

# EPA Releases MOVES2010b Mobile Source Emissions Model Revision: Questions and Answers

*Note: This document is a revised version of the Questions and Answers that were released in April 2012, when EPA originally released MOVES2010b as a minor revision to MOVES2010. Important differences from the April 2012 Questions and Answers are indicated in italics. When necessary, the new release of MOVES2010b is referred to as the “revised version of MOVES2010b.” All other references to “MOVES2010b” in this document as well as other MOVES-related documents continue to be applicable.*

## What is MOVES, and why is EPA releasing a revised version of MOVES2010b?

The MOtor Vehicle Emission Simulator (MOVES) is the U.S. Environmental Protection Agency’s (EPA’s) state-of-the-art tool for estimating emissions from highway vehicles. The model is based on analyses of millions of emission test results and considerable advances in the Agency’s understanding of vehicle emissions. Compared to previous tools, MOVES incorporates the latest emissions data, more sophisticated calculation algorithms, increased user flexibility, new software design, and significant new capabilities. EPA announced the release of MOVES2010 in March 2010 (75 FR 9411), and released a minor revision as MOVES2010a in September 2010.

EPA originally released MOVES2010b in April 2012 to allow MOVES users to benefit from several improvements to general model performance. EPA is now releasing a revised version of MOVES2010b. *As discussed in detail in Question 5 in this document, agencies that have used the April 2012 version of MOVES2010b for ongoing modeling can complete that work, but any new modeling with MOVES2010b should be based on the revised version of MOVES2010b.* MOVES2010b does not significantly affect the criteria pollutant emissions results of MOVES2010 and therefore is not a new model.

## What has changed from MOVES2010a to MOVES2010b?

When EPA originally released MOVES2010b in April 2012, EPA outlined several performance enhancements to assist as state and local agencies generate MOVES

emissions inventories. For example, MOVES2010b works better in networks and has improved capabilities that make it faster in certain circumstances. Several improvements have been made to data input managers to make MOVES2010b easier to use with more functionality. MOVES2010b also takes advantage of newer versions of Java (version 1.7.0) and MySQL (version 5.5.12).

MOVES2010b also included a number of other improvements. These are listed in Appendix A. The net impact of these changes on emissions is very small in runs at the both County and Project scale. More detailed pollutant output for air quality modeling is also available.

### **What has changed in the revised version of MOVES2010b that is being released today?**

*During ongoing MOVES development work, EPA staff discovered an error in the MOVES database that was originally released with the April 2012 version of MOVES2010b. This error affected only hydrocarbon emissions from the vapor venting process in gasoline vehicles after calendar year 2020. As a result of this error, the April 2012 version of MOVES2010b underestimated hydrocarbon emissions beginning in 2021. The error is small in 2021, but gradually increases with fleet turnover over time. For example, in generic testing, the error resulted in underestimating total volatile organic compounds (VOCs) by less than 0.5% in 2021, to almost 6.5% in 2040. This error is unique to the 4/10/2012 database originally included with the April 2012 version of MOVES2010b and does not occur in MOVES2010a or MOVES2010. This error also does not affect any other pollutants or precursors that were estimated by the April 2012 version of MOVES2010b.*

*The revised version of MOVES2010b released today includes an updated database (dated 10/30/2012) that corrects this error.*

### **What needs to be done to switch to MOVES2010b?**

*Instructions for downloading and installing the revised version of MOVES2010b are available on the MOVES web page [www.epa.gov/otaq/models/moves/](http://www.epa.gov/otaq/models/moves/).*

Users will find that Run Specifications (RunSpecs) and input databases developed with MOVES2010 or MOVES2010a need to be changed to run with MOVES2010b. EPA has created tools that easily convert old RunSpecs and databases to the MOVES2010b format.

Users should always specify in relevant documentation what version of MOVES was used to create emissions results for state implementation plans (SIPs), conformity and other purposes.

### **When should MOVES2010b be used for state implementation plans and transportation conformity analyses?**

MOVES is EPA's latest motor vehicle emissions model for state and local agencies to estimate VOCs, nitrogen oxides (NO<sub>x</sub>), particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>), carbon monoxide (CO),

and other precursors from cars, trucks, buses, and motorcycles for SIPs and transportation conformity determinations outside California.

Because MOVES2010b does not significantly affect criteria pollutant emissions results from MOVES2010, we are not considering MOVES2010b a new emissions model for SIP and transportation conformity purposes under 40 CFR 93.111, and there will be no new grace period for regional conformity analyses using MOVES2010b. The MOVES2010 grace period for regional conformity analyses will apply to the use of MOVES2010b as well. EPA extended the grace period for regional conformity analyses to March 2, 2013 (77 FR 11394). For project-level PM and CO hot-spot analyses, the 2-year conformity grace period for using MOVES ends December 20, 2012 (75 FR 79370). This MOVES2010a grace period for PM or CO hot-spot analyses for project-level conformity determinations will apply to the use of MOVES2010b as well. EPA encourages state and local agencies to use the latest version of the MOVES model available at the time that any conformity modeling begins, since the model framework enhancements included will optimize model performance.

In general, EPA believes the states should use the latest version of MOVES2010 that is available for SIP development. All states other than California should use today's MOVES2010b release for future SIPs in order to take full advantage of the improvements incorporated in this version. If states have completed significant work on a SIP with the April 2012 version of MOVES2010b, such work can be completed and submitted for EPA action. State and local agencies that have already completed significant work on a SIP with MOVES2010 or MOVES2010a can continue to use it.

*EPA has determined that the practical impact from today's release of the revised version of MOVES2010b is minimal for SIP and conformity modeling. Most state and local agencies have not yet begun using the April 2012 version of MOVES2010b for SIP or transportation conformity purposes. As noted above, the corrected database in today's release is intended to ensure that MOVES2010b VOC emissions estimates for analysis years 2021 and later are consistent with MOVES2010 and MOVES2010a. VOC estimates for earlier analysis years and estimates for all other pollutants and precursor are not affected by today's release. Due to the circumstances involved, if significant work has occurred with the April 2012 version of MOVES2010b, that work can be completed. However, any new SIP and conformity modeling work with MOVES2010b should be completed with the revised version of MOVES2010b.*

To determine when to use MOVES2010b in SIP development and transportation conformity determinations, refer to EPA's updated policy guidance on the use of MOVES for SIP development and transportation conformity at: [www.epa.gov/otaq/stateresources/transconf/policy.htm#models](http://www.epa.gov/otaq/stateresources/transconf/policy.htm#models). State and local agencies should consult their EPA Regional Office to resolve any questions for a particular nonattainment or maintenance area.

**Can MOVES2010b be used to estimate greenhouse gas emissions?**

Yes, MOVES is currently EPA's best tool for estimating greenhouse gas (GHG) emissions from the transportation sector. At this time, MOVES2010b is the latest version of MOVES that has been released, and it accounts for all national fuel economy and GHG standards for cars and trucks as of September 2010. In addition, EPA has developed MOVES technical guidance that describes how to use MOVES to estimate GHG emissions and/or energy consumption from on-road vehicles in a state or metropolitan area.<sup>1</sup> State and local agencies estimating GHG emissions in the transportation planning process should consider using the latest version of MOVES for GHG emissions analyses in the future. EPA notes that there are no SIP and transportation conformity requirements for GHGs.

**Can MOVES2010b be used to estimate mobile source toxic emissions?**

MOVES2010a estimates emissions for the following mobile source air toxics (MSATs): benzene, 1,3-butadiene, formaldehyde, acetaldehyde, acrolein, naphthalene, ethanol, and methyl tert-butyl ether (MTBE). MOVES2010b adds the other MSATs shown in Table A-2 that were previously available in the National Mobile Inventory Model (NMIM) and included in the National Emission Inventory. Consistent with EPA's approach in transitioning from MOBILE/NMIM to MOVES, additional emission factor test data were included.<sup>2</sup>

MOVES is EPA's best available tool for quantifying emissions of these MSATs. State and local agencies, academic institutions, and other parties who are interested in analyzing MSAT emissions from transportation projects are encouraged to use MOVES.

EPA notes that there are no SIP and transportation conformity requirements for air toxics. Regarding the analysis of MSAT emissions in the National Environmental Policy Act (NEPA) process, U.S. Department of Transportation (DOT) has responsibility for implementing NEPA for federally-funded or approved transportation projects.

**What other resources are available for MOVES2010b?**

The MOVES web page ([www.epa.gov/otaq/models/moves/index.htm](http://www.epa.gov/otaq/models/moves/index.htm)) is the source for MOVES2010b software as well as previous versions of MOVES, technical documentation,

<sup>1</sup> The latest version of "Using MOVES for Estimating State and Local Inventories of On-Road Greenhouse Gas Emissions and Energy Consumption -Final" (EPA-420-B-12-068, November 2012) is available on the EPA web site at [www.epa.gov/otaq/stateresources/ghgtravel.htm](http://www.epa.gov/otaq/stateresources/ghgtravel.htm).

<sup>2</sup> These data are described in the technical documentation for the MOVES model. For example, publicly available test data from the Coordinating Research Council and the Health Effects Institute's Advanced Collaborative Emissions Study (ACES) program are included for exhaust from diesel engines and permeation from gasoline engines for MSATs. For air toxics that have been added, newer data are also used for advanced technology gasoline vehicles. However, for air toxics in MOVES2010a, factors for gasoline vehicles are unchanged; thus, only very minor changes in results are anticipated.

guidance documents, tools for using MOVES, and information on MOVES training. The following documents provide additional information on the MOVES2010, MOVES2010a, and MOVES2010b:

- The MOVES User Guide (available at [www.epa.gov/otaq/models/moves/](http://www.epa.gov/otaq/models/moves/) and in the MOVES Help menu) provides detailed instructions for using MOVES and has been updated for MOVES2010b.
- “Policy Guidance on the Use of MOVES2010 (and Subsequent Minor Revisions) for State Implementation Plan Development, Transportation Conformity, and Other Purposes: Revision to April 2012 EPA Guidance” (available at [www.epa.gov/otaq/stateresources/transconf/policy.htm#models](http://www.epa.gov/otaq/stateresources/transconf/policy.htm#models)) describes how and when to use MOVES2010b for SIP development, transportation conformity, general conformity, and other purposes.
- “Using MOVES to Prepare Emission Inventories in State Implementation Plans and Transportation Conformity: Technical Guidance for MOVES2010, MOVES2010a and MOVES2010b” (available at [www.epa.gov/otaq/stateresources/transconf/policy.htm#models](http://www.epa.gov/otaq/stateresources/transconf/policy.htm#models)) provides guidance on creating a RunSpec and adding local data using the County Data Manager for SIPs and regional transportation conformity analyses.
- “Transportation Conformity Guidance for Quantitative Hot-spot Analyses in PM2.5 and PM10 Nonattainment and Maintenance Areas” (available at [www.epa.gov/otaq/stateresources/transconf/policy.htm](http://www.epa.gov/otaq/stateresources/transconf/policy.htm)) provides guidance on using MOVES for quantitative PM10 and PM2.5 hot-spot analysis for transportation projects.
- “Using MOVES in Project-Level Carbon Monoxide Analysis” (available at [www.epa.gov/otaq/stateresources/transconf/policy.htm](http://www.epa.gov/otaq/stateresources/transconf/policy.htm)) describes how to use MOVES to model CO emissions from transportation projects.
- “Using MOVES for Estimating State and Local Inventories of On-Road Greenhouse Gas Emissions and Energy Consumption – Final” (available at [www.epa.gov/otaq/stateresources/ghgtravel.htm](http://www.epa.gov/otaq/stateresources/ghgtravel.htm)) describes how to use MOVES to estimate GHG emissions and/or energy consumption from on-road vehicles in a state or metropolitan area.

If you have technical questions about MOVES2010b, please contact the MOVES team at [mobile@epa.gov](mailto:mobile@epa.gov). If you have SIP policy questions, please contact Rudy Kapichak ([kapichak.rudolph@epa.gov](mailto:kapichak.rudolph@epa.gov)), and for conformity questions, contact Meg Patulski ([patulski.meg@epa.gov](mailto:patulski.meg@epa.gov)).

## Appendix A

Table A-1. Changes from MOVES2010a to MOVES2010b<sup>1</sup>

Change from MOVES2010a to MOVES2010b	Implication
1) Allows multiple workers on an individual computer. Addition of debugging features and improvements in error recovery during network interruptions	Potential for performance improvements in some use cases. Debugging and error recovery features make network operation more efficient.
2) Additional error checks added to County Data Manager (CDM) and Project Data Manager (PDM)	Prevents run failures due to conflicts between RunSpec parameters and user data
3) Alternative Vehicle and Fuel Technologies (AVFT) moved from “Strategies” panel to CDM and PDM	Data entry now consistent with other user inputs. Takes advantage of CDM and PDM error checks. May require modification to previous Run Specs. We have created converters that easily convert those RunSpecs and databases to MOVES2010b format.
4) Custom domain improvements allow users to define separate zones, with separate vehicle miles traveled (VMT) and some other activity inputs for each zone and Source Code Classification (SCC) output available	Reduces the number of runs needed and increases functionality. Multi-county custom domain with individual counties defined as separate zones now possible. Emission results can be produced separately for each zone. SCC output option now fully functional in custom domain runs.
5) Added functionality to Emission Rates option: - Refueling emissions added to RatePerDistance and RatePerVehicle tables and -Improved calculation of extended idle emissions in SCC output	Allows calculation of refueling emissions and improved SCC output for extended idle in rates mode  RunSpec options that are not applicable for emission rates calculation are now grayed-out in the graphical user interface (GUI)
6) Added nitrous acid (HONO) and split naphthalene into gaseous and particulate fractions	Enhanced output for air quality modeling
7) Uses newer versions of Java (version 1.7.0) and MySQL (version 5.5.12)	Installation Suite installs the correct versions and users may retain or delete previous versions. Takes advantage of new functions of updated software
8) New fuel fields, T50 and T90, which are more detailed measures of fuel volatility, added to default fuel formulation tables	These fields allow for more detailed modeling of specific fuel effects for users who need this capability. Most users will not need to change fuel specifications in MOVES, but existing user input databases created with previous version of MOVES will need to be converted. We have created converters that easily convert those RunSpecs and databases to MOVES2010b format.
9) Added new counties in Alaska and Colorado that were created after 2000	Allows MOVES to keep pace with current county boundaries. No default data are available for these counties; thus they are not included in national scale runs.
10) Included all Mobile Source Air Toxic (MSAT) pollutants previously available in the National Mobile Inventory Model (NMIM)	Maintains functionality for National Emission Inventory (NEI) and air quality modeling previously available. See Table A-2 for pollutant list.

<sup>1</sup> For a description of the changes between MOVES2010 and MOVES2010a, please see “EPA Releases MOVES2010a Mobile Source Emissions Model Update, Questions and Answers,” EPA-420-F-10-050, August 2010. [www.epa.gov/otaq/models/moves/MOVES2010a/420f10050.pdf](http://www.epa.gov/otaq/models/moves/MOVES2010a/420f10050.pdf)

Table A-2. Mobile Source Air Toxic Pollutants Added to MOVES2010b

MOVES PollutantID	Pollutant Name
40	2,2,4-Trimethylpentane
41	Ethyl Benzene
42	Hexane
43	Propionaldehyde
44	Styrene
45	Toluene
46	Xylene
60	Mercury Elemental Gaseous
61	Mercury Divalent Gaseous
62	Mercury Particulate
63	Arsenic Compounds
64	Chromium 3+
65	Chromium 6+
66	Manganese Compounds
67	Nickel Compounds
68	Dibenzo(a,h)anthracene particle
69	Fluoranthene particle
70	Acenaphthene particle
71	Acenaphthylene particle
72	Anthracene particle
73	Benz(a)anthracene particle
74	Benzo(a)pyrene particle

MOVES PollutantID	Pollutant Name
75	Benzo(b)fluoranthene particle
76	Benzo(g,h,i)perylene particle
77	Benzo(k)fluoranthene particle
78	Chrysene particle
81	Fluorene particle
82	Indeno(1,2,3,c,d)pyrene particle
83	Phenanthrene particle
84	Pyrene particle
130	1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin
131	Octachlorodibenzo-p-dioxin
132	1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin
133	Octachlorodibenzofuran
134	1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin
135	1,2,3,7,8-Pentachlorodibenzo-p-Dioxin
136	2,3,7,8-Tetrachlorodibenzofuran
137	1,2,3,4,7,8,9-Heptachlorodibenzofuran
138	2,3,4,7,8-Pentachlorodibenzofuran
139	1,2,3,7,8-Pentachlorodibenzofuran
140	1,2,3,6,7,8-Hexachlorodibenzofuran
141	1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin
142	2,3,7,8-Tetrachlorodibenzo-p-Dioxin
143	2,3,4,6,7,8-Hexachlorodibenzofuran
144	1,2,3,4,6,7,8-Heptachlorodibenzofuran
145	1,2,3,4,7,8-Hexachlorodibenzofuran



MOVES PollutantID	Pollutant Name
146	1,2,3,7,8,9-Hexachlorodibenzofuran
168	Dibenzo(a,h)anthracene gas
169	Fluoranthene gas
170	Acenaphthene gas
171	Acenaphthylene gas
172	Anthracene gas
173	Benz(a)anthracene gas
174	Benzo(a)pyrene gas
175	Benzo(b)fluoranthene gas
176	Benzo(g,h,i)perylene gas
177	Benzo(k)fluoranthene gas
178	Chrysene gas
181	Fluorene gas
182	Indeno(1,2,3,c,d)pyrene gas
183	Phenanthrene gas
184	Pyrene gas
185	Naphthalene gas