Improving the Transportation Component of State Greenhouse Gas Inventories

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ABSTRACT

As a major source of GHG emissions, the transportation sector is a focus of attention for opportunities to reduce emissions. The transportation components of most state-level GHG inventories have some major limitations for transportation policy analysis. In particular, states do not typically report emissions for individual modes and vehicle types—the level of detail that is more intuitively accessible to policy makers and the public. While analysts can disaggregate on-road emissions totals by vehicle type, disaggregated estimates include error from fuel consumption estimates, VMT figures, and fuel economy figures. States can improve both the accuracy and the detail in their inventory figures by using an alternative “bottom up” approach to inventory calculation. The best tool available to produce systematic bottom-up estimates of on-road transportation GHG emissions is the MOVES model, currently under development by EPA. To further policy analysis, states should include more detailed breakdowns by mode and vehicle type, calculated using the best available data, in their transportation inventories. States should consider using “bottom up” estimation techniques, including MOVES. In the longer term, higher level guidance on transportation inventories is probably needed, especially to address the growing issue of biofuels.

INTRODUCTION

The greenhouse gas (GHG) inventory is a reporting tool used by most nations and many U.S. states to track their annual emissions of GHGs. Inventories provide detailed information on the quantity, types, and sources of emissions. They permit comparisons of emissions across geographies, time periods, and sectors. They serve as tools for disclosure and for policy development.

In the United States, interest in state inventories is growing rapidly as states move into the arena of climate policy. Many states are developing climate action plans, in which they identify specific strategies to reduce GHG emissions. The transportation sector, as one of the largest emitters of GHGs, is a primary target for reduction strategies. Transportation accounts for 28 percent of U.S. GHG emissions, and even more in some individual states. In order to credibly analyze proposed strategies, states must have detailed, accurate inventories of emissions from transportation.

While existing state inventories provide a useful basis for analysis, the transportation components of most state-level GHG inventories have some major limitations for transportation policy analysis. In particular, states do not typically report emissions for individual modes and vehicle types—the level of detail that is useful for communication with decision makers and the public. In addition, conventionally used approaches may misstate fuel consumption associated with travel activity at the state level.

A number of short- and long-term improvements could be made to state-level transportation GHG inventories. The U.S. Environmental Protection Agency (EPA) has a new tool under development, the

Motor Vehicle Emission Simulator (MOVES), which can be used to estimate GHG emissions based on travel activity data and produces detailed breakdowns of transportation emissions. Some states can use their own data to improve upon standard national datasets. In the long term, states can develop new datasets and capabilities for estimation of transportation GHG emissions.

This paper explains existing practices for state-level transportation GHG inventories. Focusing on the needs of policy analysts, it discusses challenges associated with GHG inventories and possible solutions. Finally, it provides examples of innovative practices and recommendations for potential improvements. The paper opens a dialogue for the next round of updates to GHG inventory tools and guidance.

BACKGROUND ON GREENHOUSE GAS INVENTORIES

The United Nations first adopted the greenhouse gas inventory as a tool in 1992 through the United Nations Framework Convention on Climate Change (UNFCCC).[1] The UNFCCC sought to stabilize concentrations of GHGs in the Earth's atmosphere.[2] As an essential first step, it required signatory countries to publish inventories of GHG emissions and sinks. In compliance with the UNFCCC, the U.S. Environmental Protection Agency (EPA) began publishing the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* on an annual basis. GHG inventories are now a standard product for most nations and U.S. states.

The official U.S. Inventory contains historical data for each year since 1990. Emissions are presented for the United States as a whole within the following sectors: energy; industrial processes; agriculture; waste; and land use, land change, and forestry. Energy is further broken down into end-use sectors, of which transportation is one. The *Inventory* serves as a focal point for gathering and sharing information on U.S. GHG emissions both within the US and internationally.

EPA initiated the State and Local Climate Change Program (SLCCP) in 1992 to build capacity in state and local governments and encourage them to take action to reduce GHG emissions. The SLCCP encouraged states to prepare their own GHG inventories. State GHG inventories would foster the eventual development of comprehensive climate change policies and strategies and help states identify opportunities to reduce emissions.[3]

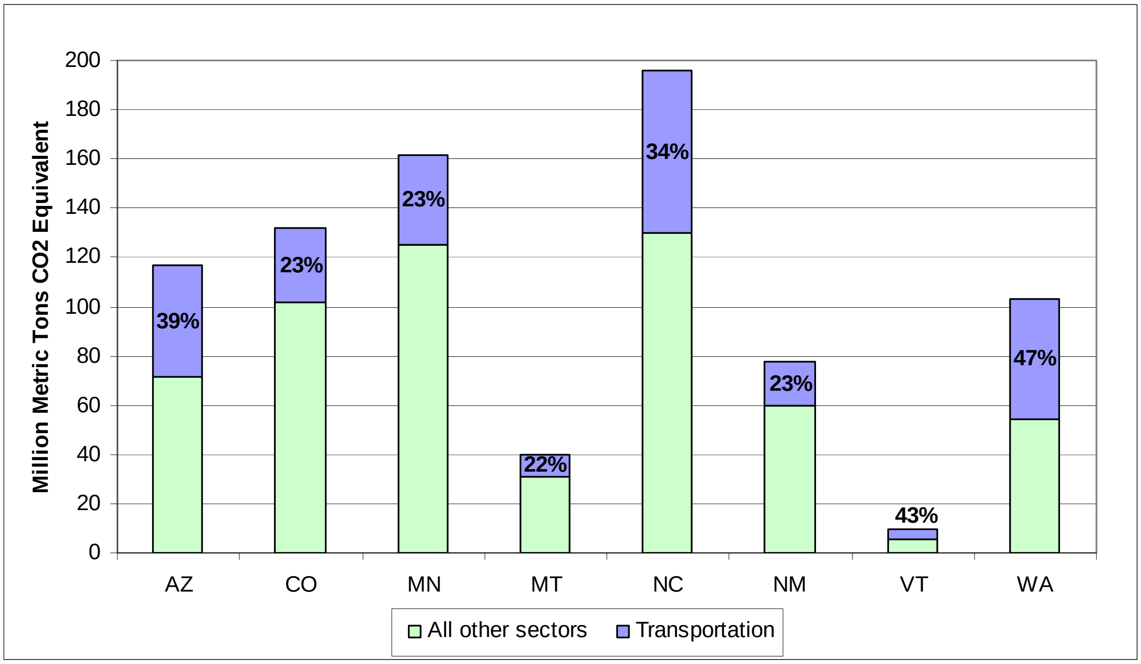
Through the SLCCP, the EPA has developed and published guidance for states to produce GHG inventories. Guidance was first issued in 1992 and is updated regularly to be consistent with methodologies for the U.S. Inventory. EPA methods conform to international guidance issued by the Intergovernmental Panel on Climate Change (IPCC), the UN-sponsored scientific organization for the study of climate change. In addition to guidance documents, EPA has also issued spreadsheet-based tools to assist states with the development of inventories.

The first state inventories were completed in the 1990s. Since then, 44 states have completed GHG inventories, and one additional state (Idaho) is presently completing an inventory. Typically, state environmental agencies lead the development of the GHG inventories, using the guidance and tools provided by EPA. Emissions from transportation are a standard component. Reference case projections often accompany the inventories.

Transportation Emissions

The transportation sector is an important component of all GHG inventories. Transportation is one of the largest sources of GHG emissions, representing 28 percent of U.S. GHG emissions in 2006.[4] It is also the fastest growing source of emissions nationally. In 14 states, the transportation sector constitutes the largest source of CO_2 emissions. Figure 1 shows the importance of transportation to total GHG emissions in eight states that have recently completed inventories. In Washington, transportation accounts for nearly half of the total projected GHG emissions in 2010.

Figure 1. Projected transportation share of GHG emissions in various states, 2010.



Source: various state inventory reports, available through www.climatestrategies.us.

In the past several years, a growing number of states have considered and enacted legislation calling for the reduction of GHG emissions within their borders. This burst of policy activity has also driven the drafting and updating of state GHG inventories. A growing number of states are also developing climate action plans, which set out specific policies and programs to reduce statewide GHG emissions and include estimates of the impacts of proposed measures. As a major source of GHG emissions, the transportation sector is a focus of attention for opportunities to reduce emissions. Reliable inventories and projections of transportation GHG emissions are essential to accurately estimate the impacts of policies.

Methods for Developing Transportation GHG Inventories

The EPA and state governments use standard methodologies to calculate GHG emissions from transportation. Emissions of the three most important gases, carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4), are calculated separately.

CO_2 is by far the most important GHG from transportation, accounting for around 95 percent of transportation emissions, weighted by global warming potential (GWP). CO_2 emissions are directly proportional to fuel consumption. Petroleum-based fuels are largely composed of carbon, and most of this carbon is emitted directly into the air as CO_2 when the fuel is combusted. The only input variable for states is the amount of each fuel consumed, since the carbon content varies slightly for different types of fuel. In most state inventories, fuel consumption data comes from fuel tax records, state energy estimates, or the U.S. Energy Information Administration's State Energy Consumption, Price, and Expenditure Estimates.

Following the format of inputs, outputs of transportation-related CO_2 emissions in most inventories are broken down by fuel type only. Gasoline, diesel, and jet fuel and aviation gasoline are typically the three largest categories. Other fuel types include natural gas, propane (LPG), and residual fuel. These smaller categories are grouped together in some inventories.

Emissions of N_2O and CH_4 are not directly related to fuel combustion, but are dependent on engine operating conditions and emissions control technologies. Consequently, the calculation of N_2O and CH_4 emissions from on-road sources requires inputs of vehicle activity and fleet characteristics for cars, trucks, and buses, including information about the age and technology used by these vehicles. For non-road modes of travel, fuel consumption by each mode is required. Emissions of these gases make up a relatively small proportion of transportation-related GHGs.

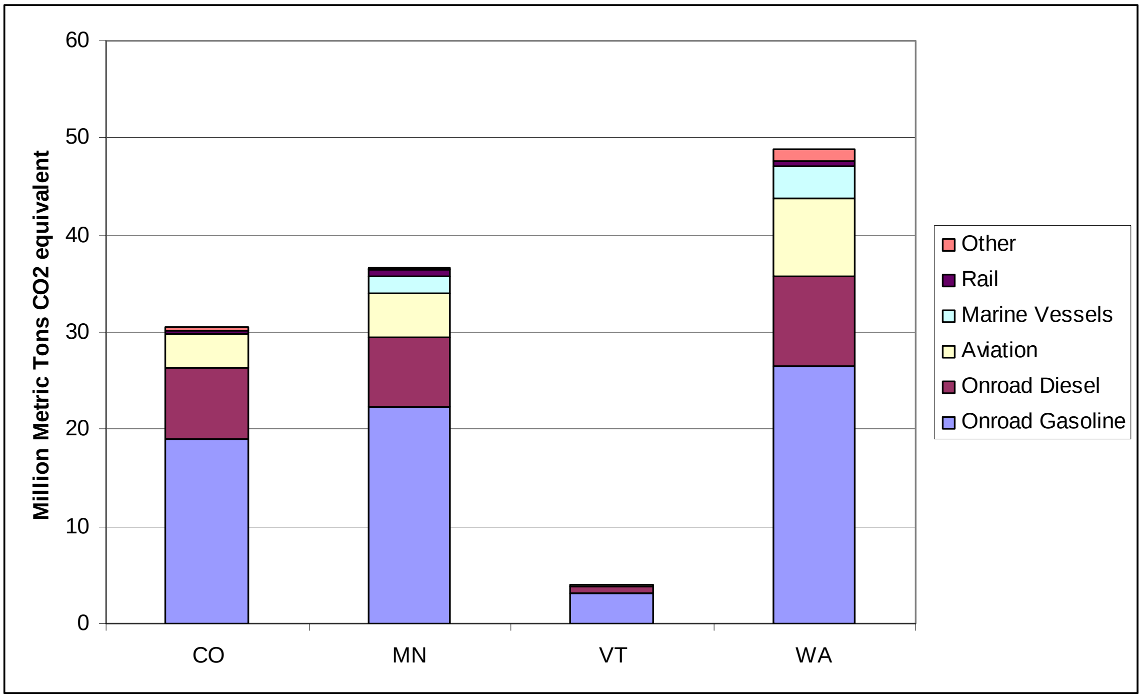
The two methodologies for CO_2 and non-CO_2 gases were established by the IPCC for international application. EPA uses these methodologies in its guidance and tools for states. The U.S. and states use these methodologies to produce their transportation GHG inventories.

Limitations for Conducting Policy Analysis

States use the reported inventory data to characterize broad trends in transportation emissions, but the typical inventory figures are often inadequate detail on the emissions from intuitively-recognized sources. . Decision makers and the public need to understand the impact of policies on emissions from specific vehicle categories and modes, such as light-duty vehicles or freight trucks. The analyst therefore needs data and projections of emissions specific to those vehicle types. State inventories do not typically provide that level of detail. Most state inventories subdivide on-road emissions of the most prevalent GHG, CO_2, by fuel type: gasoline or diesel.

Figure 2 below shows the estimated sources of transportation emissions in four states in 2010. In all four states, on-road gasoline vehicles and on-road diesel vehicles are the first and second largest sources of emissions. When looking at historical and projected values in several states, diesel fuel consumption (largely freight trucks) is responsible for a growing share of transportation emissions. For instance, in Utah, between 1990 and 2020, GHG emissions from on-road gasoline are forecasted to increase 85 percent from 6.5 to 12.0 million metric tons CO_2 equivalent, while emission from transportation diesel sources are projected to more than triple, from 2.1 to 7.1 million metric tons CO_2 equivalent.[5] Not surprisingly, many of the policies that states are considering to reduce transportation emissions address on-road emissions, including freight sources. Common policies include requirements for alternative fuels to be used in on-road vehicles, promotion of rail as an alternative to freight trucks, travel demand and parking management strategies, direct limits on GHG emissions of passenger vehicles, and anti-idling measures for trucks and buses.

Figure 2. Projected transportation emissions by source in various states, 2010.



Source: various state inventories, available at www.climatestrategies.us.

Consider a policy proposal to reduce VMT in light duty vehicles. The state legislature will want to know the current level of GHG emissions from light duty vehicles and the potential impact of the policy, based on expected growth in light duty VMT. However, most inventories do not provide a breakdown of emissions by mode and vehicle type. The analyst cannot determine the current share of emissions from light-duty vehicles or predict the effect of the policy using aggregate emissions from gasoline alone, since both heavy duty and light duty vehicles use gasoline. For instance, some inventories only report transportation diesel fuel consumption, without clearly indicating the amount used by light duty vehicles, heavy duty vehicles, ships and boats, and rail. The lack of detail in state inventories places an additional burden on the policy analyst, who must then disaggregate emissions by vehicle type and mode. In doing so, the analyst must obtain or estimate VMT projections by vehicle type in the state. Ideally, these data would already be included in the inventory.

OPTIONS FOR DEVELOPING MORE DETAILED TRANSPORTATION GHG INVENTORIES

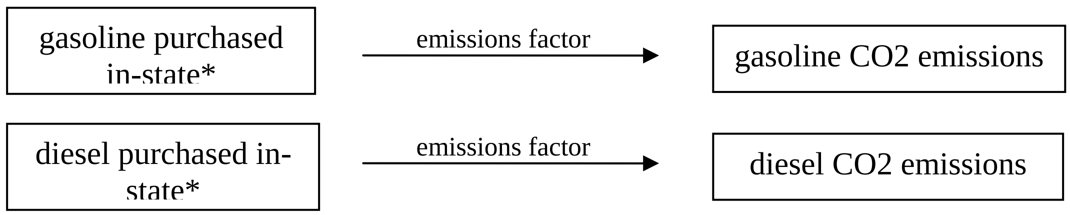
The crucial data point in the estimation of CO_2 emissions from on-road vehicles is fuel consumption. Ideally we would like to know how much gasoline and diesel fuel is consumed by which vehicle types within each state. The basic relationship on which both approaches are based is:

Fuel consumption = fuel efficiency x vehicle activity (VMT)

Top-Down Approach

Standard inventory techniques use a "top-down" approach to calculate CO_2 emissions from transportation, starting with fuel consumption. This approach uses data on fuel sales within each state as a proxy for fuel consumption. It generally provides a low level of detail. Figure 3 below presents a simplified diagram of the approach.

Figure 3. Top-down calculations of state-level emissions.

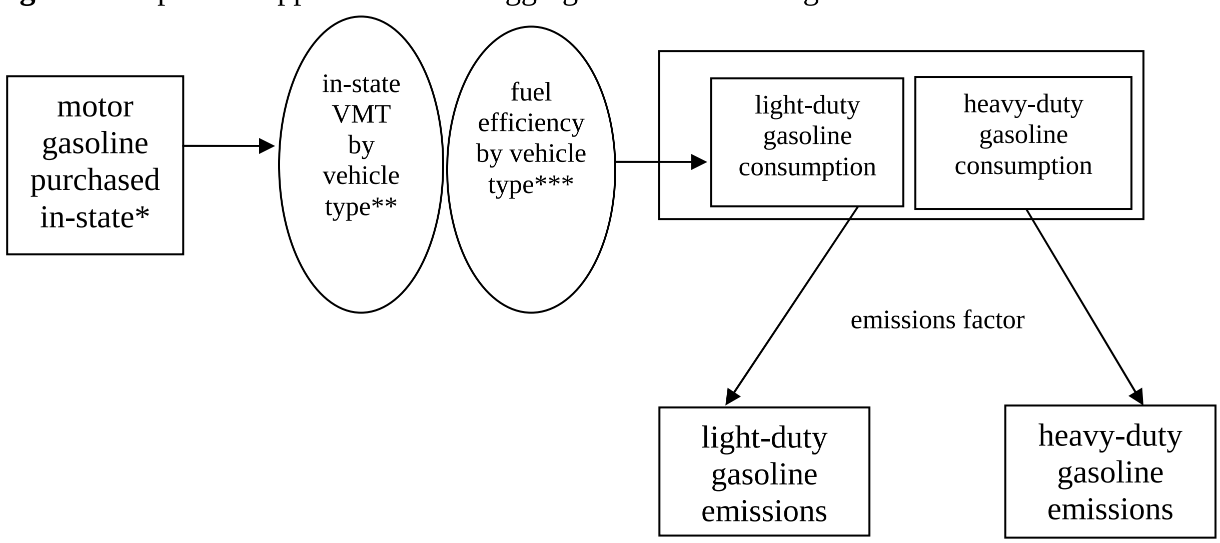


*Available from the EIA's State Energy Consumption, Price, and Expenditure Estimates. Default values are provided in EPA's State Inventory Tool (SIT). Individual states may have alternative data sources.

EPA's State Inventory Tool (SIT), the principal tool used by states to produce their inventories, follows the top-down approach. Shortcomings of this method are both a lack of accuracy and a lack of detail. Drivers do not always use their vehicles in the same state that they purchase fuel. Ships, trains, and planes often refuel in one state and travel through other states. As a result, fuel sales may not provide an accurate estimate of fuel consumption at the state level. Data on fuel sales also do not provide any information on different types of on-road vehicles.

When the top-down approach is used, analysts must post-process the data to achieve the level of detail necessary for most policy analysis. Figure 4 below provides a simplified diagram of post-processing of gasoline emissions. Analysts use data on in-state VMT and average national fuel efficiency by vehicle type to apportion gasoline consumption by vehicle type. But disaggregating introduces additional inaccuracies. The disaggregated figures include three potential error sources: 1) mismatch between fuel sales and fuel consumption, 2) misestimation of VMT for different vehicle types, and 3) fuel efficiency data for the national fleet that poorly represent state fleets.

Figure 4. Top-down approach with disaggregation for on-road gasoline.

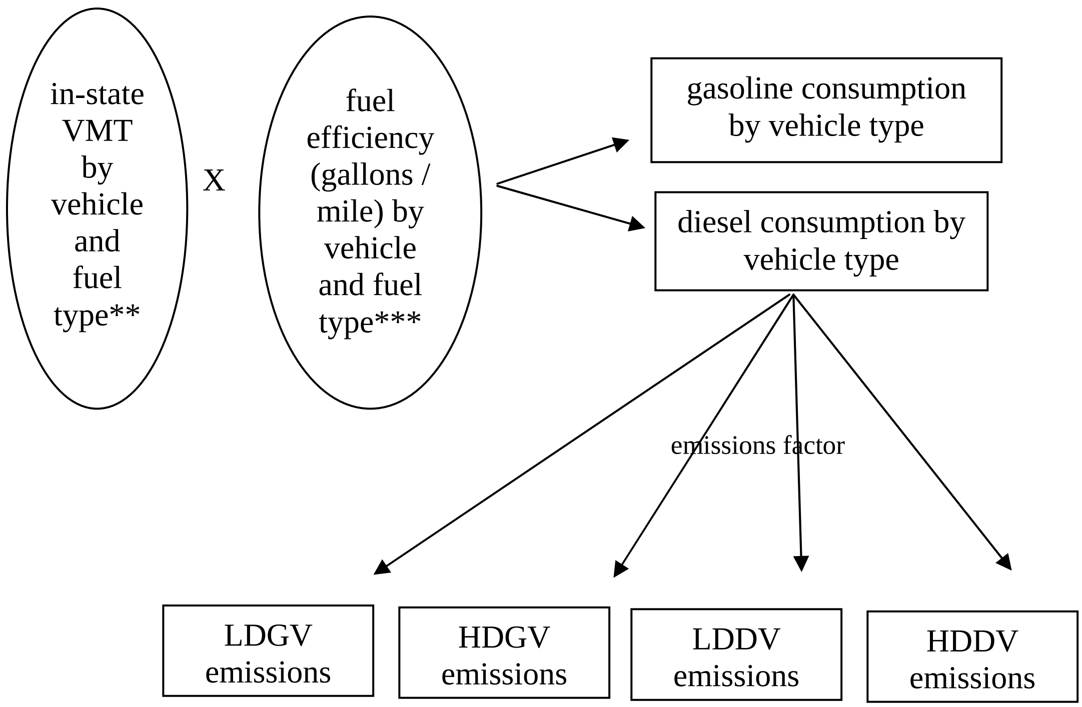


* Available from EIA's State Energy Consumption, Price, and Expenditure Estimates or from FHWA's Highway Statistics. Individual states may have alternative data sources.
**Typically available from state DOTs.
***National estimates available from default values in EPA's MOBILE6 model or from EIA's Annual Energy Outlook. State-level data are rarely available.

Bottom-Up Approach

The alternative "bottom-up" approach starts with fuel efficiency and VMT by vehicle and fuel type. From these variables it calculates fuel consumption by each vehicle type. Figure 5 below provides a simplified representation.

Figure 5. Bottom-up approach with disaggregation for on-road gasoline.



LDGV=light duty gasoline vehicle, HDGV=heavy-duty gasoline vehicle, LDDV=light duty diesel vehicle, HDDV=heavy-duty diesel vehicle

**Typically available from state DOTs and data from EPA's MOBILE6 model

***National estimates available from default values in EPA's MOBILE6 model or from EIA's Annual Energy Outlook. State-level data are rarely available.

The bottom-up approach is better suited to producing greater levels of detail in transportation inventories, and can be used more easily to estimate CO_2 emissions at a range of geographical levels: state, metropolitan area, or municipality. It fits naturally with transportation modeling activities, which estimate vehicle miles of travel (VMT) at the regional or local level.

Metropolitan planning organizations (MPOs), as well as many states and local areas, have their own transportation models calibrated to their local conditions. The standard four-step model works by predicting the amount of travel to and from specific destinations. These travel rates are used to predict trips, which are then allocated to specific modes and vehicle types. Inputs include household travel surveys, data on transportation networks, census data, and traffic and passenger counts. Depending on their complexity, travel models can output trips by mode, vehicle type, and time of day. Travel models can be used to forecast vehicle miles traveled (VMT) and average vehicle speeds and operating conditions (which affect vehicle fuel economy), under different scenarios, such as under different land use patterns and different packages of transportation investments. Many travel models, however, have limitations in predicting freight-truck travel patterns, as these depend on an array of economic and industry factors.

The primary challenge for estimating emissions within small areas is finding reliable data on the fuel efficiency of vehicle fleets. No comprehensive data on fleets is available below the national level.

EPA's MOVES

Because of the greater level of detail, the bottom-up approach is inherently more complex than the top-down approach. The best tool available to produce systematic bottom-up estimates of on-road transportation GHG emissions is the MOVES model, currently under development by EPA. The model estimates energy consumption (total, petroleum-based and fossil-based) and emissions of methane and nitrous oxide. MOVES is designed to estimate emissions from motor vehicles at levels of detail as fine as a single county, a single hour of the day, and a single vehicle type. Inputs to MOVES include data on vehicle population, fuel efficiency, and VMT. The model works by simulating actual vehicle drive cycles, including the effect of travel at different speeds. Although the current version of MOVES does not calculate emissions from off-road sources, a future version of the model will.

MOVES' methodology improves on that of SIT in two ways. First, MOVES uses VMT and fuel efficiency information to calculate fuel consumption. This methodology is likely more reliable in characterizing emissions associated with actual travel activity at the state level than using fuel sales data. Second, by simulating driving conditions in different geographical areas, MOVES produces more accurate estimations of vehicle fuel efficiency that reflect local travel conditions, such as travel speeds and congestion levels. These local estimates are superior to national level fuel efficiency data.. Thus MOVES incorporates new information into the estimation of emissions from on-road sources. The additional sensitivity to local conditions is valuable when examining transportation plans and policies, such as new highway capacity investments, congestion pricing, and other strategies that affect vehicle speeds and operating conditions.

To date, few—if any—states have used MOVES to calculate their transportation GHG inventories. But states will rely more on MOVES when the model becomes the standard for use in regional air quality conformity analyses conducted by MPOs and states. Further guidance from EPA on how to use MOVES will also encourage states to adopt the model.

CHALLENGES AND SOLUTIONS FOR STATE TRANSPORTATION INVENTORIES

States face a number of challenges related to data and methods for calculating transportation GHG inventories. For on-road emissions, state-level fuel efficiency, VMT, and fuel consumption are all subject to some uncertainty.

Fleet mix and fuel efficiency are closely related datasets. The fleet mix varies from state to state based on factors including the physical environment and personal vehicle preferences. Fuel efficiency varies based on the type of vehicles in the fleet, the age of vehicles, and driving conditions. For example, urban areas are likely to have more small vehicles, but congested urban streets may reduce overall fuel efficiency. Rural areas may have more large utilitarian vehicles operating in less congested conditions. The fleet mix and fuel efficiency of vehicles in any given state may vary significantly from national averages; but few states (with the notable exception of California) have data on the fuel efficiency of their fleets.

VMT figures by vehicle type are also uncertain at the state level. MPOs may be able to provide more reliable figures than DOTs, especially for projections. MPOs' transportation models include a range of socio-demographic, system, and policy variables, whereas VMT projections at the state level often rely heavily on population growth estimates and do not take into account infrastructure investment and policy developments. States may be able to use figures from MPOs within their boundaries to improve statewide figures. The challenge for states will be in reconciling different methodologies across MPOs to arrive at reliable statewide figures.

Uncertainties in state-level fuel consumption arise from uncertainties in fuel efficiency and vehicle activity. In addition, fuel consumption calculated from these two variables often does not match with state data on fuel sales. Thus there is an inherent data conflict between top-down and bottom-up inventory approaches. At the national level, bottom-up estimates of on-road vehicle fuel consumption compare well with top-down estimates. Gasoline results from MOVES are 1-2 percent lower than estimates from FHWA, depending on the year, while diesel ("special fuel") results are 2-4 percent lower. At the state level, the range of variance is considerably higher.[6] Part of the difference may be due to differences between fleet composition and activity patterns state-to-state relative to the national defaults in MOVES. Thus states are encouraged to include state-specific inputs such as speed distributions when available. However, part of the difference may be due to cross-border travel.

Boundary Issues

Much of the uncertainty associated with state-level transportation GHG inventories arises from complications introduced by state boundaries. Transportation emissions should be counted in the geographical area in which they are released. This convention raises a particular challenge for the use of data on in-state fuel sales. For example, a refueling station for long distance trucks close to a state border could inflate fuel sales over fuel consumption in the host state. The cross-border travel issue is accounted for to some degree with freight trucks in the FHWA estimates through the International Fuel Tax Agreement (IFTA), whose intent is to reallocate fuel taxes to states where fuel is used rather than sold. Cross-border travel for light-duty vehicles are not accounted for explicitly by FHWA. This issue is particularly relevant for smaller states, and those with metropolitan areas that cross state borders and have a lot of cross-state commuter traffic. For instance, the MOVES gasoline estimates for New Jersey and New Hampshire are 16 and 19 percent lower than the FHWA estimates, respectively. Both states have a high proportion of commuters traveling across state boundaries.[6] According to the 2000 U.S. Census, 13 percent of New Hampshire residents work in Massachusetts.

New York took a viable approach to reconciling fuel sales data with VMT data for its 2003 GHG Inventory. Working with data from the EIA and FHWA, New York examined trends in fuel sales and VMT in recent years. The state found that VMT had grown 20% between 1990 and 2000 while fuel sales had declined 4%. The clear discrepancy indicated that much of the fuel consumed in New York was purchased out of state. A review of regional VMT and fuel sales data for New Jersey found the opposite in that state: fuel sales overestimated VMT. New York concluded that the discrepancies were caused by vehicles driven in New York that refueled in New Jersey. Combining the fuel sales and VMT data for the two states, New York derived figures for the average fuel economy of the fleets driven in the two states. They applied these figures to the New York VMT figures in order to estimate in-state fuel consumption.[7]

Boundary issues also arise for emissions from non-road sources. Inter-state traffic by train, ship, and airplane are likely not accounted for accurately in top-down datasets. Like on-road vehicles, fuel for these modes that is purchased in one state is included in the emissions estimates for that state, regardless of whether it is consumed in another state. The presence of major ports or airports in a state may make sales of aviation and marine fuels higher than in-state consumption. There is also the issue of whether fuel consumed in a major port, such as the Port of Los Angeles, which is used as a port of entry for goods shipped throughout the U.S. should be fully attributed to California, or whether it should be attributed in some way to the end users.

Finally, an additional source of error for non-road modes is fuels used for international transport associated with ports and airports. International guidance directs nations to deduct fuels used for international transport from their GHG inventories. The U.S. *Inventory* follows this guidance, but states often lack the necessary data to subtract these fuels from their inventories. Standard data sources do not specify the amount of fuel purchased in each state that is used for international transportation. The EPA's guidance directs states to estimate their proportion of international fuels by disaggregating the national totals. California, for example, did estimate its share of international fuels in its 2006 GHG Inventory, but most states have not estimated these figures.

Upstream Emissions

Questions surrounding upstream emissions are closely related to boundary issues. Upstream emissions are precursors to the point-of-combustion emissions reported in standard transportation GHG inventories. The operation of most on-road vehicles has associated upstream emissions from the extraction, refining, and transportation of the petroleum burned by the vehicle.

Complications from upstream emissions arise particularly in the analysis of alternative fuels policies. For example, ethanol produced from corn has a very different lifecycle from petroleum. Corn actually sequesters carbon as it grows. Corn is harvested, processed into ethanol, and distributed as fuel. These processes are energy intensive and have associated GHG emissions from agricultural and industrial equipment. The carbon sequestered in the corn is released when the ethanol is burned.

The SIT removes ethanol entirely from inventories of CO_2 emissions on the basis that ethanol is a carbon-neutral fuel. That is, the carbon emitted when ethanol is burned is the same as the carbon sequestered in the growing of corn; therefore there is no net change in atmospheric carbon associated with ethanol. The methodology, however, ignores upstream emissions from the cultivation of corn and the production and distribution of ethanol. It accounts for upstream sequestration but not upstream emissions.

Many states are implementing or considering policies to increase the proportion of ethanol and other alternative fuels that power their motor vehicle fleets. In evaluating proposed policies, states typically evaluate changes in GHG emissions throughout the lifecycle of alternative fuels. In the case of ethanol, estimates of policy impacts include GHG emissions from production and distribution, whereas the baseline inventories do not.

CONCLUSIONS

State transportation GHG inventory methods and reports should be better integrated with the needs of policy analysis. States can take some steps immediately to make their inventories friendlier to analysts. In the longer term, new and revised tools and datasets can improve both the accuracy and detail of transportation GHG inventories.

Recommendation No. 1: Disaggregate Emissions by Mode and Vehicle Type as a Standard Part of Inventories

Breakdowns of emissions my mode and vehicle type are an essential first step for policy analysis. Despite the several challenges discussed above, analysts regularly produce their own breakdowns of top-down inventory figures using the best data available. Anyone can use VMT data from the state DOT and fuel efficiency data from EIA or MOBILE6 to produce a crude disaggregation of emissions totals. States should take it upon themselves to produce and report these disaggregations.

Formally reporting disaggregated figures will ensure more consistent and accurate policy analysis results. Policy analysts are consistently under pressure to provide detailed calculations and to justify the results of their analyses. Disaggregated inventory figures would provide a more transparent baseline from which to begin, and would reduce discrepancies across analyses. In addition, bringing the disaggregation "in house" would place the burden of identifying the best local datasets on the state agencies, who are likely to be most familiar with available data.

In conjunction with providing more detailed figures, inventory reports could also elaborate on trends that affect transportation GHG emissions, such as growth in VMT by vehicle type, changes in fuel efficiency, and shifts in consumption of different transportation fuels. By drawing out these trends, inventory reports could contribute to the identification of effective policies to reduce emissions.

Recommendation No. 2: Examine All Available Datasets for Inconsistencies and Consider Developing New Datasets

In the process of disaggregating emissions by mode and vehicle type, states will have the opportunity to consider the data available to them at the federal, state, and local levels. States are likely to find that readily available data are inadequate to produce a precise breakdown. While the common method of disaggregating emissions provides the necessary level of detail for policy analysis, it also introduces sources of error. The disaggregated figures include three potential error sources: 1) mismatch between fuel sales and fuel consumption, 2) misestimation of VMT for different vehicle types, and 3) fuel efficiency data for the national fleet that poorly represent state fleets.

States should consider what they can do to improve existing data sources or develop new data sources. New York provides an example of a state that worked effectively with existing data resources to estimate the fuel efficiency of its fleet. Although New York and New Jersey are a special case, with a distinct pattern of cross-border traffic, other states may be able to make similar improvements to datasets. Another option for states is to develop altogether new datasets. California actually developed its own model to forecast fleet mix and fuel efficiency.

Recommendation No. 3: Consider Using Bottom-Up Estimation Techniques

The bottom-up approach is better suited to producing detailed emissions inventories than is the top-down approach. If VMT and fuel efficiency data are reliable, the bottom-up approach also better estimates total fuel consumption and emissions.

At present, bottom-up techniques are not integrated into standard inventory tools. EPA's MOVES is still in development. Using the current version of MOVES requires much more staff time and expertise, and potentially much more data, than using the State Inventory Tool. The top-down approach is therefore likely to remain the standard for the immediate future.

Still, MOVES—and bottom-up approaches in general—offer important improvements to transportation inventories, especially for geographical areas smaller than states. These tools should be incorporated into inventories whenever possible.

Recommendation No. 4: Integrate Inventory Methods with Analysis Methods for Biofuels

Currently, biofuels are treated differently in state inventories and in policy analysis. The confusion arises from the upstream emissions associated with transportation fuels. Although current methods are sufficient to account for the national impacts of biofuels policies, they are inadequate for accurate accounting between states.

An integrated approach to accounting for biofuels is needed so that the predicted effects of state biofuels policies are accurately reflected in state inventories. Developing such an approach would require revisiting IPCC and EPA inventory guidance on biofuels. Therefore guidance from the federal level is probably necessary.

At present the discrepancies are probably fairly small, but if the use of biofuels continues to increase, and states continue to promote biofuels policies, gaps between policy impact projections and inventory figures will likely grow.

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KEY WORDS

Greenhouse gas emissions
Greenhouse gas inventory
MOVES
Climate change policy

Based on 2001 data. Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2004 (Table C2).*