MOVES2014 Overview and Plans for the Future

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Outline

• What is MOVES?
• MOVES history
• MOVES2014 overview
• Plans for next official version of MOVES
• MOVES development process
• Work currently underway
What is MOVES?

- **Motor Vehicle Emission Simulator**
- Estimates emissions & energy use from
  - Onroad vehicles: passenger cars, light-trucks, heavy-duty trucks, buses, motorcycles
  - Nonroad equipment: construction, industrial, agricultural, lawn & garden, commercial, logging, airport, oil & gas, mining, railroad service, recreational vehicles
- Estimates different types of emissions:
  - Engine running/working, engine starting, idling, evaporative, etc.
- Estimates fuel consumption & emissions of many different pollutants
  - Criteria pollutants and precursors: hydrocarbons (HC), nitrogen oxides (NOx), particulate matter (PM), sulfur dioxide (SO₂), and carbon monoxide
  - GHG pollutants: carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄)
  - >180 air toxics
- Accounts for national emission standards, vehicle populations and activity, local rules, fuels and meteorology
Uses of MOVES

• U.S. EPA
  – Uses MOVES to estimate emission impacts of mobile source emissions regulations and policies
  – Uses MOVES when generating national inventories of air pollutants

• States and cities
  – Use MOVES to develop State Implementation Plans (SIPs) and to show conformity of transportation activities with the SIP

• Others
  – Use MOVES to model the effects of policy choices
  – Use MOVES in academic research on vehicle emissions
MOVES – Scales of Analysis

**National**

**Input:**
- MOVES default national averages (e.g. vehicle counts, VMT, temperature, fuel, etc)

**Use:**
- Rough estimates of program impacts
- High-level emission inventory projections

**County**

**Input:**
- County-specific inputs

**Use:**
- Required state and local agency modeling
- Inputs for air quality modeling

**Project**

**Input:**
- More detailed location-specific inputs

**Use:**
- Estimates for specific transportation projects
Types of MOVES Release

• Major release
  – Typically includes new regulations, up-to-date emissions data, improved functionality, and others
  – Involves changes in emissions
  – Approved model for performing SIP and transportation conformity analyses outside of California

• Minor release
  – Often involves more functionality, improved algorithms, and minor bug fixes
  – Criteria pollutant emissions are not significantly changed from the major version
  – Not considered a new model for SIP and transportation conformity purposes
MOVES History

**MOVES2004**
- First model release
- Included only energy and greenhouse gases

**MOVES2009**
- Draft release
- Included criteria pollutants

**MOVES2010**
- First official major release
- Replaced MOBILE6 for SIPs & conformity

**MOVES2010a***
- Accounts for LD GHG and fuel economy rules
- Improvements in performance and usability

**MOVES2010b***
- New features and better performance
- Improved modeling of air toxics

* Minor release
MOVES2014 Overview

- Second official major release (Oct. 2014)
- Replaced MOVES2010 for use in SIPs & conformity
- Included new EPA regulations:
  - LD GHG 2017-2025, HD GHG Phase 1, and Tier 3
  - Updated with the latest data on fuel effects, emission rates and activity for onroad vehicles
  - Incorporated NONROAD model into MOVES

MOVES2014a*

- Released in November 2015
- No significant change in criteria pollutant emissions
- Added the capability to estimate VOC and toxics from nonroad equipment
- Included new data and features
- Corrected bugs

* Minor release
What’s Next for the Next MOVES?

• Next official version of MOVES to include
  – New data based on latest test programs and analyses
  – Latest vehicle population and activity data
  – New rules (e.g. Heavy-Duty Greenhouse Gas Phase 2)
  – Improved functionality and performance
  – Additional features

• Timing of release
  – 2018 at the earliest
MOVES PROCESS
Process for Updating MOVES

1. Collect
2. Prioritize
3. Analyze
4. Develop
5. Test Document Peer Review
6. Release
7. Evaluate
MOVES Process – Collect

- Data from new research programs
  - e.g. heavy-duty in-use program, ACES Phase II, EPA and California test programs
- Latest vehicle population and activity data
  - e.g. Annual Energy Outlook (AEO) projections
- User concerns, recommendations, suggestions
  - FACA workgroup
  - MOVES training courses
  - Research conferences/journals/publications
  - Input from other air quality and transportation agencies
  - Input from EPA staff
- Problems, potential errors, inaccuracies
  - MOVES inbox, EPA use of MOVES, feedback from evaluation work
MOVES Process – Prioritize & Analyze

• Prioritize based on:
  – User needs
  – Quality of data
  – Data availability
  – Impact on total inventory
  – Relevance for policy decisions
  – Budget and staffing

• Analyze
  – Improve current data with new analyses and updated algorithms
  – Reduce data gaps/uncertainties
  – Confirm issue and/or evaluate recommendations
MOVES Process – Develop & Test/Document/Peer Review

• Develop codes and databases
  – Incorporate the results from analyses based on latest science and data
  – Add features and improve user interface

• Test
  – Perform extensive testing and debugging in-house
  – Beta release
    • Limited confidential testing prior to the public release

• Document/Peer Review
  – Prepare user guide, software design reference manual
  – Peer review MOVES technical reports
  – Review underlying assumptions and analyses in MOVES as a part of FACA process
MOVES Process – Release & Evaluate

• Release
  – Timing of release depends on many factors (e.g. SIP schedule, regulatory agenda)

• Evaluate
  – Compare results to newest data
  – Serves to guide future work and research needs
  – By EPA and by others
    • e.g. CRC E-101 MOVES2014 Review
Several recent studies suggest that mobile source NOx emissions are sometimes too high.

We are comparing MOVES2014 emission rates to recent roadside studies:

- tunnel/remote-sensing and inspection/maintenance data

We are examining air quality results for specific times and grid cells to better understand discrepancies.

To be presented at future FACA meetings.
PROPOSED UPDATES
Potential Onroad Updates

• 2007+ heavy-duty diesel emission rates
  – New emission data from multiple studies
  – Running, starts, extended idle rates
  – Revisit real-world effectiveness of emission control technologies (SCR and DPF)
  – To be presented at future FACA meetings

• Incorporate the impact of Heavy-duty Greenhouse Gas Phase 2 Program (2018-2027)
Potential Onroad Updates (cont’d)

• Tier 2 light-duty PM emission rates
  – Using data from EPA and California test programs
  – Incorporate gasoline direct injection (GDI) PM emission rates
  – To be presented at future FACA meetings

• Minor Updates
  – Incorporate additional chemical mechanism (SAPRC07), and update CB05 (CB05e51 update)
  – Update methane emission rates
  – Others
Potential Onroad Updates (cont’d)

• Population and activity
  – Remove freeway ramps from county-scale and national MOVES runs
  – Consolidate MOVES source types
  – Update VMT and vehicle population projections using the latest estimates from Federal Highway Administration (FHWA) and Annual Energy Outlook (AEO)
  – Update default vehicle populations using inputs into the 2014 National Emissions Inventory (NEI)
  – Allow emission projections to 2060
  – Change allocation of hoteling to be consistent with the NEI
  – To be presented at future FACA meetings
Potential “Functional” Improvements

• Improve performance
• Upgrade ant and GO language
• Simplify pollutants and processes panel
• Remove fuel choices from equipment panel
• Etc...
THANK YOU!

For questions, email mobile@epa.gov