Mobile Sources Technical Review Subcommittee (MSTRS) MOVES Review Work Group: Meeting Summary

Introduction

Dr. Sarah Roberts (EPA) began the meeting by welcoming attendees and describing the agenda. She noted that the presentations and meeting summary will be posted on the workgroup webpage at https://www.epa.gov/moves/moves-model-review-work-group. She added that if members have comments or questions after the meeting, they can email her at Roberts.Sarah@epa.gov. She then conducted a Work Group roll call. A list of Work Group members and other attendees can be found at the end of this summary.

Presentation: MOVES3.0.2 Minor Updates – Presented by Megan Beardsley, U.S. EPA

Ms. Megan Beardsley (EPA) then gave a quick presentation to explain the changes made in MOVES3.0.2, the second minor update to MOVES3 that was announced on the listserv and released recently. She noted that the "patch" addresses a variety of small issues, and most importantly it increases the Tier 4 nonroad diesel particulate matter (PM) emissions. She pointed out that although the amount of emissions is small, the percentage change might be much larger. The full list of changes can be found at https://www.epa.gov/moves/moves3-update-log.

There were no questions from the attendees about MOVES3.0.2.

Presentation: MOVES3 Fuel Consumption Evaluation – Presented by Jaehoon Han, U.S. EPA

Dr. Han explained that he would discuss the highway fuel consumption for gasoline and diesel, and then move on to a comparison of vehicle miles traveled (VMT) and miles per gallon (MPG) between MOVES3 and EPA's SmartWay program. The analysis used MOVES3.0.1, the most up-to-date version of MOVES3 available at the time.

Dr. Han highlighted the variety of approaches that may be used to assess the different levels of MOVES results. The work presented today is comparing MOVES fuel consumption estimates to the Federal Highway Administration (FHWA) data. MOVES takes a "bottom-up" approach to creating these estimates from activity data, whereas the FHWA's "top-down" estimate generates them from fuel sales estimates. Other approaches include comparing the results of air quality

modeling using MOVES inputs with monitoring data, such as the current EPA EQUATES project, and comparing MOVES emission rates with alternate data sources.

Dr. Han displayed the parameters for the MOVES runs that were conducted for the evaluation. These included the use of the default or "National" scale, consideration of calendar years 2005, 2007, 2009, and 2011-2019, and output that consisted of total energy consumption, VMT, and vehicle populations (VPOP).

Dr. Han explained that because MOVES does not output fuel volumes directly, the analysis used a set of fuel energy content values to convert from the total energy output to gallons. He also noted that for the diesel fuel consumption calculation, they excluded transit buses, school buses, and refuse trucks because the FHWA excludes public vehicles, and this was the closest they could get to ensuring that the two groups would be similar enough to make valid comparisons between the two data sources. Dr. Han then discussed the limitations of the analysis, including potential inaccuracies in the state-provided fuel tax collection data, uncertainty in the methodology used to allocate between highway and off-road fuel use, and uncertainties in activity estimates, fleet characterization, and the energy rates for pre-model year 2010 light-duty trucks and heavy-duty vehicles. He also described a comparison of MOVES fuel consumption rates to data from EPA's SmartWay program.

Moving on to the results, Dr. Han summarized the overall findings as follows:

- MOVES3 fuel consumption is higher than FHWA data.
  - For historical years, gasoline is within 9% and diesel is within 20% for most years; more uncertainties exist in the diesel volume data and methodology.
  - For more recent years (2016 and later), the comparison improves to within 4% for gasoline and 10% for diesel.
- The MOVES3 fuel comparison is also higher than MOVES2014, primarily due to the updated fleet characteristics in MOVES3 that include a light-duty gasoline fleet mix shift to heavier vehicles as well as higher VMT, and VPOP in the diesel fleet, especially in the 2b3 weight class.
- Although the MPG comparison to SmartWay data does not explain the differences in fuel consumption between MOVES3 and FHWA, it serves as another data source in evaluating MOVES3 fuel consumption.

He added that they will continue to evaluate MOVES by seeking out independent data for comparison. He then invited questions from participants.

Discussion

Dr. Roberts began by reading several questions from the chat. Mr. David Kall asked, "Did you coordinate with the FHWA Office of Highway Policy Information? They have a motor fuel division that can probably provide better information on FHWA motor fuel data than most of the FHWA people on this call could." Ms. Beardsley responded, also in the chat, "Thanks for the suggestion, David. We haven't done this yet." Dr. Han agreed and stated that the more coordination, the better.

Mr. Jinchul Park asked, "According to Slide 7, MOVES3.0.1 was used for comparison. I wonder how the comparison results would be different with MOVES3.0.2?" Ms. Beardsley responded in the chat, "The changes made for 3.0.2 are expected to lead to small deceases in energy consumption for transit and "other" buses. We expect the impact on these totals would be very small (especially since transit buses are already excluded)." She elaborated verbally that the impact will be very small since the changes won't be phased in for most of the years considered in the analysis, and it only applies to buses.

Mr. Patrick Lentlie asked, "What was the average weight of light-duty passenger cars and trucks in MOVES2014 compared to MOVES3?" Ms. Beardsley responded that the mix changed, but they didn't calculate the weight changes. Mr. Daniel Bizer-Cox looked and responded in the chat later, "The average vehicle mass for passenger cars (sourceTypeID 21) did not change between 2014b and MOVES3."

Mr. Alexis Zubrow commented, "I think these types of top-down vs bottom-up comparisons are very helpful and an important part of model evaluation. With the predicted significant penetration of EV, how should we get ahead of data requirements to be able to do these comparisons in the not-so-distant future?" He elaborated that this is more forward-looking, but if this process relies on fuel data, and the fleet shifts towards electric vehicles, it may be necessary to seek out a new data source for these comparisons. Ms. Beardsley said that this is a great and important question, but they do not know the answer yet. The EPA will be looking to the Department of Transportation to take the lead on that, since measuring traffic volume and using methods other than fuel sales will be critical for them to carry out their responsibilities.

Mr. Ryan Hatch asked, "Is SmartWay data available for free?" Dr. Han responded that one would need to contact the EPA and ask for it, although some of it is publicly available. Mr. Evan Murray posted a link to some of this data in the chat: https://www.epa.gov/smartway/smartway-trends-indicators-and-partner-statistics-tips.

Mr. Kall asked, "Could the differences found in this study mean that the MOVES inputs in the MOVES default scale could be improved? Have you thought about doing a third scenario with MOVES runs with better inputs from something like NEI?" Ms. Beardsley answered that the NEI traditionally hasn't included energy consumption, but that information might be available for more recent iterations and looking at it could be interesting. Mr. Kall added that the NEI puts a lot of effort into collecting data from local agencies for activity and fuel inputs.

Mr. Mohamed Khan asked, "When will EPA release a document for fuel energy calculation for MOVES3 like in the MOVES2014 model? We need it for the 2020 emission inventory." Ms. Beardsley said she wasn't sure what document he meant but invited him to reach out via email so they could provide that information to him.

Dr. Roberts then thanked Dr. Han for his presentation and reminded the participants that if they have any more questions, they can email her.

Discussion: Recommendations to MSTRS – Lead by Megan Beardsley, U.S. EPA and Matt Barth, UC Riverside

Ms. Beardsley and Dr. Matt Barth led the next portion of the meeting, a discussion of the workgroup recommendations that will be sent to the MSTRS and Clean Air Act Advisory Committee (CAAAC).

Dr. Barth explained that the MOVES workgroup belongs to the MSTRS, which is in turn part of the CAAAC. One purpose of the workgroup meetings is to generate recommendations to the MSTRS, which has been occurring on a regular basis. The next MSTRS meeting will be October 14, 2021, and the goal of the chairs is to provide a report with recommendations at that meeting, which the MSTRS can then pass up to the CAAAC. He explained that the process for generating these recommendations will consist of discussion during today's meeting, summarization by the chairs, the creation of a ballot that will be distributed to the workgroup members so they can rank their priorities, and then revisions to create a final report for the MSTRS. Dr. Barth stated that in addition to the recommendations that have already been generated, the chairs are interested in hearing more suggestions and ideas from the workgroup members during the meeting. The deadline for submitting written recommendations to add to the report is the end of the day on September 17th; they can be emailed to Ms. Beardsley and Dr. Barth, as well as to the mobile@epa.gov mailbox.

Dr. Barth added that in the past, the recommendations have been organized into short- and long-term categories, and most of the short-term recommendations have been addressed with the release of MOVES3. So, long-term suggestions will be more valuable at this time. The chairs then invited comment from workgroup members.

Discussion

Mr. Tim French explained that there have been efforts to get second-by-second emissions data, which show that MOVES is fairly accurate. He pointed to this as a good data source for validating MOVES results.

Mr. Chris Voigt commented in the chat, "Add testing for high road grades for the second bullet on emissions and/or the last one on evaluating MOVES estimates."

Dr. Britt Holmen posted in the chat, "I suggest adding HEVs - hybrid electric, especially light-duty vehicles to list for data given increases in response to Fuel Economy regs." In response, Dr. Barth asked if anyone from the California Air Resources Board (CARB) was present, as they have similar programs. Nobody from CARB was on the line at the time.

Ms. Debbie Wilson commented, "I believe it's part of previous recommendations, but Tampering is a big deal for our agencies. Allowing MOVES to take that into account."

Mr. Dale Wells suggested that something be added that addresses nonroad emissions and the effects of altitude. He explained that there are many states with nonattainment issues at high altitudes, and nonroad emissions are becoming more of an issue as onroad sources are subject to

more controls. He stated that a white paper on these issues might be useful, as there are short-and long-term implications, and potential changes to the model would be appropriate.

Mr. Gil Grodzinsky spoke about the importance of heavy-duty vehicles, especially regarding NOx emissions, and commended the MOVES team for focusing on this area. He emphasized that in the long-term, it will be important to model the heavy-duty sector accurately. He also stated that if assumptions change, the model should reflect that as well.

Dr. Barth prompted the group to move on to the section of recommendations related to expanding MOVES capabilities by collecting new data and adding new features.

In the chat, Mr. Voigt wrote, "Adjust project level EFs based on mileage accumulation rates (MARs), as already done for regional modeling. Priorities: PM2 .5, PM10 and CO, then other project level pollutants." He elaborated aloud that there is a way to do this manually, but he would like to see this built into MOVES.

Mr. French explained that as other states consider adopting certain policies in California, tools for modeling and projecting emissions and policy efficacy nationwide and in California or other states is becoming more important. Therefore, having a tool or assessment to see how MOVES differs from EMFAC would be very relevant. He pointed specifically to the upcoming tier of regulations for heavy-duty vehicles and stated that assessing key differences and modeling results could have significant policy implications. Dr. Barth responded that this is an excellent suggestion for both the data sets and the methodology being used for the regulatory process.

Mr. Grodzinsky suggested that in the long-term it would be a good idea to link MOVES to other life cycle models, especially with more electric vehicles on the roads, as life cycles are becoming more important. Dr. Barth agreed that maybe there could be a guidance document on how to use MOVES to link to a life cycle model in the short-term, then in the long run incorporate the two more tightly.

Dr. Michael Gellar pointed to the question of how alternative fuels like electricity can be accounted for in the transportation sector, although he acknowledged that this might be beyond than what MOVES was originally intended to do. However, it could help assess progress towards greenhouse gas (GHG) goals. He also discussed local community impacts being modeled at a refinement level that falls between the county and the project level. He added that this might not be something for MOVES to address, but perhaps the outputs could be put into a dispersion model to get a better exposure estimate that's more refined than a county average.

Ms. Meg Patulski clarified that from a technical point of view, the EPA has been applying MOVES and other emissions models for project-level analyses for CO for over 30 years, and for PM for the last 10, with guidance issued consistent with public processes. So, these analyses can be done at many levels, and they can be used with EPA's dispersion model AERMOD and other kinds of exposure models. She stated that if the workgroup wants to have further conversations about what MOVES can be used for, it would be helpful to clarify what they are most concerned about, but it may go beyond the scope of MOVES.

Dr. Barth then prompted the group to proceed to recommendations related to making MOVES easier to use. He pointed to one example being the Georgia Tech MOVES matrix approach.

Mr. Lentlie commented that for regulated entities who use MOVES to meet regulatory criteria, many of the features and options of the model are irrelevant and frustrating to navigate. He suggested that for parameters over which regulated entities have no control, the model should automatically provide the appropriate values.

Ms. Lubna Shoaib added in the chat, "MPOs often use the model in emission rates mode, making the post processing easier would be very helpful and time saving."

Mr. Voigt wrote in the chat, "For project-level, provide check boxes for selecting running emissions, with the priority on PM and CO. Exhaust and crankcase running exhaust for CO. For PM, also include brake and tire wear. For project-level, provide check boxes for selecting FHWA-specified MSAT pollutants and processes (running emissions only). See: https://www.fhwa.dot.gov/environMent/air_quality/air_toxics/policy_and_guidance/msat/ FHWA-specified MSATs to model: "1,3-butadiene, acetaldehyde, acrolein, benzene, diesel particulate matter (diesel PM), ethylbenzene, formaldehyde, naphthalene, and polycyclic organic matter ." FHWA running emission processes to model: exhaust, crankcase exhaust, evap permeation, evap leaks"

Mr. Zubrow agreed with Mr. Lentlie and added that it would be useful to have the right hooks to connect MOVES to other models like GREET.

Mr. Voigt also wrote in the chat, "Not sure what category this would fall under, but consider the creation of a pooled fund to work with state DOTs and FHWA on assessing uncertainty for the entire project level modeling chain. Both EPA emission modeling and dispersion modeling staff would need to be involved."

Dr. Roberts indicated that it was time to wrap up the discussion. Ms. Beardsley reiterated that any final comments should be submitted by September 17th to allow enough time to be summarized and put into a ballot for the workgroup members to vote on. She and Dr. Barth both thanked the workgroup members as well as attendees from the public for their time and attention.

Mr. Steve Vander Griend asked if there was going to be discussion of the recommendations already submitted by individuals via email. Ms. Beardsley noted that this supplemental information was distributed by email and encouraged everyone to read them. Dr. Barth invited Mr. Vander Griend to elaborate on his comment if he had more to add beyond what was shown on the slide.

Mr. Vander Griend stated that MOVES is anti-ethanol because it does not reflect the real-world fuel properties observed by his organization. He stated that he was very disappointed and wished this was not being left until later to address.

Ms. Beardsley thanked Mr. Vander Griend and expressed interest in seeing the study he referenced as well as her intention to potentially follow up with specific questions.

Mr. Vander Griend responded that his organization had reached out to the EPA about their concerns many times but had not gotten any follow up from them. He described this as a "huge error" in the default values, which will result in false values and overestimate the reductions in NOx and other emissions.

Mr. David Choi thanked Mr. Vander Griend and said they would take this into consideration. He also thanked the workgroup members, participants from the public, workgroup chairs, and Dr. Roberts for their expertise, insights, and effort. Dr. Barth and Ms. Beardsley also thanked everyone, at which point the meeting was adjourned.

List of Attendees

Work Group Members

Matthew Barth	Gil Grodzinsky	Sam Pournazeri
Megan Beardsley	Cecilia Ho	Lubna Shoaib
Elena Craft	Britt Holmen	Steven Vander Griend
Tim French	Mark Janssen	Chris Voigt
Mike Geller	Andrew Kotz	Dale Wells

EPA Staff

Meg Patulski	Darrell Sonntag	Angelica Marchi (ORISE)
David Choi	Sarah Roberts	Evan Murray
Angela Cullen	James Warila	Naima Swisz-Hall
Jaehoon Han	Michael Aldridge	Aron Butler
Tiffany Mo	Laura Berry	Jiayi An

Other Attendees

"A Miranda"	Dustin Fitzpatrick	Todd Pasley
"Aaron"	Steven Giannitti	Diamond Pearson
"Greg M"	Jessica Goza-Tyner	Jane Posey
Rick McKeague	Ryan Hatch	Jeff Ramsey
Anna Aleynick	Brian Himes	Judy Raymond
Rohan Bakane	Rita Hoke	Rebecca Rudolph
Walter Barozi	Joey Huang	Robert Schiavone
Marc Bennett	Dennis Kahlbaum	Cody Sheets
Andrew Bollman	David Kall	Jolyon Shelton
Chris Bovee	Katie Katrichis	Kira Shonkwiler
Chris Boyd	Kenneth Kelly	Jim Sidebottom
Brian Brownworth	Mohamed Khan	Aaron Slevin
Ryan Buckley	Sandeep Kishan	James Smith
Craig Butler	Patrick Lentlie	Vivek Thimmavajjhala
Changsy Chang	Sonya Lewis-Cheatham	Marcus Tutt
Sunghye Chang	Natalie Liljenwall	Heather Walsh
Natasha Clay	George Lin	Roger Wayson
Denise Cormier	Jeff Long	Alan Welch
Marc Corrigan	Brent McDaniel	Tim Wood
David D'Onofrio	Brandon Miller	Ping Xi
Rob Dawson	Thomas Olmstead	Li Zheng
Allison DenBleyker	Kevin Ours	Alexis Zubrow
Christopher Dresser	Priyal Pandya	
Andrew Eilbert	Jinchul Park	

Contractor Support

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