

# NCHRP 25-38, Input Guidelines for MOVES

*Project Summary*

*presented to*

**AMPO Air Quality Work Group**

*presented by*

**Rich Denbow**

**April 27-28, 2015**

# Objectives and Products

- Objective

- » Produce guidelines for transportation practitioners on methods, procedures, and datasets needed to develop and obtain transportation-related regional- and project-level inputs for using MOVES

- Products

- » Resource document on developing MOVES inputs
- » Sample data & examples
- » Tools for processing data
- » Final report documenting research approach

# MOVES Inputs Covered in Resource Document

## ● Volume 1 – Regional-Level Inputs

- » Age distribution
- » Source (vehicle) type population
- » VMT by vehicle class
- » Temporal adjustments
- » Road type distribution
- » Ramp fraction
- » Average speed distribution
- » Meteorology
- » Inspection and maintenance programs
- » Fuel formulation and supply

## ● Volume 2 – Project-Level Inputs

- » Age distribution
- » Link source types
- » Link characteristics:
  - traffic volumes
  - length and grade
  - average speed
- » Operating mode distributions and drive schedules
- » Off-network data

# Activities

- Completed:
  - » Literature review and survey of practitioners (75 respondents – thank you!!!)
  - » Sensitivity analysis on MOVES inputs
  - » Resource materials for each MOVES input
  - » Examples
  - » Tools
- Panel review
- Final report & resource materials

# Sensitivity Analysis

Objective: complement other efforts, expand to more inputs

Type of Input	Input	EPA	Volpe/FHWA	NCHRP 25-38 CS/ERG	ERG/CRC
Fleet-Based Inputs	Age distribution by vehicle class		★		★
	Source (vehicle) type population			★	★
Activity-Based Inputs	VMT by vehicle class				★
	Temporal adjustments			★	
	Road type distribution			★	
	Ramp fraction		★		
	Average speed distribution		★	★	★
Other Inputs	Meteorology data (temp, humidity)	★	★		
	IM Program				
	Fuel formulation and supply				

# Sensitivity Analysis Results – Road Grade

*Effects of Road Grade on Emissions – Urban Unrestricted Access Roads*



# Summary of MOVES Inputs Falling in Different Sensitivity Ranges

MOVES Input	VOC	NO <sub>x</sub>	PM
Temperature	Very Substantial	Very Substantial	Very Substantial
Humidity	Modest	Substantial	Modest
Speed	Very Substantial	Very Substantial	Very Substantial
Age	Very Substantial	Substantial	Substantial
VMT	Substantial	Very Substantial	Very Substantial
Population	Substantial	Substantial	Substantial
Ramp Fraction	Modest	Modest	Substantial
Source Type Detail for Road Type Dist	Modest	Modest	Moderate
Source Type Detail for Speed Dist	Modest	Modest	Moderate
Month VMT Fraction	Modest	Modest	Modest
Hour VMT Fraction	Modest	Modest	Modest

# Collect and Analyze Data and Develop Sample Datasets

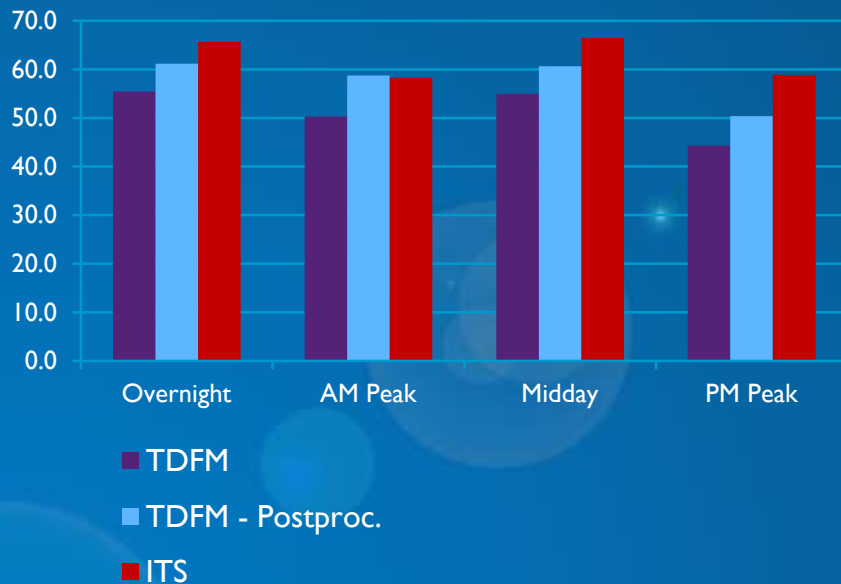
Dataset/Source	Contents	Inputs Supported
VTRIS	Classified traffic counts (reporting states)	Temporal distributions (hr and day) VMT (fractions)
Highway Statistics	VMT estimates from traffic counts (all states and UZA)	Road type distributions VMT (fractions)
ITS	Metro ITS volume and speed data	Speed distributions Temporal distributions (all)
Private Vendor Speed Data	Speed from in-vehicle devices	Speed distributions
GPS Travel Surveys	GPS-supported household travel surveys – vehicle traces	Speed distributions
Travel Demand Forecasting Models	Current and forecast volumes and speeds	VMT Road type distributions Speed distributions
MCMIS	Commercial vehicle fleets	Source type population Age distribution



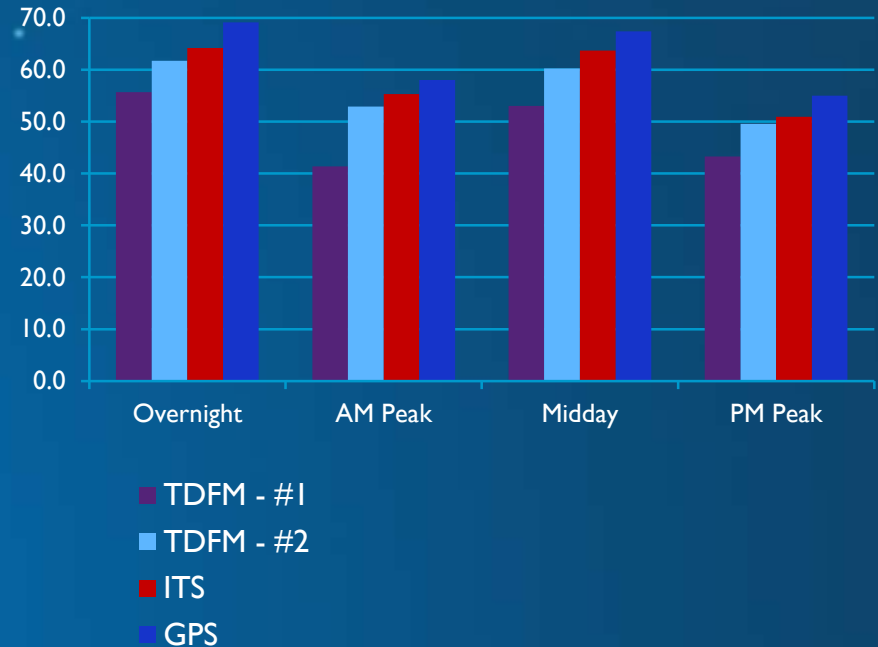
# Speed Data and Estimation Methods

- Compared a variety of speed data sources and estimation methods
  - » Models, ITS detectors, NAVTEQ/INRIX, GPS surveys

## Average Speed – Jacksonville Freeways



## Average Speed - Atlanta Freeways



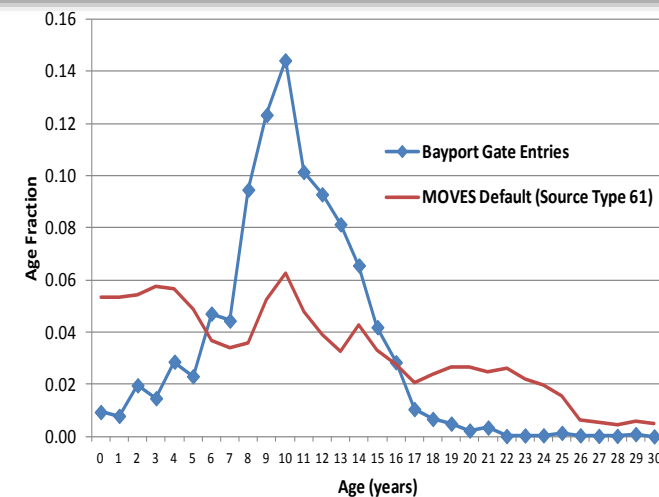
# Off-Network Examples & Data Sources

- Port Terminal
  - » Drayage truck study (EPA/ERG)
  - » Port entry/exit data
  - » Portable activity monitors
- Municipal Parking Lot
  - » Passenger vehicle starts
  - » Parking lot accumulation study
- Truck Rest Stop
  - » Heavy-Duty Extended idle
  - » Truck Idling study (M. Baker)

Port of Houston  
Bayport Terminal

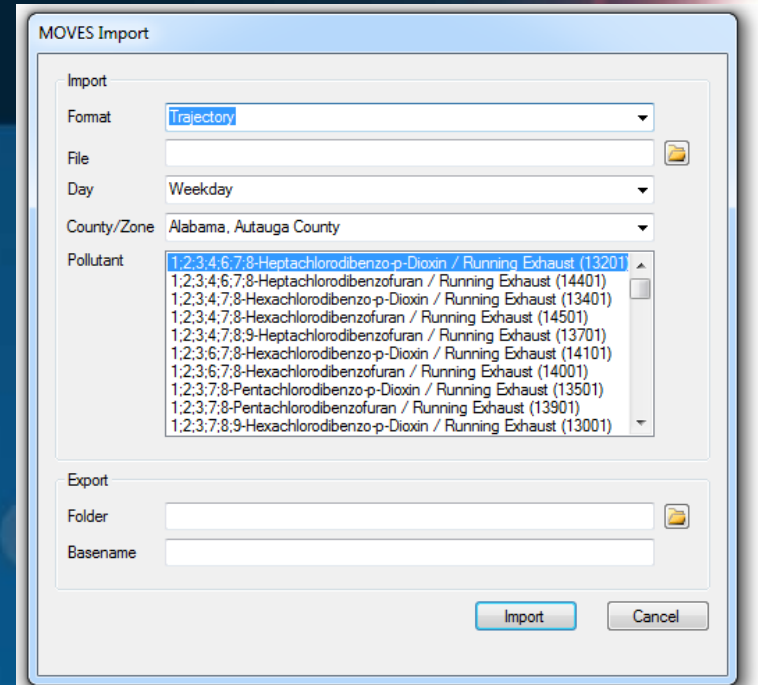


Entrance/Exit



# Tools

- MOVES Operating Mode Data Import Tool



- MOVES Meteorology Data Import Tool

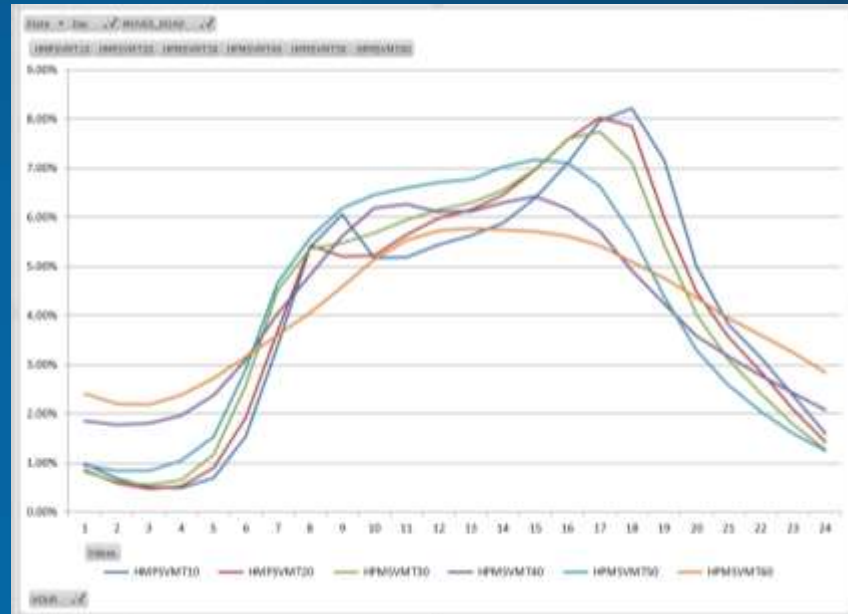


# Tools (continued)

- MOVES Highway Statistics Analysis**

State	Arizona				
Sum of Annual VMT (millions)					
MOVES HPMS Vehicle Type	Total	State VMT Fraction	MOVES Embedded VMT Fraction	State VMT Fraction with Type 20/30 Split from MOVES	
10 Motorcycle	261	0.44%	0.53%	0.44%	
20 Passenger Cars	41,894	69.83%	54.42%	52.98%	
30 Light Trucks	11,954	19.93%	37.78%	36.78%	
40 Buses	308	0.51%	0.22%	0.51%	
50 Single-Unit Trucks	1,977	3.30%	2.74%	3.30%	
60 Combination Trucks	3,601	6.00%	4.30%	6.00%	
Grand Total	59,995	100.00%	99.99%	100.00%	

- MOVES VTRIS Analysis Tool**



# Examples

- **Example #1: Regional Analysis with Limited Data**
- **Example #2: Regional Analysis with More Extensive Data**
- **Example #3 – Project-Level Analysis**
- **These are included in the Guidebook**



# Example Topics Covered in Resource Documents

- Analysis of temporal (hour, day) distributions by source type in 27 states based on FHWA Vehicle Travel Information System (VTRIS) data from traffic counters
- State-level road type distributions by source type based on Highway Statistics data
- Methods for combining registration and VMT data for source type populations inputs
- Supplementing reg. data with license plate surveys to account for out-of-area vehicles in age distribution
- Examples of drive-cycle inputs for project-level analysis

# Additional Research and Data Needs

- Data Collection

- » Classified traffic data collection for VMT-based inputs
- » Speed data and traffic networks
- » Heavy-duty vehicle fleets and activity
- » Off-network data

- Research and Methodology Development

- » Speed data by source type
- » Speed prediction methods
- » Traffic classification methods
- » Truck short- versus long-haul populations
- » Expanded use of fleet-based telematics data to measure heavy-duty vehicle activity



Thank You!