MOVES and Conformity

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What is MOVES?

- **MOtor Vehicle Emission Simulator**
- State-of-the-art modeling framework
- Replaces MOBILE for on-road vehicle emissions
  - Significant expansion of capabilities compared to MOBILE
  - Will also eventually include nonroad emissions to replace separate NONROAD model
- **Grace Period**
  - All new regional analyses started after March 2, 2012 must use MOVES
  - New nonattainment areas need to use MOVES for AQ plans (MOBILE6 cannot be used)
Why Did EPA Develop MOVES?

- CAA requires EPA to regularly update emission factor models
- 2000 National Research Council review recommended many changes to EPA’s mobile source modeling program
- FORTRAN code used in MOBILE6.2 is obsolete and difficult to maintain
- Modular database structure more modern, easier to update with new data
MOVES Inputs

- MOBILE6 inputs were provided by 1) typing data into the text input file (e.g., temperatures, VMT fractions), or 2) referencing external text files (speed distribution, VMT by facility type).
- MOVES inputs provided by 1) making selections in the graphical user interface (e.g., year), or 2) importing information from Excel spreadsheets into input database.
- Choice of local data or defaults governed by MOVES Technical Guidance; largely unchanged from MOBILE6 Technical Guidance.
Developing Inputs: Age Distribution (SourceTypeAgeDistribution)

- **Age Distribution** is entered according to MOVES source types and calendar year
  - AgeFraction must sum to 1 within these fields
- **Age Distribution** covers new (0) to 30+ year old vehicles
- MOVES does not vary age distribution by month
- **Age Distribution converter**: stand alone and in VMT converters
Developing Inputs: Average Speed Distribution (AvgSpeedDistribution)

- Avg. Speed Distribution entered according to source type, road type, and hour-day
  - AvgSpeedFraction should sum to 1 within these fields
- MOVES has 16 speed bins ranging from 2.5 to 75+ mph
- Avg. Speed Distribution is in terms of time, not distance (i.e. fraction of VHT, not VMT, in each speed bin)
- Converters available for MOBILE6 Speed VMT files
Developing Inputs: Fuel Supply (FuelSupply)

- Fuel Supply entered according to county, year, month, fuel type
  - MarketShare should sum to 1 within these fields

- Defaults can be exported for gasoline and diesel formulations
Guidance recommends use of existing fuelFormulationID’s with the appropriate fuelSubTypeID for the fuel properties being entered

- However, properties can be changed for existing formulations
Developing Inputs: Meteorology (ZoneMonthHour)

- Meteorology data is entered for every month and hour selected in the run
- Temperatures are in degrees Fahrenheit, relative humidity in %
Ramp Fraction is the fraction of time spent on ramps as compared to the total time on restricted roadways and ramp.

- Default fraction of 0.08 (8%) will be applied if data is not imported.
- Only applies to restricted access roadways (freeways).
Developing Inputs: Road Type Distribution (RoadTypeDistribution)

- **RoadTypeVMTFraction** is the fraction of VMT (in this case distance, not time) on each road type by a vehicle type.

- The **RoadTypeVMTFraction** values sum to 1 within each vehicle type.
Developing Inputs: Source Type Population (SourceTypeYear)

- Source Type Population is the actual number of vehicles of each source (vehicle) type in the county being modeled.
- Used to calculate start and evaporative emissions.
Annual VMT is entered for each HPMS vehicle class

Converters can be used to map VMT from MOBILE vehicle classes to HPMS vehicle classes used as MOVES inputs

AADVMT Calculator can be used to scale daily VMT up to yearly VMT
MonthVMTFraction (fraction of annual VMT by month) must sum to 1 within each source type.

MonthVMTFraction table can be generated with month adjustment factors in AADVMT Calculator.
Developing Inputs: Day VMT Fraction (DayVMTFraction)

- Day VMT fraction represents the relative share of VMT on weekdays and weekend days; sums to 1 within each source type, month, road type combination.
- DayVMTFraction is in terms of the fraction of VMT on each type of day throughout the entire month (i.e., ~22 weekdays and 9 weekend days in a 31 day month; 22/31 = 0.71, similar to default values)
- DayVMTFraction can be generated with weekend day adjustment factors in AADVMT Calculator
Developing Inputs: Hour VMT Fraction (HourVMTFraction)

- HourVMTFraction must sum to 1 within each source type, road type, type of day combination
- HourVMTFraction table can be generated with some VMT converters and Daily VMT Calculator
Developing Inputs: I/M Programs (IMCoverage)

- Only one I/M program can be applied to each pollutant-process, source type, fuel type, model year combination
- IMProgramID is arbitrary number, but must be unique for each fuel type, inspection frequency, test standard combination
## Differences in Inputs Between MOBILE6 and MOVES

<table>
<thead>
<tr>
<th>MOBILE6 Input</th>
<th>MOVES Input</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meteorology (Temperature and Humidity)</td>
<td>Same</td>
<td>Some format differences; EPA converter tool available</td>
</tr>
<tr>
<td>Fuel inputs (~ a dozen separate variables)</td>
<td>Fuel Supply and Fuel Formulation tables</td>
<td>Defaults can be used after verification, or can be edited in Excel</td>
</tr>
<tr>
<td>I/M programs: parameters typed into input file, or separate external file</td>
<td>Same parameters (some minor simplification); now housed in Excel spreadsheet</td>
<td></td>
</tr>
</tbody>
</table>
## Differences in Inputs Between MOBILE6 and MOVES

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<tr>
<td>Speed distribution (VMT by speed bin) or average speed</td>
<td>Speed distribution (VHT by speed bin)</td>
<td>EPA converter tool available</td>
</tr>
<tr>
<td>Age distribution: 25 age fractions, in external text file</td>
<td>Age distribution: 30 age fractions, imported from external Excel file</td>
<td>Local data recommended (same as MOBILE6); national defaults posted online by EPA</td>
</tr>
<tr>
<td>Source Type Population (number of vehicles in modeling area; new input in MOVES)</td>
<td>LDV data can be obtained from registration database; training materials show how to obtain defaults</td>
<td></td>
</tr>
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### Differences in Inputs Between MOBILE6 and MOVES

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<td>VMT Fractions</td>
<td>VMT by HPMS vehicle type</td>
<td>EPA converter tool available</td>
</tr>
<tr>
<td>VMT Fraction on Ramps</td>
<td>VHT Fraction on Ramps</td>
<td>Format change</td>
</tr>
<tr>
<td>VMT by Facility</td>
<td>Road Type Distribution</td>
<td>EPA converter tool available</td>
</tr>
<tr>
<td>VMT by Hour</td>
<td>VMT by Hour</td>
<td>Optional Input</td>
</tr>
<tr>
<td></td>
<td>VMT by Day and Month</td>
<td>Applied outside the model in MOBILE6 inventories; EPA converter tool available</td>
</tr>
</tbody>
</table>
MOVES2010 Results

- Data collected since MOBILE6 released drives differences between MOVES and MOBILE6

- National trends
  - HC and CO emissions similar or lower than MOBILE6.2
  - Total NOx emissions higher than MOBILE6.2
  - Total PM emissions substantially higher than MOBILE6.2

- Local results may vary
  - Local fleet mix, fuels, activity are important
  - Temperature drives PM emissions
• I/M program data shows MOBILE6 underestimated NOx emissions from light trucks
• On-road data on heavy trucks shows higher emissions than MOBILE6 estimated from cert data
• Extended idle emissions become significant share of heavy-duty inventory in future
VOC

- I/M program data shows MOBILE6 overestimated HC emissions from newer technology cars
- Evaporative emissions on newer technology vehicles very low
- Kansas City program found high gas PM emissions esp. at cold temps
- New data on heavy trucks shows higher deterioration than MOBILE6
- MOVES accounts for impact of vehicle speed – MOBILE did not
What It Means

- Higher NOx and PM emissions mean on-road mobile sources have bigger role in attainment than previously thought.
- Percent reduction from base year is key to attainment analysis.
  - PM2.5 shows higher overall emissions and higher % reductions.
    - Effect on attainment demonstrations could be positive.
  - NOx shows higher overall emissions but lower % reduction.
    - Could be harder to show attainment.
    - Future NOx control measures could have a bigger impact.
- States need to evaluate these impacts and consider their effects on SIP and conformity requirements.
**MOVES Policy and Guidance Documents**

- **Federal Register Notice of Availability**
  - Published March 2, 2010 (75 FR 9411)
    - Link at www.epa.gov/otaq/models/moves/index.htm
    - Approves the use of MOVES2010 for SIPs in states other than California
    - Starts a two-year grace period for use of MOVES2010 in regional conformity analyses

- **MOVES2010 SIP and Conformity Policy Guidance**
  - Published December 2009
    - www.epa.gov/otaq/models/moves/420b09046.pdf
    - Provides detailed guidance on when MOVES2010 should be used in SIPs and transportation conformity analyses
The MOVES User Guide describes:

- Installation instructions
- The features of the graphical user interface (GUI)
- Instructions on how to access each feature
- Step-by-step example run
- Exporting results to MS Access
- Running MOVES in a batch mode
- “MOVES Decoder”
MOVES Policy and Guidance Documents

- MOVES2010 Technical Guidance
  - Published December 2009; currently being updated
    - [www.epa.gov/otaq/models/moves/420b10023.pdf](http://www.epa.gov/otaq/models/moves/420b10023.pdf)
  - Provides guidance on appropriate inputs for MOVES2010 in SIPs and regional conformity analyses
    - Defaults vs. local information
    - Developing appropriate local inputs
MOVES Training

- **MOVES training a cooperative effort of EPA and FHWA staff**
  - Last year, gave hands-on Draft MOVES2009 training in 20 locations to over 400 participants

- **Currently giving MOVES2010 hands-on course:**
  - Training already given in 12 locations
  - Approximately 12 additional locations planned for FY 2011, including Louisiana

- **Starting a series of webinars**
  - Introduction to MOVES and Running MOVES in batch mode have been conducted; will schedule additional webinars as they are developed
  - FHWA is also hosting user group webinars aimed at regional-scale and project-level users
What Do MPOs Need to Do?

- Install MOVES2010a
  - Powerful desktop computers are useful to reduce runtimes
- Read through Users Guide and Technical Guidance
  - Start working with other state and local agencies to gather input data
- Read through MOVES training materials and work through class exercises
Visit the MOVES Website:

- **Main Page**
  - [www.epa.gov/otaq/models/moves/](http://www.epa.gov/otaq/models/moves/)

- **Training Sessions**
  - [www.epa.gov/otaq/models/moves/trainingsessions.htm](http://www.epa.gov/otaq/models/moves/trainingsessions.htm)

- **Training Materials**
  - [www.epa.gov/otaq/models/moves/training.htm](http://www.epa.gov/otaq/models/moves/training.htm)

- **Background Information**
  - [www.epa.gov/otaq/models/moves/movesback.htm](http://www.epa.gov/otaq/models/moves/movesback.htm)

- **Listserver Information**
  - [www.epa.gov/otaq/models/mobilelist.htm](http://www.epa.gov/otaq/models/mobilelist.htm)
What’s New in Conformity

- CO and PM hotspot guidance (doesn’t apply in Louisiana at this point—no CO or PM areas)
- EPA proposal to restructure conformity rule
  - www.epa.gov/otaq/stateresources/transconf/conf-reg.htm
FHWA/FTA Conformity Resources

- Reorganized FHWA conformity web page
  - www.fhwa.dot.gov/environment/air_quality/conformity/
  - Basic information for new areas
  - Comprehensive listing of guidance for all areas

- FHWA Research Reports
  - MOBILE and MOVES inputs
  - Conformity practices in complex nonattainment areas

- Conformity training available from the National Transit Institute
Questions?