

## EPA Releases “Draft MOVES2009” for Comment: Questions and Answers

### Q1. Why is EPA releasing Draft MOVES2009?

A1. Under the Clean Air Act (CAA), EPA is required to regularly update its mobile source emissions model. EPA is continuously collecting data and conducting emission studies to make sure the Agency has the best possible basis for its assessment. This assessment, in turn, informs the development of EPA’s mobile source emissions models. MOBILE6.2 is currently the only model approved to do State Implementation Plan (SIP) and conformity analyses outside of California<sup>1</sup>. Draft MOVES2009 is the draft version of EPA’s new mobile source emissions model which, when finalized, will represent the Agency’s most up-to-date assessment of mobile source emissions. It will also incorporate changes based upon recommendations made to the Agency by the National Academies of Science.

### Q2. When will MOVES2009 be available for SIP and conformity analyses?

A2. When the final MOVES2009 is released later this year, it will replace MOBILE6.2 as the model states and local areas will use to develop emission inventories for SIPs and conformity determinations. It will also be used to estimate the emission reduction benefits from a range of mobile source control strategies. In conjunction with the official release of MOVES2009, EPA will release several guidance documents, including guidance on when the official MOVES2009 model will be required for SIP use and establishing what the grace period will be before the final model will be required for new conformity analyses.

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For California, the approved model for these analyses is currently the EMFAC2007 model.

**Q3. Why has EPA changed the name of its mobile source model from “MOBILE” to “MOVES”?**

A3. The name “MOVES” is an acronym for “Motor Vehicle Emission Simulator.” The name change signals the new approach to projecting mobile source emissions being taken in the new model. Specifically, the MOVES model is designed to improve upon the MOBILE6.2 model in two key respects. First, the MOVES model is based on a review of the vast amount of in-use vehicle data collected and analyzed since the release of MOBILE6.2, including millions of emissions measurements from light-duty vehicles. Analysis of this in-use data has enhanced EPA’s understanding of how mobile sources contribute to emission inventories and it has also improved the Agency’s understanding of the relative effectiveness of various in-use control strategies. Second, the MOVES model is designed to allow users much greater flexibility with input and output options. This added flexibility allows EPA to easily update emissions data incorporated in MOVES and will allow users to incorporate a much wider array of activity data to improve estimation of local emissions.

**Q4. What is the schedule for the release of a final MOVES2009?**

A4. EPA plans to release a final, official version of MOVES2009 at the end of 2009. The final version of MOVES2009 will replace MOBILE6.2 as the official approved emissions model for SIPs and conformity analyses.

Between the release of draft and final versions of MOVES2009, EPA and the Federal Highway Administration (FHWA) will be providing MOVES2009 training to state and local users (training sessions will be posted and updated at <http://www.epa.gov/otaq/models/moves/index.htm> as they are scheduled).

During this time, EPA will also be accepting comments from users, and making any necessary changes to the final model. EPA requests comments by July 2009 in order to give the Agency sufficient time to review comments and make necessary changes in time for the end-of-year release deadline. All comments should be submitted via e-mail to: [mobile@epa.gov](mailto:mobile@epa.gov).

In addition to training and on-going model development work, EPA will also produce guidance documents during the draft review period. A technical guidance document will address issues related to development of local input information for MOVES2009. A second guidance document will describe how to use MOVES2009 and air quality models to do project-level hotspot analyses. A third guidance document will address when final MOVES2009 will be required for SIP use and will specify a grace period before the final version of MOVES2009 is required for new conformity analyses. EPA plans to release all of these documents in draft form for comment later in 2009. Final guidance documents will be released along with the final version of MOVES2009. EPA will announce the release of the final model and the beginning of the conformity grace period in the Federal Register.

**Q5. How does Draft MOVES2009 compare to EPA's previous mobile source emission factor models?**

A5. Unlike the EPA's previous mobile source emission models, Draft MOVES2009 has been designed around a graphical user interface (GUI) using the open source database management software known as MySQL. Using this database approach to modeling allows EPA to easily incorporate large amounts of in-use data from a wide variety of sources, such as data from vehicle inspection and maintenance (I/M) programs, remote sensing device (RSD) testing, certification testing, portable emission measurement systems, etc. This approach also provides users much greater flexibility with regard to output choices. Unlike earlier models which provided emission factors in grams-per-mile in fixed output formats, Draft MOVES2009 output can be expressed as total mass (in tons, pounds, kilograms, or grams) or as emission factors (grams-per-mile and in some cases grams-per-hour). Output can be easily aggregated or disaggregated to look at emissions in a range of scales, from national emissions impacts down to the emissions impacts of individual transportation projects.

**Q6. How does the current Draft MOVES2009 compare to previously released drafts of MOVES?**

A6. The first draft release of MOVES – MOVES2004 – was a proof-of-concept model that only looked at two aspects of mobile source activity: well-to-wheel energy consumption and greenhouse gas (GHG) impacts. MOVES2004 was then followed by the MOVES Demo model, which was released in May 2007. MOVES Demo allowed potential users to gain familiarity with what would be the basic structure for subsequent iterations of the model but did not include the ability to model emissions of criteria pollutants. The reason for the release of MOVES Demo was to get comments from likely users on the user interface and other model functions. With Draft MOVES2009, EPA is releasing a more refined version of the model for likely users to “test drive” and comment upon so that EPA can resolve any issues and implement any improvements suggested in time for the official release at the end of 2009.

Unlike MOVES Demo, Draft MOVES2009 does include the ability to model criteria pollutant emissions and also includes additional features to simplify regional and project-level analyses for SIP and conformity determinations. It should be noted, however, that Draft MOVES2009 is not approved for use in either official SIP submissions to EPA or for making conformity determinations due to reasons discussed in further detail below. In addition, Draft MOVES2009 is not approved for quantitative particulate matter (PM) 2.5 or PM10 hot-spot analyses for project-level conformity determinations, nor is it to be used for required emissions analyses needed to meet the National Environmental Policy Act (NEPA).

**Q7. What can Draft MOVES2009 be used for?**

A7. Draft MOVES2009 is a work-in-progress that is being released now to solicit user comments that can be used to improve the official, final version of MOVES2009 scheduled

for release at the end of 2009. In addition to aiding EPA as it works toward finalizing the model, potential users can also use this draft version to gain valuable experience with the new input requirements for MOVES2009, many of which may be unfamiliar to users of MOBILE6.2.

Given its unofficial status, Draft MOVES2009 cannot be used to meet Federal clean air planning requirements, such as SIP submissions and/or conformity analyses, nor is it to be used for emissions analyses needed to meet any other regulatory requirements. Draft MOVES2009 cannot be used for these purposes because it does not include all the data or features currently planned for the official version and because the data and features may change subject to comments. Furthermore, EPA expects that this draft will undergo several anticipated changes, a list of which will be made available at the MOVES website at <http://www.epa.gov/otaq/models/moves/index.htm>. MOBILE6.2 remains the approved motor vehicle emission model for use in SIPs and conformity analyses outside of California.

While Draft MOVES2009 is not intended for official SIP and/or conformity submissions to EPA, states may want to consider using this draft release to perform any informal GHG inventory work they may have planned. Even in its draft form, MOVES2009 is considered the best available model for state and local GHG modeling exercises.

**Q8. How will emission estimates using Draft MOVES2009 compare to those of MOBILE6.2? Why may they be different?**

A8. As part of its own internal testing, EPA has performed a preliminary comparison of Draft MOVES2009 to MOBILE6.2 using local data for several different urban counties, varying the local data used by fleet age distribution, fraction of light- and heavy-duty VMT, local fuel specifications, meteorology, and other input factors. The results described here are based on the most recent data available and will vary depending on actual local inputs. EPA's findings are described below, by criteria pollutant.

For hydrocarbons (HC), based on analysis of newer in-use data, EPA found that emissions from newer technology vehicles are lower, especially for evaporative emissions.

For oxides of nitrogen (NO<sub>x</sub>), EPA has found that emissions from both light- and heavy-duty trucks are higher than previously estimated. In Draft MOVES2009, emissions estimates are based on EPA's analysis of I/M testing data, which incorporates in-use emissions data on a very large number of vehicles with model years from the mid-1990s to 2004. For heavy-duty trucks, Draft MOVES2009 incorporates newer "real world" data from on-road testing. In Draft MOVES2009, uncontrolled extended idle emissions from heavy-duty vehicles are projected to become a significant share of the mobile source NO<sub>x</sub> inventory in the future, assuming no change in extended idle activity as a fraction of total activity.

For fine particulate matter (PM<sub>2.5</sub>), Draft MOVES2009 increases the Agency's estimates of emissions for both light- and heavy-duty vehicles. For passenger cars and light trucks,

these increases are based on data developed as part of EPA's Kansas City study, which showed much higher PM<sub>2.5</sub> emissions at low ambient temperatures than previously known. For heavy-duty trucks, Draft MOVES2009 incorporates new data from a large study of trucks conducted by the Coordinating Research Council (known as the CRC E-55 study) which includes deterioration effects on in-use emissions. Draft MOVES2009 also models the impact of vehicle speed and load on PM emissions, showing very large rates of PM generation in stop-and-go traffic conditions.

**Q9. How are the changes in emission rates in Draft MOVES2009 anticipated to affect attainment demonstrations?**

A9. When considering how the change to MOVES2009 may affect attainment demonstrations, the relative reduction in emissions between a base year and an attainment year is often more important than absolute increases or decreases in emissions. Preliminary modeling by EPA indicates larger relative reductions in PM<sub>2.5</sub> and volatile organic compound (VOC) emissions over time in Draft MOVES2009 compared to MOBILE6.2, but smaller NO<sub>x</sub> reductions. Once again, these results will vary based on local inputs in a given nonattainment area, with local variations in fleet age distribution and composition having a significant influence on the final results.

**Q10. How are the changes in Draft MOVES2009 anticipated to affect I/M program credit?**

A10. The shift to the MOVES emissions model will also have an impact on the emission reductions credited to I/M programs. Because of the updated data included in MOVES2009, on average, such programs can expect to see roughly 20-70% less credit than previously claimed, depending upon the criteria pollutant and evaluation year being considered. The reasons for this reduced credit are two-fold.

First, in the area of in-use deterioration, Draft MOVES2009 – like MOBILE6.2 before it – continues the “good news” trend of in-use, light-duty vehicles staying cleaner, longer. One side-effect of this trend is that I/M programs (which reduce emissions by identifying cars in need of repair and getting them fixed) will achieve less SIP credit than previously projected because there are fewer vehicles in need of repair than originally believed.

Second, Draft MOVES2009 reflects updated information regarding the public's response rate to an illuminated “Check Engine” light for areas without I/M to create the incentive for fixing a vehicle in need of emissions repairs. Previously, it was assumed that the public response rate dropped off sharply as soon as the vehicle was outside its warranty period. Data collected more recently by the Coordinating Research Council (CRC) suggests, however, that the response rate is actually relatively high, even without I/M and/or warranty coverage to act as an incentive. As a result, Draft MOVES2009 attributes significantly less credit to OBD-based I/M than previously projected.

Taken together, these two aspects of Draft MOVES2009 result in I/M programs receiving roughly 20-70% less SIP credit than previously projected because data shows that



I/M is not as important for enforcing OBD-triggered repairs as previously believed. The emission reductions resulting from the public's voluntary response to OBD will now be accounted for in the baseline emissions inventory as opposed to being credited to the effects of I/M. As suggested above, this result is good news for the environment because it means that in-use light-duty vehicles are continuing to stay cleaner, longer, and that motorists are getting the message that the "Check Engine" light is not something to be ignored

## **Q11. Why is EPA changing its estimates of vehicle emissions?**

- A11. Over the last ten years, EPA's in-use data about technologies such as Tier 2, OBD II and enhanced evaporative emission control systems has dramatically improved. For MOVES, EPA has been able to carefully study these newer technologies, examining millions of results for light-duty vehicles. A detailed analysis of 70,000 vehicles in Arizona's I/M program provided information on how vehicles from the late-1990's and early 2000's age. Information on even newer vehicles was captured in nearly 2,000 manufacturer compliance tests. Other I/M and remote sensing data and special purpose studies helped EPA to better understand trends in HC, carbon monoxide (CO) and NO<sub>x</sub> emissions for light-duty cars and trucks. EPA found little change in HC and CO from our original MOBILE6 projections, but a noticeable increase in NO<sub>x</sub> emissions.

Also in support of MOVES development, the Agency conducted a landmark study of PM emissions, testing nearly 500 gasoline-fueled light-duty cars and trucks in Kansas City, Missouri. Because PM emissions are technically difficult to measure, the Kansas City study – a collaborative effort including EPA, the Department of Transportation (DOT), the Department of Energy (DOE), and the automotive and petroleum industries – represents the largest such study ever conducted. The Kansas City study confirmed that PM emissions from light-duty gasoline-fueled vehicles are higher than earlier predicted, and clearly showed that cold ambient temperatures can dramatically increase PM start emissions. The MOVES model includes these dramatic increases in PM start emissions at low temperatures.

EPA's understanding of emissions from heavy-duty vehicles has continued to improve since our last model was issued. Most earlier heavy-duty emission rates were based on certification tests of then-new, mid-1990's engines. For MOVES, EPA has been able to analyze data on more than 400 in-use trucks, some in the laboratory and some with on-road measurement equipment. This allowed the Agency to understand how real trucks pollute at a range of speeds and driving conditions. EPA also has been able to better incorporate emissions from heavy duty diesel crankcase ventilation and from extended idling (also known as "hotelling") – two emission processes that were relatively unstudied at the time MOBILE6.2 was developed. The incorporation of this additional data accounts for the increases in heavy duty NO<sub>x</sub> and PM emissions reflected in MOVES. Emission differences in MOVES are especially large for heavy duty PM emissions because they reflect updated data on the effects of both speed and vehicle deterioration not previously available.

It must be stressed that, despite the discussion above, Draft MOVES2009 is a draft model and there will likely be some changes between the draft and final version with regard to emission rates. Furthermore, emission rates in the official MOVES will eventually need to be updated and improved as a result of future research. Future emission rate changes will be easier, however, due to the improved structure of MOVES, which stores emission rates in an easily updated database. EPA expects that future model updates will be more frequent, resulting in a model that better reflects how changing vehicle technology and control strategies affect the emissions inventory.

**Q12. Why is EPA releasing a draft version of the MOVES model at this time?**

A12. EPA is releasing Draft MOVES2009 now to give users the opportunity to gain practical experience with MOVES2009's new user inputs and output formats, and to solicit user comments in time to make additional improvements to the model prior to its official release. User review of the draft model is essential because EPA staff cannot foresee and test all the scenarios in which the MOVES model will be used. Identifying user concerns quickly will allow EPA staff to address many concerns prior to December 2009. Meeting the December 2009 release deadline is important so that states will be able to make use of MOVES2009 for the next round of SIP submissions, which are expected to be due in 2012.

**Q13. What should users know prior to using the Draft MOVES2009 model?**

A13. As mentioned above, EPA is anticipating changes to Draft MOVES2009 based on its own testing of the model. A list of these anticipated changes will be posted and updated regularly at the MOVES website at <http://www.epa.gov/otaq/models/moves/index.htm>. Users who believe they may have identified an issue with Draft MOVES2009 or need technical support are asked to contact EPA at [mobile@epa.gov](mailto:mobile@epa.gov) with a description of the issue. Please be sure to include electronic copies of both the input and output files that illustrate the issue in question.

EPA also strongly recommends that potential users of Draft MOVES2009 take advantage of training that will be offered jointly by EPA and FHWA so they can gain practical experience with running the model prior to its official release in December 2009 (training opportunities will be posted at <http://www.epa.gov/otaq/models/moves/index.htm> as they are scheduled). Concerning other recommended training, knowing MySQL is not necessary for simple runs, but some basic knowledge of the MySQL database management software package will give users greater flexibility to customize MOVES2009 outputs to meet their needs. For more advanced analyses such as official SIP and/or conformity submissions, it is highly recommended that states develop in-house expertise in using MySQL prior to the official release of MOVES2009 in December.

Lastly, with regard to the computer system requirements needed to run the Draft MOVES2009 model, EPA recommends the following minimum system specifications: processor – dual-core; memory – 1 GB RAM; storage – 40 GB; operating system: Windows XP or 32-bit Vista. As is often the case when running computer-based applications,

a faster processor, more memory, and greater storage capacity will improve the speed at which the model performs user runs.

- Q14. Given that EPA anticipates changes to Draft MOVES2009, should state and local modelers wait to try MOVES2009 until EPA releases the official version in December 2009?**
- A14. EPA recommends that state and local modelers get trained and begin using Draft MOVES2009 as soon as possible. Although every effort has been made to make MOVES2009 as user-friendly as possible, it is a new model with different input requirements and different output formats. Users will need to think about how to collect and process local input information in different ways, and they will need to develop new methods for post-processing model output. Users should start making the shift now by getting trained (visit <http://www.epa.gov/otaq/models/moves/index.htm> for information on training opportunities) and by performing trial runs with Draft MOVES2009. EPA's future SIP and conformity policy guidance will address the timing of using MOVES2009 for these official purposes.