

# Incorporating Greenhouse Gas Emissions into Transportation Planning and Decision Making

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**M**ost climate scientists agree that humans are accelerating a change in the Earth's climate through the emission of greenhouse gases (GHG). In response, governments and organizations in the United States at the state, regional, and local levels have been enacting policies aimed at reducing energy consumption and GHG emissions. These policies typically include an overall emissions reduction target for a city, a state, or an agency. To meet reduction targets, some agencies and organizations are developing plans and strategies that are often disaggregated by emissions sources. Transportation, surface transportation in particular, is one of the most significant sources of GHG emissions: About 29% of all U.S. GHG emissions are from transportation, and emissions are expected to increase, as can be seen in Figure 1.

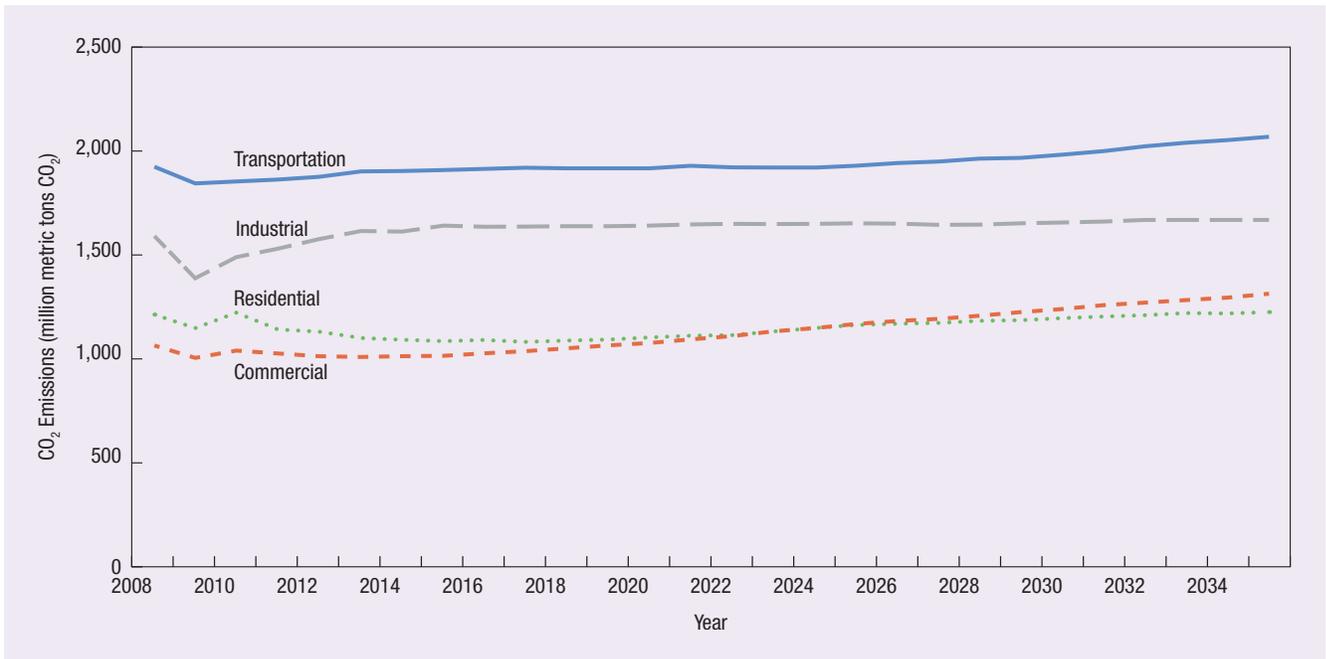
So far, the most common transportation-related response to reduce GHG emissions and promote energy security through reduced energy consumption has focused on four core strategies: reduce vehicle miles traveled (VMT), reduce carbon intensity of fuels, improve vehicle efficiency, and improve overall operational efficiency of the surface transportation system. Several of these strategies would require federal policy changes, namely advancements in vehicle technology and further regulation of fuel sources. However, transportation agencies at the state and local levels have more control over reducing VMT and improving the operational efficiency of the surface transportation system since they own, operate, and regulate much of the nation's transportation system. Systematically incorporating GHG emissions into transportation planning and decision making can lead to successful strategies and plans for mitigation.

To further this process, SHRP 2 undertook Project C09, Incorporating Greenhouse Gas Emissions into the Collaborative Decision-Making Process, which had three objectives:

1. Develop strategies for incorporating GHG emissions at key points in transportation planning and decision making, using an analysis framework as a point of departure;
2. Identify relevant information and materials for GHG emissions analysis, and areas where more information is needed; and
3. Prepare materials and methods that guide GHG emissions and energy analyses.

The products of this research project include *Incorporating Greenhouse Gas Emissions into the Collaborative Decision-Making Process* (SHRP 2 Report S2-C09-RR-1), *Practitioner's Guide to Incorporating Greenhouse Gas Emissions into the Collaborative Decision-Making Process* (SHRP 2 Report S2-C09-RW-2), and a web application. The appendices to the Practitioner's Guide provide—in one location—a wealth of data and methods that can be used to estimate the impacts of greenhouse gas-reducing strategies. The SHRP 2 Report S2-C09-RR-1 contains eight case

**Figure 1. Forecasted CO<sub>2</sub> Emissions, by Sector**



Source: US Department of Energy's Annual Energy Outlook 2011 Early Release

studies describing how state departments of transportation, metropolitan planning organizations, and local governments have been addressing the issue.

## Intended Audience

The products of this research are useful to transportation agencies, especially state transportation agencies and metropolitan planning organizations that lead and manage decision-making processes. These organizations can use the practitioner's guide or the web application to identify critical points in the planning process at which GHG emissions should be considered and to identify which tools and data will be necessary to undertake meaningful GHG emissions analysis. Both agency managers and analysts can find useful information for the types of decisions they are likely to face.

Given that GHG emissions analysis is a process that could include a wide variety of interests, this research could be useful to a large number of stakeholders who participate in various decision-making processes. For example, environmental resource agencies, nongovernmental organizations, elected officials, and the business community might be interested in the results of GHG emissions analysis from a variety of perspectives, including the specifics of how many tons of GHG emissions might be emitted under particular strategies and the cost effectiveness of different strategies to mitigate this impact.

## Final Report

*Incorporating Greenhouse Gas Emissions into the Collaborative Decision-Making Process* (SHRP 2 Report S2-C09-RR-1) provides background research on GHG emissions and energy consumption, information that is important for understanding where the transportation sector fits into an overall policy or program for reducing GHG emissions. Up-to-date information on the types of transportation-related strategies that can be considered as part of a GHG emissions reduction program is also presented. A technical framework (Table 1) is described that can be used for considering GHG emissions in different transportation planning and decision-making contexts. The framework is organized around questions that guide analysts to the tools and data that are necessary to conduct a GHG analysis. Case studies are used to illustrate GHG analyses that have been undertaken for highway and transit projects.

The GHG-reducing strategies examined in this report that are most directly under the influence of transportation agencies include the following:

- Infrastructure provision (including the design, construction, and maintenance of highway, transit, and other transportation facilities and networks);
- Management and operation of the transportation system (including technologies and operational

practices to improve traffic flow, and transportation system pricing policies); and

- Provision of transportation services and demand management measures to encourage the use of less carbon-intensive modes (including transit service improvements, rideshare and vanpool programs, and worksite trip reduction).

Other strategies that may be influenced by transportation agencies include the following:

- Land use planning, for which transportation agencies may provide regional coordination, funding, or technical assistance to support state and local efforts to develop more efficient land use patterns;
- Pricing strategies (including tax and insurance policies, mileage-based pricing, or registration fees), for which transportation agencies may provide analysis support and encourage state-level policy changes; and
- Provision of alternative fuels infrastructure, as well as direct purchase of alternative fuel vehicles for agency fleets.

The impacts of any single transportation system strategy (system efficiency and travel activity) are generally modest, with most strategies showing impacts of less than (and usually considerably less than) 1 percent of total transportation GHG emissions in 2030. A few strategies, however, show larger impacts (greater than 1 percent), including reduced speed limits, compact development (metropolitan development that uses less land than traditional development), various pricing measures, and ecodriving; but the ability to implement these strategies at sufficiently aggressive levels is uncertain due to institutional and/or political barriers. Despite the modest individual strategy impacts, the combined effects of all transportation system strategies may be significant—on the order of 5 to 20 percent of transportation GHG emissions.

**Availability:** *Incorporating Greenhouse Gas Emissions into the Collaborative Decision-Making Process* (SHRP 2 Report S2-C09-RR-1) is available at <http://www.trb.org/Main/Blurbs/166936.aspx> or by searching the title of the report at [www.TRB.org](http://www.TRB.org).

## Practitioner’s Guide

*Practitioner’s Guide to Incorporating Greenhouse Gas Emissions into the Collaborative Decision-Making Process* (SHRP 2 Report S2-C09-RW-2) suggests approaches for

**Table 1. GHG Analysis Framework**

| ANALYSIS STEP  | KEY QUESTIONS  |
|--|--|
| I. Determine information needs   | 1. Which stakeholders should be included in GHG strategy development and evaluation?   |
|  | 2. What is the scope of GHG emissions analysis?  |
| II. Define goals, measures, and resources  | 3. Which goals, objectives, and policies relate to GHG reduction?  |
|  | 4. Which GHG-related evaluation criteria and metrics will be used?   |
|  | 5. What are the baseline emissions for the region or study area?   |
|  | 6. What is the goal or target for GHG reduction?   |
|  | 7. How will GHG considerations affect funding availability and needs?  |
| III. Define range of strategies for consideration                                  | 8. Which GHG reduction strategies should be considered?  |
|  | 9. Are strategies and alternatives consistent with a long-range plan or other relevant plans that meet GHG reduction objectives?                     |
| IV. Evaluate GHG benefits and impacts of candidate strategies                      | 10. Which calculation methods and data sources will be used to evaluate the GHG impacts of projects and strategies?                                  |
|  | 11. What are the emissions and other impacts of a particular project, strategy, or design feature?   |
| V. Select strategies and document overall GHG benefits and impacts of alternatives | 12. What GHG-reducing strategies should be part of the plan, program, or project?  |
|  | 13. What are the net emissions impacts for the overall plan, program, corridor, or project alternatives considered, or for the alternative selected? |

considering greenhouse gas emissions in transportation planning and decision making. The material is structured around the Decision Guide, which was the basis for the Transportation for Communities—Advancing Projects through Partnerships (TCAPP) web tool. The Decision Guide is a framework of key decisions, which are required by law or regulation or which have become part of successful practice. These decisions require action by those empowered to make the final decisions about plan adoption, funding priorities, or project implementation. To better inform decision makers, TCAPP provides technical information for each of the key decision points.

The guidebook presents the Decision Guide, showing where and how GHG emissions can be considered in planning and decision making. After determining which decision context (long-range planning, programming, corridor planning, or project development/permitting) is most relevant to their situation, users can find the information most relevant to them.

**Table 2. Example Fuel Economy for 2000 to 2007**

| VEHICLE TYPE      | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|-------------------|------|------|------|------|------|------|------|------|
| Passenger cars    | 21.9 | 22.1 | 22.0 | 22.2 | 22.5 | 22.1 | 22.5 | 22.5 |
| Light-duty trucks | 17.4 | 17.6 | 17.5 | 16.2 | 16.2 | 17.7 | 17.8 | 18.0 |
| Heavy-duty trucks | 6.01 | 6.12 | 6.01 | 6.91 | 6.85 | 6.28 | 6.17 | 6.20 |

Source: Bureau of Transportation Statistics (2009), Tables 4-13, 4-14, 4-15, and 4-23.

Note: Fuel economy is expressed in miles per gallon of gasoline equivalent.

At each decision point, information is presented to the user. The specific consideration of GHG emissions in that particular decision point is explained, and the linkage between the GHG role in that decision point and how it relates to other decision points in the framework is described. Key questions that an analyst should consider are then presented. Finally, the type of information that will be necessary to answer these questions is provided. In this way, guidebook users can focus on a particular decision point and obtain information on how GHG emissions can be considered in that decision, or alternatively, they can

trace the role of GHG emissions analysis through different decision-making processes.

The guidebook describes methods and approaches that can be used for considering GHG emissions in different decision-making contexts. It also allows users to identify how GHG emissions can be considered through the planning process and pinpoints specific approaches for individual planning tasks.

An annotated bibliography is included. The bibliography provides a description of useful references for those researching more specific approaches and methods for analyzing GHG emissions. For users who wish to have more information on different technical aspects of GHG emissions analysis, a technical reference document is included as an appendix.

**Availability:** *Practitioner's Guide to Incorporating Greenhouse Gas Emissions into the Collaborative Decision-Making Process* (SHRP 2 Report S2-C09-RW-2) is available at <http://www.trb.org/Main/Blurbs/166940.aspx> or by searching the title of the report at [www.TRB.org](http://www.TRB.org).

**Table 3. Example Fuel Economy for Future Years**

| VEHICLE TYPE      | 2015  | 2020  | 2025  | 2030  | 2035  |
|-------------------|-------|-------|-------|-------|-------|
| Passenger cars    | 25.29 | 27.73 | 29.79 | 31.46 | 32.68 |
| Light-duty trucks | 19.47 | 21.05 | 22.57 | 23.93 | 25.08 |
| Heavy-duty trucks | 6.30  | 6.62  | 6.82  | 6.95  | 7.03  |

Source: Energy Information Administration (2010), Supplemental Tables 59 and 67.

Note: Fuel economy is expressed in miles per gallon of gasoline equivalent.

### SHRP 2 CONTACT

The contact for this project is **Stephen J. Andrle**, Deputy Director of SHRP 2, [sandrle@nas.edu](mailto:sandrle@nas.edu).

### CAPACITY TECHNICAL COORDINATING COMMITTEE

**Mark Van Port Fleet**, Michigan Department of Transportation; **Kome Ajise**, California Department of Transportation; **Mike Bruff**, North Carolina Department of Transportation; **Jacquelyn D. Grimshaw**, Center for Neighborhood Technology; **Kris Hoellen**, The Conservation Fund; **Carolyn H. Ismart**, Florida Department of Transportation (Retired); **Randy Iwasaki**, Contra Cost Transportation Authority; **Thomas J. Kane**, Thomas J. Kane Consulting; **Keith L. Killough**, Arizona Department of Transportation; **T. Keith Lawton**, Keith Lawton Consulting, Inc.; **Edward A. Mierzejewski**, Gannett Fleming, Inc.; **Joseph L. Schofer**, Northwestern University; **Barry Seymour**, Delaware Valley Regional Planning Commission; **John V. Thomas**, Environmental Protection Agency; **Gary Toth**, Project for Public Spaces; **Jeff Welch**, Knoxville Regional Transportation Planning Organization; **Doug Woodall**, Texas Department of Transportation; **Janet P. Oakley** and **Matthew Hardy**, American Association of State Highway and Transportation Officials; **James Cheatham**, **Gary A. Jensen**, and **Spencer Stevens**, Federal Highway Administration

### SHRP 2 CAPACITY STAFF

**Stephen J. Andrle**, SHRP 2 Deputy Director; **David J. Plazak**, Senior Program Officer; **Jo Allen Gause**, Senior Program Officer; **Reena Mathews**, Senior Program Officer; **Matthew Miller**, Program Officer; **Jo Ann Coleman**, Senior Program Assistant