MOVES2014 for Experienced Users

September 2014

Office of Transportation and Air Quality

US Environmental Protection Agency

EPA

Webinar Logistics

- Webinar slides are available at: www.epa.gov/otaq/models/moves/training.htm
- This webinar is offered September 17th & 25th
- 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

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2

Outline

- Changes to the Graphical User Interface (GUI)
- New input options
- Database converter
- Setting up and viewing output in MySQL Workbench

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3

What's New in MOVES2014

- New OTAQ rules
  - Tier 3
  - HD GHG phase 1
  - LD GHG
- New science
  - Relied on dozens of new test programs and scientific studies
  - Future forecasts (VMT, population, sales)
- Improved functionality

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4

Changes to the Graphical User Interface

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Changes to the Graphical User Interface (GUI)

- Nonroad modeling capability
- Ethanol (E-85) as a vehicle fuel type
- Output for highway ramps
- Automatic selection of pollutant prerequisites
- Output by regulatory class

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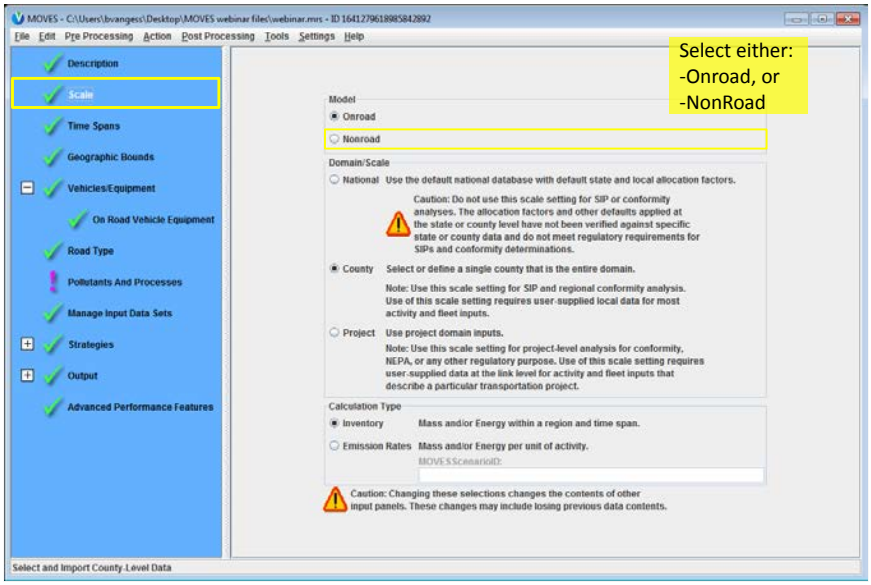
6

GUI Changes – Scale: Nonroad



7

GUI Changes – On Road Vehicles Equipment

- EPA has added ethanol (E-85) to the model
- To obtain emissions for the entire fleet, select:
  - Compressed Natural Gas (CNG)
  - Diesel
  - Ethanol (E-85) and
  - Gasoline
- Our defaults include some E-85 vehicles – not selecting ethanol will result in lost VMT from these vehicles
- If no ethanol exists in your county, the new **fuelusage** input table can be used to specify this (covered later)

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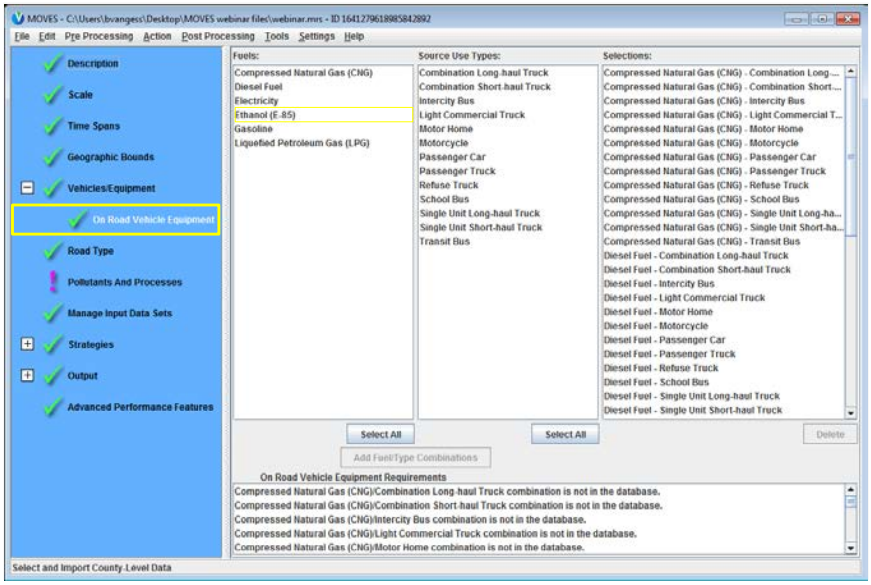
8

GUI Changes – On Road Vehicles Equipment



9

GUI Changes – Road Type

- MOVES now allows ramps to be modeled separately by selecting "Provide separate ramp output"

NOTE: This selection is optional and total inventory will not be affected

If not selected:	If selected:
1 Off-Network	1 Off-Network
2 Rural Restricted	
3 Rural Unrestricted	3 Rural Unrestricted
4 Urban Restricted	
5 Urban Unrestricted	5 Urban Unrestricted
	6 Rural Restricted without ramps
	7 Urban Restricted without ramps
	8 Rural Restricted ramps
	9 Urban Restricted ramps

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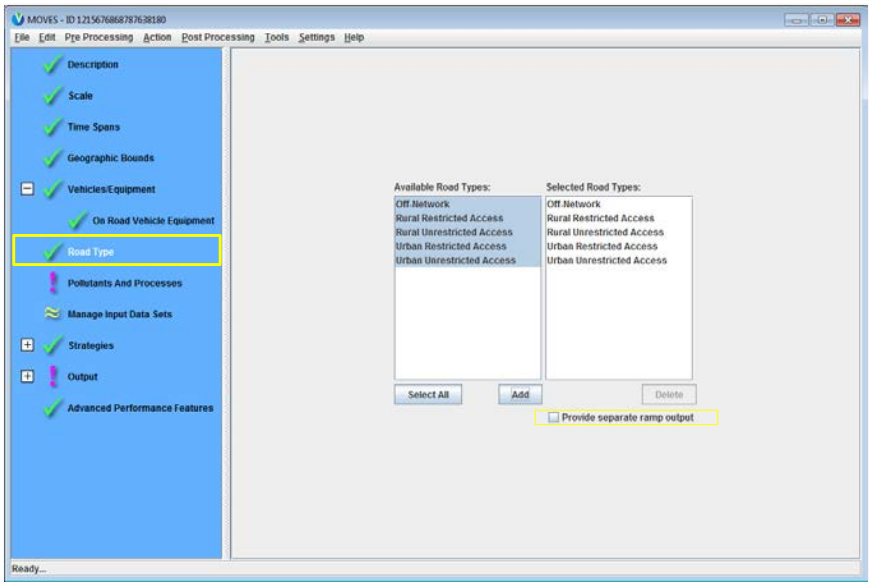
10

GUI Changes – Road Type



11

GUI Changes – Pollutants and Processes

- In MOVES 2010b many pollutant/processes require additional pollutant/processes to be selected
- MOVES 2014 features "Autochaining"
  - Clicking "Select Prerequisites" will automatically select required pollutant/processes

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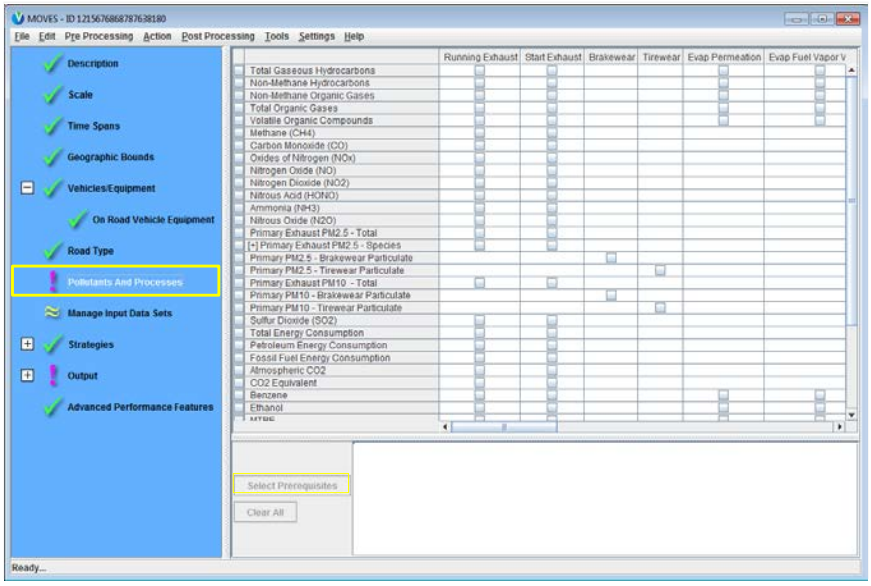
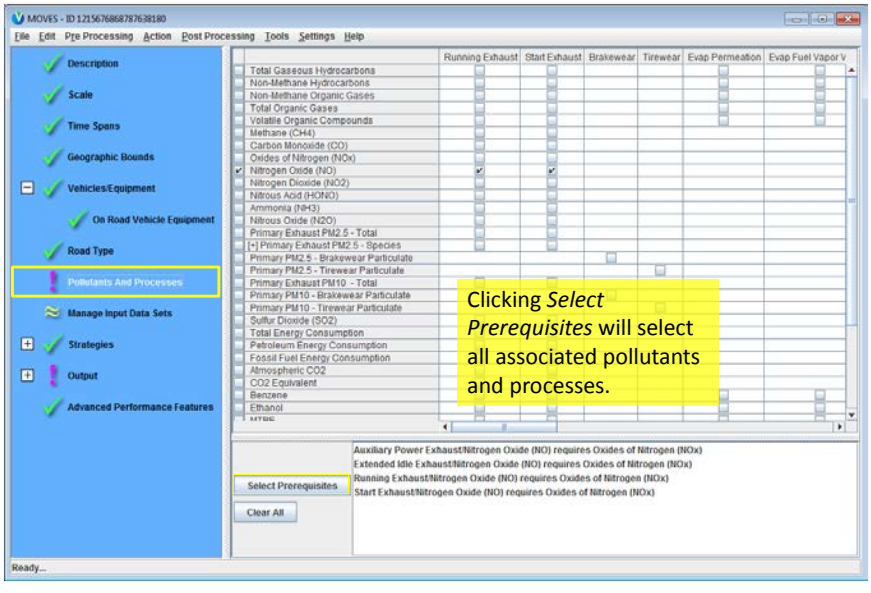
12

GUI Changes – Pollutants and Processes



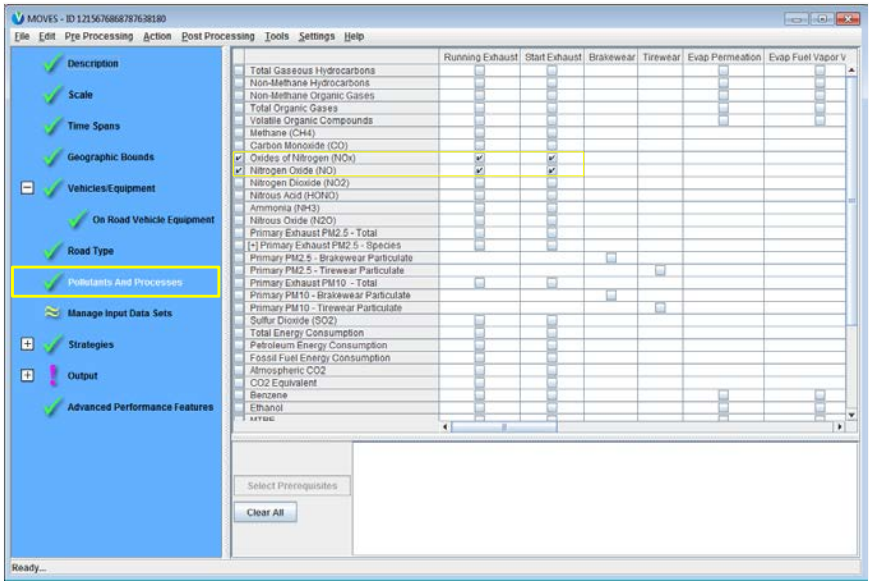
13

GUI Changes – Pollutants and Processes



14

GUI Changes – Pollutants and Processes



15

GUI Changes – Output

- Users can now obtain output by EPA Regulatory Class

NOTE: This selection is optional and will not affect the total inventory

ID	regClassName	regClassDesc
10	MC	Motorcycles
20	LDV	Light Duty Vehicles
30	LDT	Light Duty Trucks
40	LHD <=10 K	Class 2b Trucks with 2 axles and 4 tires (8500 lbs < GVWR <=10,000 lbs)
41	LHD <=14 K	Class 2b Trucks with 2 axles and at least 6 tires Or Class 3 Trucks (8500 lbs < GVWR <=14,000 lbs)
42	LHD45	Light Heavy Duty (14,000 lbs < GVWR <=19,500 lbs)
46	MHD	Medium Heavy Duty (19,500 lbs < GVWR <=33,000 lbs)
47	HHD	Heavy Heavy Duty (GVWR > 33,000 lbs)
48	Urban Bus	Urban Bus (see CFR Sect. 86.091_2)

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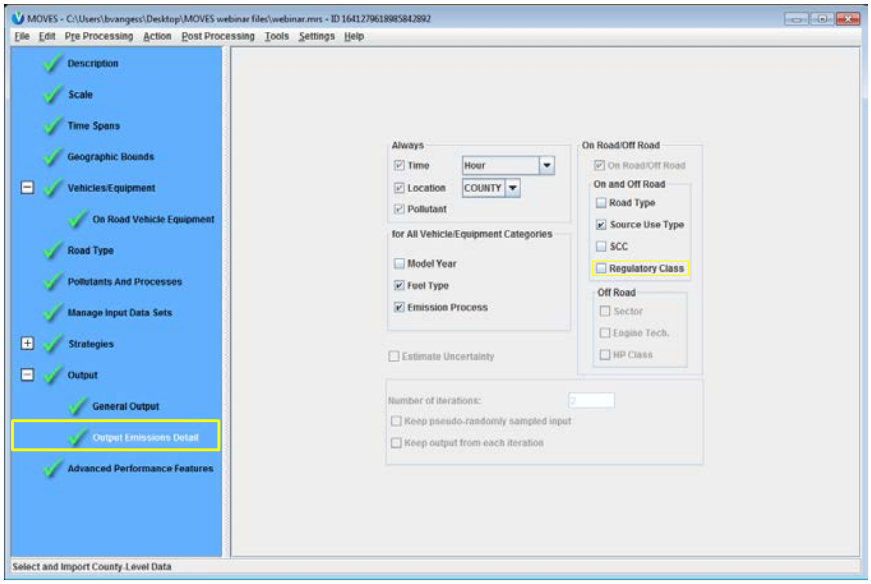
16

GUI Changes – Output



17

GUI Changes – Scale: Nonroad

- The existing NONROAD2008 model has been incorporated into MOVES2014
- Nonroad sectors can be modeled by selecting "Nonroad" in the Scale panel

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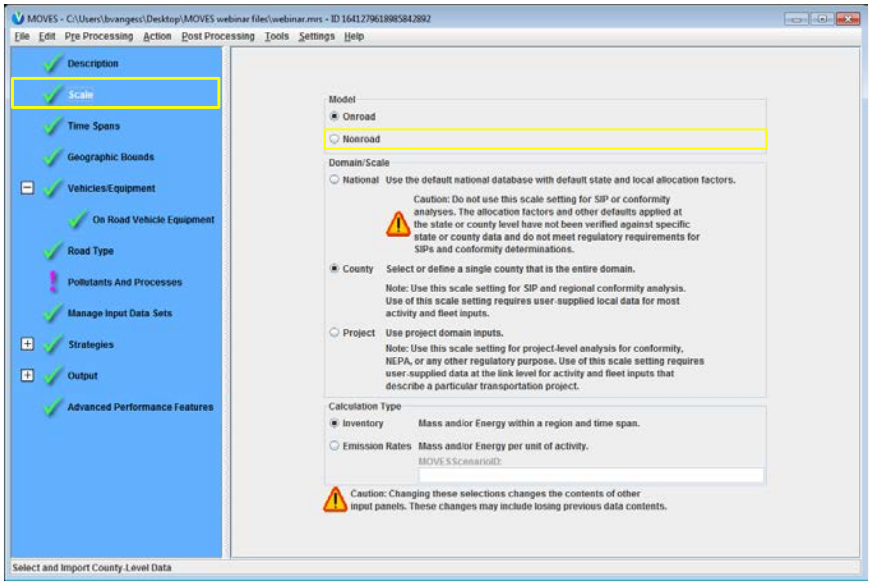
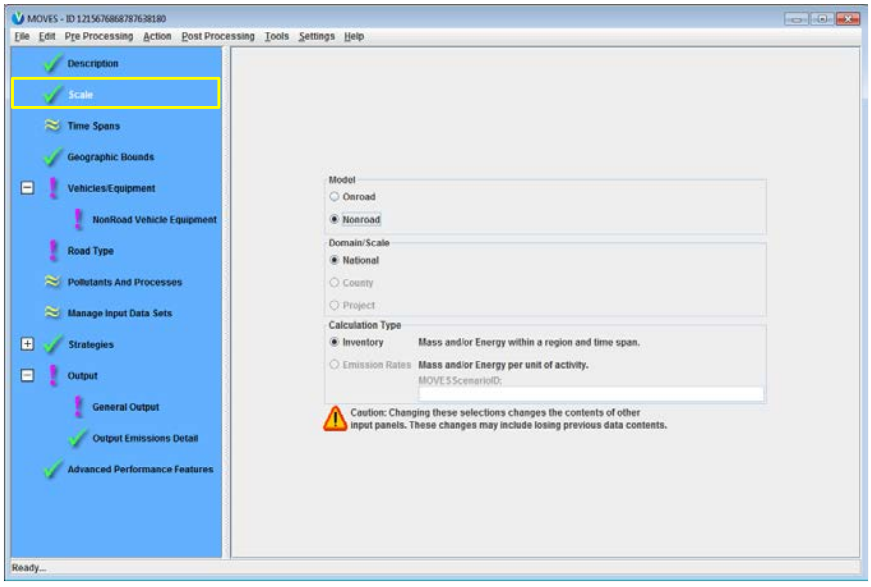
18

GUI Changes – Scale: Nonroad



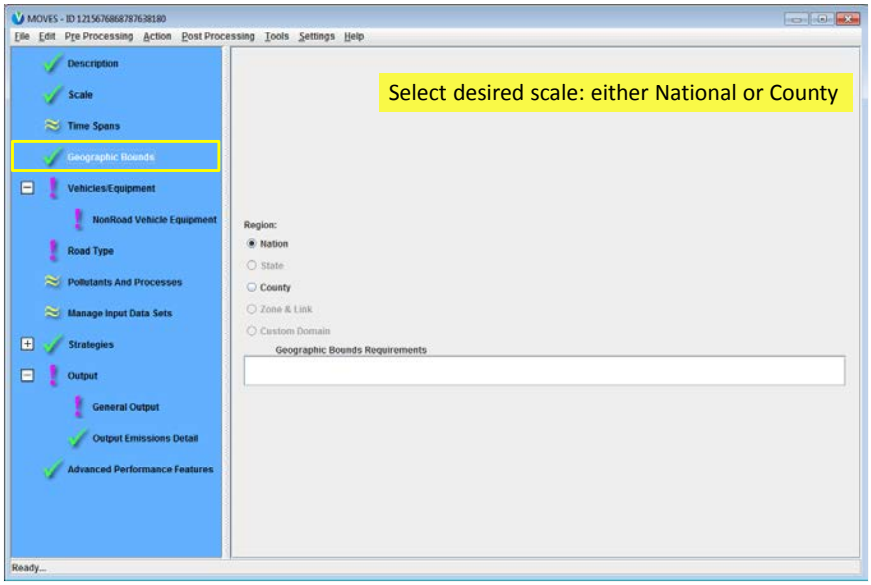
19

GUI Changes – Scale: Nonroad



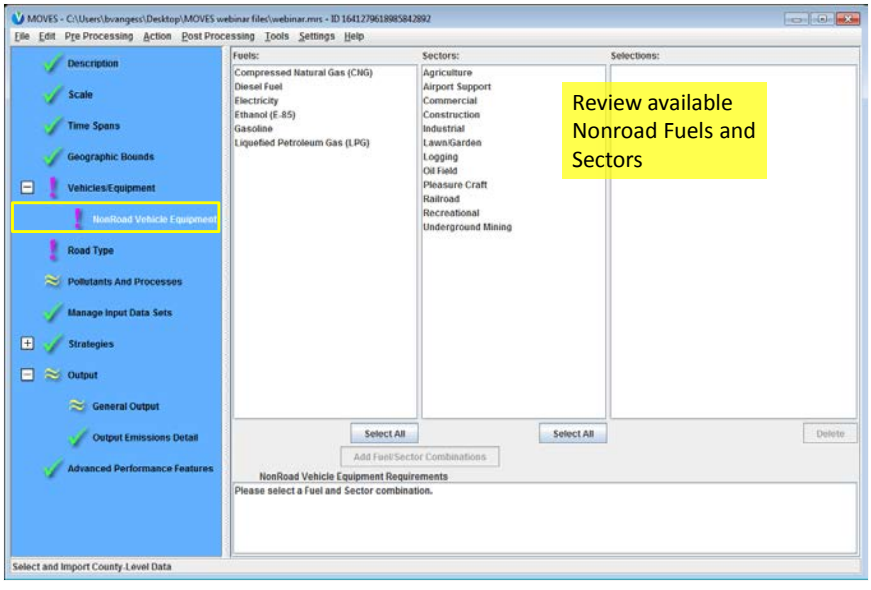
20

GUI Changes – Pollutants & Processes: Nonroad



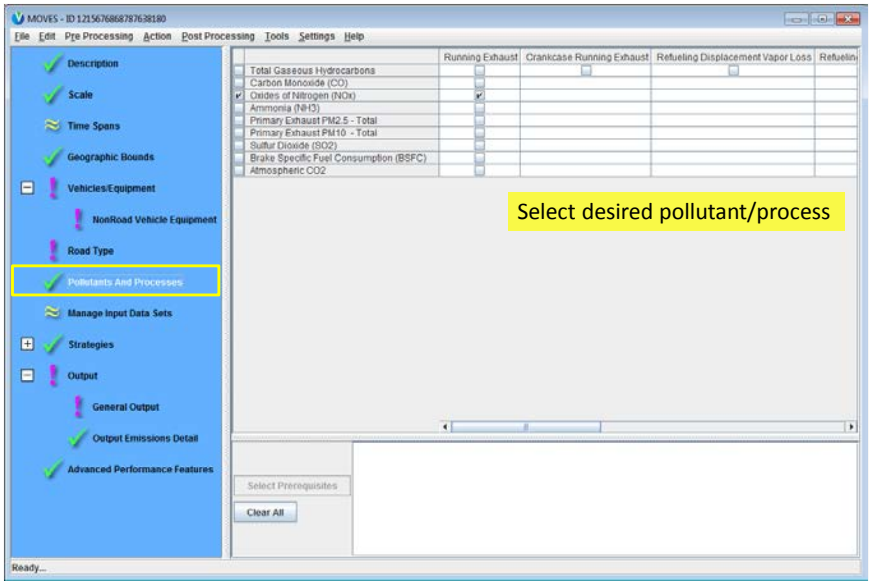
21

GUI Changes – Pollutants & Processes: Nonroad



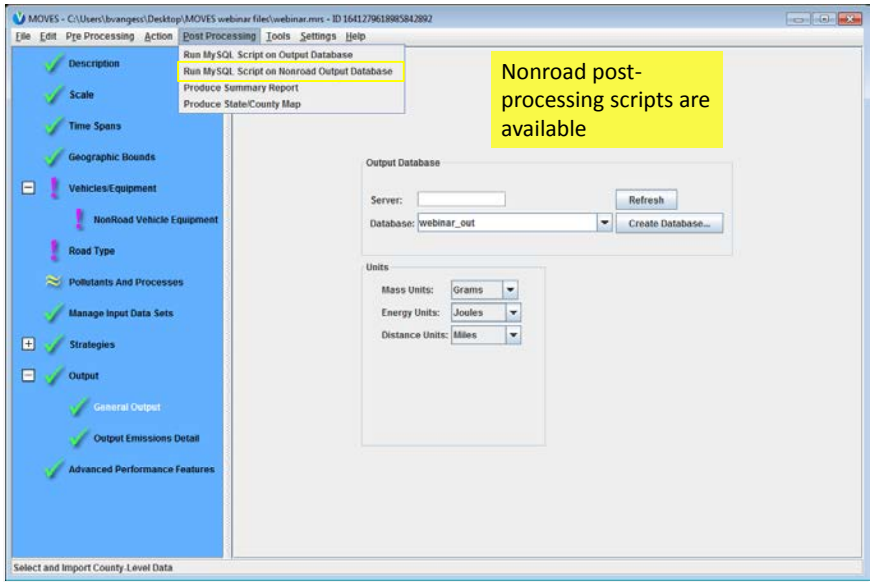
22

GUI Changes – Pollutants & Processes: Nonroad



23

GUI Changes – Post Processing: Nonroad



24

New Input Options

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Changes to the County Data Manager (CDM)

- VMT
- Fuels
- Retrofits
- Hotelling
- Starts

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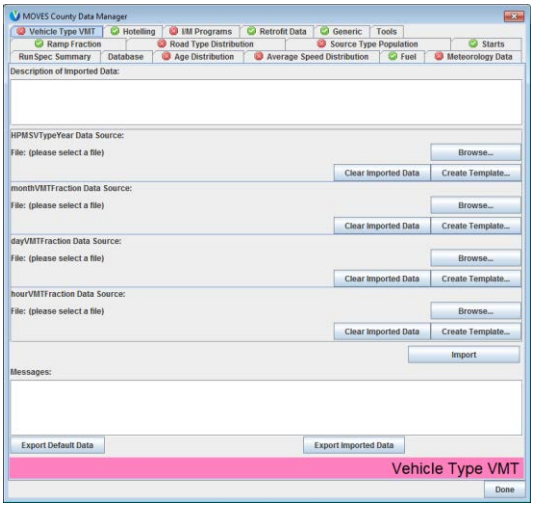
26

New Input Options – Vehicle Type VMT



HPMS vehicle type IDs have changed

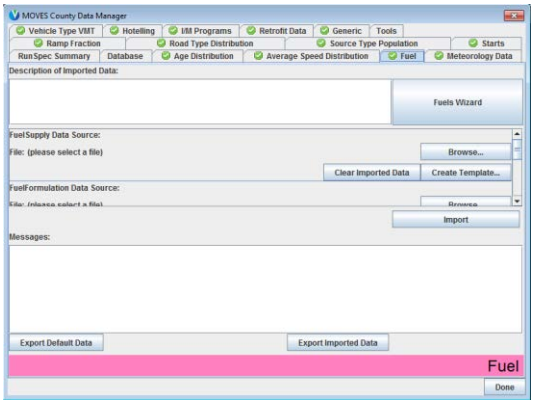
New vehicle type 25 replaces vehicle types 20 and 30

New Input Options – Vehicle Type VMT

HPMSVtypeID	yearID	VMTGrowthFac...	HPMSBaseYea...
10	2024	0	65553800
25	2024	0	14354400000
40	2024	0	56920300
50	2024	0	632594000
60	2024	0	951305000

- HPMS changed methodologies after release of MOVES2010
  - Old system divided light-duty vehicles into passenger cars (ID=20) and 2-axel, 4-tire trucks (ID=30)
  - New system divides light-duty vehicles into short wheelbase and long wheelbase
- No easy way to map wheelbase length to MOVES source types
- In MOVES2014, all light-duty vehicle VMT is combined into a single light duty category (ID=25)

New Input Options – Fuels



Updated fuel supply/formulation information has been provided for all counties… now organized by "fuelregionID"

Ethanol (E-85) added to default fuels

New Input Options – FuelUsageFraction

countyID	fuelYearID	modelYearGroupID	sourceBinFuelTypeID	fuelSupply	usageFraction
13121	2024	0	1	1	1
13121	2024	0	2	2	1
13121	2024	0	3	3	1
13121	2024	0	5	1	0.792421
13121	2024	0	5	5	0.207579

- 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)

New Input Options – FuelUsageFraction

countyID	fuelYearID	modelYearGroupID	sourceBinFuelTypeID	fuelSupply	usageFraction
13121	2024	0	1	1	1
13121	2024	0	2	2	1
13121	2024	0	3	3	1
13121	2024	0	5	1	0.792421
13121	2024	0	5	5	0.207579

- What if your county 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 county 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"

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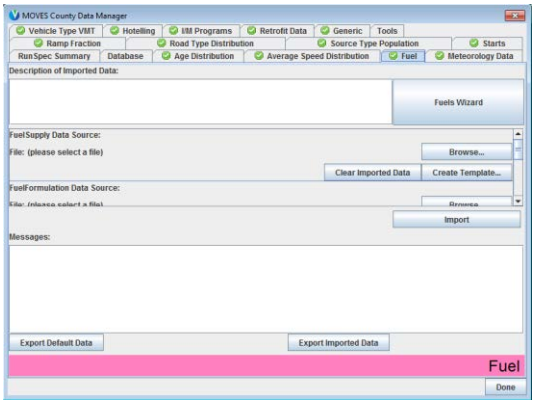
31

New Input Options – "Fuels Wizard"



- The Fuels Wizard allows the user to customize a fuel for their area based on known fuel properties
- Begin with the default fuel and edit the known properties (e.g., RVP); the Wizard will automatically adjust other properties to be consistent
- If you have multiple properties to change, begin with the least important or least certain first
- The adjustments are based on EPA refinery modeling

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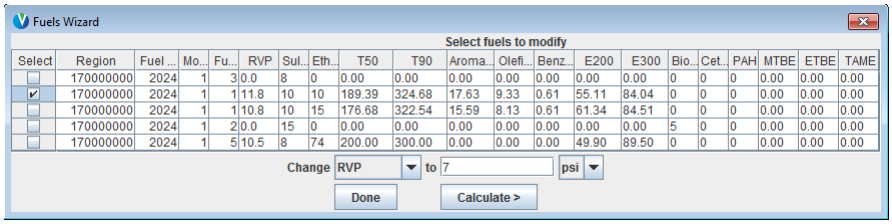
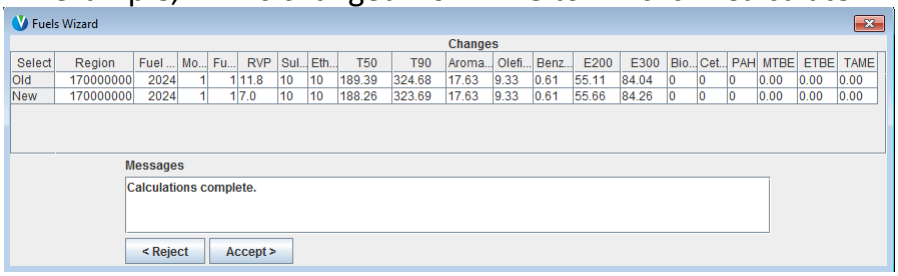
32

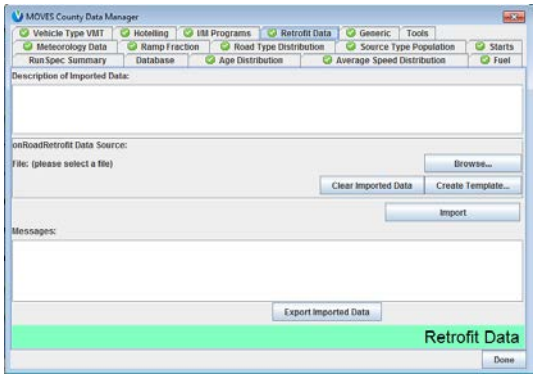
New Input Options – "Fuels Wizard"



- 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 CDM/PDM
- Use to model diesel retrofit programs
- This is an optional input

New Input Options – Retrofit

pollutantID	processID	fuelTypeID	sourceTypeID	retrofitYearID	beginModelYea	endModelYearID	cumFractionRetrofit	retrofitEffectiveFraction
3	1	2	62	2024	2020	2024	0.5	0.3

The example above describes a retrofit program:

- Applying to diesel combination long-haul trucks (sourceTypeID 62)
- Affecting running emissions (process ID 1) of NOx (pollutantID 3)
- For model years 2020 through 2024 (beginModelYearID/endModelYearID)
- Where 50% of all vehicles in that MY range are retrofitted (cumFractionRetrofit 0.5)
- And the retrofit technology reduces emissions 30% (retrofiteffectivefraction 0.3)

- The retrofityearID should always be the analysis year
- Consult EPA guidance material for more information on when to use the Retrofit input

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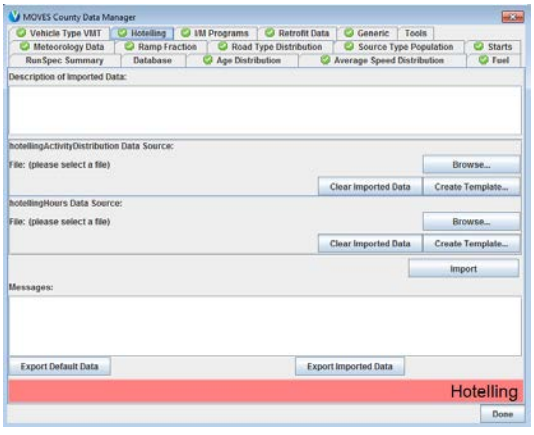
35

New Input Options – Hotelling



- The Hotelling input allows users to describe long-haul combination truck hotelling behavior
- The two panels are:
  - **hotellingactivitydistribution** and
  - **hotellinghours**
- Both are optional inputs
- Output in Rates mode is provided in the **ratepervehicle** table, but also in a new **rateperhour** table. ***Only one should be used*** depending on if activity is available in terms of vehicle population or hotelling hours

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36

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

beginModelYearID	endModelYearID	opModeID	opModeFraction
1960	2009	200	1
1960	2009	201	0
1960	2009	203	0
1960	2009	204	0
2010	2050	200	0.7
2010	2050	201	0.3
2010	2050	203	0
2010	2050	204	0

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37

New Input Options – Hotelling

hourDayID	monthID	yearID	ageID	zoneID	sourceTyp	hotellingHo
15	1	2024	30	131210	62	0
15	1	2024	29	131210	62	0
15	1	2024	28	131210	62	0
15	1	2024	27	131210	62	0
15	1	2024	26	131210	62	0
15	1	2024	25	131210	62	0.033932
15	1	2024	24	131210	62	0.146956
15	1	2024	23	131210	62	0.141804
15	1	2024	22	131210	62	0.113281
15	1	2024	21	131210	62	0.129963
15	1	2024	20	131210	62	0.23111
15	1	2024	19	131210	62	0.102025
15	1	2024	18	131210	62	0.409672
15	1	2024	17	131210	62	0.397336
15	1	2024	16	131210	62	0.402312
15	1	2024	15	131210	62	0.737026
15	1	2024	14	131210	62	0.82595
15	1	2024	13	131210	62	1.388
15	1	2024	12	131210	62	1.41376
15	1	2024	11	131210	62	1.52765
15	1	2024	10	131210	62	1.05556
15	1	2024	9	131210	62	2.35206
15	1	2024	8	131210	62	1.73303
15	1	2024	7	131210	62	3.48606
15	1	2024	6	131210	62	1.39675
15	1	2024	5	131210	62	2.19772
15	1	2024	4	131210	62	2.56074
15	1	2024	3	131210	62	5.66776
15	1	2024	2	131210	62	4.5037
15	1	2024	1	131210	62	3.1559
15	1	2024	0	131210	62	3.07248

- The **hotellinghours** table is used to define the total number of hotelling hours in your modeling domain
- In MOVES2014 extended idle hours are allocated to counties based on rural combination truck VMT – in MOVES2010b it was based on long-haul combination truck population
- This input can be used to override the defaults and provide local hotelling hours (if available)
- Note that hotelling hours are by "day-type"
  - day 5 = 5 weekdays
  - day 2 = 2 weekend days

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38

New Input Options – Starts

- MOVES2014 offers the option to import local vehicle start information. This importer helps "shape" and create a complete "**starts**" table. Depending on the data available, users can use one or more of the following panels:
- **starts** – allows users to provide the complete starts table (by source type, hourdayid, modelyear, monthid)
- **startsPerDay** – defines the number of starts per day
- **startsHourFraction** – specifies the distribution of starts throughout the day
- **startsSourceTypeFraction** – allocates starts to different source types
- **startsMonthAdjust** – adjusts start activity by month

An importer is also available to provide information on vehicle soak time

- **importStartsOpModeDistribution** – defines vehicles soak times

The starts importer is optional. If no data are provided, MOVES will calculate starts based on the user defined source type population input.

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New Input Options – Starts

- An entire "**starts**" table can be imported. This will completely replace the MOVES generated default starts profile.
- Note that this input requires all information on starts for all hours, dayIDs, age (model year), and source type selected in the runspec

hourDayID	monthID	yearID	ageID	zoneID	sourceTypeID	starts	startsCV
15	1	2024	0	131210	11		
15	1	2024	0	131210	21		
15	1	2024	0	131210	31		
15	1	2024	0	131210	32		
15	1	2024	0	131210	41		
15	1	2024	0	131210	42		
15	1	2024	0	131210	43		
15	1	2024	0	131210	51		
15	1	2024	0	131210	52		
15	1	2024	0	131210	53		
15	1	2024	0	131210	54		
15	1	2024	0	131210	61		
15	1	2024	0	131210	62		
15	1	2024	1	131210	11		
15	1	2024	1	131210	21		
15	1	2024	1	131210	31		
15	1	2024	1	131210	32		

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New Input Options – StartsPerDay

- The startsperday importer is used to provide total starts by day type
- Starts should be entered for all vehicles and all days within the day type (day 5 represents five weekdays, and day 2 represents two weekends)
- This input can be used independently, or in combination with startsHourFraction, startsSourceTypeFraction, and startsMonthAdjust

zoneID	dayID	yearID	startsPerDay
131210	5	2024	

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41

New Input Options – StartsHourFraction

zoneID	dayID	hourID	allocationFraction
131210	5	1	
131210	5	2	
131210	5	3	
131210	5	4	
131210	5	5	
131210	5	6	
131210	5	7	
131210	5	8	
131210	5	9	
131210	5	10	
131210	5	11	
131210	5	12	
131210	5	13	
131210	5	14	
131210	5	15	
131210	5	16	
131210	5	17	
131210	5	18	
131210	5	19	
131210	5	20	

- The **startshourfraction** importer is used to define the distribution of total starts across the day
- Different distributions can be provided for each day type
- This input can be used independently, or in combination with **startsperday**, **startsSourceTypeFraction**, and **startsMonthAdjust**

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42

New Input Options – StartsSourceTypeFraction

sourceTypeID	allocationFraction
11	
21	
31	
32	
41	
42	
43	
51	
52	
53	
54	
61	
62	

- The **startssourcetypefraction** importer is used to define the distribution of total starts by source type
- This input can be used independently, or in combination with **startsperday**, **startshourfraction**, and **startsMonthAdjust**

New Input Options – StartsMonthAdjust

monthID	monthAdjustment
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

- The **startsmonthadjust** importer is used to define the distribution of total starts by month
- A fraction of 1 for all months indicates every month has an equal number of starts
- These can be varied to adjust for a scenario where there is greater start activity in the summer months vs. winter months
- This input can be used independently, or in combination with **startsperday**, **startshourfraction**, and **startssourcetypefraction**

New Input Options – StartsOpmodeDistribution

sourceTyp	hourDayID	linkID	polProcess	opModeID	opModeFraction
11	15	1312101	302	101	
11	15	1312101	302	102	
11	15	1312101	302	103	
11	15	1312101	302	104	
11	15	1312101	302	105	
11	15	1312101	302	106	
11	15	1312101	302	107	
11	15	1312101	302	108	
11	25	1312101	302	101	
11	25	1312101	302	102	
11	25	1312101	302	103	
11	25	1312101	302	104	
11	25	1312101	302	105	
11	25	1312101	302	106	
11	25	1312101	302	107	
11	25	1312101	302	108	
11	35	1312101	302	101	
11	35	1312101	302	102	
11	35	1312101	302	103	
11	35	1312101	302	104	
11	35	1312101	302	105	
11	35	1312101	302	106	
11	35	1312101	302	107	
11	35	1312101	302	108	

- The **startsopmodedistribution** importer is used to define the distribution of soak times by sourcetype, hour, and dayID
- For each combination of sourcetype, hourDayid, and polprocessID, opmodefractions should sum to 1
- The table below shows the available soak times

opModeID	opModeName
101	Soak Time < 6 minutes
102	6 minutes <= Soak Time < 30 minutes
103	30 minutes <= Soak Time < 60 minutes
104	60 minutes <= Soak Time < 90 minutes
105	90 minutes <= Soak Time < 120 minutes
106	120 minutes <= Soak Time < 360 minutes
107	360 minutes <= Soak Time < 720 minutes
108	720 minutes <= Soak Time

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45

New Input Options – Starts

- In the General Output panel of the runspec, checking output by "Starts" allows you to confirm that MOVES used the correct number of starts
- For Rates runs, two new tables are created called "**startpervehicle**" and "**rateperstart**"
  - The **startpervehicle** table is primarily informational and can be used for diagnostic purposes

  Only one of these tables should be used for developing a starts emissions inventory:
  - The **rateperstart** table can be used as a substitute for the **ratepervehicle** table if start information is available
  - If you have start info: Multiply **rateperstart** rates x [# of vehicle starts]
  - If you don't: Multiply **ratepervehicle** rate x [vehicle population]

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46

MOVES2014 Database Converter

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Database Converter

- Converts MOVES2010b project/county database into MOVES2014 compatible database
  - Converts 6 HPMS vehicle classes used in MOVES2010 to 5 MOVES2014 classes
  - Removes leap year from monthVMTfraction table
  - Adds fuel region to fuel supply table
- Converter has limitations for use in SIPs and conformity
  - Need to update database with default MOVES2014 fuels
  - Need to update any other MOVES2010 defaults to MOVES2014
  - Need to re-import monthVMTfraction table for leap years

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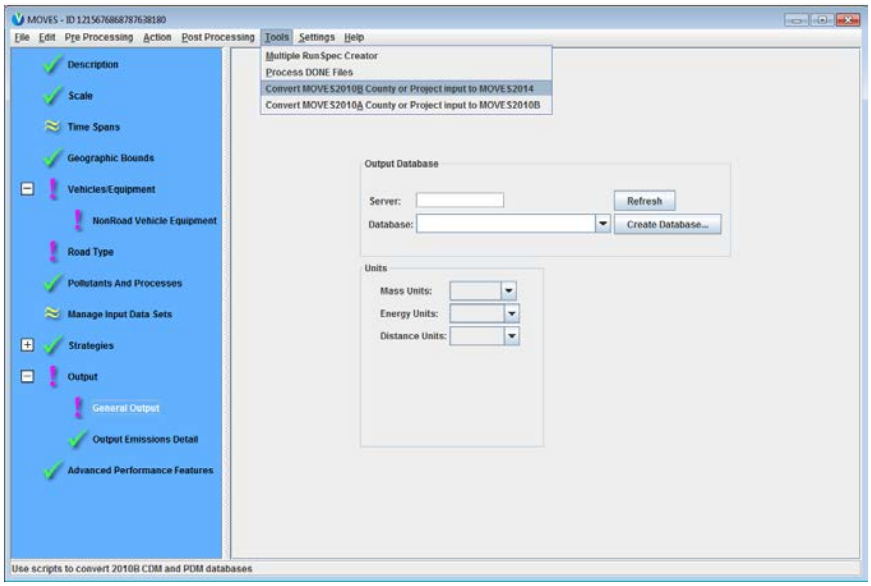
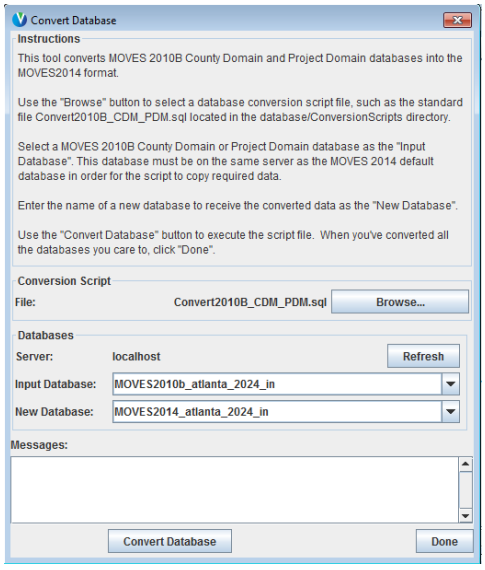
48

Database Converter



Database Converter



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:

http://www.epa.gov/otaq/models/moves/documents/420b14057.pdf

Database Converter

HPMSVtypeID	yearID	VMTGrowthFac...	HPMSBaseYea...	baseYearOffNe...
10	2024	0	65553800	NULL
20	2024	0	41990700000	NULL
30	2024	0	10155400000	NULL
40	2024	0	56920300	NULL
50	2024	0	632594000	NULL
60	2024	0	951305000	NULL

HPMSVtypeID	yearID	VMTGrowthFac...	HPMSBaseYea...
10	2024	0	65553800
25	2024	0	14354400000
40	2024	0	56920300
50	2024	0	632594000
60	2024	0	951305000

6 → 5 Vehicle Classes:

- HPMS now classifies 20s and 30s as short/long wheelbase
- The converters sums these together into a single light-duty category (25)

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51

Database Converter

countyID	fuelYearID	monthGroupID	fuelFormulati...	marketShare	marketShareCV
13121	2012	1	20011	1	0.5
13121	2012	1	3836	1	0.5
13121	2012	7	20011	1	0.5
13121	2012	7	3847	1	0.5

fuelRegionID	fuelYearID	monthGroupID	fuelFormulati...	marketShare	marketShareCV
170000000	2012	1	20011	1	0.5
170000000	2012	1	3836	1	0.5
170000000	2012	7	20011	1	0.5
170000000	2012	7	3847	1	0.5

- Default fuel data are provided by the EPA for fuel region
- Fuel supply tables must now be by fuelregionID

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52

Database Converter – Additional Steps

- Update the fuel tables 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
- When a leap-year is modeled, monthVMTfraction may need to be re-imported
  - MOVES2014 only uses one set of month VMT fractions and the converter automatically selects the non-leap year fractions
  - If your MOVES2010 database has zeros for non-leap year fraction entries, you will need to re-import the correct fractions (fill in MonthVMTfraction table and re-import it)

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53

Viewing Output in MySQL Workbench

MOVES
Motor Vehicle Emission Simulator

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MySQL Workbench – Basics

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

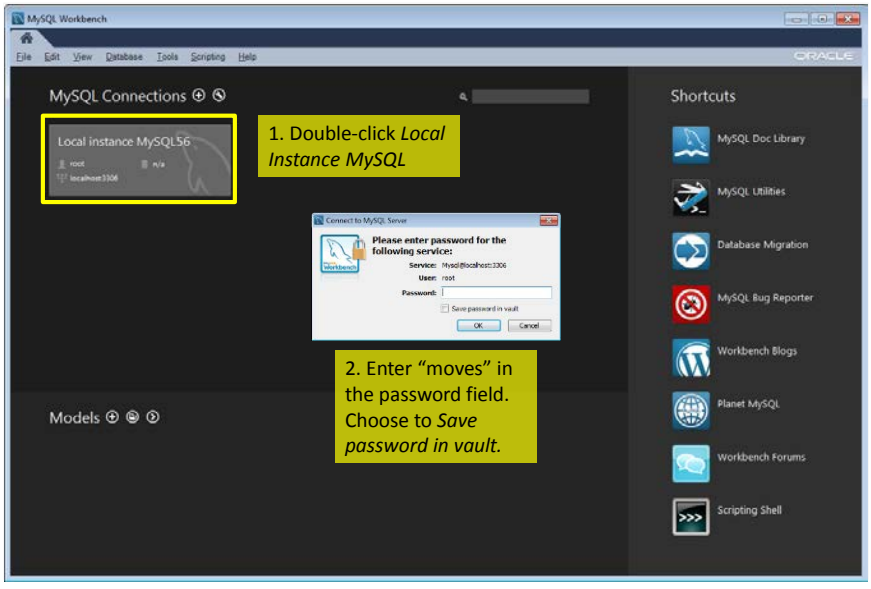
  NOTE: Query Browser still works with MOVES2014 but is no longer supported by Oracle.

- 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.

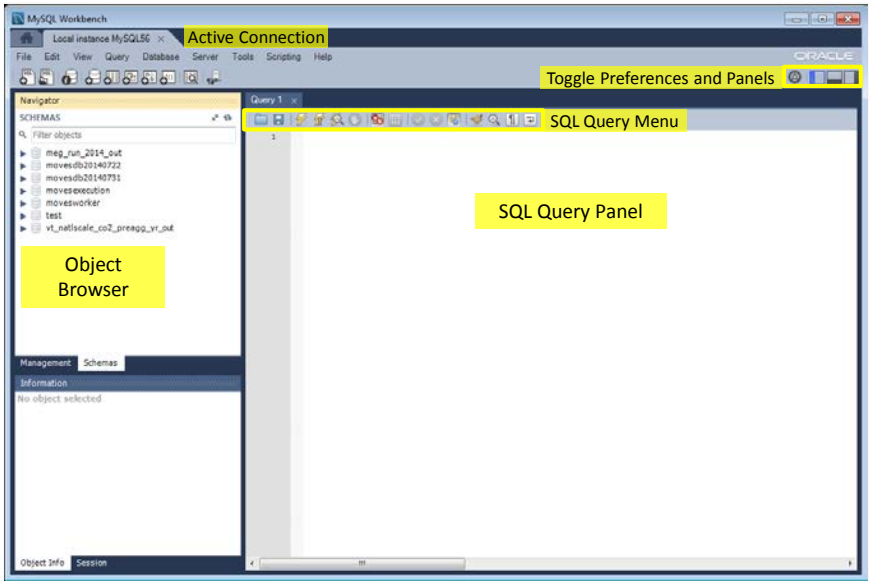
55

MySQL Workbench – Basics: Input password



56

MySQL Workbench – Basics: Layout



57

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.
- ***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.

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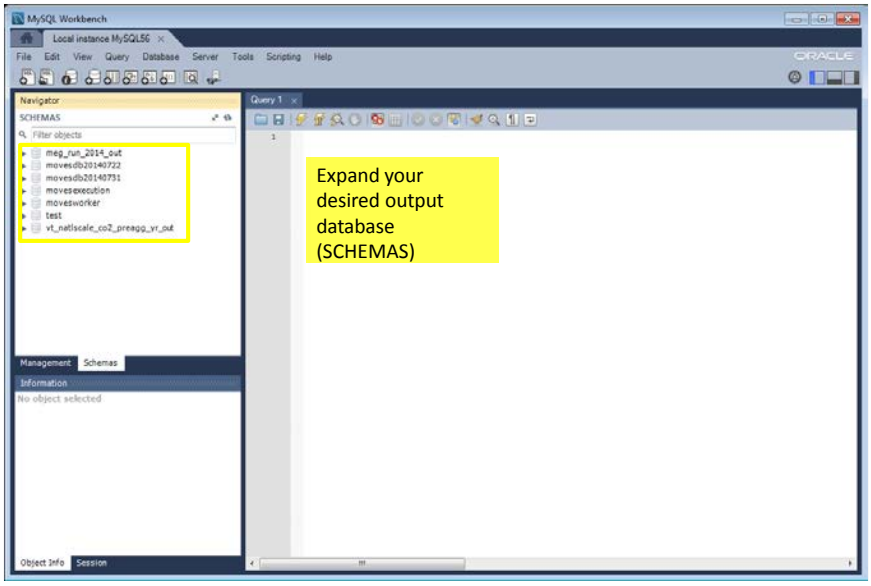
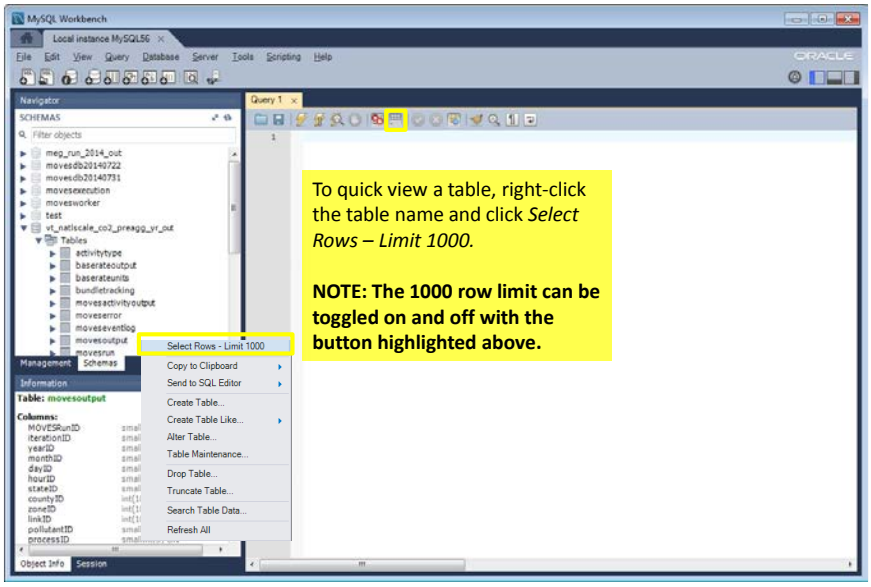
58

MySQL Workbench – Basics



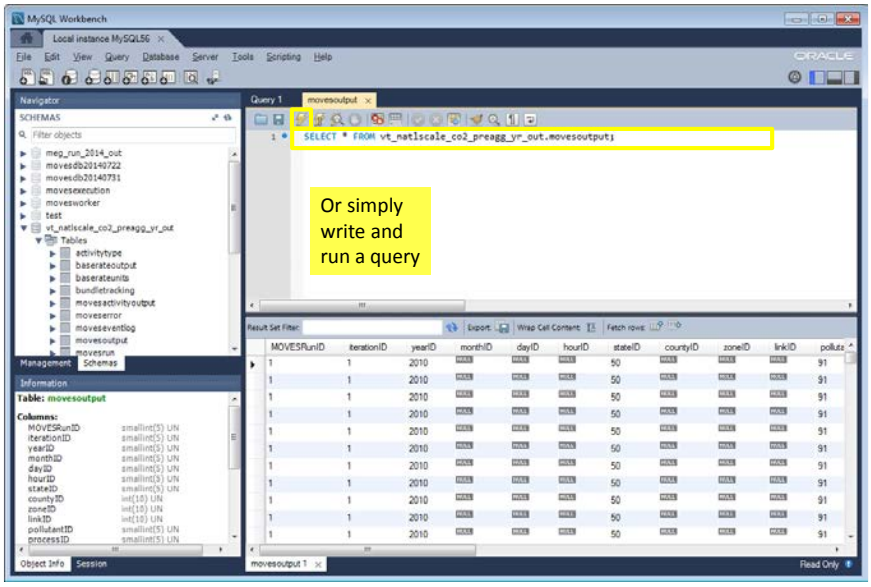
59

MySQL Workbench – Basics



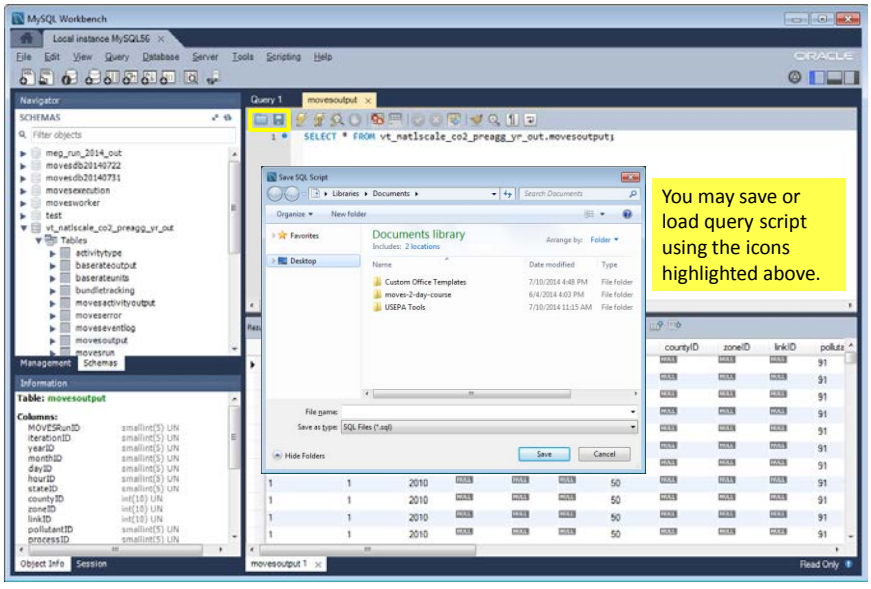
60

MySQL Workbench – Basics



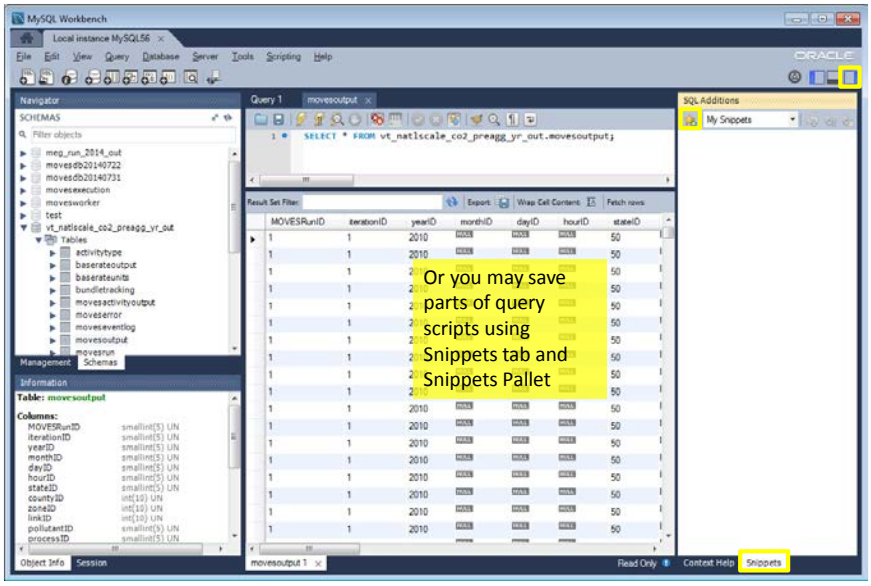
61

MySQL Workbench – Basics



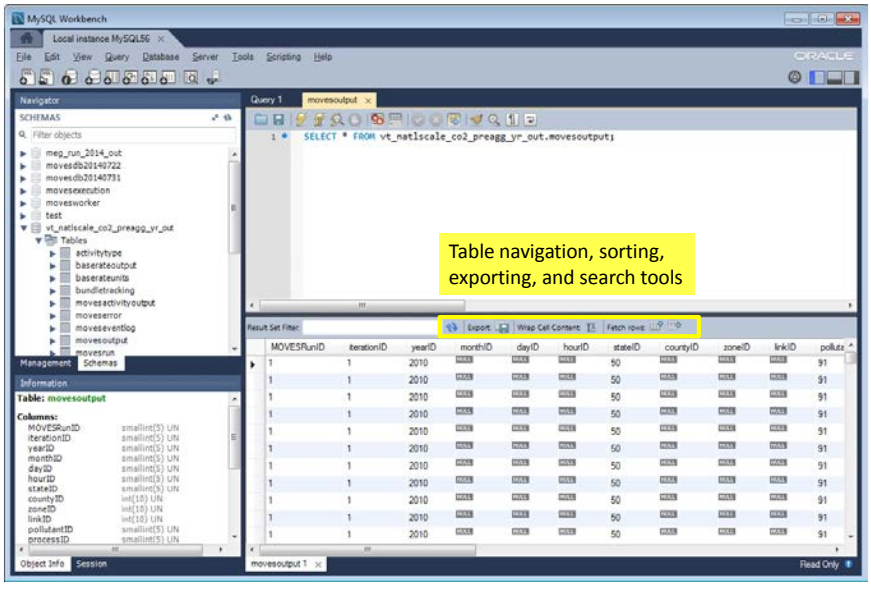
62

MySQL Workbench – Basics



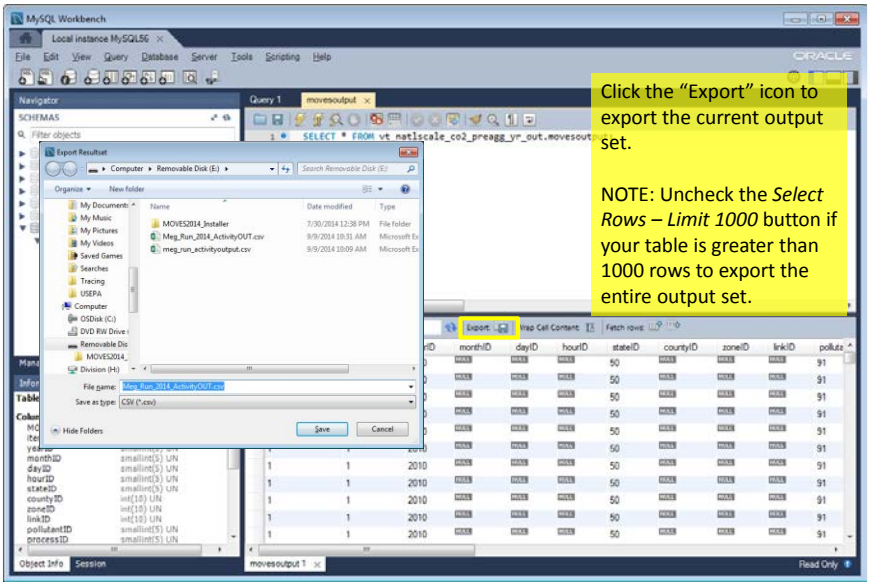
63

MySQL Workbench – Basics



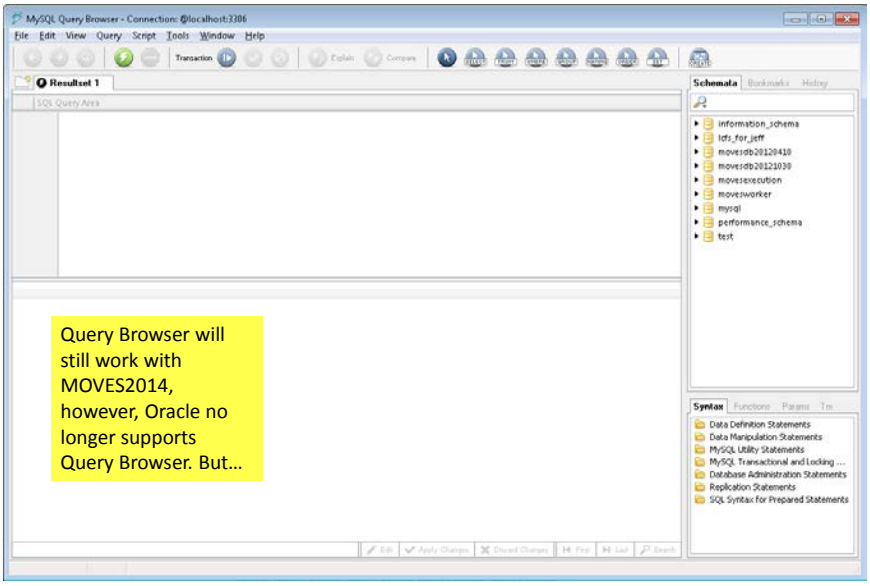
64

MySQL Workbench – Basics



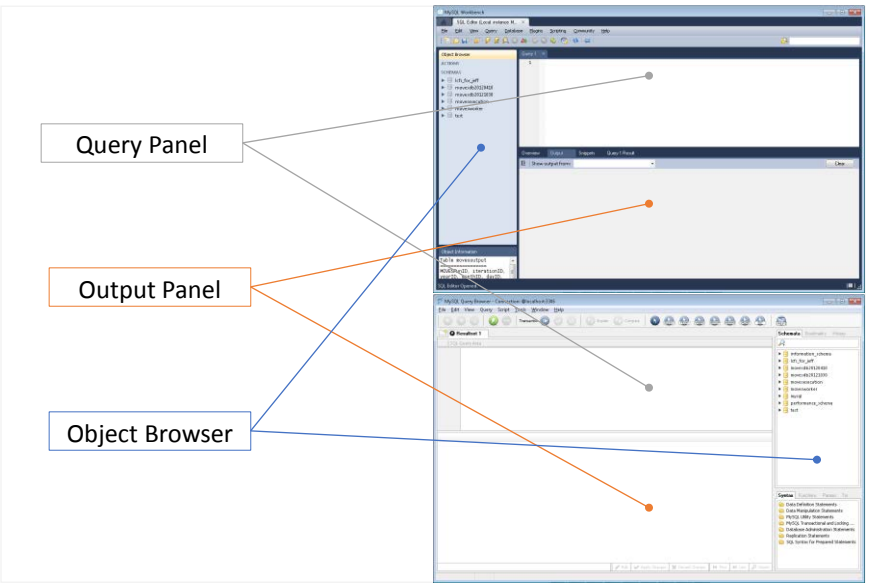
65

MySQL Query Browser



66

Same Parts, New Box



67

Summary

- Changes to the Graphical User Interface (GUI)
  - Nonroad
  - Ethanol
  - Ramps
  - Auto-chaining
- New Input Options
  - Numerous new refinements to county-level inputs
- Database Converter
  - Helps convert older databases to MOVES2014 format
- Viewing output in MySQL Workbench
  - New look, same function

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68

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

- **NOTE: Not recommended if you've already taken the 2-day MOVES2010 training**

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

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69