MOVES2014 Project Level for Experienced Users

October 2014
Office of Transportation and Air Quality
US Environmental Protection Agency
Webinar Logistics

• Webinar slides are available at: www.epa.gov/otaq/models/moves/training.htm

• Please use the Q & A pod within Adobe Connect to send questions. We will try to respond to as many as possible throughout the webinar

NOTE: Please ensure that your computer’s volume is properly adjusted
Outline

• Updates

• Under-the-hood improvements to the MOVES project-level

• Changes to the Graphical User Interface (GUI)

• Database converter

• New input options

• MySQL Workbench
Updates

• MOVES2014 October Release – posted October 23, 2014

• Federal Register notice October 7, 2014
  • MOVES2014 approved for SIP and conformity purposes
  • A two year grace period applies before MOVES2014 must be used in conformity
  • Until October 7, 2016, for project-level conformity, use either MOVES2010a/b, or MOVES2014
Under-the-hood Improvements
New Drive Cycles Added

• New York City Bus Cycle (avg speed = 3.7 mph)
• Washington Metro Area Transit Authority Bus Cycle (8.3 mph)
• Modified HHDDT Creep Mode Cycle (1.8 mph)
• Modified EPA HD High Speed Freeway Driving Schedule (76.7 mph)
• Modified EPA MD High Speed Freeway Driving Schedule (77.8 mph)
New York City Bus Cycle (3.69 mph)
# MOVES2014 Drive Cycle Map

<table>
<thead>
<tr>
<th>Source</th>
<th>Min Speed (mph)</th>
<th>0</th>
<th>2.5</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
<th>55</th>
<th>60</th>
<th>65</th>
<th>70</th>
<th>75</th>
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</thead>
<tbody>
<tr>
<td>Type</td>
<td>Max Speed (mph)</td>
<td>2.5</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>35</td>
<td>40</td>
<td>45</td>
<td>50</td>
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<td>70</td>
<td>75</td>
<td>100</td>
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<tr>
<td>11</td>
<td>Motorcycle</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
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<td>X</td>
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</tr>
<tr>
<td>21</td>
<td>Passenger Car</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
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<td>X</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Passenger Truck</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
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<td>X</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Light Commercial Truck</td>
<td>X</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<td></td>
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<td>X</td>
<td></td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>41</td>
<td>Intercity Bus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
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<td>X</td>
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<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>42</td>
<td>Transit Bus</td>
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<td></td>
<td></td>
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<td>X</td>
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<td></td>
<td>X</td>
</tr>
<tr>
<td>43</td>
<td>School Bus</td>
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<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>51</td>
<td>Refuse Truck</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
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<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>Single Unit Short-haul Truck</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>Single Unit Long-haul Truck</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
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<td></td>
<td>X</td>
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<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>Motor Home</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>Combination Short-haul Truck</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
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<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>Combination Long-haul Truck</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

White boxes with X have existing driving schedules in MOVES
Blue boxes indicate new schedules added for MOVES2014
Gray boxes require interpolation between explicit schedules
Updates to PM rates

• Lower running PM emission rates in MOVES2014 (esp. for cold weather climates)
  • Running temperature sensitivity removed for Tier 2 and newer vehicles
  • MOVES2014 retains running temperature sensitivity for Tier 1 and older vehicles

• 2011 in-house EPA study validated cold start sensitivity seen in Kansas City PM study
Updates to PM rates

- Exhaust and crankcase PM$_{10}$/PM$_{2.5}$ ratios
  - Gasoline changed from 1.086 to 1.13
  - Also applied gasoline ratio to CNG emissions
  - Diesel changed from 1.0309 to 1.087
  - Ratios updated based on citable data

- Brakewear and Tirewear PM$_{10}$/PM$_{2.5}$ ratios
  - Brakewear changed from 3.82 to 8
  - Tirewear changed from 4.17 to 6.667
Updates to CO rates

• CO start rates for new vehicles were lowered
  • Based on EPA cold start study

• No temperature sensitivity for running emissions (same as MOVES2010)
Changes to the Graphical User Interface
GUI Changes – Ethanol

• EPA has added ethanol (E-85) to the model
• To obtain emissions for an entire fleet, ethanol should be selected, along with gasoline, diesel, and CNG
• If no ethanol exists in your county, the new fuelusage input table can be used to specify this (covered later)
GUI Changes – Ethanol

The image shows a software interface with a list of fuels and source use types. The fuels include Compressed Natural Gas (CNG), Diesel Fuel, Electricity, Ethanol (E-85), and Gasoline. The source use types listed are related to different types of vehicles and equipment. The screen also displays options for selecting and managing inputs.
GUI Changes – Pollutants and Processes

• PM speciation was added for CMAQ AQ modeling
• PM hot-spot analysis should use “Primary Exhaust PM2.5 – Total” and prerequisites
GUI Changes – Pollutants and Processes
MOVES2014 Database Converter
Database Converter

• Converts MOVES2010b project database into MOVES2014 compatible database
  • Adds fuel region to fuel supply table

• Converter has limitations for use in regulatory modeling (e.g., PM hot-spot analysis)
  • Once a MOVES2010b db has been converted, additional steps are necessary:
    • Need to update database with default MOVES2014 fuels
    • Need to update any other MOVES2010 defaults to MOVES2014
Database Converter

Use scripts to convert 2010B CDM and PDM databases
Steps:

• Select the existing 2010b database from dropdown menu
• Give the new converted database a unique name
• See pg 50 of the MOVES2014 User Interface Manual for instruction on batch conversion:
Default fuel data are provided by the EPA for fuel region.

Fuel supply tables must now be by fuelRegionID.

Database Converter
Database Converter – Additional Steps

• Update the fuel tables in a converted database by exporting default fuel tables in MOVES2014, review, and re-import
  • Because fuel supply/fuel formulation information has been substantially changed in MOVES2014; MOVES2010b fuel tables should not be used

• Update any other MOVES2010b defaults used in the database to MOVES2014 defaults
  • Most other default activity and fleet information has been updated in MOVES2014; MOVES2010b defaults should not be used
New Input Options
New Input Options – Fuels

• Update fuel supply/formulation information has been provided for every county in the country... now organized by “fuelregionID”

• Ethanol (E-85) added to default fuels
New Input Options – FuelUsageFraction

<table>
<thead>
<tr>
<th>countyID</th>
<th>fuelYearID</th>
<th>modelYearGroupId</th>
<th>sourceBinFuelTypeID</th>
<th>fuelSupply</th>
<th>usageFraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>13121</td>
<td>2024</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>13121</td>
<td>2024</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>13121</td>
<td>2024</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>13121</td>
<td>2024</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>0.792421</td>
</tr>
<tr>
<td>13121</td>
<td>2024</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>0.207579</td>
</tr>
</tbody>
</table>

- Fuelusagefraction specifies the fraction of E-85 capable vehicles that use E-85 (sourcebinfueltypeid 5) vs. conventional gasoline
- Defaults are available, but this table is required for all MOVES runs
- The example table (above) shows that 79.2% of E-85 capable vehicles use conventional gasoline and 20.8% use E-85 for Fulton County, Georgia in the MOVES default
- Fractions of 1 are also required for sourcebinfueltypeID 1, 2, and 3 (gas, diesel, and CNG fuel types)
What if your project’s fleet does not use E-85? How should this table be changed?

- Fuelusagefraction: the fraction of E-85 capable vehicles that use E-85 (sourcebinfueltypeid = 5) vs. conventional gasoline
- If your project’s fleet does not use E-85, then:
  - 100% of E-85 capable vehicles use conventional gasoline; change 0.792421 to “1”
  - 0% of E-85 capable vehicles use E-85; change 0.207579 to “0”
New Input Options – “Fuels Wizard”

- The Fuels Wizard allows the user to customize a fuel for their area based on known fuel properties.
- Usually, you should begin with the default fuel and edit the known properties (e.g., RVP). The Fuels Wizard will automatically adjust other unknown fuel properties consistent with the known fuel properties.
- The adjustments are based on EPA refinery modeling.
New Input Options – “Fuels Wizard”

• Select desired fuel, and change fuel property – in this example, RVP is changed from 11.8 to 7... click “Calculate”
New Input Options – Retrofit

- The retrofit importer (formerly in the runspec of MOVES2010b) is now located in the PDM
- Retrofit programs can be modeled using the retrofit importer
- This is an optional input
- Consult EPA guidance material for more information on when to use this input
New Input Options – Retrofit

- The example above shows a program applying to diesel combination long-haul trucks, for running NOx emissions.
- The retrofitYearID should always be equal to the analysis year.
- This example shows a retrofit program applying to model years 2020 through 2024, and 50% of all vehicles in that MY range being retrofitted.
- The retrofitEffectiveFraction specifies how effective the retrofit technology is: 0.3 indicates a 30% reduction in emissions.
New Input Options – Hotelling

- The Hotelling input allows users to describe long-haul combination truck hotelling behavior.
- This input is optional – however, if you are modeling hotelling activity, defaults will be used if no information is entered.
New Input Options – Hotelling

• The hotellingactivitydistribution table is used to define the fraction of trucks in each of four modes of hotelling activity:
  • 200 – Extended Idling
  • 201 – Auxiliary Power Units (APUs)
  • 203 – Battery Power
  • 204 – Engine Off
• The example shows the national default fractions
Hotelling: Updating OpModeDistribution

- If modeling hotelling activity, an Opmode distribution table is still required with fractions of 1 for each hotelling OpModeID used (200, 201, 202, and/or 203)

<table>
<thead>
<tr>
<th>sourceTypeID</th>
<th>hourDayID</th>
<th>linkID</th>
<th>polProcessID</th>
<th>opModeID</th>
<th>opModeFraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>62</td>
<td>15</td>
<td>1</td>
<td>290</td>
<td>200</td>
<td>1</td>
</tr>
<tr>
<td>62</td>
<td>15</td>
<td>1</td>
<td>291</td>
<td>201</td>
<td>1</td>
</tr>
</tbody>
</table>
Viewing Output in MySQL Workbench
MySQL Workbench – Basics

• MySQL Workbench is Oracle’s new integrated environment featuring:
  • Database administration (replacing MySQL Administrator), and
  • SQL development (replacing MySQL Query Browser).

  NOTE: Query Browser still works with MOVES2014 but is no longer supported by Oracle.

• MySQL Workbench release notes:
  • Current stable release: MySQL Workbench 6.1.7
  • MOVES2014 release version: MySQL Workbench 5.6.x

  NOTE: The following processes and screenshots may not match your experience.
MySQL Workbench – Basics: Input Password

1. Double-click **Local Instance MySQL**

2. Enter “moves” in the password field. Choose to **Save password in vault**.
MySQL Workbench – Basics: Layout

- Active Connection
- Toggle Preferences and Panels
- SQL Query Menu
- SQL Query Panel
- Object Browser
MySQL Workbench – Basics: SQL Query Menu

From left to right, these buttons are:

- **Open a SQL Script File**: Loads a saved SQL script to be ready for execution.
- **Save SQL Script to File**: Saves the current SQL script to a specified file.
- **Execute SQL Script**: Executes the selected portion of the query, or the entire query if nothing is selected.
- **Execute Current SQL Script**: Execute the statement under the keyboard cursor.
- **Explain**: Execute the EXPLAIN command on the query after the keyboard cursor.
- **Stop the query being executed**: Halts execution of the currently executing SQL script.
- **Toggle whether execution of SQL script should continue after failed statements**: If the red “breakpoint” circle is displayed, the script terminates on a statement that fails. If the button is depressed so that the green arrow is displayed, execution continues past the failed code, possibly generating additional result sets. In either case, any error generated from attempting to execute the faulty statement is recorded in the Output tab sheet.
- **Toggle Row limit**: Turns on and off the result set row limit.
- **Commit**: Commits the current transaction. Note: All query tabs in the same connection share the same transactions. To have independent transactions, a new connection must be opened.
- **Rollback**: Rolls back the current transaction. Note: All query tabs in the same connection share the same transactions. To have independent transactions, a new connection must be opened.
- **Toggle Auto-Commit Mode**: If selected, each statement will be committed independently. Note: All query tabs in the same connection share the same transactions. To have independent transactions, a new connection must be opened.
- **Beautify SQL**: Beautify/reformat the SQL script.
- **Find panel**: Show the Find panel for the editor.
- **Invisible characters**: Toggle display of invisible characters, such as newlines, tabs or spaces.
- **Wrapping**: Toggles the wrapping of long lines in the SQL editor window.
MySQL Workbench – Basics

Expand your desired output database (SCHEMAS)
MySQL Workbench – Basics

To quick view a table, right-click the table name and click Select Rows – Limit 1000.

NOTE: The 1000 row limit can be toggled on and off with the button highlighted above.
MySQL Workbench – Basics

Or simply write and run a query
MySQL Workbench – Basics

You may save or load query script using the icons highlighted above.
MySQL Workbench – Basics

Or you may save parts of query scripts using Snippets tab and Snippets Pallet
MySQL Workbench – Basics

Table navigation, sorting, exporting, and search tools
Click the “Export” icon to export the current output set.

NOTE: Uncheck the Select Rows – Limit 1000 button if your table is greater than 1000 rows to export the entire output set.
MySQL Query Browser

Query Browser will still work with MOVES2014, however, Oracle no longer supports Query Browser. But...
Same Parts, New Box

Query Panel
Output Panel
Object Browser
Summary

• Under-the-hood improvements to MOVES

• Changes to the Graphical User Interface (GUI)

• Database converter

• New input options
Questions?

MOVES
Motor Vehicle Emission Simulator
Thank You

Please send follow-up questions or feedback about this webinar to mobile@epa.gov

Coming Soon!

• MOVES2014 Hands-On Training Course for New Users
• PM Hot-spot guidance for transportation conformity
• MOVES CO project-level guidance
• 3-day training for PM-hot-spot analyses

• See the MOVES webpage for updates and additional reference materials www.epa.gov/otaq/models/moves/

• Conformity updates will be posted here: http://www.epa.gov/otaq/stateresources/transconf/projectlevel-hotspot.htm