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Greenhouse Gas Analysis Resources and Tools

U.S. National Blueprint for Transportation Decarbonization - landmark strategy for cutting greenhouse emissions from all modes of transportation.

Resources and tools by mode of transportation on this page:

- Surface Transportation (highways, public transportation, bicycle and pedestrian)
- Public Transportation
- Electric Vehicles
- Rail
- Aviation
- Maritime
- Clean Energy Use of Transportation Right of Way

Surface Transportation (highways, public transportation, bicycle and pedestrian)

Technical Assistance Program

Integrating GHG Assessment and Reduction Targets in Transportation Planning – outreach and assistance to State Departments of Transportation (DOTs) and Metropolitan Planning Organizations (MPOs) under the FHWA Every Day Counts Program, which highlights innovations ready for deployment. This effort includes webinars, workshops, development of updated handbooks, case studies, and on-call technical assistance.

Handbooks and Guides

Reducing Greenhouse Gas Emissions: A Guide for State DOTs (2022) Developed by the National Highway Cooperative Research Program (NCHRP), this guide presents methods for State DOTs to reduce GHG emissions, including analytical tools, data sources, and self-assessment rubrics for addressing GHG in policy, planning, programming, design, environmental review, construction, maintenance, operations, and partnership opportunities.

Handbook for Estimating Transportation Greenhouse Gases for Integration into Planning Process (2013) This handbook helps State DOTs and MPOs understand the possible approaches, data sources, and step-by-step procedures for analyzing GHG emissions. It provides an overview of estimating GHG emissions in the planning process and identifies and describes several key methodologies used to estimate emissions.

A Performance-Based Approach to Addressing Greenhouse Gas Emissions through Transportation Planning (2013). A companion resource to the above handbook, this resource helps State DOTs and MPOs integrate GHG analysis into performance-based planning and programming. Provides case studies.

Tools

An increasing number of DOTs and MPOs are quantifying greenhouse gas (GHG) emissions as part of National Environmental Policy Act (NEPA) analysis and transportation planning, particularly in response to new federal initiatives addressing on-road GHG emissions. Most of the available tools estimate tailpipe GHG emissions from on-road vehicle activity (also known as “use phase” or “operating” emissions). Some tools include emissions from construction and maintenance of transportation infrastructure and/or emissions from extracting, refining, and transporting fuels as well as electricity use by electric vehicles. This section highlights a small number of tools that may be most useful to State DOTs and MPOs.

Travel Demand Model + MOVES

This is the most common approach. The main advantage is that it leverages analyses that many MPOs and some State DOTs conduct for other purposes (such as criteria pollutants for transportation conformity or mobile source air toxics for NEPA). The analysis pairs outputs from travel demand models (such as travel volumes and vehicle speeds) with EPA's Motor Vehicle Emissions Simulator (MOVES) model, which is EPA's official model for state implementation plans (SIPs) and transportation conformity analyses. This approach can also provide the most accurate way of evaluating the travel and tailpipe GHG emissions of current fuel economy standards, along with major capital investments in roads and transit. However, this approach is often less suitable for evaluating multiple policy combinations, given the complexity of changing model inputs, as well as the longer run times of travel models and MOVES. It is also limited to tailpipe GHG emissions, which do not include GHG emissions from electricity used by electric vehicles or GHG emissions from the production of fuels. This approach is often less sensitive to the effect of some strategies, such as pricing, parking management, active transportation and land use (the latter of which requires external assumptions).

Spreadsheet Tools

Spreadsheet tools are simple to use and some have been developed specifically for transportation GHG analysis. They do not generally include interactions between policies and often use simplifying assumptions.

CMAQ Emissions Calculator Toolkit – provides estimates of the amount of emissions reductions projected from implementing various types of transportation projects eligible under the Congestion Mitigation and Air Quality Program (CMAQ), such as pedestrian improvements, electric vehicle and alternative fueling infrastructure, managed lanes, and adaptive traffic control. Includes GHG emissions along with criteria air pollutant emissions.

Scenario Planning and Policy Analysis Models

These models are designed to evaluate many alternative futures and policy options, which can be critical in identifying different pathways for achieving GHG reduction goals. In terms of complexity and ease of use, these models fall between the two above types of tools. Compared to travel demand models, they can be run more quickly and are more sensitive to many demand-side strategies for reducing GHG (such pricing, parking management, TDM, etc). However, they rely on a highly abstracted representation of the transportation network, so they are less accurate for evaluating the effect of capital-intensive projects and also roadway operations. Compared to spreadsheet tools, they require more effort, data, and expertise.

VisionEval - modeling system at the state and metropolitan region levels for evaluating a wide range of transportation policy scenarios and their impacts on vehicle travel and GHG emissions. Supported by a pooled fund group Including FHWA.

Energy Emissions Reduction and Policy Analysis Tool (EERPAT)- an integrated, state-level modeling system designed by FHWA to evaluate strategies for reducing surface transportation energy consumption and GHG emissions.

Life Cycle Emissions Tools

Infrastructure Carbon Estimator (ICE) - a spreadsheet tool that estimates the lifecycle energy and GHG emissions from the construction and maintenance of transportation facilities. ICE it is intended to inform planning and other pre-engineering analysis such as those conducted during the NEPA process.

The Greenhouse Gasses, Regulated Emissions, and Energy Use in Transportation (GREET) model is a system developed by Argonne National Laboratories to examine the lifecycle GHG emissions from different transportation fuels (including electricity) and also the manufacture of vehicles.

LCA Pave - a pavement life-cycle assessment tool that can be used to quantify the environmental impacts of pavement material and design decisions.

FHWA Sustainable Pavements Program – research and technical assistance to reduce the carbon footprint of pavements, including information on life cycle assessments and Environmental Product Declarations.

For additional information on tools, see NCHRP overview and assessment of GHG evaluation tools.

Case Studies

Integrating Climate Change in Transportation and Land Use Scenario Planning: An Example from Central New Mexico

Case studies on California, Greater Buffalo Niagara Regional Transportation Council, Delaware Valley Regional Planning Commission (DVRPC), The Genesee Transportation Council (GTC), Maryland, The Puget Sound Regional Council, Portland Oregon, Sacramento Area Council of Governments (SACOG), and Massachusetts are embedded in this report.

Case studies on Atlanta Regional Council (ARC), Metropolitan Washington Council of Governments (MWCOG), Southern California Association of Governments (SCAG) are embedded in this report.

Public Transportation

Sustainable Transit for a Healthy Planet Challenge – guidance, templates, and examples of public transportation agency plans to reduce GHG emissions.

FTA's Transit Greenhouse Gas (GHG) Programmatic Assessment and Emissions Estimator - a spreadsheet tool that allows users to estimate the partial lifecycle GHG emissions generated from the construction, operation, and maintenance phases of a project across select transit modes.

An Update on Public Transportation's Impact on Greenhouse Gas Emissions – report, fact sheets, and slide presentation summarizing research on transit as a climate solution. Also includes a simple spreadsheet tool that provides findings by transit agency and allows the user to apply several future scenarios to see how their agency's GHG impacts change with electrification, clean power, and ridership increases.

Electric Vehicles

Joint Office of Energy and Transportation - provides technical assistance on planning and implementation of a national network of electric vehicle chargers and zero-emission fueling infrastructure as well as zero-emission transit and school buses.

Federal Funding Available for Electric Vehicle Charging Infrastructure – information on federal funding sources available for building EV charging stations.

Charging Forward: A Toolkit for Planning and Funding Rural Electric Mobility Infrastructure - a one-stop resource to help rural communities scope, plan, and fund EV charging infrastructure.

Charging Forward: A Toolkit for Planning and Funding Urban Electric Mobility Infrastructure - the urban counterpart to the above.

Electric Vehicle Infrastructure Projection Tool – Pro and Lite Versions – tools developed by the National Renewable Energy Laboratory to estimate how much charging infrastructure is needed in a designated area to meet given demand.

AFLEET CFI Emissions Tool - estimates well-to-wheel greenhouse gas emissions and vehicle operation air pollutant emissions for proposals to the Federal Highway Administration's (FHWA) Charging and Fueling Infrastructure Discretionary Grant Program (CFI Program). The CFI Program covers electric vehicle charging, as well as hydrogen, propane, and natural gas fueling infrastructure. This tool was developed with the support of the Joint Office of Energy and Transportation, using the AFLEET Tool. The AFLEET Tool uses emissions data from both the EPA's MOVES and Argonne's GREET models.

Market Acceptance of Advanced Automotive Technologies (MA3T) is a model developed by the Oak Ridge National Laboratory to evaluate the effect of policies such as public charging infrastructure on the sales of electric vehicles and other advanced automotive technologies.

Rail

Workshop on Rail Decarbonization, 2023 – presentations available.

Carbon Dioxide Emissions from Four Real World Inter-City Passenger Trips: A Comparison of Rail, Air, and Road Travel Modes by City Pair (2022) - compares the operational carbon dioxide (CO2) emissions of three main travel modes (rail, air, and road – both passenger vehicle and bus) for four real-world trips between different city pairs across the U.S.

FRA Rail Climate Considerations – includes GHG related resources on rail from FRA.

Aviation

Airport Carbon Emissions Reduction – resources from FAA and the Airport Cooperative Research Program (ACRP).

Aviation Environmental Design Tool (AEDT) - a software system that models aircraft performance in space and time to estimate fuel consumption, emissions, noise, and air quality consequences. Facilitates environmental review activities required under NEPA by consolidating the modeling of these environmental impacts in a single tool.

Maritime

Ship Alternative Fuel and Emissions Toolkit (SAFE-T) - a web-based suite of tools for vessel owner/operators to use when considering actions to reduce greenhouse gas emissions. SAFE-T provides tools enabling shippers to track fuel use and emissions, compare the carbon intensity of different shipping routes, and compare properties of conventional and alternative marine fuels.

Maritime Decarbonization - links to studies on reducing greenhouse gas emissions from ports and ships.

Clean Energy Use of Right of Way

State DOTs Leveraging Alternative Uses of the Highway Right-of-Way Guidance - FHWA guidance on how State DOTs can use highway right-of-way for solar panels, electricity transmission, broadband and other clean energy and connectivity projects.

Renewable Energy in Highway Right-of-Way - information on solar and other renewable energy generation in highway right-of-way and on transportation agency properties.

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