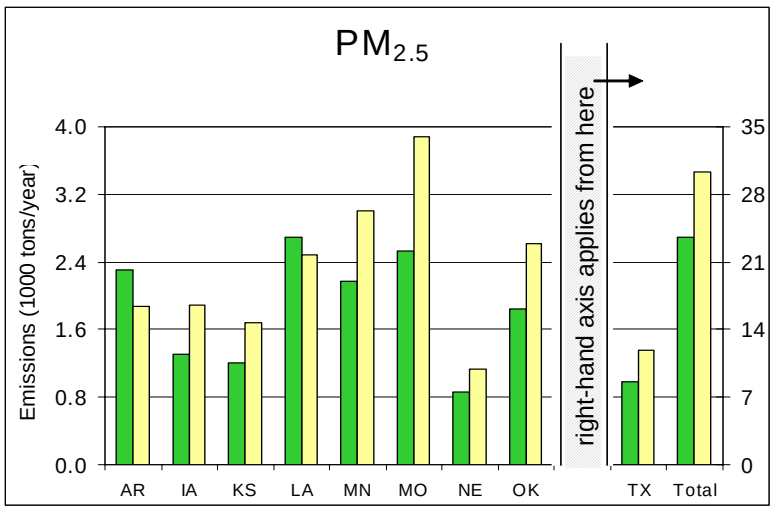
Comparison with the Draft 2002 NEI (2 of 3)

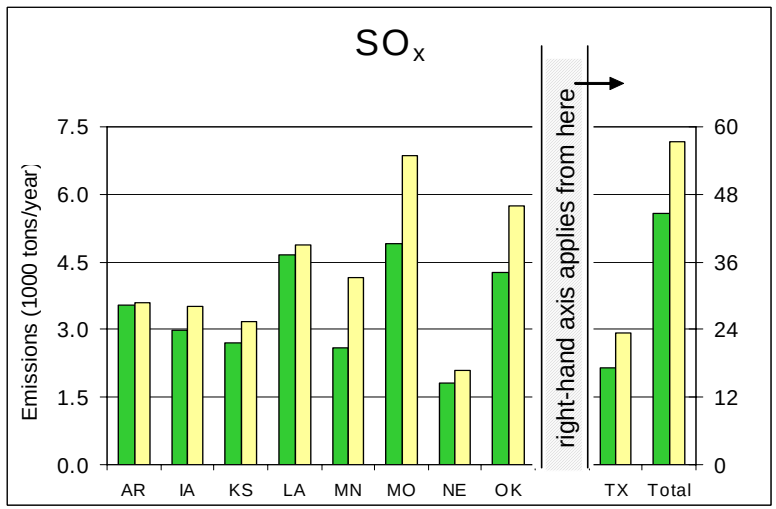


Comparison with the Draft 2002 NEI (3 of 3)









Conclusions

Take-home message: Using data representative of local conditions (instead of national-average defaults) makes a difference.

Differences in state-level VOC, NO_x, and $PM_{2.5}$ emissions were as large as ±25%.

Opportunities for Further Improvements

Incorporate additional local data as they become available.

Investigate and improve vehicle registration databases.

Use fleet distributions to refine VMT distributions.

Improve inventories for alternative-fuel vehicles, which are likely to become more important in the future.

Glossary

ATP = Anti-Tampering program

CENRAP = Central States Regional Air Planning Association

DOT = Department of Transportation

HPMS = Highway Performance Monitoring System

IDA = Inventory Data Analyzer format

IM = Inspection and Maintenance program

NEI = National Emissions Inventory

NIF = NEI Input Format

SMOKE = Sparse Matrix Operator Kernel Emissions Modeling System

VMT = Vehicle miles traveled