



Updates to EPA's Motor Vehicle Emission Simulator (MOVES)

Highlights from presentation to
Coordinating Research Council
Real World Emissions Workshop
March 11, 2019



Next Major Version of MOVES

- Next major version of MOVES to include
 - New data
 - Newer rules (e.g. Heavy-Duty Greenhouse Gas Phase 2)
 - Improved functionality and performance
 - Additional features
- Peer reviewed draft reports available
 - <https://cfpub.epa.gov/si/>
 - Search “MOVES201X” or “NONROAD”
- Timing of release
 - TBD, but 2020 at the earliest
- Net impact on emissions is unclear at this time



Activity Improvements for Next Version of MOVES

| | |
|--|--|
| <p>Starts (Updated User Inputs)</p> | <p>Allow users to enter starts per day activity by:</p> <ul style="list-style-type: none"> • Vehicle type • Vehicle age • Soak time (fraction of cold starts vs. hot starts) • Month • Day (weekday or weekend) • Hour |
| <p>Hotelling (Updated User Inputs)</p> | <p>Allow users to enter either 1) total hotelling activity or 2) ratio of hotelling activity to long-haul freeway miles by:</p> <ul style="list-style-type: none"> • Vehicle age • Month • Day • Hour • Activity (extended idling/APU/AC or battery power/engine on) <div style="border: 1px solid black; background-color: #e0f2e0; padding: 5px; margin-top: 10px;"> <p>Hotelling = using the truck as a resting place for long-haul truck drivers</p> </div> |
| <p>Off-network idle (Not included previously)</p> | <p>Users enter <u>total</u> idle fraction (idle time/engine-on time) by:</p> <ul style="list-style-type: none"> • Vehicle type • Month • Day (weekday or weekend) <div style="border: 1px solid black; background-color: #ffe0b2; padding: 5px; margin-top: 10px;"> <p>Off-network idle = total idle – driving idle Idling at curbside, parking lots, depots, pickup and delivery, etc.</p> </div> |

Other Vehicle Population & Activity Updates

- Historical and projection data for national VMT and vehicle populations
- National age distributions
- Vehicle weights and other characteristics



Planned Major Onroad Changes & Expected Emissions Impacts—LD & General

| Change | Description | Expected Impact NOx | Expected Impact PM |
|---|---|---------------------|--------------------------------|
| LD PM rates | Including new data from GDI vehicles, and updated PM temperature adjustments | na | ↓ (near-term) ↑ (long-term) |
| LD gaseous rates | Revised assumptions regarding high-power emission rates, deterioration of starts. Significant decrease in LD NOx in future years. | ↓ | na |
| Improved speciation | Updating organic gas speciation profiles, including methane emissions | na | na |
| Humidity Adjustments | Update the humidity adjustments to be based on Part 86 and Part 1065 values | tbd | na |
| LD and HD off-network idle time | Account for off-network and work-day idling (idling in parking lots, distribution centers, etc). Based on Verizon, NREL datasets. | ↑ | ↑ |
| LD and HD start activity | Update start activity based on Verizon, NREL datasets. Account for fewer starts by vehicle age. | ↓ | ↓ |
| LD start emission rates vs. parked time | Update the relationship between starts and soak time based on EPA and ARB data | ↑ | ↑ |

Planned Major Onroad Changes & Expected Emissions Impacts—HD only

| Change | Description | Expected Impact NOx | Expected Impact PM |
|------------------------------------|--|---------------------|--------------------|
| Heavy-duty GHG Phase 2 standards | Incorporate Heavy-duty 2017-2025 GHG regulation into MOVES | ↓ | ↓ |
| HD diesel running rates | Based on heavy-duty in-use data (next slide) | ↑ | ↓ |
| HD CNG and gasoline emission rates | Update 2010+ CNG and 2008+ Gasoline emission rates | tbd | tbd |
| HD start emission rates | Update 2010+ Diesel and 2008+ Gasoline starts based on compliance data, update relationship of starts vs. parking time | ↑ | ≈ |
| HD extended idle rates | Update heavy-duty diesel emission rates for extended idling and auxiliary power units | ↓ | ↓ |
| Hotelling activity | Decrease hotelling (extended idling trucks at truck stops) nation-wide by ~ 2/3 | ↓ | ↓ |
| HD vehicle masses | Increased resolution in vehicle masses, using weigh-in-motion and other data | ↑ | ≈ |
| Add Gliders | Account for gliders in vehicle fleet | ↑ | ↑ |

Other Planned Changes

- Update default fuel characteristics
- Extend model to cover calendar years to 2060
- Remove freeway ramps as a separate roadtype at county & national scale
- Update “chemical mechanisms” used to generate the emission species used in air quality modeling



Nonroad Model Development

- Continuing work on a comprehensive Nonroad update
- Initial focus is diesel engines
 - Compiling population & activity data
 - Redesigning model structure
- More data needed
 - Working with TTI & CE-CERT to gather real-world activity data (telematics, PAMS)



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- ORISE Participants hosted by US EPA
 - Gurdas Sandhu, Claudia Toro, Sudheer Ballare
- Senior Environmental Employment (SEE) Program at US EPA
 - Ken Reader*, Ted Maciag, Richard Zarczynski
- For more information, see the MOVES web page:
<https://www.epa.gov/moves>

*Retired



Workgroup Presentations (1 of 2)

<https://www.epa.gov/moves/moves-model-review-work-group>

- **September 2016:**
 - MOVES2014 Overview and Plans for the Future
 - Options for Simplifying MOVES Onroad Source Types and Ramps
 - MOVES-NONROAD Model Plans and Data Updates
 - Heavy-Duty Greenhouse Gas Phase 2 in MOVES
- **December 2016:**
 - Update to Running Exhaust Criteria Pollutant Emission Rates for Model Year 2010+ Heavy-Duty Diesel Vehicles
 - Updated Emission Rates for Extended Idle and Auxiliary Power Units
 - MOVES Onroad Population and Activity Update
 - Updating Hotelling Hours in MOVES
- **March 2017:**
 - Vehicle Idle Activity in MOVES
 - Model Evaluation
 - Light-Duty Particulate Matter Emission Rates Update
- **June 2017:**
 - Revising Start/Soak Emissions for LDGV and HDV
 - Heavy Duty CNG category
 - Telematics: valuable for many aspects of MOVES
 - Updated Speciation Profiles
 - Updated Total Organic Gases
- **September 2017:**
 - Updated NONROAD population rates
 - Updated LD Emission Rate Comparison
 - MOVES Future Fuel Supply Updates



Workgroup Presentations (2 of 2)

<https://www.epa.gov/moves/moves-model-review-work-group>

- **December 2017:**
 - Update for Tier-4 Nonroad Diesel Engines
 - Draft Tool to Model Ramps in Project Scale
 - Updates to MOVES HD Source Masses using VTRIS
 - Updates to HDV Fixed Mass Factor and Diesel PM rates
 - CRC 2017 and 2018 MOVES related projects*
- **March 2018:**
 - Ethanol Emission Effects in MOVES2014*
 - Growth Energy Ethanol and Aromatics Testing*
 - Trends and Needs for MOVES*
- **June 2018:**
 - MOVES2014b Plans and Comparisons
 - Heavy-Duty Vehicle Activity in MOVES
 - Update on Revised Light-Duty Start-Soak Relationships
 - MOVES for Shared, Electric, Connected and Automated Vehicles*
- **April 2019:**
 - MOVES Updates (this presentation)
 - Updates to “high power” emission rates and start deterioration for light-duty vehicles
 - Updates to MOVES Heavy Duty Running Exhaust Rates: Diesel, Gasoline, and CNG
 - Modeling of Gliders in MOVES

*Guest presentation

