Using MOVES for Estimating State and Local Inventories of On-Road Greenhouse Gas Emissions and Energy Consumption

Public Draft

United States Environmental Protection Agency

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Transportation and Climate Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

NOTE:

EPA is releasing this guidance as a draft and readers are welcome to submit comments by March 31, 2012. After this date, EPA may revise this guidance without further notice. Submit comments via email to Laura Berry, berry.laura@epa.gov.

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Section 1: Introduction

1.1 Purpose of this Guidance

This guidance provides information on how to use the MOtor Vehicle Emissions Simulator (MOVES) model to estimate greenhouse gas (GHG) emissions from on-road vehicles to create state or local inventories, or to estimate total energy consumption from the on-road sector. MOVES is the U.S. Environmental Protection Agency's (EPA's) preferred tool for developing on-road GHG emission inventories at the state and local level.[1] Note that this guidance does not create a requirement for GHG analysis, but merely provides recommendations for using MOVES for this type of analysis for those that choose to do so, either voluntarily or as a result of a state or local requirement.

This guidance provides recommendations for using MOVES to create annual on-road mobile GHG inventories and to estimate energy consumption. Many people may already be familiar with MOVES, as it is currently used across the country except in California to develop on-road emission inventories of transportation-related criteria pollutants and their precursors.[2] These criteria pollutant inventories are needed either for state air quality plans (state implementation plans, or SIPs) or transportation conformity determinations, and existing EPA guidance describes how and when to use MOVES for these regulatory purposes.[3] In addition, MOVES can also be used to estimate emissions of GHGs from on-road vehicles, including carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4). It can also estimate elemental carbon (black carbon)[4] as well as energy use.

MOVES allows users to analyze motor vehicle emissions at various scales: National, County, and Project. While the County scale is necessary to meet statutory and regulatory requirements

[1] EPA made this statement previously in "Policy Guidance on the Use of MOVES2010 for State Implementation Plan Development, Transportation Conformity, and Other Purposes," EPA-420-B-09-046, December 2009, see Q.& A. 16, on the web at: www.epa.gov/otaq/models/moves/420b09046.pdf , and in "EPA Releases MOVES2010 Mobile Source Emissions Model: Questions and Answers," EPA-420-F-09-073, December 2009, see Q.&A. 5, on the web at: www.epa.gov/otaq/models/moves/420f09073.pdf.

[2] On-road emissions include those emissions that result from the operation of on-highway vehicles such as passenger cars and trucks, commercial trucks, buses, motorcycles, and motorhomes. It does not include non-road vehicles such as construction equipment, agricultural equipment, or recreational off-road vehicles. For more information about the difference between on-road and non-road sources, please refer to EPA's website at: www.epa.gov/otaq/inventory/overview/examples.htm . Transportation-related criteria pollutants are carbon monoxide (CO), ozone, nitrogen dioxide (NO2), and particulate matter (PM2.5 and PM10).

[3] Refer to EPA's website at www.epa.gov/otaq/stateresources/transconf/policy.htm#models for the latest versions of EPA's policy and technical guidance for using MOVES for SIP and conformity purposes. As of the date of this document's release, the lastest versions of these documents are: "Policy Guidance on the Use of MOVES2010 for State Implementation Plan Development, Transportation Conformity, and Other Purposes," EPA-420-B-09-046, December 2009," and "Technical Guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity," EPA-420-B-10-023, April 2010.

[4] For the purposes of this guidance, elemental carbon can be considered the same as black carbon.

for SIPs and transportation conformity, either the County or National scale can be used for GHG inventories. This guidance covers both of these scales with an emphasis on the County scale. This document does not contain guidance for use of the Project scale for estimating on-road GHG emissions or energy consumption. However, MOVES is EPA's best tool for project-level GHG analyses, and EPA may offer such guidance in the future, particularly if there is interest from the user community.

This guidance describes approaches for developing an on-road GHG inventory in different types of areas and the implications of each of these approaches. It discusses the input options in MOVES that are most important for estimating on-road GHG emissions and explains which inputs should be populated with locally-derived data versus when data from the MOVES default database can be used without affecting the quality of the results. This guidance should help users develop an approach for using MOVES to estimate GHG emissions or energy consumption with the time and data resources available.

This guidance covers the use of MOVES for estimating on-road GHG emissions and energy consumption only; it should not be followed when using MOVES to develop criteria pollutant inventories for SIP or conformity purposes. See Section 1.7 for information about other MOVES guidance and information. EPA has coordinated with the Department of Transportation during the development of this guidance.

1.2 What is MOVES?

MOVES is EPA's most recent on-road emissions model and can be downloaded for free from the web. [5] EPA created MOVES as a state-of-the-art model for estimating emissions from all on-road vehicles including cars, trucks, motorcycles, and buses. MOVES is based on analysis of millions of emission test results and considerable advances in the Agency's understanding of vehicle emissions. MOVES can estimate exhaust and evaporative emissions as well as brake and tire wear emissions from all types of on-road vehicles for any part of the country, except California.[6]

In 2010, EPA approved the MOVES model, which replaces the previous on-road emissions model called MOBILE6.2.[7] MOVES incorporates substantial recent emissions test data and accounts for changes in vehicle technology and regulations as well as improved understanding of in-use emission levels and the factors that influence them. MOVES significantly improves estimates of criteria pollutants, air toxics, and GHG emissions compared to EPA's earlier model. MOVES also has a new software framework that provides more flexibility for input and output options than MOBILE6.2.[8] Some MOVES features should make it easier for users to develop

[5] See EPA's website at: www.epa.gov/otaq/models/moves/index.htm. Note that this guidance refers to "MOVES" generally rather than a particular MOVES version because EPA will release updated versions of MOVES in the future. EPA will revise this guidance if a future version of MOVES warrants such an update.
[6] In California, a different on-road emissions model, EMFAC, is used for regulatory purposes instead of MOVES.
[7] See EPA's Federal Register announcement, 75 FR 9411 (March 2, 2010).
[8] New input options in MOVES and changes in the way MOVES handles existing information may appear to require more types of information as compared to MOBILE6.2, however, in most cases, existing MOBILE6.2 inputs can be

local data for MOVES. For example, MOVES uses a vehicle classification system based on the way vehicles are classified in the Federal Highway Administration's Highway Performance Monitoring System (HPMS) rather than on the way they are classified in EPA emissions regulations. This change should make it easier to use highway activity information as inputs to MOVES.

At the time of this document's release, MOVES2010a is the latest version of the MOVES model. This version incorporates new car and light truck GHG emissions standards affecting model years 2012-and-later (these standards were published May 7, 2010) and updates the effects of corporate average fuel economy standards for model years 2008-2011. Thus for estimating GHG emissions or energy consumption, this version is a significant improvement over MOBILE6.2, and even over earlier versions of MOVES.

This document reflects the most recent MOVES model, MOVES2010a. However, this guidance refers to "MOVES" generally rather than a particular version, as EPA will be updating the MOVES model over time to account for revisions to GHG emissions and fuel economy standards as well as other new information. Before beginning a new GHG or energy analysis, users should consider using the latest version of MOVES available on EPA's website at www.epa.gov/otaq/models/moves/index.htm. EPA will revise this guidance as needed to reflect future versions of MOVES.

1.3 What kinds of GHG and energy analyses can be done with MOVES?

MOVES can be used to create an annual GHG emissions inventory retrospectively or prospectively, because it can model the year 1990 and any year from 1999 through 2050. Thus far, most reporting of GHGs has been in terms of annual inventories. Some state and local governments have already developed annual inventories. MOVES can also be used to calculate daily inventories, but this guidance does not specifically address daily inventories. (The MOVES User Guide and Technical Guidance explain how to specify different time periods for analysis.)

MOVES can be used to estimate GHG emissions and energy consumption at a variety of geographic scales: county, metropolitan area, state, or multi-state region. For example, MOVES could be used to generate a statewide or metropolitan area on-road GHG inventory. It could also be used for scenario planning or to compare GHG and energy impacts of different policy choices on a regional, state, or local level such as a metropolitan area or a county.

MOVES performs a series of calculations to estimate emissions or energy consumption for the geographic area and time frame of interest, based on information related to this specific place and time that the user inputs, or based on default information contained within the model. Emissions are estimated based on vehicle activity and emission factors. MOVES includes

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modified to be used with MOVES. Software tools to convert MOBILE6.2 inputs for MOVES are described in this guidance. See also the Appendix of this document.

emission factors for vehicles based on vehicle type, such as passenger car, passenger truck, bus, other types of trucks; vehicle age; and what the vehicle is doing at a particular moment in time, i.e., its operating mode. MOVES includes operating modes for running, start, and idle emissions. Operating modes for running emissions are based on vehicle speed as well as whether the vehicle is accelerating, decelerating, or cruising. In general, these various emission factors are multiplied by the corresponding vehicle activity (e.g., vehicle miles traveled or VMT, number of vehicle starts) to estimate emissions or energy consumption.

Because MOVES emissions are based in part on vehicle activity, MOVES can be used to assess the GHG and energy use impacts of various travel efficiency strategies, such as:

- Region-wide travel demand management e.g., rideshare programs, employer-based programs;
- Land use and smart growth strategies, e.g., transit-oriented development policies, policies to increase diversity and density of land uses;
- Transit-promoting programs, such as increased transit frequency or lower fares; and
- Pricing strategies, such as parking pricing or mileage fees.[9]

MOVES can answer these types of questions based on user information about how travel activity – such as VMT and speeds – will change as a result of the strategy.

MOVES could also be used to evaluate GHG or energy impacts of other types of strategies, such as those that affect vehicle and fuel technologies or that are designed to change the composition of the vehicle fleet. MOVES captures the effects of fleet turnover and the change in vehicle emissions and fuels over time. Note that MOVES includes vehicle and fuel technologies that are currently in widespread use. As new technologies are adopted and sufficient emissions data are developed, they will be included in future versions of MOVES.

1.4 Why use MOVES to estimate on-road GHG emissions or energy consumption instead of just using fuel sales?

Both MOVES and fuel sales are valid approaches for estimating GHG emissions and energy consumed. As stated in a recent National Cooperative Highway Research Program report:

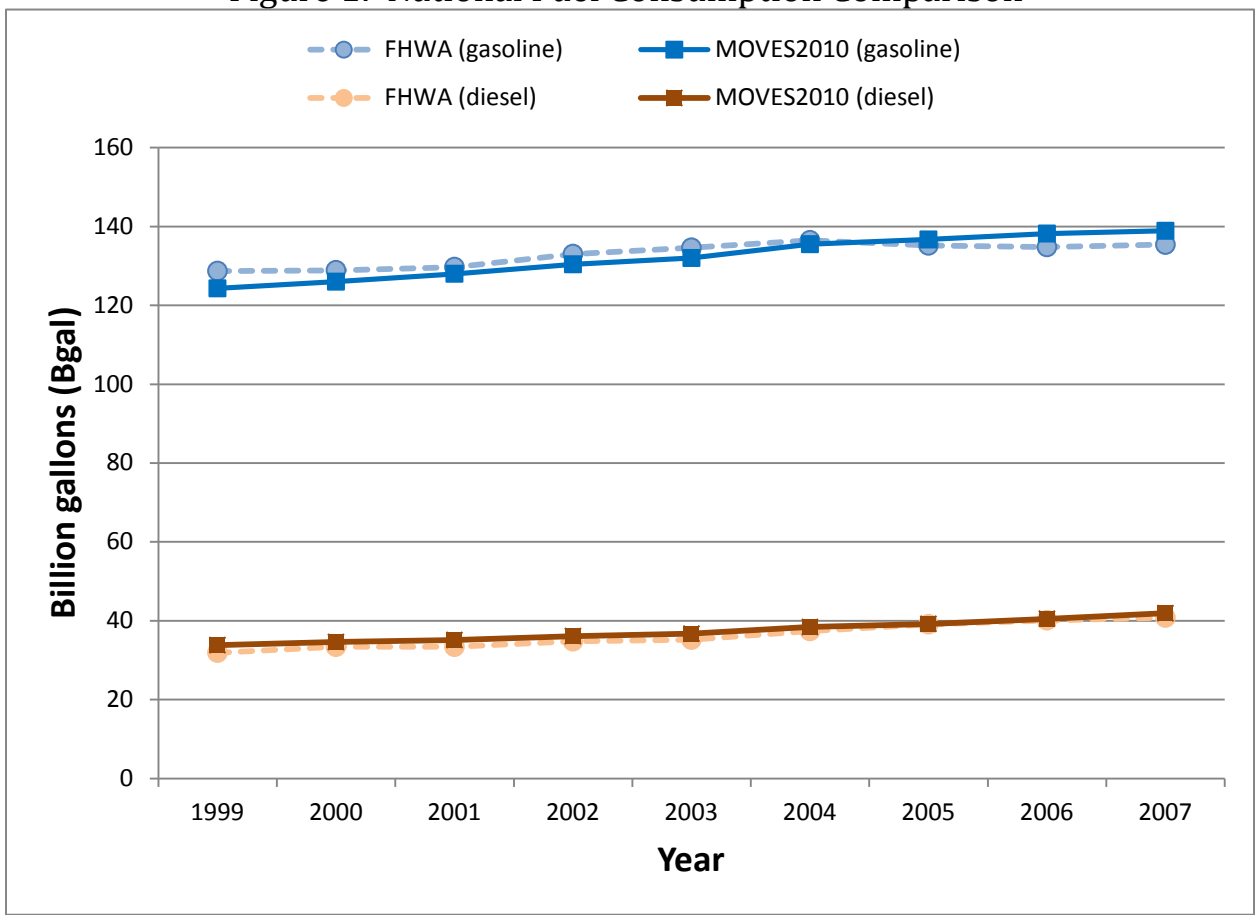
> Conceptually, there are two approaches to estimate on-road transportation GHG emissions – a fuel-based top-down approach and VMT-based bottom-up approach. The top-down approach, used in national and state GHG inventories, relies on fuel consumption by fuel type to determine emissions. The bottom-up approach, typically applied at the regional or municipal level, relies on estimates

[9] For more information about travel efficiency strategies, please see the following documents: "Potential Changes in Emissions Due to Improvements in Travel Efficiency – Final Report," EPA-420-R-11-003, March 2011, available on the web at: www.epa.gov/otaq/stateresources/policy/420r11003.pdf, and "Transportation Control Measures: An Information Document for Developing and Implementing Emission Reduction Programs," EPA-430-R-09-040, March 2011, available on the web at: www.epa.gov/otaq/stateresources/policy/430r09040.pdf.

of VMT data and fleet fuel efficiency or emission factors to calculate GHG emissions.[10]

With the fuel-based method, CO_2 produced per gallon of fuel is multiplied by the total amount of fuel sold. In contrast, MOVES produces an estimate based on travel activity multiplied by emission factors. Figure 1 shows national fuel consumption estimates based on both approaches. The dashed lines show fuel consumption estimates based on fuel sales records compiled by Federal Highway Administration (FHWA) and the solid lines show fuel consumption estimates based on MOVES2010.[11] This figure illustrates that at the national level, estimates of fuel consumption based on MOVES closely matches those based on fuel sales records.

Figure 1: National Fuel Consumption Comparison



[10] Grant, Michael, et al, NCHRP Web-Only Document 152: "Assessing Mechanisms for Integrating Transportation-Related Greenhouse Gas Reduction Objectives into Transportation Decision Making," p. 67, http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w152.pdf

[11] The information used to create this graph can be found at EPA's website at: www.epa.gov/otaq/models/moves/conference2011/validation-moves-2011.pdf. The FHWA estimates used in the comparison are found at www.fhwa.dot.gov/policyinformation/statistics.cfm. Total U.S. gasoline consumptions estimates were taken from the "total highway use" column of table MF-21. Diesel fuel consumption was estimated from the "special fuel" column of table MF-21. Note that MOVES2010a rather than MOVES2010 is the latest available emissions model at the date of this document's release.

For the nation as a whole, using fuel sales data can produce valid estimates of CO_2 and energy use for a year in the past without the effort needed to run MOVES. However, using MOVES to estimate on-road GHG emissions or energy use has several advantages:

- First, MOVES can estimate future year emissions or energy consumption more precisely because MOVES accounts for future changes in the vehicle fleet and its activity. Future year estimates of GHG emissions based on fuel sales may be based on anticipated population and demographic changes over time; some estimates may also account for fleet turnover or new technology. However, fuel based estimates may not be able to account for changes in vehicle activity. For example, projections of future fuel sales based on economic and demographic projections alone would not account for the emissions impacts of travel model projections of decreases in average vehicle speeds due to increased congestion. In contrast, MOVES is specifically designed to account for fleet turnover as well as changes in vehicle activity. Since MOVES emissions estimates depend on vehicle types, vehicle ages, vehicle activity (including speeds and operating modes), road types, and fuel types, MOVES can answer the question of how emissions would change in the future under various scenarios that affect any of these inputs. MOVES can estimate the effects of individual control measures and emission reduction strategies, or combinations of them, in any future year up to 2050.

- Second, a bottom-up GHG inventory that uses MOVES would be based on the specific transportation plans that are developed for the modeling area, for example, a metropolitan or statewide transportation plan. The bottom-up method of estimating GHG that uses MOVES allows transportation planners to analyze the effects of different planning scenarios in the modeling area. In contrast, top-down fuel sales approaches are more general estimates that do not include specific information that would allow planners to compare effects of different scenarios.

- MOVES can give a more precise estimate of GHG emissions or energy consumed because there will be some mismatch between the fuel purchased in the modeling area and the fuel used within the modeling area. At the national level, fuel sales can provide an accurate estimate of GHG emissions, but such estimates may not be as accurate for a specific state, metropolitan area, or county. Because vehicles move around and people purchase fuel without regard to geographic boundaries within the U.S., inventories based on fuel sales for these smaller geographic areas could either significantly under or overestimate GHG emissions in that area. MOVES can estimate GHG emissions or energy consumption from on-road activity within a small geographic area (e.g., a county, or portion of a county), because they would be based on user-defined vehicle activity in the area, rather than the fuel sold in the area.

- MOVES can generate better estimates of other GHGs. While CO_2 emissions can be estimated using fuel sales, this method does not work as well for other GHGs that users may want to include in their analyses: nitrous oxide (N_2O), methane (CH_4), or elemental carbon. These other GHGs are more dependent on fuel controls than fuel consumption, and thus cannot be accurately estimated based on fuel sales.

- Last, in some cases MPOs and state DOTs are already using MOVES or will need to for analyzing criteria pollutants and precursors for SIP or conformity purposes. In these areas, it may be efficient for modelers to select GHG emissions when running MOVES for these other purposes.

1.5 If we have no prior experience using MOVES, should we still use it for estimating on-road GHG emissions or energy consumption?

EPA encourages the use of MOVES for estimating on-road GHG emissions or energy consumption, even where it has not been used before. EPA believes that MOVES is the most robust tool for creating on-road GHG emission inventories and estimates of energy consumed at the state and local level, particularly when users have reliable local information to input into MOVES for the data fields where they matter most.

MOVES is a sophisticated model, and provides users with various options for analyzing emissions. Therefore, there are many details with which users will need to become familiar. However, MOVES includes a graphical user interface to help users define each MOVES run – users can make most selections for a MOVES run using a mouse, and the interface helps users structure a Run Specification. MOVES also includes data managers to facilitate entering local information into the model. As with the Run Specification interface, these data managers help users track their progress in completing inputs for the model.

MOVES can also be run with less effort by using the model's National scale, which may help new users become familiar with MOVES.[12] Section 2 provides more details about this approach, including its advantages and disadvantages.

Directions for installing MOVES can be found on EPA's website, and the MOVES User Guide can also be found there. For those who are unfamiliar with MOVES, spending a few minutes browsing through the graphical user interface once the model is downloaded may be worthwhile. EPA and FHWA also offer free classes on using MOVES; see the MOVES website for details about course offerings.

1.6 What other MOVES guidance and information is available?

Additional information about MOVES, including guidance for using MOVES for SIP and conformity purposes, can be found at EPA's MOVES website:

www.epa.gov/otaq/models/moves/index.htm.

[12] As stated in other MOVES documentation, the National scale cannot be used for preparing SIPs or transportation conformity analyses.

This website has information about upcoming MOVES training and subscribing to EPA's MOVES listserver announcements. It also hosts EPA guidance and documentation related to MOVES such as the MOVES User Guide[13] and technical and policy guidance on using MOVES for SIPs and transportation conformity determinations.[14]

In addition, these MOVES SIP and conformity guidance documents as well as transportation conformity guidance for using MOVES at the project level for PM hot-spot analyses and CO hot-spot analyses[15] can be found on EPA's transportation conformity website:

www.epa.gov/otaq/stateresources/transconf/policy.htm.

(See both "Project-Level Conformity" and "Emission Models and Conformity" headings on this page.)

EPA will continue to update MOVES in the future, and will provide additional documentation and supplementary guidance as needed. EPA encourages MOVES users to check the MOVES website regularly and subscribe to EPA's mobile source emissions model listserver (subscription information on the MOVES website) to find information about updates to MOVES and guidance for its use.

In general, this document assumes that users have a basic understanding of how to run MOVES, by for example attending MOVES training and reviewing the MOVES User Guide. As you read this guidance, please refer to the applicable sections of the MOVES User Guide for details about the operation of MOVES.

1.7 Who can I contact for more information?

Technical questions about using MOVES for estimating GHG emissions should be sent to mobile@EPA.gov.

General or policy questions related to this guidance can be directed to Laura Berry at EPA's Office of Transportation and Air Quality, berry.laura@epa.gov, (734) 214-4858.

[13] "Motor Vehicle Emission Simulator (MOVES) User Guide for MOVES 2010a," EPA-420-B-10-036, August 2010.

[14] These documents include "Technical Guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity," EPA-420-B-10-023, April 2010, and "Policy Guidance on the Use of MOVES2010 for State Implementation Plan Development, Transportation Conformity, and Other Purposes," EPA-420-B-09-046, December 2009.

[15] These documents include "Transportation Conformity Guidance for Quantitative Hot-spot Analyses in PM2.5 and PM10 Nonattainment and Maintenance Areas," EPA420-B-10-040, December 2010, and "Using MOVES in Project-Level Carbon Monoxide Analyses," EPA420-B-10-041, December 2010.

For questions regarding the application of this guidance to specific situations, please contact the mobile source expert at the appropriate EPA Regional Office. Contact information can be found at http://www.epa.gov/otaq/stateresources/transconf/contacts.htm.[16]

1.8 Does this document create any new requirements?

This document does not create any new requirements. There is no federal requirement to estimate on-road GHG emissions or energy consumption. This document does not impose legally binding requirements on EPA, DOT, states, or the regulated community, and may not apply to a particular situation based upon the circumstances. This document may be revised periodically without public notice.

[16] This website provides a list of EPA Regional transportation conformity contacts, who are familiar with MOVES. The use of MOVES for on-road GHG inventories is not subject to conformity, but since MOVES is used for both of these purposes, the EPA Regional transportation conformity contact is a good place to start if you have questions. Please be sure to indicate your question is related to GHG emissions rather than criteria pollutant emissions.

Section 2: Modeling Approaches

2.1 Introduction

Because MOVES is a flexible model that offers users an array of input and output options, there is more than one way to use MOVES to develop emissions and energy consumption estimates. This section covers some of the approaches a modeler could choose when developing an annual on-road GHG inventory or estimate of on-road energy consumption using MOVES. These approaches are combinations of decisions that affect the precision of the analysis, the number of runs that will be needed to create an annual inventory, and the degree to which additional data calculations or "post-processing" of the MOVES output will be necessary after the runs. Modelers can determine which options will best meet their needs. The discussion below is in terms of creating a GHG emissions inventory, but it also applies to estimating energy consumed.

To create an annual GHG inventory, a modeler will need to identify the GHGs of interest (see Section 3.7), the geographic area, and the year for which an inventory is to be calculated. Once these basic aspects are determined, a modeler will also need to decide how to use MOVES to go about creating this inventory. These choices are made when the user develops the MOVES Run Specification and therefore are described in Section 3, "Creating a Run Specification File." However, some of these choices are highlighted in this section:

- Whether to use County or National scale,
- Whether to have MOVES create an inventory or provide emission rates;
- Options for modeling the particular geographic area of interest; and
- Options for modeling the particular time period of interest.

In general, if a comparison of on-road GHG emissions between two cases is to be made (e.g., a comparison of two different years, or a comparison with and without a particular transportation strategy), EPA recommends that the same options for scale, calculation type, geographic area covered, and time period modeled should be used for each of those cases.

State and local agencies may already be creating inventories for criteria pollutants using MOVES, and could model GHGs as well when doing those MOVES runs. This would quantify the GHG co-benefits of programs designed to reduce emissions of criteria pollutants. But even where MOVES is used for estimating criteria pollutants, users may choose to do the modeling runs for an on-road GHG inventory separately from MOVES runs for SIP or conformity purposes, if users want to estimate a different year, area covered, or type of inventory (daily vs. annual). Estimating GHG emissions with MOVES, whether separately or in conjunction with other emissions modeling, is completely voluntary. EPA recognizes that areas may have already begun to estimate GHG inventories using a particular approach that they want to continue using. These other approaches may also be valid even if not discussed here. Please see Section 1.8 for EPA contact information if you have questions about the technical validity of a specific approach for your area.

2.2 What data are needed to run MOVES?

MOVES needs certain information about the time and place being modeled to calculate emissions, including information about VMT by vehicle type, the number of each type of vehicle in the fleet (that is, the population of vehicles), vehicle age distribution, fuel information, meteorological data, et cetera. Section 4 of this guidance describes the information that is needed and how users can enter it. Modelers can either input local data, or rely on the default database of information included in MOVES.

As with any model, the quality of the inputs affects the quality of the model's results. EPA recommends that local data be used in MOVES for GHG analyses when they are available. Including specific information about a particular state or county helps to ensure that the GHG emissions estimates from MOVES will be as accurate as possible. Where MOVES is used for SIP or transportation conformity analyses, local inputs in the format needed for MOVES may already be available.[17]

However, the MOVES database of default information may be useful in some cases. The data in the MOVES database are typically not the most current or best available for any specific county, but there are some instances where default information can be used without affecting the quality of the results. Section 4 discusses the data fields for which it would be appropriate to use default data. Default data could also be used when local data are not available.

EPA strongly encourages the use of local VMT and vehicle population data at a minimum, even when relying on default data for other inputs.[18] EPA believes these inputs have the greatest impact on the results. Local VMT and vehicle population data may already be available and prepared for use in MOVES for areas where MOVES has been used for SIP or transportation conformity analyses. If not, other sources of VMT and vehicle population data are available. For a historical year, one source of VMT data is the Federal Highway Administration's Highway Performance Monitoring System.[19] For a future year, travel activity information for a GHG analysis can be estimated using a variety of reasonable methods. For example, future VMT can be estimated by applying a growth rate to historical VMT, or with a commercially available sketch planning tool, a traditional four-step travel demand model, or a microsimulation model. For example, in EPA's Travel Efficiency Assessment Method, a sketch planning tool was used to estimate changes in travel activity that resulted from various transportation control strategies, and MOVES was then used to estimate the changes in criteria pollutant and GHG emissions that

[17] MOVES is required for use in SIPs and transportation conformity analyses in nonattainment and maintenance areas for ozone, carbon monoxide, particulate matter, and nitrogen dioxide. For a list of these areas, refer to EPA's website at: www.epa.gov/oar/oaqps/greenbk/

[18] The national default VMT data included in MOVES2010a is for the year 1999. When a future year is modeled using the National scale (see Section 2.4), MOVES applies an annual growth rate to the 1999 national VMT for the appropriate number of years. A portion of this scaled-up VMT is then allocated to the geographic area of interest. Thus EPA expects that users will always be able to find more recent and accurate VMT information than what is available within the MOVES model.

[19] For more information, see the Federal Highway Administration's website at: www.fhwa.dot.gov/policyinformation/hpms.cfm

resulted.[20] Information about vehicle population can come from a state's vehicle registration records. Section 4.4 of this document provides additional suggestions for obtaining vehicle population data.

2.3 How can the County scale be used for a GHG analysis?

EPA recommends using the County scale for GHG or energy consumption analyses covered by this guidance. The County scale facilitates entering county-specific data through the County Data Manager (covered in Section 4), which helps to ensure results that are more precise. For example, the County scale would be appropriate for creating an on-road GHG inventory that will be combined with or compared to GHG inventories for other sectors, such as industrial, commercial, and residential. The County scale is also appropriate when estimating differences that depend on detailed local data, such as comparing GHG emissions from various transportation planning alternatives in a metropolitan area. The County scale allows modelers to include local data in the input file through the County Data Manager, but if the modeler wants to use MOVES default data for some inputs, the County Data Manager can be used to export them from the MOVES database and import them into the input database. The County scale may also be preferred by experienced MOVES users already running MOVES for other purposes.

The County scale can be used to create on-road GHG inventories for an individual or multi-county area, a metropolitan area, a region of a state, an entire state, or a multi-state area or region. MOVES provides modelers with various options for analyzing emissions using the County scale, as described further below. Some combinations may be more convenient than others depending on the number of counties to be modeled.

When using the County scale, there are two choices for calculation type: "Inventory" (total emissions in units of mass), or "Emission Rates" (emissions per unit of distance for running emissions or per vehicle for starts and extended idle emissions).[21] With an Inventory approach, users input VMT and vehicle population data into MOVES and the model calculates the inventory. With the Emission Rates approach, users apply VMT and vehicle population to the emission rates that MOVES generates to calculate an inventory (although VMT and vehicle population data are still needed as inputs for an Emission Rates MOVES run). The Emission Rates option produces a look-up table of emission rates. Using "Inventory" may be preferable when the user wants to minimize post-processing steps needed; having MOVES calculate the inventory avoids errors that could be inadvertently introduced when these calculations are done outside the model. Emission Rates may be preferable when the user wants to apply emission rates as appropriate to various geographic locations. Section 3.2 provides more information.

Users have two options for defining an area when using the County scale: either "County" or "Custom Domain." Selecting "County" will mean that only one county is modeled in the run; the user chooses the particular county from a pull-down list. For a multi-county area, users

[20] For more information, see "Potential Changes in Emissions Due to Improvements in Travel Efficiency," EPA-420-R-11-003, March 2011, on the web at www.epa.gov/otaq/stateresources/policy/420r11003.pdf

[21] Note that none of the GHG pollutants result from evaporative processes, so these rates would not have to be calculated when creating an on-road GHG inventory.

selecting this choice will need to run MOVES multiple times, once for each county. Use of the County option has two advantages: it allows the user to more easily access some of the MOVES database default inputs for that county if appropriate, as described in Section 4 of this document, and it provides individual output for each county.

Selecting "Custom Domain" allows the user to define a geographic area that may consist of multiple counties, parts of counties, or combinations of counties and partial counties that can be described using a single set of inputs. When using Custom Domain, the same set of inputs -- meteorology, age distribution, average speed distribution, road type distribution, ramp fraction, fuel formulation and supply, and I/M program -- are used to describe the entire area. Using the Custom Domain option can reduce the number of MOVES runs required, but it should only be used if the entire area can be represented by a single set of inputs. When Custom Domain is selected, users do not have direct access to county-specific information in the MOVES database, but can obtain this information with some extra steps. The Custom Domain option does not produce separate output by county. Instead, it generates one set of values that apply to the entire area. Section 3.4 provides further information on County and Custom Domain.

These choices mean that there is more than one approach that a user could use when creating an on-road GHG inventory for an area made up of more than one county, such as a metropolitan area or an entire state. For example:

- Each county could be modeled individually, either with "Inventory" or with "Emission Rates," depending on the user's preference.
- The user could define the modeling area as one or more "Custom Domains." One "Custom Domain" might be appropriate for a metropolitan area; more than one may be needed to represent an entire state.
- Another option a modeler could use would be to model one county as a representative county with "Emission Rates" to generate emission rates at various temperatures. These emission rates could then be applied to a larger area, as long as fuel used in the larger area is the same as that modeled for the representative county. If methane emissions are modeled, the Inspection/Maintenance (I/M) program in the larger area also must be the same as that modeled for the representative county.

Table 2-1 summarizes the combinations of calculation type and geographic area definition that users can employ for creating GHG emissions inventories using the County scale. Any of the combinations will produce accurate results when executed correctly. The number of counties included in the area to be modeled and whether results for each individual county are needed are key considerations in choosing an approach.

Table 2-1: Summary of Modeling Approaches Using the County Scale

Geographic area to be modeled	Approach	Advantages	Considerations
one county	Use "Inventory" and "County"	• Shorter run time and smaller output files	
	Use "Emission Rates" and "County"	• Rates can be applied on a link basis if desired	• Longer run time, larger output files • Users may want to estimate start emissions with a separate run, because temperatures and number of starts vary by hour • Running, start, and extended idle rates must be post-processed to create GHG inventory
a portion of a state (e.g., a multi-county metropolitan area), or an entire state	Use "Inventory" and "County" to model each county separately	• Automatic access to MOVES default database • Produces results for each county	• An individual run is needed for each county, so this strategy is more feasible if the number of counties is small
	Use "Emission Rates" and "County" to model a representative county (or counties), and create inventories from rates with activity data for each county	• Only one run per representative county is necessary • Allows user to generate results for each county • Automatic access to MOVES default database • Rates can be applied on a link basis if desired • Better able to model an area when vehicle characterization (age distribution, fuel type, I/M) are uniform in the area, but temperatures vary widely	• Emission rates from the representative county can be used for other counties only if they have the same fuels, and if methane emissions are being modeled, the same I/M program as the representative county (i.e., a separate run is needed for each combination of fuel type and I/M program present in the area). See Section 4.9 (fuels) and Section 4.10 (I/M programs) for more information. • Users may want to estimate start emissions with a separate run because temperatures and number of starts vary by hour • Running, start, and extended idle rates must be post-processed to create GHG inventory
a portion of a state (e.g., a multi-	Use "Inventory" and "Custom Domain" to model	• Only one run per "Custom Domain" is necessary	• No automatic access to MOVES default database

Geographic area to be modeled	Approach	Advantages	Considerations
county metropolitan area), or an entire state, continued	the entire area		• The same fuels, I/M program, and temperature profile must apply throughout the area of the custom domain • Results cannot be easily disaggregated by county
	Use "Emission Rates" and "Custom Domain" to model the entire area, and create inventories from rates with activity data for each county *Note: this approach has no advantage over using "Emission Rates" and a representative county (see below)*	• Only one run per "Custom Domain" is necessary • Allows user to generate an inventory for each county, by taking the MOVES output of emission rates and multiplying them by activity data from each county • Rates can be applied on a link basis if desired	• No automatic access to MOVES default database • The same fuels and if methane emissions are modeled, same I/M program must apply throughout the area of the custom domain • A separate run is needed for start emissions (temps., number of starts vary by hour) • Running, start, and extended idle rates must be post-processed to create GHG inventory
a portion of a state (e.g., a multi-county metropolitan area), or an entire state, or a multi-state region	Use "Emission Rates" and "County" to model a representative county; model each hour as a separate temperature to get emission rates for each temperature; then create inventories from rates at the appropriate temperature with activity data for each county[22]	• Allows user to generate results for each county • Automatic access to MOVES default database	• For a multi-state area, several representative counties will need to be run to capture the combinations of fuels and I/M programs that exist • A separate run is needed for start emissions (temps., number of starts vary by hour) • Running, start, and extended idle rates must be post-processed to create GHG inventory • Users will need to use care to ensure appropriate rates are used for each county

[22] This strategy is covered in Section 4.2.1 of this guidance, and additional detail about this option can be found in the MOVES User Guide, Appendix A (Using MOVES to Generate Lookup Tables).

2.4 Can the National scale be used for a GHG analysis?

Since there is no federal requirement for GHG analysis, use of MOVES at the National scale for GHG analysis may be appropriate for some purposes, but users should understand the limitations of estimates based on the National scale. In addition, as stated elsewhere in EPA's MOVES guidance and training materials, use of MOVES at the National scale is not appropriate for SIP and conformity analysis. Use of MOVES at the County scale, in conjunction with the County Data Manager, is required for SIP and conformity analysis in order to ensure that local data are used consistent with EPA guidance to meet the Clean Air Act and federal regulations.

At the National scale, MOVES will use its default database information for the run, unless local data are entered instead. Use of local data with the National scale is optional; if none are entered the model will use default data. Users can enter data for just some inputs, and MOVES will rely on its default database for the remainder. At the County scale, the opposite is the case: the model expects that the user will supply local data for the run through the County Data Manager. Users can use the default database information, but only if they export it from the database first. With the National scale, local data are entered through the Data Importer, which is similar in structure to the County Data Manager and serves a comparable function when using MOVES at the National scale.

Since MOVES will use default data with the National scale, the National scale can be run for the entire nation or for a geographic area smaller than the entire nation: users can select one or more counties and/or states. The National scale also allows the user to model more than one year at a time. These features could make the National scale convenient for GHG analyses. In contrast, the County scale models one county at a time and one year at a time.

However, this convenience comes at a cost: relying exclusively on MOVES default database information for an analysis reduces the precision of the analysis. The default data are typically not the most current or best available information for any specific county, and users should use caution when considering the results from a MOVES run at the National scale. When the National scale is used to model counties or states, the default database information is applied to the area being modeled in different ways which affect how well the information represents the geographic area chosen. For some data fields, the national average data are used for the area as-is, such as vehicle age distributions and speed distributions; however, both vehicle age distribution and speed distribution vary across the U.S. For VMT and vehicle population ("source type population"), the national data are "scaled down" to the area using allocation factors within the model.[23] The MOVES default database includes information that varies by county for fuel and I/M program type, based on survey data at the time the model was developed, and the model will use the information it has for the specific county.

[23] The default VMT data included in MOVES2010a database is national VMT for the year 1999. When a future year is modeled using the National scale, MOVES applies an annual growth rate to the 1999 national VMT for the appropriate number of years. A portion of this scaled-up VMT is then allocated to the geographic area of interest.

As stated above, EPA strongly encourages users to input local VMT and vehicle population data when using MOVES to develop on-road GHG inventories. EPA expects that users will always have more precise local VMT information than the National scale default VMT for the area. However, users cannot enter local data for either VMT or vehicle population via the Data Importer because the model will treat this information as if it applies to the nation as a whole and produce erroneous results. Because VMT cannot be input through the Data Importer, a method to incorporate local VMT when using the National scale is described in Appendix B. This method should improve the GHG estimates obtained compared to not including local VMT. However, there is no analogous method for inputting vehicle population data when using the National scale. Thus users should expect their results to be less precise using the National scale, even when applying local VMT. If the user has local information for vehicle population, EPA recommends the use of the County scale instead of the National scale so that this important information can be included. Alternatively, users can run MOVES in Emission Rates mode at the National scale and then apply local VMT and vehicle populations outside of the model, using the same approach described in Section 2.3 for the County scale.

Although the National scale allows the user to model multiple counties or states, and more than one year, the user cannot enter more than one set of data through the Data Importer. If the user has more than one set of data, EPA recommends using the County scale. For example, if the user is modeling two states and has information about each state's vehicle age distribution or each state's speed distribution, both sets of information could not be entered for the run. In this case, the user should use the County scale, and include the information unique to each state via the County Data Manager (see Section 2.3 for various approaches). If the analysis is for more than one year and local data are entered, it will apply to all analysis years. If users have information that varies by analysis years, again, the County scale should be used.

While EPA cautions users about relying on MOVES default data because it is not the most current or best available information for any specific county, there may be instances when GHG estimates using the National scale will be sufficient for a user's purpose. For example, because the user does not have to input data, the National scale may help new users become familiar with the model. The National scale may be sufficient for users in areas that are not already using MOVES for other purposes. In addition, the National scale may be helpful for a screening analysis designed to inform more detailed subsequent analyses, or for some types of comparative GHG analyses, where the relative difference in emissions between different scenarios is more important than the precision of the absolute level of emissions. Examples of comparative analyses could include developing simple projections of GHG emissions trends over time or over different speeds, or comparing GHG emissions rates of different vehicle types (e.g., passenger cars versus passenger trucks) or different road types. If a statewide inventory is needed, the user may want to use the County scale for each county for which the user has local data, and the National scale for the rest of the counties in the state, with local VMT information applied for those counties as described in Appendix B.

In summary, the National scale with MOVES default database information produces a less precise estimate of on-road GHG emissions. Including local VMT information will improve the precision of this estimate. If in addition to VMT, the user has other local data, or the user has

data that varies by analysis year, users are encouraged to run MOVES at the County scale instead of the National scale.

2.5 Creating Annual Inventories by Modeling Various Periods of Time

MOVES provides a range of time periods that a modeler can select to create an annual on-road GHG inventory. MOVES can generate an annual GHG inventory by estimating hourly emissions individually and subsequently summing them up to produce the year's emissions, or by "pre-aggregating" data over time to estimate emissions by each day, each month, or the whole year. The level of aggregation selected can affect the precision of the analysis and the amount of time it takes to run the model.

The main reason for pre-aggregating hourly data over a longer time period such as "Year," "Month," or "Day," instead of "Hour" would be to reduce model run time. In this case, the model will compute a weighted average of some of the data that are differentiated by hour, such as VMT distributions and temperature, prior to the execution of the run. For example, if the user chooses Month, the model will average the temperature of all selected days and hours into an average Month set, and perform the simulation with these average values for the selected month or months. While pre-aggregation saves model time, it can reduce precision. For more details, see the MOVES2010 User Guide at p. 20.

Pre-aggregation does account well for hourly variations in travel activity data, because the model weights each hour's activity when it averages over the time period. However, because temperature effects are non-linear, pre-aggregation does not account as well for variations in temperatures, and some information about peak emissions at high and low temperatures will be lost. Runs using average temperatures typically produce lower emissions than runs that account for all the high and low temperatures.

EPA's general recommendation is that users consider the purpose of the analysis and how the results will be used when deciding whether to pre-aggregate and over what time period. Users will want to consider how much variation there is in their input data, how sensitive MOVES is to those inputs, and whether any control strategies being considered will affect those inputs. For example, while temperature and humidity vary over the course of a day and year, this variation may not be of concern for a particular run. At very low temperatures, elemental carbon emissions will be greater for light-duty gasoline vehicles, but this effect would be irrelevant if only CO_2 is being modeled. At high temperatures, the use of air conditioners affects fuel economy and will increase CO_2 emissions, but this effect may be less of a concern in northern states. Note that air conditioner use is not a user input, but is estimated by the model as a function of temperature and humidity.

Users should use judgment about whether pre-aggregating their MOVES GHG runs will produce output that meets their needs for precision. Users may want to do a simple sensitivity analysis to determine whether the range of temperatures that occur in the area being modeled has a significant impact on their GHG emissions inventory. There may be some applications where

precision is not as important as the general trends over time or differences between scenarios where pre-aggregation may make sense. There may also be some analyses where precision is more important, such as when an on-road GHG inventory will be combined with or compared to a GHG inventory for other source sectors.

Specific recommendations:

- If temperatures matter for a GHG inventory, EPA recommends using the default selection of Hour for the time aggregation level on the "Time Spans" panel instead of pre-aggregating over a day, month, or year. EPA recommends that users model all 24 hours in a single run to reduce the post-processing steps needed. (There is no substantial advantage to running only some and not all hours. If users do not have unique data inputs for all 24 hours of the day, users should apply the data for the hours they do have to the 24 hours of the day as appropriate. Sections 3 and 4 provide further information.) In addition to choosing all 24 hours, EPA recommends using a set of 12 average temperature and humidity profiles, each one representing a month of the year. Results will need to be aggregated appropriately (i.e., the 24-hour total emissions in each month need to be multiplied by the number of days in that month, and these 12 monthly totals summed together) to represent emissions over the entire year.

- Where temperature variations are less important in the GHG analysis, users could save time when using Inventory mode by pre-aggregating by day, month, or year, depending on the level of detail desired in the output. Pre-aggregated MOVES runs may also be useful for purposes such as approximate comparisons of GHG emissions between two different years, even if they are not accurate enough for assessing the effects of various programs or control strategies. Before using pre-aggregated MOVES output for a GHG inventory, users may want to compare results with different levels of aggregation to determine how much these differences matter based on local inputs.

- When using Emission Rates instead of Inventory, EPA recommends that the time aggregation level be set to Hour. Preaggregating time does not make sense when using Emission Rates and would produce emission rates that are not meaningful. All running and start emission rates vary with temperature, and start emission rates also vary by time of day because vehicle activity differs throughout the day. For example, the temperature may be the same at 8 am and 8 pm, but there are more starts at 8 am, and a higher fraction of those are cold starts. Thus start emission rates at 8 am will be considerably higher than at 8 pm. This variation in emission rates in different hours would be lost if the Time Aggregation Level is set to anything other than Hour.

Section 3: Creating a Run Specification File

3.1 Creating a Run Specification (RunSpec) File

Users need to set up a RunSpec file to define the place and time of the analysis as well as the vehicle types, road types, fuel types, and the emission-producing processes and pollutants that will be included in the analysis. In other words, the MOVES RunSpec defines the question you are asking. The RunSpec is a computer file in XML format that can be edited and executed directly, or that can be accessed, changed, and run through the MOVES graphical user interface.

The Navigation panel in MOVES is used to access a series of other panels that specify the parameters used for creation of the RunSpec file. The following subsections describe each set of input options needed to create the RunSpec, as defined in the Navigation panel. For a GHG inventory, the user would go down the Navigation panel and make the appropriate selections or fill in the appropriate data in each one of the following panels:

- Description
- Scale
- Time Spans
- Geographic Bounds
- Vehicles/Equipment
- Road Type
- Pollutants and Processes
- Manage Input Data Sets
- Strategies
- Output
- Advanced Performance Features

Each panel is described below and the appropriate references to the MOVES User Guide is indicated. The information below applies for all GHG and energy consumption analyses unless otherwise indicated (e.g., there are some differences between the County and National scales). Additional guidance for developing a National scale RunSpec is found in Appendix B, which describes how to include local VMT information when using the National scale.

3.1.1 Description

(MOVES User Guide Section 2.2.1)

The Description panel allows the user to enter a description of the RunSpec using up to 5,000 characters of text. Entering a complete description of the RunSpec will help users keep track of their MOVES runs. Users may want to identify key aspects to help identify the run later, such as the GHG emissions, geographic area, and time period modeled.

3.2 Selecting Scale and Calculation Type

(MOVES User Guide Section 2.2.2)

Selecting Scale on the Navigation panel in MOVES brings up the Domain/Scale and Calculation Type panel. Either the National or County scale can be used for estimating on-road GHG emissions for a county, a metropolitan area, a region of a state, or an entire state; Section 2 contains a discussion of the two scales. MOVES also provides two options for calculation type: Inventory or Emission Rates, and either option can be used, depending on the user's preference and purpose, as described in Section 2.

This guidance provides additional detail where necessary to indicate the differences that result from selecting the Inventory versus the Emission Rates option.

3.2.1 Domain/Scale

Each scale option in MOVES has its own intended purpose and the amount of data that the user must supply varies depending on the selection:

- The National scale can be used to estimate emissions for the entire country, for a state, for a group of counties, or for individual counties. At the National scale, MOVES uses information in its default database to calculate emissions for the geographic area chosen. The default data used for a county or state is based on a mix of national data, allocation factors, and pre-loaded local data. Users can also input local data using the Data Importer, if desired; see Section 4.2 for more information about the Data Importer.

- The County scale requires the user to enter data to characterize local meteorology, fleet, and activity information through the County Data Manager. The County Data Manager facilitates the input of local data and also allows the user to review county data included in the MOVES default database. The County scale will generally give more precise GHG estimates compared to the National scale. See Section 2 for more information about choosing between the National and County scale. Section 2.3 describes possible approaches for creating inventories for geographic areas comprised of multiple counties. Detailed guidance on specific inputs in the County Data Manager, including the use of default inputs, is given in Section 4 of this guidance.

- While it is beyond the scope of this guidance, the Project scale is designed to allow analysis of emissions on individual roadway links or locations where emissions from vehicles starts or extended idle activity occur. The Project scale could be used to examine GHG emissions from a specific travel facility, or to examine GHG impacts of changes that affect travel (number of trips or driving behavior) on a specific facility. This document does not cover the use of the Project scale for estimating on-road GHG emissions. EPA may offer such guidance in the future, particularly if there is interest from the user community. In the meantime, EPA has provided guidance on the use of the Project scale in MOVES for quantitative hot-spot analysis for transportation

conformity.[24] Users can refer to that guidance for information about setting up run specifications and using the Project Data Manager for Project scale MOVES runs.

Further description of the Domain/Scale panel is given in Section 2.2.2 of the MOVES User Guide.

3.2.2 Calculation Type

Under the Scale panel, MOVES gives users the option to calculate emissions either as:

- Inventory (total emissions in units of mass) or,
- Emission Rates (emissions per unit of distance for running emissions or per vehicle for starts and extended idle emissions) in a look-up table format.[25]

The selection of calculation type is required early in the RunSpec construction process because this choice affects the available options in later panels.

- If Inventory is selected, MOVES provides emissions estimates as mass, using VMT and vehicle population entered by the user. For additional guidance when using the National scale and Inventory, see Appendix B of this guidance.

- If Emission Rates is selected, MOVES provides emission rates as mass per unit of activity. The Emission Rates option produces a look-up table of emission rates that must be post-processed to produce an inventory. Even though vehicle activity would be applied outside of MOVES when developing an on-road GHG inventory using Emission Rates, vehicle activity inputs are still important because they are used by MOVES to calculate the relative amounts of running and non-running activity, which in turn affects the rates for these processes.

Users may use either approach to develop GHG emissions estimates, but should be consistent in approach when using MOVES to make control strategy comparisons. Differences in guidance for inputs when producing the emission factor output and inventory output are noted in the guidance text. Each approach has advantages and limitations; refer to Section 2.3 for the full discussion. If you select Emission Rates, you must assign a MOVESScenarioID which will be used in the rates tables. The MOVESScenarioID should be a unique identifier for the scenario for which the rates apply. Details on the use of the Emission Rates option are provided in Appendix A of the MOVES User Guide.

[24] See Section 4 of "Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas," EPA-420-B-10-040, December 2010; and "Using MOVES in Project-Level Carbon Monoxide Analyses, EPA-420-B-10-041, December 2010. Both documents are available at: www.epa.gov/otaq/stateresources/transconf/policy.htm.

[25] Evaporative emission rates would not need to be generated when using MOVES to estimate on-road GHG emissions.

3.3 Time Spans

(MOVES User Guide Section 2.2.3)

The Time Spans panel includes five sections – one to select the Time Aggregation Level, and four more to select specific years, months, days, and hours. Guidance for each of these inputs is described separately in this section. For additional guidance on selections to be made in this panel when using the National scale, see Appendix B of this guidance. For further details on the Time Spans panel, see Section 2.2.3 of the MOVES User Guide.

3.3.1 Time Aggregation Level

The Time Aggregation Level has 4 options: Year, Month, Day, and Hour, and determines the amount of pre-aggregation of input data. A longer time span will aggregate (or average) input data to create a single value for the time aggregation level chosen. For example, if the user chooses Hour, MOVES will calculate emissions for each hour of a day based on the specific inputs for that hour (e.g., temperature, speed distribution, etc.). If the user chooses Day, MOVES calculates emissions for a day based on the average of the hourly inputs for the day, e.g., a single average temperature is applied to the whole day. Likewise, if the user chooses Month or Year, MOVES will calculate emissions based on single monthly or annual average inputs, e.g., a single average temperature will be applied to a full month or year. Refer to Section 2.5 for discussion regarding when the aggregation at a level above Hour could be used for a GHG inventory.

3.3.2 Calendar Year of Evaluation

MOVES can model calendar years 1990 and the years 1999 through 2050. Note that the County scale in MOVES allows only a single calendar year in a RunSpec. Users who want to model multiple calendar years using the County scale will need to create multiple RunSpecs, with local data specific to each calendar year, and run MOVES multiple times. Users can refer to Appendix C of the MOVES User Guide to learn about batch mode operation to automate the process of doing multiple MOVES runs.

Alternatively, MOVES can model multiple calendar years when operating at the National scale.

3.3.3 Month of Evaluation

MOVES allows users to calculate emissions for any month of the year. Emissions for multiple months may be produced by a single RunSpec. The best choice for developing an annual inventory of on-road GHG emissions is to select all months. Since MOVES can model all 12 months in one run, there is no advantage to running only some months and not all of them.

When modeling multiple months (e.g., all 12), the user must be aware of how MOVES treats the input data. Fuel Supply and Meteorology can vary by month in a single RunSpec because the month is defined in the data tables used for these inputs. However, the other data fields in the County Data Manager (or CDM, described in Section 4 of this document) can be input only as a single set applied to all months selected. Therefore, if the user has, for example, Average Speed Distribution data that vary by month, the user would have to execute multiple RunSpecs to use each data set with the corresponding month.

If the user has selected the Emission Rates option, the Month can be used to input groups of temperatures as a shortcut for generating rate tables for use in creating inventories for large geographic areas. However, this is useful only for estimating running exhaust emissions, and not start or extended idle emissions. Appendix A of the MOVES User Guide and the MOVES training materials provide more details.

3.3.4 Type of Day of Evaluation

Weekdays and weekend days can be modeled separately in MOVES. MOVES provides the option of supplying different speed and VMT information for weekdays and weekend days to allow the calculation of separate emissions estimates by type of day. Average Speed Distribution, Day VMT Fraction and Hour VMT Fraction are the only inputs in the CDM that differentiate between weekdays and weekend days.

If you have separate weekend day data for speed distributions, daily VMT fractions, and/or hourly VMT fractions, then select both weekdays and weekend days and input the weekday and weekend day speed and VMT data accordingly.

However, if you have speed distributions for only one type of day, use the same information for both types of days. Doing so will make using built-in post aggregation tools easier. These tools are covered in Section 3.10.4 of this document, "Output Emission Detail". (Note that if data is input for only one type of day, and Month or Year is selected in this panel, MOVES will provide an incorrect result. The Month or Year will be the total emissions from only one day type (e.g., weekdays) in that month or year and emissions from the other day type (e.g., weekend-days) will be missing.)

For the Day VMT Fraction, users can generate the appropriate mix of VMT on each type of day with the EPA-provided Daily VMT Calculator (described in Section 4.6 of this document). If only one type of day is selected, then the day VMT fraction for that type of day can be set to one and the other type of day can be set to zero.

The Hour VMT Fraction can also differ by type of day and users can supply this information if available; however, if information is available only for a single type of day, either the default value or the user-supplied value for the single day can be used for the other type of day.

3.3.5 Hour of Evaluation

To properly estimate emissions for a day, month or year, EPA recommends that the user select all 24 hours to reduce the post-processing steps needed (see Section 2.3 for additional explanation).

Note, when the Time Aggregation Level is Day, then all 24 hours should be selected; with Month, then all 24 hours and both day types should be selected; with Year, then all 24 hours, both day types, and all 12 months should be selected. Refer to Section 2.5 for additional explanation of time aggregation level.

3.4 Geographic Bounds

(MOVES User Guide Section 2.2.4)

3.4.1 National Scale

When using the National scale, the Region section choices in the Geographic Bounds panel are "Nation," "State," and "County." As this guidance is focused on using MOVES to create state or local GHG and/or energy consumption estimates, users should choose either State or County rather than Nation. Choosing State will give the user an alphabetical list of states (plus the District of Columbia, Puerto Rico, and the Virgin Islands to select. Users can select one or multiple states at the National scale. Choosing County will give the user the list of states, and once a state is selected, a list of counties will appear. Users can select one or multiple counties at the National scale. For additional guidance on selections to be made in this panel when using the National scale, see Appendix B of this guidance.

3.4.2 County Scale

Once the County scale is selected, the Region section of the Geographic Bounds panel gives the user the choice between County or Custom Domain. Either option can be used for estimating on-road GHG emissions and the user should choose the one that is best suited for the data they have. These options are discussed in Section 2.3 and each option is explained in greater detail below.

The Geographic Bounds panel is described in Section 2.2.4 of the MOVES User Guide.

3.4.2.1 County

If users choose County, they also specify which county they are modeling in the Geographic Bounds panel. The County scale allows only one county and one calendar year to be analyzed at a time. As a result, users will need to do multiple runs of MOVES, using multiple RunSpec files, to develop emission estimates for multiple counties. Users can refer to Appendix C of the MOVES User Guide to learn about batch mode operation to automate the process of doing multiple MOVES runs.

Use of the County option has two advantages. The county option allows the user to more easily make use of some of the MOVES database default inputs for that county if appropriate, as described in Section 4 of this document. The County option also provides individual output for each county.

3.4.1.2 Custom Domain

A custom domain is a geographic area that may consist of multiple counties, parts of counties, or combinations of counties and partial counties that can be described using a single set of inputs in the County Data Manager. A custom domain uses the same meteorology, age distribution, average speed distribution, road type distribution, ramp fraction, fuel formulation and supply, and I/M program to describe the entire area. The custom domain area is described by a single RunSpec file. Using the Custom Domain option can reduce the number of MOVES runs required, if the entire area can be represented by a single set of inputs.

While the Custom Domain option allows users to more easily model multiple counties where input data are identical, MOVES treats the custom domain as a single county. When using Custom Domain with the Inventory calculation option, MOVES produces an inventory for the area and cannot disaggregate results to provide an inventory for each of the original counties that the custom domain represents.

However, when using the Emission Rates calculation option, MOVES produces a lookup table of emission rates. These emission rates can then be post-processed externally to MOVES to produce separate emissions estimates for each county by multiplying the emission rates by the appropriate source type population and VMT for each county. This combination of Custom Domain and Emission Rates can be an effective way to develop emissions estimates for a large number of areas with similar characteristics, while preserving the ability to specify the emissions within each area.

By selecting Custom Domain, users will create a generic county for which there are no data available in the default database. Therefore, users must supply data for all the tabs in the County Data Manager (see Section 4 of this document) and essentially re-create entries in the County and CountyYear tables of the default database by providing information about the area on the Geographic Bounds panel. Users can refer to these tables to find data for the counties that comprise the custom domain being created. Users must provide the following information to create new entries for the County and CountyYear tables for the custom domain:

- CountyID (e.g. a unique number to identify the domain),
- Description (e.g., the name of the custom domain),
- Geographic Phase-in Area (GPA) Fraction,
- Barometric Pressure (in inches of mercury), and
- Refueling Vapor and Spill Adjustment Factors.

The GPA is an area around the Rocky Mountains where the Federal Tier 2 sulfur control program was implemented on a delayed schedule. Users should enter 1 if the custom domain falls within the GPA and 0 if it is outside the GPA; in the unlikely event the custom domain is split, users should enter the fraction of VMT that occurs inside the GPA. The refueling Vapor and Spill Adjustment Factor terms are factors that describe the extent and effectiveness of a Stage II refueling program in the area, but have no impact on GHG emissions. Users can refer to the CountyYear table in the MOVES default database to see the default factors for the counties in the Custom Domain, or Appendix I of the MOVES User Guide.

3.4.3 Domain Input Database

In this section of the Geographic Bounds panel, which is present when the user has selected the County scale, the user can open the CDM by clicking on the "Enter/Edit Data" button (the CDM can also be accessed from the Pre-Processing Menu). The user should complete the rest of the RunSpec panels before importing data in the CDM. Users can reference Section 4 of this document for guidance on developing inputs and User Guide Section 2.3.3.4 for how to import the data files.

Users may have to hit the Refresh button to make sure the database they create appears on the drop down list.

When the National scale has been chosen, there is no Domain Input Database section in the Geographic Bounds panel.

3.5 Vehicles/Equipment: On-Road Vehicle Equipment

(MOVES User Guide Section 2.2.5)

The Vehicles/Equipment menu item and panel is used to specify the vehicle types that are included in the MOVES run. MOVES allows the user to select from among 13 "source use types" (the terminology that MOVES uses to describe vehicle types), and four different fuel types (gasoline, diesel, compressed natural gas (CNG), and electricity). Some fuel/source type combinations are not valid and therefore not included in the MOVES database (e.g., diesel motorcycles). For estimating on-road GHG emissions, users must select the appropriate fuel and vehicle type combinations in the On Road Vehicle Equipment panel to reflect the full range of vehicles that will operate in the county. In general, users should simply select all valid diesel, gasoline, and CNG (this fuel type only available for transit buses in MOVES) vehicle and fuel combinations, unless data are available showing that some vehicles or fuels are not used in the area of analysis. For more information on the relationship between source types and HPMS vehicle types, see Sections 4.4 and 4.6 of this document as well as Tables A-1 and A-2 in Appendix A of this document.

The fuel and vehicle combinations selected on this panel will be affected by the Alternate Vehicle Fuel and Technology (AVFT) panel and Fuel Supply tab of the CDM. If no changes are made on the AVFT panel, default gasoline, diesel, and CNG fractions (national defaults) will be used. If the user has local data, those different gasoline, diesel, and CNG fractions would be entered in the AVFT panel. In the Fuel Supply tab of the CDM, the user must provide valid fuel formulations that correspond to all vehicle-fuel combinations selected in the On-Road Vehicle Equipment panel. See Section 4.10 of this document for more information about the requirements for this tab.

Detailed information describing the local vehicle fleet and its activity can be entered in the CDM using the Source Type Population, Age Distribution, Vehicle Type VMT, Average Speed Distribution, and Road Type Distribution tabs. See Section 4 of this document for more information on these input options and the use of default vs. local information.

The Vehicles/Equipment panel is described in more detail in Section 2.2.5 of the MOVES User Guide.

3.6 Road Type

(MOVES User Guide Section 2.2.6)

The Road Type Panel is used to define the types of roads that are included in the run. MOVES defines five different road types:

MOVES roadtypeid	Road type	Description
1	Off-Network	locations where the predominant activity is vehicle starts, parking and idling (parking lots, truck stops, rest areas, freight or bus terminals)
2	Rural Restricted Access	rural highways that can be accessed only by an on-ramp
3	Rural Unrestricted Access	all other rural roads (arterials, connectors, and local streets)
4	Urban Restricted Access	urban highways that can be accessed only by an on-ramp
5	Urban Unrestricted Access	all other urban roads (arterials, connectors, and local streets)

Users should select the road types present in the area being analyzed. The determination of rural or urban road types should be based on the HPMS classification of the roads in the county being analyzed. Generally, all road types should be selected.

Estimates of on-road GHG emissions should include the Off-Network road type in order to account for GHG emissions from vehicle starts and extended idle activity. The Off-Network road type is automatically selected when start or extended idle pollutant processes are chosen. Off-Network activity in MOVES is primarily determined by the Source Type Population input, which is described in Section 4.4 of this document.

MOVES uses Road Type to assign default drive cycles to activity on roadtypes 2, 3, 4, and 5. For example, for unrestricted access road types, MOVES uses drive cycles that assume stop and go driving, including multiple accelerations, decelerations, and short periods of idling. For restricted access road types, MOVES uses drive cycles that include a higher fraction of cruise activity with less time spent accelerating or idling, although some ramp activity is also included.

Selection of road types in the Road Type panel also determines the road types that will be included in the MOVES run results. Different characteristics of local activity by road type are entered in the CDM using the Average Speed Distribution and Road Type Distribution importers as described in Sections 4.7 and 4.8 of this document.

The Road Type panel is described in Section 2.2.6 of the MOVES User Guide.

3.7 Pollutants and Processes

(MOVES User Guide Section 2.2.7)

In MOVES, pollutant refers to particular types of pollutants or precursors of the pollutant, such as CO_2 or N_2O, while process refers to the mechanism by which emissions are created, such as running exhaust or start exhaust. Users may want to select any of the following pollutants, depending on the purpose of their analysis:

- Primary PM_{10} – Elemental Carbon,
- Primary $PM_{2.5}$ – Elemental Carbon,[26]
- Methane (CH_4),
- Nitrous Oxide (N_2O), and
- Atmospheric CO_2.

Users can also select "CO_2 Equivalent" from the Pollutants and Processes panel.[27] The CO_2 equivalents that MOVES uses are as follows:

Pollutant	**CO2 Equivalent**[28]
CO_2	1
Methane (CH_4)	21
Nitrous Oxide (N_2O)	320

If CO_2 Equivalent is chosen, MOVES will compute the sum of CO_2 equivalent of the methane, nitrous oxide, or both, depending on what the user has selected. Elemental carbon is not included in this calculation.

Users must select all processes associated with a particular pollutant in order to account for all emissions of that pollutant. This can be done by checking the box to the left of the pollutant, which selects all of the relevant processes for that pollutant.

For many pollutants, the emissions calculation is based on a prior calculation of another pollutant. In such cases, users must select all of the base pollutants that determine a particular dependent pollutant. For example, if "Atmospheric CO2" is chosen, then "Total Energy Consumption" must also be chosen. MOVES will display warning messages in the box on the Pollutants and Processes screen until all necessary base pollutants are selected.

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[26] If you are interested in modeling elemental carbon, you can choose either "Primary PM10 – Elemental Carbon" or "Primary PM2.5 – Elemental Carbon." Since all elemental carbon is smaller than 2.5 microns, either choice will provide the same result.

[27] Based on EPA's Glossary of Climate Change Terms, the "Carbon Dioxide Equivalent" is a metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as "million metric tons of carbon dioxide equivalents (MMTCO2Eq)." The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP.
MMTCO2Eq = (million metric tons of a gas) * (GWP of the gas)
See www.epa.gov/climatechange/glossary.html

[28] This information is found in "MOVES2004 Energy and Emission Inputs, Draft Report," EPA420-P-05-003, March 2005, found on EPA's website at: www.epa.gov/otaq/models/ngm/420p05003.pdf

Note that if the pollutant methane is chosen, the user will be prompted to select "Total Gaseous Hydrocarbons." However, evaporative processes – "Evap Permeation," "Evap Fuel Vapor Venting," and "Evap Fuel Leaks" – do not need to be selected when modeling methane because methane is a result of combustion. Ensuring that evaporative processes are not selected will save run time.

The Pollutants and Processes panel is discussed in Section 2.2.7 of the MOVES User Guide.

3.8 Manage Input Data Sets

(MOVES User Guide Section 2.2.8)

Most analyses will not use the Manage Input Data Sets panel.

This panel allows users to create alternate data tables that are used in place of data from the MOVES default database. For GHG analyses in MOVES, the County Data Manager at the County scale and the Data Importer at the National scale serve the same function. However, if the user wishes to enter additional data about the area being analyzed that is not one of the input requirements in the CDM or Data Importer, then the data could either be included in the generic importer or referenced in this panel. Users should consult with EPA before using the Manage Input Data Sets panel to input other additional data.

The Manage Input Data Sets panel is described in Section 2.2.8 of the MOVES User Guide.

3.9 Strategies

(MOVES User Guide Section 2.2.9)

The Strategies option in the Navigation panel provides access to three additional panels – Alternative Vehicle Fuels and Technologies, On-Road Retrofit, and Rate of Progress. The Rate of Progress panel applies only to SIP analyses in certain ozone areas; as it is not applicable to GHG inventories, it is not covered in this guidance.[29]

Applying different control strategy options using these panels is described in Section 2.2.9 of the MOVES User Guide.

3.9.1 Alternative Vehicle Fuels and Technologies

The AVFT panel is used to adjust the fraction of VMT from gasoline, diesel, and alternative fuel vehicles by MOVES source type and model year. In other words, the AVFT panel allows users to define the split between diesel, gasoline, CNG, and electricity, for each vehicle type and model year.[30]

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[29] For more information about the Rate of Progress panel, see "Technical Guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity," EPA-420-B-10-023, April 2010, available on the web at www.epa.gov/otaq/models/moves/420b10023.pdf.

[30] In MOVES2010a, the only vehicles that can be fueled by CNG are transit buses; however, future versions may include other fuels and vehicle technologies for other source types. Please check the user guide and other appropriate documentation for the version of the model you are using to understand any changes from the previous versions.

The AVFT panel takes the place of the "Diesel Fraction" and "NGV fraction" commands in MOBILE6.2. However, the MOBILE6.2 inputs were in the form of sales fractions, while the MOVES input is in the form of activity fractions. This means the most appropriate input is the fraction of total VMT for each sourcetype and model year that is travelled by vehicles of each fuel/technology type. If a user does not have information to calculate fractions using VMT or energy, fraction of vehicle population may be used. MOVES will assume the same driving behavior for a source type, regardless of fuel or technology (e.g., the same average speed and road type distributions).[31]

Users can rely on the default split between diesel, gasoline, CNG, and electricity, unless they have other information. For transit buses, the default is that some activity will be gasoline, some diesel, and some CNG. However, if users have detailed local information, they can modify the information on this panel. For example, if the transit bus fleet in the area being modeled is entirely CNG, then the user would go to this panel and assign 100% of the transit bus activity to CNG (i.e., a "1"), and assign a zero for gasoline and diesel transit bus activity.

Note that if the user relies on the model's default allocation of vehicle activity, some portion of the transit bus activity is always assumed to be CNG. This is true even if the combination of "CNG Transit Bus" is not selected in the On Road Vehicle Equipment panel. That is, the if user selects only gasoline and diesel vehicles in the On Road Vehicle Equipment panel, MOVES still assumes some transit bus VMT is from CNG buses. If there are no transit buses fueled by CNG in the modeling area, the user needs to allocate zero activity to CNG transit buses in the AVFT panel to get correct results for transit buses. Otherwise, some VMT will be allocated to CNG transit buses and the emissions associated with this VMT not included in the output (as only gasoline and diesel vehicles were selected in the On Road Vehicle Equipment panel).

Similarly, users should be aware that the fractions entered in the AVFT panel have implications for the On Road Vehicle Equipment panel (see Section 3.5) and the Fuel Supply information entered in the County Data Manager (see Section 4.10.2). Any fuel or engine technology for which the AVFT fraction entered is greater than 0 must be selected in the On Road Vehicle Equipment panel, otherwise the fraction of VMT allocated to the portion of the vehicle fleet that operates with this fuel or engine technology, and the associated VMT, will not be included in the run and the results will be incorrect. With respect to the data input in the Fuel Supply tab of the CDM, a fuel formulation must be supplied for all vehicle-fuel combinations selected in the On-Road Vehicle Equipment and AVFT panels. Please refer to Section 4.10.2 of this document for more detail.

Users can also refer to Appendix F of the MOVES User Guide for an example application of the AVFT to simulate the GHG effects of different future fuel economy standards.[32]

[31] If the user has information detailing distinct driving behavior for the different vehicle-fuel combinations, then individual RunSpecs must be conducted for each combination to capture how this will impact emissions. For example, if diesel buses have a different activity from CNG buses, they cannot be estimated in the same run.

[32] While this type of simulation is useful for GHG policy analysis, it cannot be applied in SIP or conformity analyses for criteria pollutants because fuel economy also affects hydrocarbon and sulfur emissions from the MOVES model.

When estimating on-road GHG emissions, EPA assumes no future changes in vehicle activity associated with alternate fuel or engine technologies unless those alternate fuels or technologies are required by regulation or law. EPA recommends that users follow this same approach.

3.9.2 On-Road Retrofits

MOVES currently estimates emissions from on-road vehicles only, therefore only retrofits of on-road vehicles are important in running MOVES. Pollutants for which EPA has verified specific on-road retrofit technologies include particulate matter (PM), oxides of nitrogen (NOx), hydrocarbons (HC), and carbon monoxide (CO). Therefore, this panel may be of interest only if users are estimating either methane or elemental carbon (black carbon). This panel would not be relevant for GHG analyses of CO_2 or N_2O at the time of this guidance's release. See EPA's website at www.epa.gov/cleandiesel/verification/verif-list.htm for more information about verified retrofit technologies and the pollutants for which they are verified.

Users can refer to Appendix D of the MOVES User Guide for an explanation of how to use this panel. In the future, use of the On-Road Retrofit panel will be addressed separately in an update to EPA's retrofit guidance, which will be posted at www.epa.gov/otaq/stateresources/transconf/policy.htm.[33]

3.10 Output

(MOVES User Guide Section 2.2.10)

The Output option in the Navigation panel provides access to two panels – General Output and Output Emissions Detail. In general, users can generate output in whatever form works best for their specific needs. The following subsections provide some considerations when specifying output details and format. For additional guidance on selections to be made in this panel when using the National scale, see Appendix B of this guidance.

The Output panels are described in detail in Section 2.2.10 of the MOVES User Guide.

3.10.1 Output Database

Users can create databases and name them according to personal naming conventions, but EPA recommends that users indicate that a database is an output database (such as using "_out" at the end of the output database name). Results from multiple RunSpecs can be stored in a single output database, but generally these RunSpecs should be similar in units and aggregation because, typically, the user wants to compare results (e.g., RunSpecs that are identical except that a different fuel formulation was used) or sum them (e.g., RunSpecs for multiple counties that are part of the same metropolitan area). EPA recommends that users create a new output database for RunSpecs that are considerably different from RunSpecs whose output is already stored in existing output databases. Users will also want to consider total database size when deciding which RunSpecs to store in the same output database.

[33] The current version of EPA's diesel retrofit guidance, issued June 2006 (EPA420-B-06-005), addresses the criteria pollutant reductions that result from diesel retrofits. It is based on MOBILE, and does not address GHG benefits of retrofits.

3.10.2 Unit Selection

Users are free to choose any of the mass unit selection options, but should generally choose a unit whose magnitude is appropriate for the parameters of the RunSpec so that interpretation and processing of the output is easier. For example, selecting tons in the output for a run aggregated hourly may produce emissions of "0" in the summary reporter if emissions are less than one ton. (Results can still be seen in MySQL.) For CO_2 emissions at the county level, selecting tons may be appropriate. If the National scale is used, and local VMT will be incorporated into the analysis according to Appendix B, grams may be a better choice (because you will have MOVES compute CO_2 per mile traveled). For other GHG emissions such as elemental carbon or methane, users may want to select grams.

3.10.3 Activity Output

MOVES allows the user to select multiple activity output options. These options are distance traveled, population, starts, source hours, source hours idling, source hours operating, and source hours parked. For Inventory calculations, activity output is not required, but can provide a check on whether activity was properly entered in MOVES. EPA recommends selecting "Distance Traveled," "Population," and "Starts" in its MOVES training course. For Emission Rate calculations, distance and population are reported automatically, but the values in the output are intermediate steps in the rate calculation and do not represent the true activity.

Users can refer to Section 2.2.10.1.3 of the MOVES User Guide for instructions on selections that must be made to ensure the Activity Output is produced.

3.10.4 Output Emission Detail

This panel allows the user to select the amount of detail that will be provided in the output. Having MOVES provide more detail could be useful as these results can later be aggregated by the user so that the output can be analyzed in a variety of ways. However, too much detail can lead to large output tables and longer query execution in MySQL, so users should not select the most detail for all RunSpecs. It is up to users to determine exactly what output detail is needed and care should be taken ahead of time to determine where analysis will be focused in post-processing. Once the run is executed, detail that was not selected cannot be recovered without re-running MOVES; however, MOVES execution times for runs involving only energy consumptions and/or CO_2 are fairly short, in the event that another run is needed to obtain more detail in the output. For additional guidance on selections to be made in this panel when using the National scale, see Appendix B of this guidance.

Output at the Hour level is recommended for Time unless the user is certain that emission results are not needed by time of day. As described in Section 3.3, if the user only selected a single Type of Day because the user had a single Average Speed Distribution, then selecting any time period longer than the Portion of the Week would not be appropriate.

For Location, the County scale allows only one county or custom domain to be modeled at a time, so selection of "County" is automatic. For the National scale where more than one county is selected, the user can have the output reported by "Nation," "State," or "County." If state is selected, MOVES will show the output by state but only for the counties selected. For example, if four counties in one state and five counties in another state were selected in the Geographic

Bounds panel and "State" is selected in the Output Emission Detail panel, the output for these counties will be grouped by state. For the National scale, see Appendix B for recommendations in this panel.

For the All/Vehicle Equipment Categories section, in most cases Model Year does not have to be selected. Detailing output by Fuel Type may be helpful if the AVFT was used to input activity by alternate fuel vehicles or if separate output for gasoline and diesel vehicles are needed.

For the On Road section, detail for Source Type and/or Road Type can provide useful information and users will generally want to select at least one of these to be able to differentiate light and heavy duty emissions or restricted and unrestricted roadway emissions.

Another output option is SCC, an abbreviation for Source Classification Code. EPA uses SCCs to classify different types of anthropogenic emission activities. The existing SCCs for on-road vehicles are combinations of vehicle type and road type based on the classifications used in MOBILE6.2. When SCC output is selected, MOVES internally maps emissions by source type and road type to the MOBILE6.2 equivalents and then prepares output by SCC.

3.10.4.1 Output Emission Detail in Emission Rate Calculations

When the Emission Rates option is chosen in MOVES, Road Type is automatically selected in the Output Emissions Detail panel. Users should also select Source Type when using the Emission Rates option. If Source Type is not selected, MOVES will calculate aggregate emission rates for all source types based on the VMT by source type used as an input in the RunSpec (i.e., values entered using the County Data Manager). Thus, the output emission rates would be valid only for the mix of VMT by source type used to aggregate them. When users select Source Type in Output Emissions Detail and produce a table of running emission rates by road type and source type, these emission rates can be correctly applied to VMT estimates that may have different amounts of VMT by individual source type.

When Road Type and Source Type detail are selected, MOVES produces lookup tables of emission rates by source type and road type, for each average speed bin. These emission rates are independent of the source type population, vehicle type VMT, road type distribution, and average speed distribution entered in the CDM. For running emissions, users then post-process these lookup tables outside of MOVES to apply local VMT by source type and road type to the gram per mile emission rates for each speed bin (based on local distributions of average speed). For start emissions, users would post-process the lookup tables outside of MOVES to apply local source type population information to the gram per vehicle emission rates. Additional detail on the applicability of data entered in the CDM when using the Emission Rates option is provided in the individual subsections of Section 4 of this document.

3.11 Advanced Performance Features

(MOVES User Guide Section 2.2.11)

The Advanced Performance Features panel is used to invoke features which may be used to improve the run time for long model runs by saving and reusing intermediate results. It is not

necessary for creating estimates of on-road GHG emissions. Use of these features requires knowledge of the detailed software components of the MOVES program, the inputs they require, and the outputs they produce. Users interested in these features should review Section 2.2.11 in the MOVES User Guide and the MOVES Software Design and Reference Manual.[34]

[34] The MOVES Software Design and Reference Manual can be downloaded from www.epa.gov/oms/models/moves/.

Section 4: Importing Local Data

After completion of the necessary panels to create the RunSpec, the user would then create the appropriate input database tables that will include local data. When using the County scale, the County Data Manager (CDM) is used. With the National scale, the Data Importer serves a similar function. Users that have several local data inputs are encouraged to use the County scale instead of the National scale. Refer to Section 2 for more information about the difference between the scales and when each would be appropriate for a GHG analysis.

4.1 Introduction to the County Data Manager

The CDM is a user interface developed to simplify importing specific local data without requiring direct interaction with the underlying MySQL input database, and it includes the following set of importers, each on its own tab:

- Meteorology Data
- Source Type Population
- Age Distribution
- Vehicle Type VMT
- Average Speed Distribution
- Road Type Distribution
- Ramp Fraction
- Fuel
- I/M Programs
- Generic

Each of the importers allows the user to create an import template file with required data field names and some key fields populated. The user will then edit these templates to add specific local data with a spreadsheet application or other tool, and import each data file into an input database for the run. In some importers, there is also the option to export default data from the MOVES default database in order to review it. Once the user determines that the default data are applicable to the particular analysis, or determines that the default data need to be changed and makes those changes, the user then imports that data into the input database. Details of the mechanics of using the data importers are provided in the MOVES User Guide. Guidance for the use of these importers for estimating on-road GHG emissions is given below, with the corresponding MOVES User Guide section provided for reference.

Use of the CDM is necessary when the scale is set to County. In order to complete a RunSpec at the County scale, the user must either import local data, or review and import default data for each tab in the CDM except for Ramp Fraction.

The CDM can be accessed either from the "Pre-Processing" pull-down menu at the top of the MOVES User Interface, or by selecting "Enter/Edit Data" on the Geographic Bounds panel. However, before a user can input any locality specific data, an input database must be created on

the Database tab on the Geographic Bounds panel. EPA recommends that this database name end with "_in" to indicate it is a user input database. When the database is created, MOVES keeps track of the selections made in the RunSpec at that moment. Users should be careful of making changes to the RunSpec after the Domain Input Database has been created, because this can create inconsistencies between the Domain Input Database and the rest of the RunSpec. Users should review Section 2.3.3.4 of the MOVES User Guide for more information on the RunSpec and the Domain Input Database.

4.2 Importing Local Data When Using the National Scale

As described in Section 2, the National scale could be sufficient for some types of GHG analyses. At the National scale, local data other than VMT and vehicle population can be imported to an input database for a MOVES run using the Data Importer, which has the same set of importers as the County Data Manager, each on its own tab.

When using the National scale for a smaller geographic area than the entire nation, do not use the Data Importer to import local VMT or vehicle population ("source type population") data. MOVES will treat VMT and population data entered as applying to the nation as a whole and apportion only some fraction of what is entered to the chosen geographic area, thus producing erroneous results. When using the National scale, VMT information can be included using the process described in Appendix B. In this process, the user will run MOVES to calculate an inventory, have MOVES post-process the inventory to calculate emissions rates, and then multiply those rates by the VMT in the area. Emissions resulting from vehicle starts will be included in the estimated emissions rates rather than calculated based on vehicle population. Therefore with this method, the user cannot include local information about vehicle population. If the user has both VMT and vehicle population information, EPA encourages the use of the County scale rather than the National scale so this information can be utilized by the model for a more precise estimate of emissions.

The Data Importer can be accessed from the "Pre-Processing" pull-down menu at the top of the MOVES User Interface. Users will be prompted to create an input database name on the Database tab. EPA recommends that this database name end with "_in" to indicate it is a user input database.

The remainder of Section 4 describes the panels to create an input database file in terms of the County Data Manager. Because of the similarities between the County Data Manager and the Data Importer, this information applies to the Data Importer except where otherwise noted.

4.3 Meteorology Data

(MOVES User Guide Section 2.3.3.4.1)

Local temperature and humidity data are important inputs for estimating on-road GHG emissions with MOVES. Ambient temperature and relative humidity are important for estimating GHG emissions from motor vehicles as these affect air conditioner use. MOVES requires a

temperature (in degrees Fahrenheit) and relative humidity (in terms of a percentage, on a scale from 0 to 100) for each hour selected in the Run Spec. For example, MOVES requires a 24-hour temperature and humidity profile to model a full day of emissions on an hourly basis. EPA has created a tool (available at www.epa.gov/otaq/models/moves/tools.htm) that takes minimum and maximum daily temperatures and creates an hourly temperature profile that could be used as input to MOVES. As discussed in Section 3.3, EPA recommends that users input average daily temperature profiles if they are modeling all 12 months.

Temperature assumptions used for estimating on-road GHG emissions should be based on the latest available information. Detailed local meteorological data are available from the National Climatic Data Center at www.ncdc.noaa.gov. The MOVES database also includes default average monthly temperature and humidity data for every county in the country that are based on 30 year averages from the National Climatic Data Center for the period from 1971 to 2000. These national defaults can be used for a GHG inventory, or more recent data can be used.[35] EPA recommends documenting the sources of temperature data and any methods used to adjust them to fit the requirements of MOVES, as a means of keeping track of the inputs to the analysis and to ensure that the same method can be replicated over time.

4.3.1 Meteorology Data in Emission Rate Calculations

If the Emission Rate calculation type is chosen in the RunSpec, users can enter a different temperature and humidity for each hour of the day to create an emission rate table that varies by temperature. Emission rates from a lookup table that varies by temperature can be post-processed outside of MOVES to calculate emissions for any mix of temperatures that can occur during a day. This creates the potential to create a lookup table of emission rates by temperature for the range of temperatures that can occur over a longer period of time such as a month or year from a relatively small number of MOVES runs. Appendix A of the MOVES User Guide provides more detail about how to produce emission rate lookup tables by temperature. This approach is valid only for running emissions (e.g., the emissions reported in the "rateperdistance" table of the MOVES output); non-running emissions in the "ratepervehicle" table vary both by temperature and by hour of the day.

The Meteorology Data Importer in MOVES is described in Section 2.3.3.4.1 of the MOVES User Guide.

4.4 Source Type Population

(MOVES User Guide Section 2.3.3.4.2)

Use this importer with the CDM (County scale) only. Do not use this importer with the Data Importer (National scale). MOVES will treat source type population data entered in the Data Importer as applying to the nation as a whole and apportion only some fraction of what is entered to the chosen geographic area, thus producing erroneous results. If users have information about source type population, the County scale should be used.

[35] In general, more recent temperature data is likely to be warmer, which may increase emissions because the model estimates vehicle air conditioner use based on temperature.

Source type (vehicle type) population is used by MOVES to calculate start and evaporative emissions. As stated earlier, evaporative emissions are not necessary when estimating GHG emissions. In MOBILE6.2, starts were calculated as emission factors in grams per mile. As a result, these emissions were related to VMT. However, the relationship between VMT and vehicle starts is not always consistent. Chained trips may involve multiple starts with relatively low VMT. In MOVES, start emissions are a function of the population of vehicles in an area and therefore users need to develop local data for vehicle population.

MOVES categorizes vehicles into 13 source types, which are subsets of six HPMS vehicle types in MOVES, as shown in Table 4-1. EPA believes that states should be able to develop population data for many of these source type categories from state motor vehicle registration data (e.g., passenger cars, passenger trucks, light commercial trucks, motorcycles). States may be able to obtain population data for other types of vehicles from their owners or operators: population data for intercity buses may be available from bus companies, data for transit buses may be available from local transit agencies, data for school buses may be available from school districts, and data for refuse trucks may be available from refuse haulers or local governments.

Estimating population for other source types may be more difficult. If population is not available for a particular source type, users could estimate population for that source type based on the MOVES default split of that source type within the HPMS vehicle class. In the absence of any other source of population data, users could base population estimates on the VMT estimates for a particular source type and the ratio of MOVES default population to VMT by source type. That ratio can be calculated by doing a very simple MOVES run at the national scale for the county in question, and including VMT and population in the output (a running emissions process must be selected to generate VMT). Local VMT multiplied by the ratio of default population to default VMT will give an estimate of local population based on local VMT.

Table 4-1
MOVES Source Types and HPMS Vehicle Types

Source Type ID	Source Types	HPMS Vehicle Type ID	HPMS Vehicle Type
11	Motorcycle	10	Motorcycles
21	Passenger Car	20	Passenger Cars
31	Passenger Truck	30	Other 2 axle-4 tire vehicles
32	Light Commercial Truck	30	Other 2 axle-4 tire vehicles
41	Intercity Bus	40	Buses
42	Transit Bus	40	Buses
43	School Bus	40	Buses
51	Refuse Truck	50	Single Unit Trucks
52	Single Unit Short-haul Truck	50	Single Unit Trucks
53	Single Unit Long-haul Truck	50	Single Unit Trucks
54	Motor Home	50	Single Unit Trucks
61	Combination Short-haul Truck	60	Combination Trucks
62	Combination Long-haul Truck	60	Combination Trucks

Users who have already developed population data for MOBILE6.2 vehicle types can use Table A-1 in Appendix A to assign those populations to the MOVES source types.

The Source Type Population Importer in MOVES is described in Section 2.3.3.4.2 of the MOVES User Guide.

4.4.1 Source Type Population in Emission Rate Calculations

If the Emission Rates option is used at the County scale, and Source Type is selected in the Output Emission Detail panel, MOVES will produce emission rates for start emissions by source type in terms of grams per vehicle. Total start emissions would then be calculated outside of MOVES by multiplying the emission rates by the vehicle populations for each source type. However, users will still need to enter data using the Source Type Population Importer that represents the population of vehicles in the total area where the lookup table results will be applied. This is necessary because MOVES uses the relationship between source type population and VMT to determine the relative amount of time vehicles spend parking vs. running. If the lookup table results will be applied to a large number of counties, use the total source type population for all the counties covered. The guidance in this section concerning the use of local vehicle population data applies both for generating the total population as an input to the model and for generating more geographically detailed population values to use in applying the emission rate results.

4.5 Age Distribution

(MOVES User Guide Section 2.3.3.4.3)

The age distribution of vehicle fleets can vary significantly from area to area. Fleets with a higher percentage of older vehicles will have higher emissions for two reasons. Older vehicles have typically been driven more miles and have experienced more deterioration in emission control systems. A higher percentage of older vehicles means that there are more vehicles in the fleet that do not meet newer, more stringent emission standards or CAFÉ standards. Surveys of registration data indicate considerable local variability in vehicle age distributions.

A typical vehicle fleet includes a mix of vehicles of different ages. MOVES covers a 31 year range of vehicle ages, with vehicles 30 years and older grouped together. MOVES allows the user to specify the fraction of vehicles in each of 30 vehicle ages for each of the 13 source types in the model.

For estimating on-road GHG emissions, EPA recommends and encourages states to develop age distributions that are applicable to the area being analyzed (e.g., for one or more individual counties, a state as a whole, etc.). Only one age distribution can be entered for the area being modeled, so if you have age distribution information that varies by county, you would have to do a run for each county to utilize it. An age distribution may have already been developed for SIP and conformity purposes and if so, it could also be used for estimating on-road GHG emissions. EPA has created data converters that take registration distribution input files created for MOBILE6.2 or NMIM and convert them to the appropriate age distribution input tables for MOVES. These converters are available at www.epa.gov/otaq/models/moves/tools.htm. As

users develop new data in the future, EPA recommends recording those data according to MOVES vehicle classifications and model year breakdown.

While the MOVES age distribution input asks for an age distribution by source type, EPA does not expect that detailed local age distribution data will be readily available for all 13 of these source types. If local age distribution information is not available for some source types, states can use the same age distribution for all source types within an HPMS vehicle class. For example, states could use the same age distribution for source types 31 and 32 if separate age distributions for passenger trucks and light commercial trucks are not available.

Local age distributions can be estimated from local vehicle registration data. If users are unable to acquire data to develop a local age distribution or have reason to believe that data about locally registered vehicles is not necessarily representative of that entire portion of the fleet (as may be the case with long-haul trucks), then MOVES national default age distributions can be used.[36] A set of these national default age distributions for all source types and all calendar years is available on EPA's website at www.epa.gov/otaq/models/moves/tools.htm. (Age distributions cannot be exported directly from the default database within MOVES.)

The default age distributions in MOVES are specific to each calendar year and include assumptions about changes in age distributions over time. If local registration age distributions are used, they normally should not change across calendar years. That is, regardless of what year one is considering, the same percentage of the fleet can be assumed to be zero to one year old, one to two years old, two to three years old, etc. The vehicle fleet turns over, as people replace aging vehicles, but the age *distribution* generally remains the same. When creating an on-road GHG inventory for a future year, EPA believes it is reasonable to assume, in the absence of other information, that the vehicle fleet will have the same average age in the future as it does at the time of the analysis. Therefore, users can use the current local age distribution for a future year. In other words, for future GHG inventories, users can use the latest registration age distribution information currently available.[37]

States should fully document the sources of data and methods used to develop local age distributions, as a means of keeping track of the inputs to the analysis and to ensure that the same method can be replicated over time.

It would be possible to model the effects of an accelerated vehicle retirement program on GHG emissions or energy consumption, when such programs exist in a given area. One way would be to modify the age distribution, by increasing the fraction of new vehicles and decreasing the relative fractions of the model years targeted for retirement to reflect the anticipated effect of the program on the vehicle fleet. The effect of an accelerated vehicle retirement program can also be

[36] For example, if an entire fleet of trucks belonging to a national freight company are registered in the county being modeled and these trucks operate across a larger region of the U.S., it may be more accurate to use the MOVES national default age distributions for long-haul trucks rather than the county's long-haul truck registration data. The county's data may be unduly influenced by the freight distributor's particular fleet.

[37] Note, though, that over the last few decades, the life span of vehicles has been increasing, and in some areas the average age of the fleet has increased substantially.

modeled by obtaining emissions rates output by model year, and calculating the effects of the program outside of the MOVES model using information on how vehicle activity would change by model year. Note that an accelerated vehicle retirement program would have to be quite large to have a discernable effect on fleetwide GHG emissions in MOVES. While either of these approaches could be used for a GHG analysis, it is not acceptable to assume that a future fleet will be younger than the existing age distribution when modeling emissions for SIP and conformity analyses, unless there is some enforceable mechanism to bring about this change.

The Age Distribution Importer in MOVES is described in Section 2.3.3.4.3 of the MOVES User Guide.

4.6 Vehicle Type VMT

(MOVES User Guide Section 2.3.3.4.4)

Use this importer with the CDM (County scale) only. Do not use this importer with the Data Importer (National scale). MOVES will treat vehicle type VMT data entered in the Data Importer as applying to the nation as a whole and apportion only some fraction of what is entered to the chosen geographic area, thus producing erroneous results. To include local VMT information when using the National scale, see Appendix B.

As stated in Section 2.2, EPA believes VMT is one of the inputs that have the greatest impact on the results of a state or local GHG or energy consumption analysis. MOVES estimates emissions based on travel activity multiplied by emission factors. MOVES will multiply the VMT from each vehicle source type, on each road type, by the corresponding emission factors to generate an emissions inventory.[38] Regardless of whether Inventory or Emission Rates is chosen as the calculation type, MOVES will need VMT by hour for each vehicle source type and road type. If you have this level of detail, it is included within this input. However, if all you have is the annual VMT by HPMS vehicle class, you can enter it and rely on MOVES to allocate it by month, type of day, and hour of the day.

Within this input, there are four components that the user can enter. First, MOVES needs annual VMT by HPMS vehicle type for the year being modeled. Of the four components, this is the one for which no default exists at the County scale. Second, MOVES needs the month fraction – for each source type, what fraction of the annual VMT occurs in each month. Third, MOVES needs the fraction of VMT that occurs on each type of day, i.e., weekday and weekend day, for each month and road type. Fourth, MOVES needs the fraction of VMT in each hour of the day, for each source type, road type, and type of day. Default fractions are available for month fraction, type of day fraction, and hour fraction.

Given that there is no default VMT available at the County scale, the user needs a VMT estimate for the area being modeled. Travel demand forecasting models are often the source of information used by MPOs and state DOTs to estimate VMT. Transportation modelers for MPOs and state DOTs traditionally adjust estimates of VMT generated by travel demand models to the HPMS estimates of VMT and/or other locally developed actual vehicle counts. These

[38] This is true even when the calculation type is Emission Rates.

procedures ensure that travel demand models generate VMT estimates consistent with ground counts for roadway functional classes within HPMS for use in SIP and conformity analyses. If available, these VMT estimates could be used for estimating on-road GHG emissions as well. Section 3, "Developing Locality-Specific Inputs from Travel Demand Models," of the EPA document, "Volume IV: Chapter 2, Use of Locality- Specific Transportation Data for the Development of Mobile Source Emission Inventories," (September 1996), discusses how to reconcile traffic demand model results with HPMS VMT estimates. In areas without such a model, VMT can be estimated using other appropriate methods. Other information or procedures, such as locally developed count-based programs, may be acceptable.

MOVES requires *annual* VMT by HPMS vehicle class; however, users may have only daily VMT. EPA has created a tool that allows users to input average annual daily VMT as well as monthly and weekend day adjustment factors to create the annual VMT by HPMS class and appropriate monthly and daily adjustments needed by MOVES.[39] EPA has also created a set of software tools that can import VMT tables by MOBILE6.2 vehicle types (either 8, 12, 16, or 28 MOBILE6.2 vehicle types) and facility types, as well as MOBILE6.2 hourly VMT fractions, VMT mix, and ramp fractions and convert these to the equivalent MOVES tables of VMT by HPMS class, VMT fractions by hour, and road type distribution.[40]

Mapping MOBILE6.2 vehicle types to their equivalent MOVES source types is a complex process. Table A.2 in the Appendix shows the mapping scheme the converter tools use to convert VMT by MOBILE6.2 vehicle types to their equivalent MOVES source types. To avoid data errors, EPA strongly encourages states to use the converter tools to create the appropriate MOVES input tables from MOBILE6.2 data rather than manually apply the values in this table.

The Vehicle Type VMT Importer in MOVES is described in Section 2.3.3.4.4 of the MOVES User Guide.

4.6.1 Vehicle Type VMT in Emission Rate Calculations

If the Emission Rates option is used, and Source Type is selected in the Output Emission Detail panel, MOVES will produce emission rates for running emissions by source type and road type in terms of grams per mile. Total running emissions would then be calculated outside of MOVES by multiplying the emission rates by the VMT for each source type and road type. However, users will still need to enter data using the Vehicle Type VMT Importer that reflects the VMT in the total area where the lookup table results will be applied. This is necessary because MOVES uses the relationship between source type population and VMT to determine the relative amount of time vehicles spend parked vs. running. If the lookup table results will be applied to a large number of counties, use the total VMT for all the counties covered. The guidance in this section concerning the use of local VMT data applies both for developing the

[39] This spreadsheet-based tool is called "AAD VMT Calculator HPMS" and can be found at www.epa.gov/otaq/models/moves/tools.htm. Instructions for use of the VMT calculator can be found within the spreadsheet.

[40] EPA's Tools for MOVES website (www.epa.gov/otaq/models/moves/tools.htm) includes 8 different VMT spreadsheet-based converters to address ways VMT could be broken down by MOBILE6.2 vehicle types and facility types. The website describes the basic differences between the converters, and more detailed instructions on their use can be found within the spreadsheets.

total VMT to input and for developing the geographically detailed VMT to use when applying the emission rates.

4.7 Average Speed Distribution

(MOVES User Guide Section 2.3.3.4.5)

Vehicle power, speed, and acceleration have a significant effect on vehicle emissions, including GHG emissions. MOVES models those emission effects by assigning activity to specific drive cycles. While direct input of operating modes and drive schedules is possible using Project scale inputs, the model also can use the distribution of vehicle hours traveled (VHT) by average speed to determine an appropriate operating mode distribution. Thus, for estimating on-road GHG emissions where activity is averaged over a wide variety of driving patterns, a local speed distribution by road type and source type is a reasonable surrogate for more detailed local drive cycles or operating mode distributions. In these cases, states could develop and use local estimates of average speed. The Average Speed Distribution Importer in MOVES calls for a speed distribution in VHT in 16 speed bins, by each road type, source type, and hour of the day included in the analysis. EPA urges users to develop the most detailed local speed information that is reasonable to obtain. However, EPA acknowledges that average speed distribution information may not be available at the level of detail that MOVES allows. The following paragraphs provide additional guidance regarding the development of average speed distribution inputs.

Average speed, as defined for use in MOVES, is the distance traveled (in miles) divided by the time (in hours). This is not the same as the instantaneous velocity of vehicles or the nominal speed limit on the roadway link. The MOVES definition of speed includes all operation of vehicles including intersections and other obstacles to travel which may result in stopping and idling. As a result, average speeds, as used in MOVES, will tend to be less than nominal speed limits for individual roadway links.

Selection of vehicle speeds is a complex process. The recommended approach for estimating average speeds is to post-process the output from a travel demand network model. In most transportation models, speed is estimated primarily to allocate travel across the roadway network. Speed is used as a measure of impedance to travel rather than as a prediction of accurate travel times. For this reason, speed results from most travel demand models must be adjusted to properly estimate actual average speeds.

In cases where on-road emissions modeling has been done to meet SIP and conformity requirements, areas may already have developed this information for MOBILE modeling. To ease the transition from MOBILE6.2 to MOVES, EPA has provided data converters that convert MOBILE6.2 speed distribution inputs to MOVES format (an additional data converter is available to convert National Mobile Inventory Model-formatted speed distributions to MOVES format). These converters also handle the conversion of a VMT based speed distribution to a VHT based speed distribution. These data converters are available at www.epa.gov/otaq/models/moves/tools.htm. These converters can assist users in applying current vehicle speed information for MOVES inventories, if this reflects the latest available information for a given area. Over time, EPA anticipates that users will generate updated speed

information through updated travel demand modeling, rather than continuing to use data generated for the previous MOBILE6.2 model. These updated data could also be used for estimating on-road GHG emissions.

Speed is entered in MOVES as a distribution rather than a single value. Table 4-2 shows the speed bin structure that MOVES uses for speed distribution input. Section 4.7.3 of this document explains how to create a speed distribution from a single average speed. However, EPA encourages users to use underlying speed distribution data to represent vehicle speed as an input to MOVES, rather than one average value. Use of a distribution will give a more accurate estimate of emissions than use of a single average speed. This is particularly important for GHG analysis, since GHG emission rates are highest at low speeds and very high speeds. A single average speed will tend to be in the middle of the speed range where emission rates are lower, leading the analysis to underestimate GHG emissions.

Table 4-2
MOVES Speed Bins

Speed Bin ID	Average Bin Speed	Speed Bin Range
1	2.5	speed < 2.5mph
2	5	2.5mph <= speed < 7.5mph
3	10	7.5mph <= speed < 12.5mph
4	15	12.5mph <= speed < 17.5mph
5	20	17.5mph <= speed <22.5mph
6	25	22.5mph <= speed < 27.5mph
7	30	27.5mph <= speed < 32.5mph
8	35	32.5mph <= speed < 37.5mph
9	40	37.5mph <= speed < 42.5mph
10	45	42.5mph <= speed < 47.5mph
11	50	47.5mph <= speed < 52.5mph
12	55	52.5mph <= speed < 57.5mph
13	60	57.5mph <= speed < 62.5mph
14	65	62.5mph <= speed < 67.5mph
15	70	67.5mph <= speed < 72.5mph
16	75	72.5mph <= speed

As is the case for other MOVES inputs, EPA does not expect that users will be able to develop distinct local speed distributions for all 13 vehicle source types. If local average speed distribution information is not available for some source types, states can use the same average speed distribution for all source types within an HPMS vehicle class. For example, users could apply the same average speed distribution for source types 31 and 32 if separate average speed distributions for passenger trucks and light commercial trucks are not available. Users could also apply the same speed distributions across multiple HPMS vehicle classes if more detailed information is not available.

Average speed estimates for calendar years other than the calendar year on which the average speed estimates are based should be logically related to the current year methodology and

estimates, with no arbitrary or unsupported assumptions of changes in average speeds. Future average speed estimates should account for the effect of growth in overall fleet VMT on roadway congestion and average speeds.

The Average Speed Distribution Importer in MOVES is described in Section 2.3.3.4.5 of the MOVES User Guide.

4.7.1 Additional Guidance for Speeds on Local Roadways

MOVES uses four different roadway types that are affected by the average speed distribution input: rural restricted access, rural unrestricted access, urban restricted access, and urban unrestricted access. In MOBILE6.2, local roadways were a separate category with a fixed speed of 12.9 mph. In MOVES, local roadways are included with arterials and collectors in the urban and rural unrestricted access roads category. Therefore, EPA recommends that the average speed distribution for local roadway activity be included as part of a weighted distribution of average speeds across all unrestricted roads: local roadways, arterials, and connectors. Users who want to treat local roadways and arterials separately can develop separate average speed distributions and estimate results using two separate MOVES runs, each with appropriate VMT, one using the local roadway average speed distribution for unrestricted access roads and one using the arterial average speed distribution for unrestricted access roads. However, using properly weighted average speed distributions for the combination of all unrestricted access roads should give the same result as using separate average speed distributions for arterials and local roadways.

4.7.2 Average Speed Distributions in Emission Rates Calculations

If the Emission Rates option is used, and Source Type is selected in the Output Emission Detail panel, MOVES will produce a table of emission rates by source type and road type for each speed bin. Total running emissions would then be calculated outside of MOVES by multiplying the emission rates by the VMT for each source type in each speed bin. However, the CDM still requires a complete speed distribution to work, and the information provided in this input is used by MOVES to calculate the relative amounts of running and non-running activity, which in turn affects the rates for these processes. Users should supply an accurate speed distribution to produce the necessary emission rates (and at the National scale, the user could rely on the default speed distribution). The guidance in this section concerning the use of local speed distribution data still applies whether local average speed distributions are applied within MOVES using the Inventory option or outside of MOVES using the Emission Rate option.

4.7.3 Creating a Distribution from a Single Average Speed

If only a single average speed is available for a particular road type and that average speed is not identical to the average speed in a particular speed bin, users should apply the following formula for creating the appropriate speed distribution among two adjacent speed bins.

The general formula is:

VHT Fraction A in Speed Bin with closest average speed lower than observed average speed +
VHT Fraction B in Speed Bin with closest average speed higher that observed average speed = 1

VHT Fraction A = 1 – [(observed average speed – average speed of lower speed bin) / (average speed of higher speed bin – average speed of lower speed bin)]

VHT Fraction B = 1- [(average speed of higher speed bin – observed average speed) / (average speed of higher speed bin – average speed of lower speed bin)]

Or more simply: VHT Fraction B = 1 – VHT fraction A

For example, if the single average speed for a roadway is 28.7 miles per hour, the average speed distribution will be split between the 25 mph and 30 mph bins with values of 0.26 and 0.74, respectively. These values are found with the following equations:

VHT Fraction A in 25 mph Speed Bin + VHT Fraction B in 30 mph Speed Bin = 1

A = 1 – (28.7 mph Avg. Speed – 25 mph (Bin Speed)) / (30 mph Bin Speed – 25 mph Bin Speed) = 0.26

B = 1 – (30 mph Bin Speed – 28.7 mph Avg. Speed) / (30 mph Bin Speed – 25 mph Bin Speed) = 0.74,

Or more simply, B = 1 - A

4.7.4 Average Speed Distributions for Highways and Ramps

For rural and urban restricted access highways, users should enter the speed distribution of vehicles traveling on the highway only, not including any activity that occurs on entrance and exit ramps. The current version of MOVES automatically calculates a speed distribution for ramp activity based on the speed distribution of vehicles traveling on the highway.[41] Faster or slower highway speeds result in faster or slower ramp speeds calculated by MOVES. MOVES then calculates emissions for ramp activity based on this internally-calculated speed distribution for the ramps, using the appropriate distribution of operating modes related to that speed distribution, and the fraction of VHT that occurs on ramps. At this point, MOVES adds emissions for ramp activity to emissions calculated for vehicles traveling on the highway itself to get the total emissions for restricted access roads.

Section 4.9 describes the ramp fraction input and how it might be used to model ramps separately from highways. As noted in that section, even when ramps are handled separately from highways, the speed distribution entered in MOVES should be the speed distribution for the associated highways, not a ramp-specific speed distribution.

[41] The algorithm that calculates the ramp speed distribution was incorporated in MOVES2010a.

4.8 Road Type Distribution

(MOVES User Guide Section 2.3.3.4.6)

The fraction of VMT by road type varies from area to area and can have a significant effect on GHG emissions from on-road mobile sources. EPA expects states to develop and use their own specific estimates of VMT by road type. The VMT fractions by road type used in inventory modeling for estimating on-road GHG emissions should be consistent with the most recent information used for transportation planning.

For each source type, the Road Type Distribution table stores the distribution of VMT by road type (e.g., the fraction of passenger car VMT on each of the road types). EPA has created a series of VMT converters (based on different options for describing the MOBILE6.2 vehicle types), that also incorporate a road type distribution converter. These can be found at www.epa.gov/otaq/models/moves/tools.htm.

As is the case for other MOVES inputs, EPA does not expect that users will be able to develop local distributions of VMT by road type for all 13 vehicle source types. If local road type distributions are available for some, but not all source types, the same road type distribution can be used for all source types within an HPMS vehicle class. For example, users could apply the same road type distribution for source types 31 and 32 if separate average speed distributions for passenger trucks and light commercial trucks are not available. Users could also apply the same road type distribution across multiple HPMS vehicle classes if more detailed information is not available.

The Road Type Distribution Importer in MOVES is described in Section 2.3.3.4.6 of the MOVES User Guide.

4.8.1 Road Type Distributions in Emission Rate Calculations

If the Emission Rates option is used, MOVES will automatically produce a table of emission rates by road type. Running emissions would then be calculated outside of MOVES by multiplying the emission rates by the VMT on each road type for each source type in each speed bin. In that case, data entered using the Road Type Distribution Importer is ignored by MOVES. However, the CDM still requires a complete road type distribution to work. Users should supply a table with an accurate road type distribution to produce the necessary emission rates. The guidance in this section concerning the use of local road type data still applies whether local road type distributions are applied within MOVES using the Inventory option or outside of MOVES using the Emission Rate option.

4.9 Ramp Fraction

(MOVES User Guide Section 2.3.3.4.7)

The default ramp fraction on both rural restricted roads (road type 2) and urban restricted roads (road type 4) is 8% of VHT. Use of the Ramp Fraction tab is optional; the default value of 8% will be automatically applied if the user does not import local data. Users who have good local data indicating a different fraction for ramp activity should use it.

The Ramp Fraction tab imports a table that duplicates the roadtype table in the MOVES default database. The user enters the fraction of VHT on ramps for either rural restricted (road type 2) or urban restricted (road type 4) roads in the rampFraction field of this table.

When the Emission Rates option is selected, the emission factors produced for any one highway speed apply both to highways and to ramps. In other words, the emission rate for a particular highway speed should be multiplied by the total of highway and ramp VMT. These emission factors are weighted based on the fractions of VHT on the highway and on ramps. The resulting emission factors table will give rates for both highway and ramp emissions based on the highway speeds. For example, if the urban restricted highway (road type 4) average speed is 60 mph, the total highway and ramp VMT would be multiplied by the emission rate for urban restricted highways at an average speed of 60 mph.

Some users may wish to model ramp emissions separately from highway emissions. This requires two separate RunSpecs. Emissions on the highways without including ramps would be modeled by setting Ramp Fraction to 0 in the first run. Emissions on ramps would be modeled by setting Ramp Fraction to 1 in a second run. For each run, the user would input only the appropriate VMT in the Vehicle Type VMT tab (i.e., only highway VMT for the first run where the Ramp Fraction is 0, and only ramp VMT for the second where the Ramp Fraction is 1). However, the same average speed distribution, representing vehicle travel on the highway only, should be used in both runs because MOVES calculates an appropriate speed distribution for ramps based on the speed distribution on the highway (see Section 4.7.4 for more details). If in the second run where Ramp Fraction is 1, users try to enter a ramp speed distribution with the Average Speed Distribution Importer, MOVES will treat that speed distribution as if it were a highway speed distribution and use it to calculate the corresponding ramp distribution. This ramp distribution would be inappropriate because it would not reflect the user's ramp information, and would thus produce erroneous results for the run.

If users model ramps separately with this approach and use the Emission Rates option, emission rates for both the highway and ramp calculation should be based on the same speed, i.e., the speed of vehicles on the highway. For example, if the highway speed is 60 mph, highway VMT would be multiplied by the emission rate at 60 mph in the first run and ramp VMT would be multiplied by the emission rate at 60 mph in the second run. Ramp speeds should not be used in determining emission factors.

The Ramp Fraction Importer in MOVES is described in Section 2.3.3.4.7 of the MOVES User Guide.

4.10 Fuel Formulation and Supply

(MOVES User Guide Sections 2.3.3.4.8 and 2.3.3.4.9)

In general, the default database information for fuel supply and formulation can be used in a GHG analysis. Users should review the default fuel formulation and fuel supply data and make changes only where local volumetric fuel property information is available. However, for RVP the user should change the value to reflect the regulatory requirements and differences between

ethanol- and non-ethanol blended gasolines. With the exception of ethanol content, fuel properties are not likely to have a significant impact on GHG emissions.[42] Users that want information about the biofuels included in MOVES should consult the most recent version of the MOVES User Guide on the web (see Section 1.7 of this document).

4.10.1 Fuel Formulation

Users that would like more information about fuel formulation portion of the fuel panel in MOVES can refer to the MOVES SIP and conformity technical guidance.[43] The SIP and conformity guidance provides detail about each field in the fuelformulation table and highlights the characteristics users should be able to provide and where default data can be used. In addition, the Fuel Formulation Importer in MOVES is described in Section 2.3.3.4.8 of the MOVES User Guide.

4.10.2 Fuel Supply

After the fuel formulations for the area being modeled have been reviewed and/or modified, the fuel supply table can be populated. There are six fields in this table. The countyID field identifies the area being modeled; this number is 4- or 5-digits and is the FIPSstateID followed by the FIPScountyID. [44] The fuelyearID is equal to the yearID for years up to 2012; for years after 2012, the fuelyearID should remain 2012. The monthgroupID is the same as the monthID. The fuelformulationID is explained above. The marketshare is described in detail below.

The marketshare is each fuel formulation's fraction of the volume consumed in the area. The marketshare should sum to one within each fuel type, listed below:

fueltypeID	Description
1	Gasoline
2	Diesel Fuel
3	Compressed Natural Gas (CNG) Note, CNG fuel will not be in defaults; must be manually added to the fuel supply table
9	Electricity

In many cases, only gasoline and diesel fuel vehicles will be selected and therefore only these two fuel types have to be imported. Within each fuel type, multiple fuel formulations can be listed as long as the market share sums to one (e.g., three gasoline fuel formulations with market shares of 0.5, 0.4, and 0.1, and two diesel fuel formulations with market shares of 0.6 and 0.4).

If more vehicle-fuel combinations are selected on the On Road Vehicle Equipment panel (and some fraction of VMT assigned to them on the AVFT panel), then each additional fuel type must

[42] Ethanol does not have an impact on estimates of CO_2 emissions in MOVES, but users may want to quantify ethanol used when preparing a GHG inventory because ethanol is a renewable fuel.
[43] "Technical Guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity," EPA-420-B-10-023, April 2010, available on EPA's website at: www.epa.gov/otaq/stateresources/transconf/policy.htm#models.
[44] FIPS refers to the Federal Information Processing Standard, featuring standard codes used in computer systems.

also be entered. However, it should be noted that only gasoline and diesel fuels exist in the default fuelsupply table; so if other fuel types are selected and the defaults are exported from the CDM, no default alternative fuel formulations will be exported. Therefore, it is the user's responsibility to enter the fuelformulationID for the alternative fuel type in the fuelsupply table before importing.

The GHG effects of changes in the fuel mix used by vehicles can also be modeled in MOVES. While MOVES2010a does not distinguish the GHG impacts of different fuel blends (such as E10, E15 and E85), AVFT can be used to change the fraction of future vehicles using gasoline, diesel, CNG and electricity.[45] These changes will be reflected in MOVES GHG results. Note that while this type of "what-if" analysis is reasonable for GHG emissions analysis, it would not be acceptable for SIP or transportation conformity analyses without an enforceable mechanism to ensure that the anticipated change in fuel use actually occurred; please consult the relevant guidance documents.

The Fuel Supply Importer in MOVES is described in Section 2.3.3.4.9 of the MOVES User Guide.

4.11 Inspection and Maintenance Programs

(MOVES User Guide Section 2.3.3.4.10)

If a user is modeling methane emissions, and is modeling an area where an inspection and maintenance (I/M) program applies, the user should include the same I/M program inputs used for SIP and conformity analyses and should refer to Section 3.10 of the MOVES SIP and conformity technical guidance for more information. However, if a user is modeling CO_2, N_2O, and/or elemental carbon emissions only, or modeling an area where no I/M program applies, the user can skip this panel altogether.

[45] In MOVES2010a, the only vehicles that can be fueled by CNG are transit buses; however, future versions may include other fuels and vehicle technologies for other source types. For electric vehicles, MOVES assumes no emissions directly from the vehicle and does not estimate emissions from electricity generation. Please check the user guide and other appropriate documentation for the version of the model you are using to understand any changes from previous versions.

Appendix A

Table A-1: Users who have already developed population data for MOBILE6.2 vehicle types can use the following table to assign those populations to the MOVES source types.

Table A-1 Population Mapping from MOBILE6.2 Vehicle Types to MOVES Source Types				
MOBILE6.2 Vehicle Type		MOVES Source Type		
ID	Name	ID	Name	Fraction
1	LDGV	21	Passenger Car	1.00
2	LDGT1	31	Passenger Truck	0.78
		32	Light Commercial Truck	0.22
3	LDGT2	31	Passenger Truck	0.78
		32	Light Commercial Truck	0.22
4	LDGT3	31	Passenger Truck	0.78
		32	Light Commercial Truck	0.22
5	LDGT4	31	Passenger Truck	0.78
		32	Light Commercial Truck	0.22
6	HDGV2B	31	Passenger Truck	0.63
		32	Light Commercial Truck	0.37
7	HDGV3	31	Passenger Truck	0.63
		32	Light Commercial Truck	0.37
8	HDGV4	31	Passenger Truck	0.06
		32	Light Commercial Truck	0.94
9	HDGV5	31	Passenger Truck	0.06
		32	Light Commercial Truck	0.94
10	HDGV6	43	School Bus	0.04
		52	Single Unit Short-haul Truck	0.69
		53	Single Unit Long-haul Truck	0.03
		54	Motor Home	0.23
		61	Combination Short-haul Truck	0.01
11	HDGV7	43	School Bus	0.04
		52	Single Unit Short-haul Truck	0.69
		53	Single Unit Long-haul Truck	0.03
		54	Motor Home	0.23
		61	Combination Short-haul Truck	0.01
12	HDGV8A	52	Single Unit Short-haul Truck	0.90
		53	Single Unit Long-haul Truck	0.08
		61	Combination Short-haul Truck	0.02
13	HDGV8B	52	Single Unit Short-haul Truck	0.90
		53	Single Unit Long-haul Truck	0.08
		61	Combination Short-haul Truck	0.02
14	LDDV	21	Passenger Car	1.00
15	LDDT12	31	Passenger Truck	0.42
		32	Light Commercial Truck	0.58
16	HDDV2B	31	Passenger Truck	0.43

		32	Light Commercial Truck	0.57
17	HDDV3	31	Passenger Truck	0.43
		32	Light Commercial Truck	0.57
18	HDDV4	31	Passenger Truck	0.10
		32	Light Commercial Truck	0.90
19	HDDV5	31	Passenger Truck	0.10
		32	Light Commercial Truck	0.90
20	HDDV6	51	Refuse Truck	0.01
		52	Single Unit Short-haul Truck	0.72
		53	Single Unit Long-haul Truck	0.06
		54	Motor Home	0.07
		61	Combination Short-haul Truck	0.11
		62	Combination Long-haul Truck	0.03
21	HDDV7	51	Refuse Truck	0.01
		52	Single Unit Short-haul Truck	0.72
		53	Single Unit Long-haul Truck	0.06
		54	Motor Home	0.07
		61	Combination Short-haul Truck	0.11
		62	Combination Long-haul Truck	0.03
22	HDDV8A	51	Refuse Truck	0.02
		52	Single Unit Short-haul Truck	0.30
		53	Single Unit Long-haul Truck	0.02
		61	Combination Short-haul Truck	0.35
		62	Combination Long-haul Truck	0.31
23	HDDV8B	51	Refuse Truck	0.02
		52	Single Unit Short-haul Truck	0.30
		53	Single Unit Long-haul Truck	0.02
		61	Combination Short-haul Truck	0.35
		62	Combination Long-haul Truck	0.31
24	MC	11	Motorcycle	1.00
25	HDGB	43	School Bus	1.00
26	HDDBT	41	Intercity Bus	0.62
		42	Transit Bus	0.38
27	HDDBS	43	School Bus	1.00
28	LDDT34	31	Passenger Truck	0.42
		32	Light Commercial Truck	0.58

Table A-2: The following table shows the mapping scheme the converter tools use to convert VMT by MOBILE6.2 vehicle types to their equivalent MOVES source types.

Table A-2 Vehicle Miles Traveled Mapping from MOBILE6.2 Vehicle Types to MOVES Source Types				
MOBILE6.2 Vehicle Type		MOVES Source Type		
ID	Name	ID	Name	Fraction
1	LDGV	21	Passenger Car	1.00
2	LDGT1	31	Passenger Truck	0.78
		32	Light Commercial Truck	0.22
3	LDGT2	31	Passenger Truck	0.78
		32	Light Commercial Truck	0.22
4	LDGT3	31	Passenger Truck	0.78
		32	Light Commercial Truck	0.22
5	LDGT4	31	Passenger Truck	0.78
		32	Light Commercial Truck	0.22
6	HDGV2B	31	Passenger Truck	0.63
		32	Light Commercial Truck	0.37
7	HDGV3	31	Passenger Truck	0.63
		32	Light Commercial Truck	0.37
8	HDGV4	31	Passenger Truck	0.05
		32	Light Commercial Truck	0.95
9	HDGV5	31	Passenger Truck	0.05
		32	Light Commercial Truck	0.95
10	HDGV6	43	School Bus	0.03
		52	Single Unit Short-haul Truck	0.80
		53	Single Unit Long-haul Truck	0.06
		54	Motor Home	0.09
		61	Combination Short-haul Truck	0.02
11	HDGV7	43	School Bus	0.03
		52	Single Unit Short-haul Truck	0.80
		53	Single Unit Long-haul Truck	0.06
		54	Motor Home	0.09
		61	Combination Short-haul Truck	0.02
12	HDGV8A	52	Single Unit Short-haul Truck	0.88
		53	Single Unit Long-haul Truck	0.08
		61	Combination Short-haul Truck	0.04
13	HDGV8B	52	Single Unit Short-haul Truck	0.88
		53	Single Unit Long-haul Truck	0.08
		61	Combination Short-haul Truck	0.04
14	LDDV	21	Passenger Car	1.00
15	LDDT12	31	Passenger Truck	0.41
		32	Light Commercial Truck	0.59
16	HDDV2B	31	Passenger Truck	0.42
		32	Light Commercial Truck	0.58
17	HDDV3	31	Passenger Truck	0.42
		32	Light Commercial Truck	0.58
18	HDDV4	31	Passenger Truck	0.08
		32	Light Commercial Truck	0.92

19	HDDV5	31	Passenger Truck	0.08
		32	Light Commercial Truck	0.92
20	HDDV6	51	Refuse Truck	0.01
		52	Single Unit Short-haul Truck	0.55
		53	Single Unit Long-haul Truck	0.05
		54	Motor Home	0.01
		61	Combination Short-haul Truck	0.27
		62	Combination Long-haul Truck	0.11
21	HDDV7	51	Refuse Truck	0.01
		52	Single Unit Short-haul Truck	0.55
		53	Single Unit Long-haul Truck	0.05
		54	Motor Home	0.01
		61	Combination Short-haul Truck	0.27
		62	Combination Long-haul Truck	0.11
22	HDDV8A	51	Refuse Truck	0.01
		52	Single Unit Short-haul Truck	0.08
		53	Single Unit Long-haul Truck	0.01
		61	Combination Short-haul Truck	0.42
		62	Combination Long-haul Truck	0.48
23	HDDV8B	51	Refuse Truck	0.01
		52	Single Unit Short-haul Truck	0.08
		53	Single Unit Long-haul Truck	0.01
		61	Combination Short-haul Truck	0.42
		62	Combination Long-haul Truck	0.48
24	MC	11	Motorcycle	1.00
25	HDGB	43	School Bus	1.00
26	HDDBT	41	Intercity Bus	0.73
		42	Transit Bus	0.27
27	HDDBS	43	School Bus	1.00
28	LDDT34	31	Passenger Truck	0.41
		32	Light Commercial Truck	0.59

Appendix B: Including Local VMT Information Using the National Scale

B.1 Introduction

EPA strongly encourages users to use local VMT information in MOVES, even when using the National scale. As explained in Section 4, at the National scale VMT information for one or more counties or states cannot be included via the Data Importer. This is because MOVES will treat VMT entered via the Data Importer as applying to the nation as a whole rather than the geographic area chosen, and will apportion only some fraction of this VMT to the geographic area chosen, producing erroneous results.

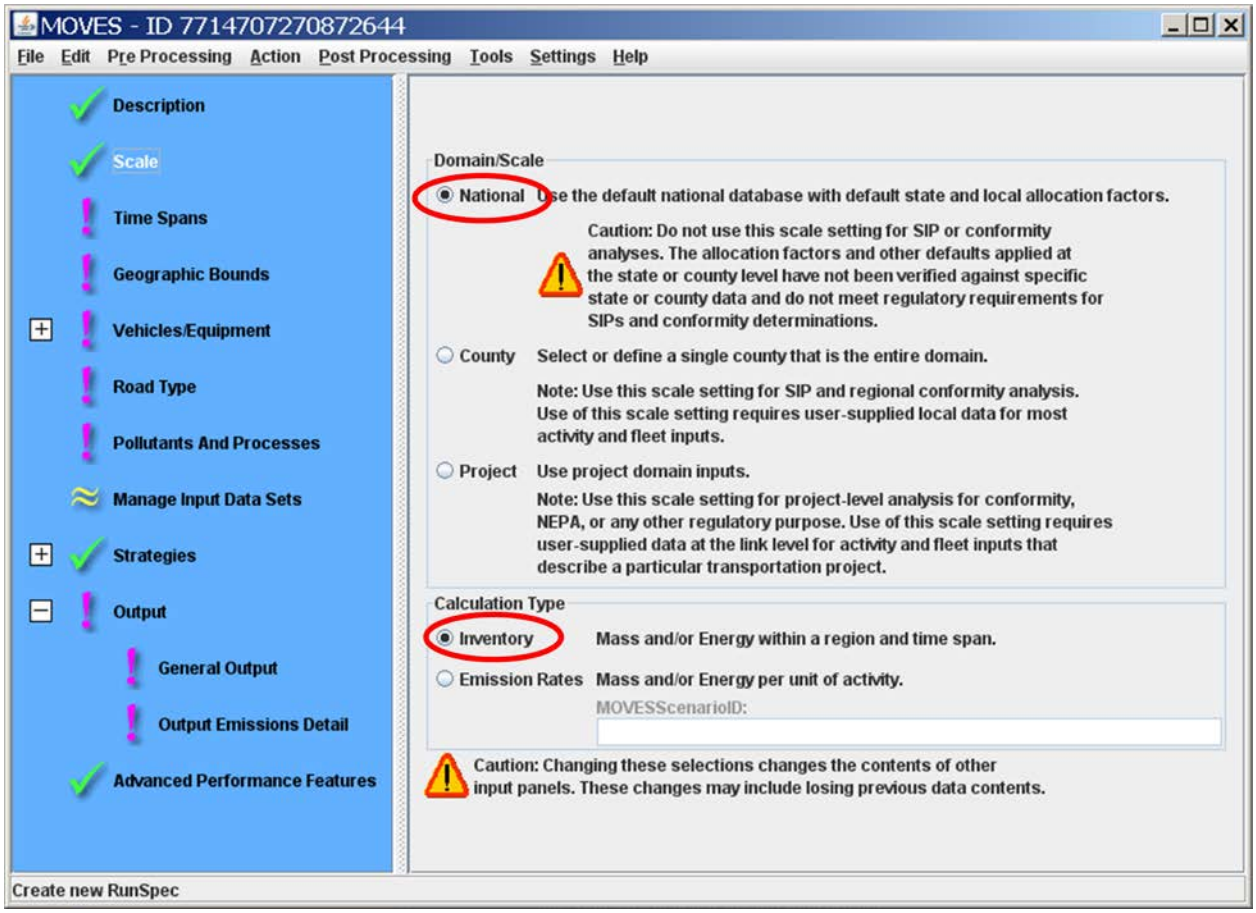
Instead, the directions given below can be used to include local VMT information when MOVES is run using the National scale. In this process, the user has MOVES calculate an inventory for the geographic area chosen. Once MOVES is executed, the user runs a "post-processing" script to have MOVES calculate one or more emissions rates from this inventory. The user then applies these emission rates to their local VMT information. EPA believes these additional steps to include local VMT information will produce a more precise estimate of GHG emissions or energy consumption than the National scale results that MOVES produces. See Section 2 for additional discussion.

B.2 RunSpec Settings

Assuming the user has chosen the National scale, the user should make certain selections in the "Scale," "Time Spans," "Geographic Bounds" and "Output" panels depending on the local VMT information that the user has, as described below. These directions are not a comprehensive guide to creating a RunSpec, which is covered in Section 3 of this document.

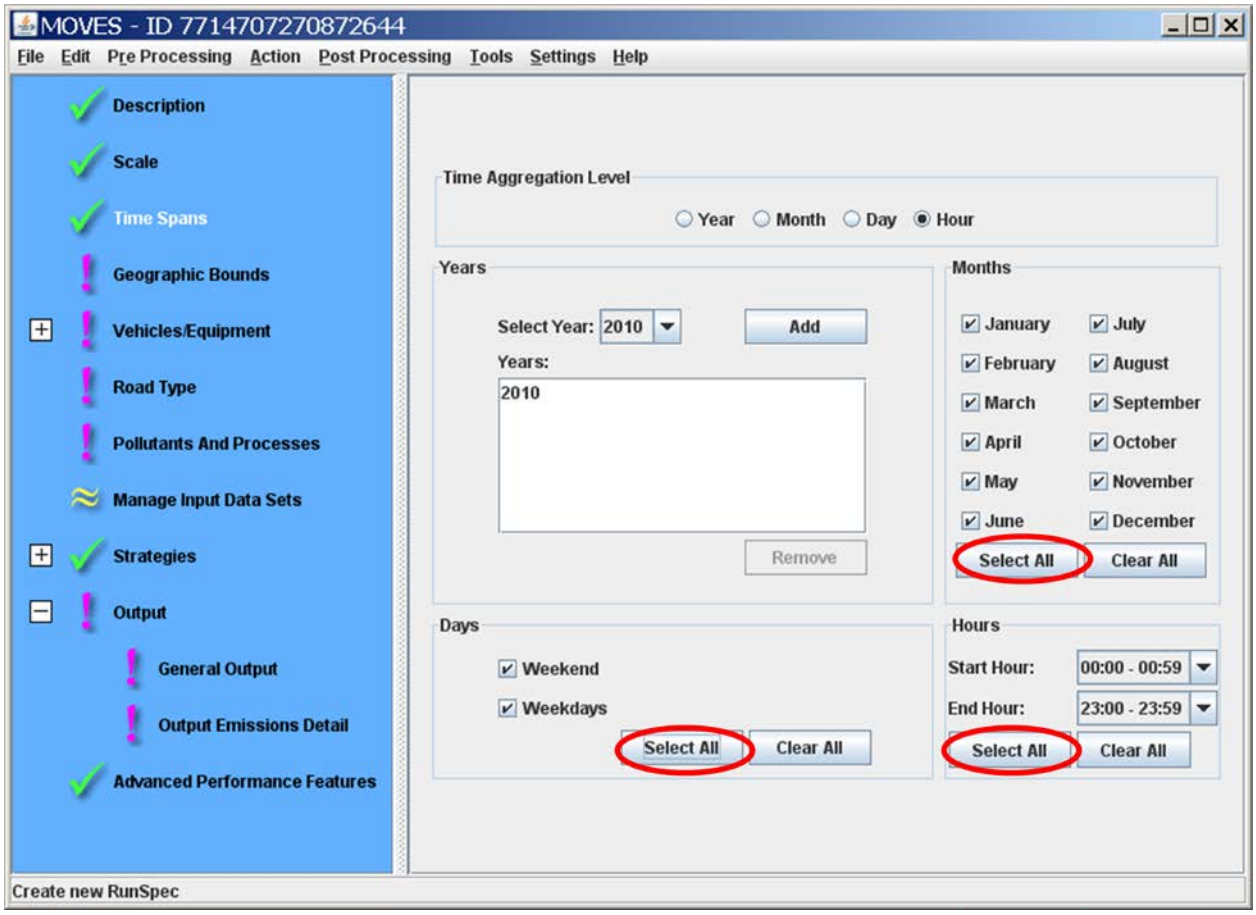
B.2.1. Scale Panel

Select “Inventory” for calculation type, as shown below.



B.2.2. Time Spans Panel

After selecting the appropriate year, and choosing a time aggregation level (see Section 2.5 for a discussion of time aggregation level), select "Months, Days, and Hours" according to the local VMT information you have. For example, if you have annual VMT for the geographic area being modeled, then select all months, all days, and all hours. These selections are shown below.



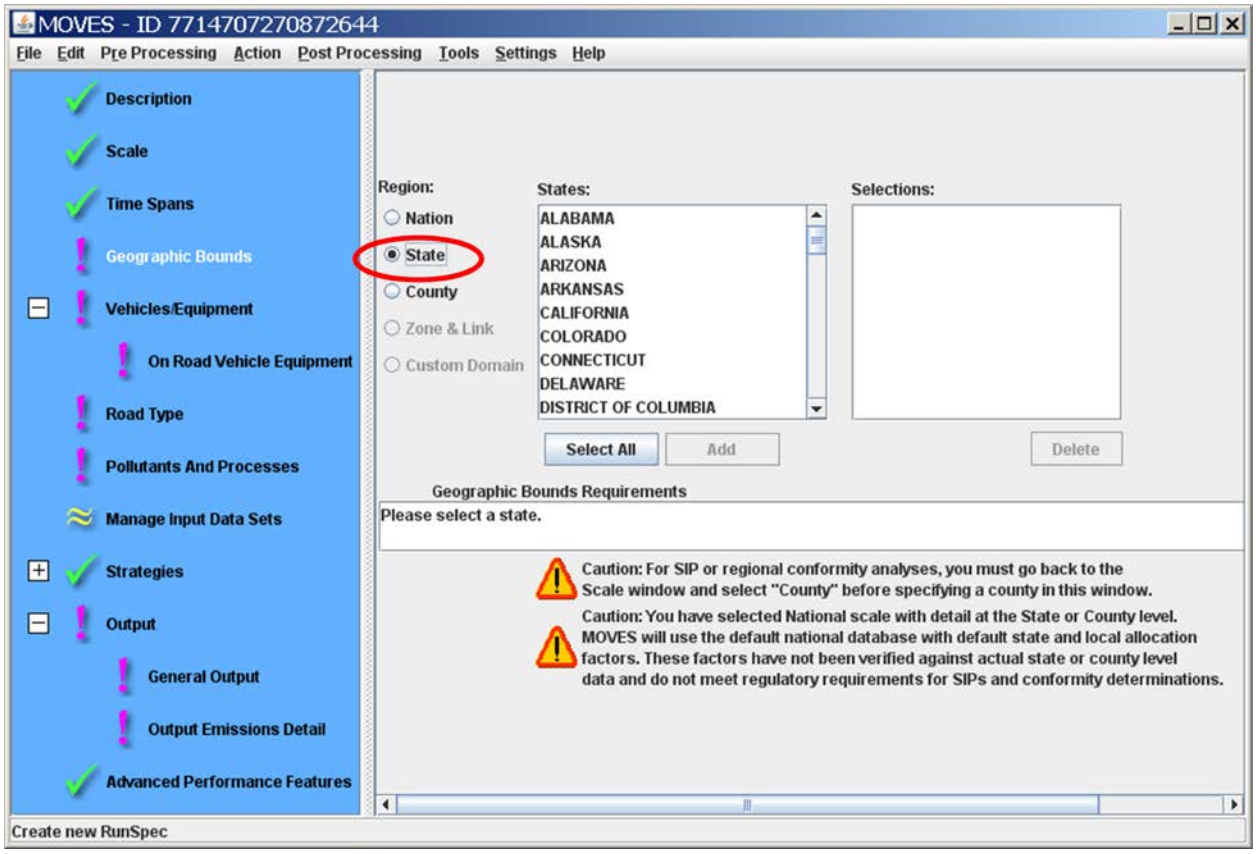
If you have local VMT data for an average day, the same selections should be made – you will need to multiply the average daily VMT by 365 days for a annual VMT number.

If you have local VMT data for a specific day such as a "typical summer day," you could select the appropriate months (e.g., June, July, and August); "Weekdays;" and all hours. The output that MOVES produces will be relevant for just the time periods selected. In this example, MOVES output will be for the weekday days in the months of June, July, and August (66 days) and additional VMT information would still be needed to create an annual inventory. If you have VMT information that varies by time period, such as by month, or type of day, or hour, EPA strongly recommends running MOVES at the County scale, to take advantage of the detail in the local data.

B.2.3. Geographic Bounds Panel

If your local VMT data differs by county, then select County in this panel. Selecting County in this panel will mean that the script will calculate an emissions rate for each county selected in the run. If your VMT data differs by state, or applies to the entire state, select State in this panel. If State is selected in this panel, the script will calculate an emissions rate for each state selected in the run. Note that the input VMT data will need to be labeled with the appropriate state and county codes, or error messages will be produced.

You will also need to select the counties or states to be modeled in this panel. The panel is shown below with "State" selected; at this point the state or states to be modeled would be selected from the menu and added to the RunSpec. If "County" were selected instead, you could choose one or more counties from one or more states.

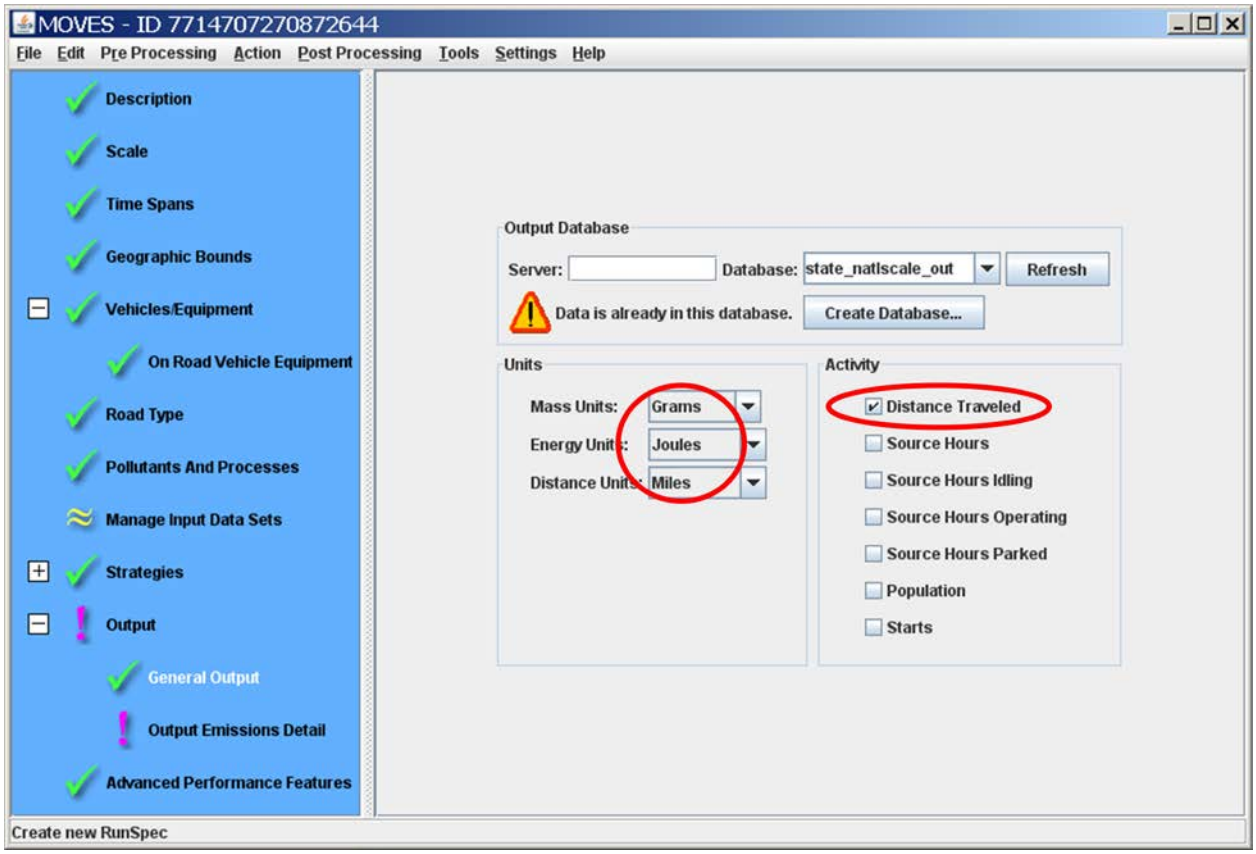


B.2.4 Output Panel

This panel includes two other panels, the General Output panel and the Output Emissions Detail panel.

General Output panel: Under "Activity," "Distance Traveled" must be selected for the post-processing script to run. You will also need to select the appropriate units (for most analyses, grams, joules, and miles are appropriate) and create an output database in this panel. Mass units of grams may be a good choice because with the post-processing script, mass units will be divided by VMT to produce an emissions rate.

The screen below shows these selections, with an output database called "state_natlscale_out." (You may want to include the name of the state or county in the output database name. EPA recommends naming output databases with "_out" at the end to identify it as an output database as noted in Section 3.10.1).

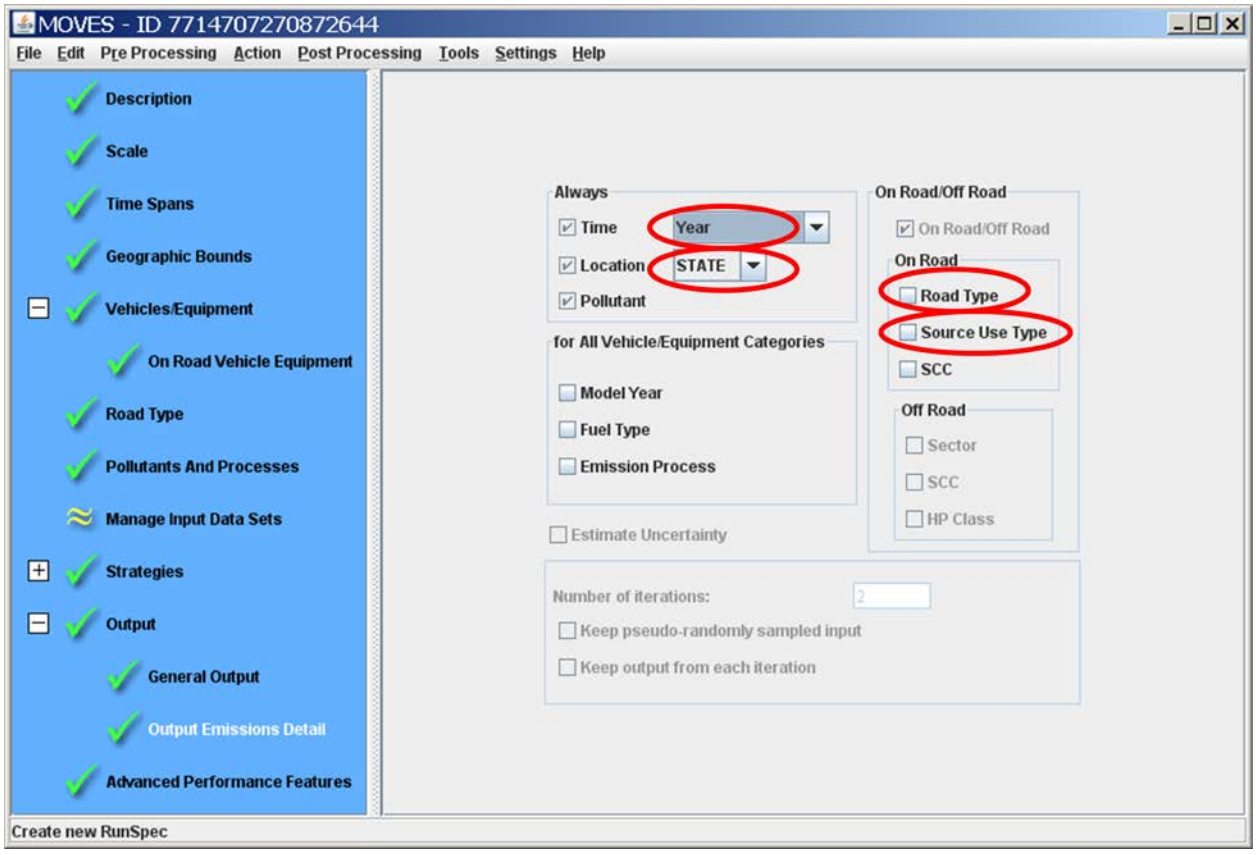


Output Emissions Detail panel: Depending on what type of detail is present in your local VMT data, you will need to make selections in the in the Output Emissions Detail panel as follows.

If local VMT data is for the entire year, then under the "Time" pull-down menu, select "Year." If your VMT data varies by day or by hour, as noted above, EPA recommends running MOVES at the County scale to take advantage of the detail in the local data instead of the National scale approach.

If local VMT data varies by state, then under the "Location" pull-down menu, select "STATE." If local VMT data varies by county, then under the "Location" pull-down menu, select "COUNTY."

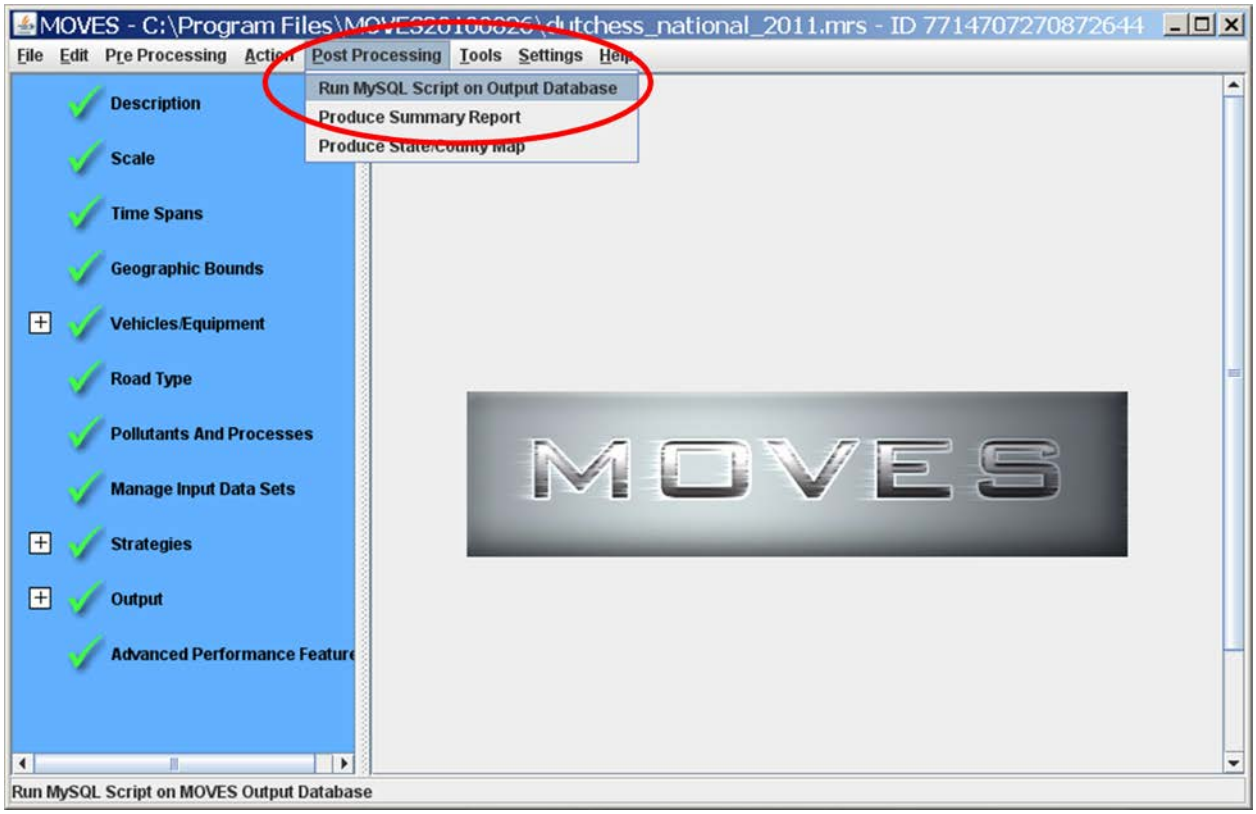
Furthermore, if local VMT data varies by road type, then select "Road Type," if it varies by vehicle type, then select "Source Use Type." Your local VMT data may not contain this level of detail, in which case you should leave them blank. The screen below highlights the fields that would vary depending on the local VMT information you have, and in this case, the local VMT data to be applied is for the entire year, for the entire state.



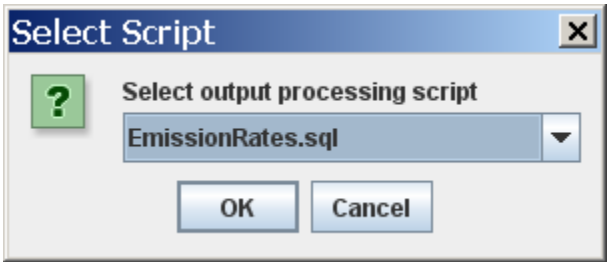
B.3 Execute the Run and Post-Process Results

When the RunSpec has been completed, go to the "Action" pull-down menu at the top of the screen and select "Execute." This will run MOVES and results will be included in the output database you specified.

Once the MOVES run has been successfully executed, go to the "Post Processing" pull-down menu at the top of the screen, and select "Run MySQL Script on MOVES Output Database."



From the list of scripts available in the pull-down menu, select the script called, "EmissionRates.sql."



After getting a message that the script has been successfully executed, open the MySQL Query Browser. In the output database created for the MOVES run, there will be a new data table

produced by the script called "movesrates." This table provides emission rates per unit of distance for the GHG emissions selected in the Pollutants and Processes panel of the RunSpec. The user can find emission rates in this data table according to what was selected in the RunSpec, and multiply these rates by the appropriate VMT. These rates will include emissions for all processes selected in the Pollutants and Processes panel in the RunSpec, expressed in units of mass per distance, regardless of whether some of these processes (e.g., starts and extended idle) are a function of distance.