



EPA's MOtor Vehicle Emission Simulator (MOVES): Future Plans and Data Needs

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Outline

- Background
- Plans for next official version of MOVES
- Data needs



What is MOVES?

- EPA's 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.



What is MOVES? Cont.

- Estimates fuel consumption & emissions of many different pollutants
 - Criteria pollutants and precursors: hydrocarbons (HC), nitrogen oxides (NO_x), 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, 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
- State, regional, and local governments
 - 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:

- National 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
 - Official model for performing SIP and transportation conformity analyses outside of California
- Minor release
 - Often involves more functionality, improved algorithms, and minor bug fixes
 - Onroad 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*

- Accounted for LD GHG and fuel economy rules
- Improved performance and usability

MOVES2010b*

- Added new features and better performance
- Improved modeling of air toxics

* Minor release



MOVES2014 Overview

MOVES2014

- 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 VOCs and toxics from nonroad equipment
- Included new data and features
- Corrected bugs

* Minor release

MOVES2014 Evaluation

- Several recent studies suggest that mobile source NO_x emissions are sometimes too high
- We have compared MOVES2014 emission rates to recent roadside studies
 - We have not yet found evidence that we need to adjust MOVES rates or default inputs
 - Presented the findings at IEIC, CMAS, and AGU
 - We are continuing our investigation
- Understanding the sources of modeled NO_x bias continues to be a complex problem requiring careful analysis of many potential factors



MOVES Plans

- Next official version of MOVES to include
 - New data based on latest test programs and analyses
 - Latest vehicle population and activity data
 - Newer rules (e.g. Heavy-Duty Greenhouse Gas Phase 2)
 - Improved functionality and performance
 - Additional features
- Timing of release
 - TBD, but 2019 at the earliest
- Impact on emissions is unclear at this time



Updated Emissions

- Updated estimates for:
 - Heavy-duty: Criteria pollutant & GHG emissions, CNG for all sourcetypes
 - Light-duty particulate matter
 - Impact of parking time on start emissions
 - Humidity adjustments
 - Temperature adjustments for LD PM running
 - Improved pollutant speciation, including methane



Updated Fleet & Activity

- Historical and projection data for national VMT and vehicle populations
- National age distributions
- Vehicle starts and idling
- Hotelling activity
- Vehicle weights and other characteristics
- Remove ramps as a separate roadtype
 - Drafting tool to help users model ramps in project mode



New Vehicle Activity Inputs

- Starts
 - Start emissions are important for onroad vehicles
 - Emission controls not as effective at start
 - “Soak time” matters
 - Telematics data provides improved data on start activity for both light-duty and heavy-duty
 - Updating MOVES to incorporate improved emissions information and activity defaults
 - Improving options for user activity inputs



New Vehicle Activity Inputs Cont.

- Off-network Idle
 - MOVES2014 accounts for idle activity that is part of the driving cycle
 - Additional idle happens, “off-network”
 - Telematics data provides improved data on idle activity for both light-duty and heavy-duty
 - Updating MOVES to incorporate improved emissions information and activity defaults
 - Improving options for user activity inputs



Other Planned Changes

- Allow CNG inputs for all HD onroad sourcetypes
- Update nonroad growth factors (and thus equipment populations)
- Update classification and emission rates for Tier 4 nonroad equipment
- Extend model to cover calendar years to 2060
- Reduce model run time



New Data Needs: MOVES Users

- Option to enter data on “off-network idle”
 - Time spent idling that is not part of onroad driving cycles
- Additional options for entering start activity
- Improved options for entering HD hotelling activity



Data Needs: EPA

- Historic and projected VMT, vehicle population, activity
- Geographic & temporal resolution
- Nonroad equipment population & activity data



Summary

- EPA continues work to improve MOVES modeling of mobile source emissions
- Detailed information available on EPA MOVES website:

<https://www.epa.gov/moves>

