### **Clean Air Act Advisory Committee** Mobile Sources Technical Review Subcommittee MOVES Review Work Group Report

December 15, 2021

**Work Group Co-Chairs** 

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## **Overview**

- 1. What is MOVES?
- 2. Introduction to the MOVES Review Work Group
- 3. Work Group's Final Report and Top Five Recommendations
- 4. Next Steps



## **EPA MOVES Model**

- EPA's <u>MO</u>tor <u>Vehicle Emission Simulator</u>
- Estimates emissions and energy use for:
  - Onroad vehicles
  - Nonroad equipment (except airplanes, locomotives, and commercial marine vessels)
- Estimates different types of emissions:
  - Engine running, engine starting, hotelling (extended idle), evaporative, brake and tire wear
- Estimates emissions of criteria pollutants, greenhouse gases (GHGs), and air toxics, as well as fuel consumption
- Accounts for national emission standards, vehicle populations and activity, state and local rules, fuels, temperatures & humidity

MOVES3 (latest version) was released November 2020









# Who Uses MOVES and Why?

- U.S. EPA
  - Estimate emission impacts of mobile source regulations and policies
  - Generate national inventories of air pollutants (e.g., National Emissions Inventory (NEI), Air Toxics Data Update, etc.)
  - Provide inputs for many other models and tools
- State, tribal and local air and transportation agencies
  - Prepare emission inventories for state implementation plans, National Environmental Policy Act (NEPA) analyses, and transportation conformity evaluations
  - Note: in California, the EMFAC model is used instead of MOVES
- Others
  - Academic and interest group research on onroad and nonroad emissions, transportation, and air quality
  - Other countries—although the model is designed for modelling the U.S. and includes only vehicles that meet U.S. standards





## **MOVES Review Work Group**

### • Created by MSTRS to provide input on the development of MOVES

- Met from September 2016 to September 2021
- Members had expertise in modeling emissions from highway and nonroad vehicles and represented a wide spectrum of stakeholders
- Meeting notes and presentations available at <a href="https://www.epa.gov/moves/moves-model-review-work-group">https://www.epa.gov/moves/moves-model-review-work-group</a>
  - EPA presented planned updates to MOVES, including underlying data and analyses
  - Work group members and other experts also shared relevant information

### • The work group developed recommendations to the MSTRS based on the meetings

- Most of the group's short-term recommendations have been incorporated into MOVES3
- Work group chairs compiled members' recommendations for future MOVES
- Work group members voted for their top five priorities
- All recommendations are listed in the work group's final report

## **Work Group Members**

Name	Home Organization	Representing Organization
Matthew Barth	University of California, Riverside (CE-CERT)	University of California-Riverside (CE-CERT); Work Group Co-Chair
Megan Beardsley	EPA OTAQ	EPA; Work Group Co-Chair
Elena Craft	Environmental Defense Fund (EDF)	EDF
Tim French	Engine Manufacturers Association (EMA)	EMA
Mike Geller	Manufacturers of Emission Controls Association (MECA)	MECA
Gil Grodzinsky	Georgia Department of Natural Resources	Association of Air Pollution Control Agencies (AAPCA)
Michael Hartrick	Alliance for Automotive Innovation	Alliance for Automotive Innovation
Cecilia Ho	Federal Highway Administration (FHWA)	FHWA
Britt Holmen	University of Vermont	University of Vermont
Jeremy Hunt	Northeast States for Coordinated Air Use Management (NESCAUM)	NESCAUM
Mark Janssen	Lake Michigan Air Directors Consortium (LADCO)	LADCO
Andrew Kotz	National Renewable Energy Laboratory (NREL)	NREL
David Lax	American Petroleum Institute (API)	API
Sam Pournazeri	California Air Resources Board (CARB)	CARB
Lubna Shoaib	East-West Gateway Council of Governments	Association of Metropolitan Planning Organizations
Jenny Sigelko	Volkswagen of America, Inc.	Coordinating Research Council (CRC)
Steven Vander Griend	ICM Inc.	Energy Future Coalition/Urban Air Initiative
Chris Voigt	Virginia Department of Transportation	Amer. Assoc. of State Highway and Transportation Officials
Dale Wells	Colorado Department of Public Health and Environment	National Association of Clean Air Agencies (NACAA)
Wei Zhang	Idaho Department of Environmental Quality	NACAA

# **Final Report**

- The MOVES Review Work Group has created a final report that lists 14 recommendations.
- The report also describes the work group charter and membership, lists all the work group meetings and presentations, and summarizes previous communication with MSTRS.
- The report was shared with MSTRS members in October of this year, and they voted to accept the report and forward it to CAAAC for your consideration.
- The following slides summarize the top five recommendations. Details on these and the remaining recommendations are available in the report.

#### MOVES Review Work Group 2016-2021 Report to Mobile Source Technical Review Subcommittee October 06, 2021

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#### 1. Background

The U.S. Environmental Protection Agency's MOtor. Vehicle Emission Simulator (MOVES) is an emission modeling system for estimating air pollution emissions from highway vehicles and nonroad mobile sources. MOVES is used for many purposes; it is used by the U.S. EPA to estimate emission impacts of mobile source regulations and policies, and to generate mobile sector information for national inventories of air pollutants such as the National Emissions Inventory and the National Air Toxics Assessment. In addition, U.S. states and local agencies outside of California use MOVES to develop emission inventories for a variety of regulatory purposes, including the development of state implementation plans (SIPs), transportation conformity determinations, general conformity evaluations, and analyses required under the National Environmental Policy Act (NEPA), among other uses. Academics and interest groups also use MOVES to model the effects of policy choices and various mobile source scenarios. Over time, MOVES has been improved and updated to better characterize the changing mobile sector and to better incorporate new regulations and other new information about vehicle and nonroad engine emissions.<sup>4</sup>

To provide expert feedback and advice on MOVES development, the Mobile Sources Technical Review Subcommittee (MSTRS) has chartered a series of MOVES Review Work Groups. The work group is not designed for policy or advocacy, but rather is a focal point for sharing technical expertise. The first work group was chartered in April 2007 and met through April 2010 to provide feedback on MOVES initial development<sup>2</sup>, culminating with the release of MOVES2010 in December 2009. A second work group met from July 2012 through July 2013 during the development of MOVES2014, released in October

 <sup>&</sup>lt;sup>1</sup> Overview of EPA's MOtor Vehicle Emission Simulator (MOVES3)
<sup>2</sup> MOVES Review Workgroup Final Report to Mobile Source Technical Review Subcommittee, September 2010

Improve modeling of energy use and direct emissions from vehicles using **alternative fuels and technologies** by compiling emissions, activity, and vehicle characteristics of, for example:

- battery electric
- hybrid electric
- hydrogen fuel cell
- natural gas
- propane



Update modeling of exhaust emissions from **conventional (diesel and gasoline) heavy-duty vehicles** in MOVES, such as:

- <u>Activity</u> Incorporate latest data on heavy-duty vehicle operations, and better account for road grade and changes in vehicle mass and road load.
- <u>Emissions</u> Update with latest real-world data and account for new regulations.
- <u>Adjustments</u> better account for tampering and inspection/maintenance programs.
- <u>Speciation</u> Better account for secondary organic aerosol (SOA)-precursors and ultra-fine particles.





Update modeling of exhaust emissions from **conventional (gasoline and diesel) light-duty vehicles** in MOVES, such as:

- <u>Activity</u> Make use of large vehicle activity datasets that are becoming increasingly available (e.g., connected and automated vehicle data sets, vehicle telematics). Better account for road grade and changes in vehicle mass and road load.
- <u>Emissions</u> Collect more data on latest technologies on light-duty vehicles and account for new regulations.
- <u>Adjustments</u> Update air conditioning effects. Update default fuel properties and fuel property effects, including those related to ethanol and aromatics.
- <u>Speciation</u> Better account for secondary organic aerosol (SOA)-precursors and ultra-fine particles



Improve how MOVES **works with other models and tools** (SMOKE, GREET, VISSIM, AERMOD, etc.), for example:

- Develop, test, and document best practices.
- Provide software tools and application programming interfaces (APIs).
- Facilitate life-cycle analysis for electric vehicles and greenhouse gases.
- Simplify source types to better align with Federal Highway Administration's vehicle categories.
- Allow additional user inputs such as vehicle load or weight.

SMOKE – Sparse Matrix Operator Kernel Emissions Modeling System GREET – Greenhouse gases, Regulated Emissions, and Energy use in Transportation life-cycle model VISSIM – microscale traffic simulation model AERMOD – air quality dispersion model



### Improve MOVES capabilities for community-scale modeling and equity analysis, for example:

- Expand on existing project-level guidance to estimate emissions at the community level
- Develop and test techniques such as Automated License Plate Readers to estimate vehicle mix and activity at the sub-county level
- Develop MOVES-based tools for equity or environmental justice analyses, or to support other EPA tools that require mobile source emissions input.





MSTRS requests that CAAAC approve the final report and the work group recommendations and forward them to EPA for consideration.

## **Questions?**