Handbook for Estimating Transportation Greenhouse Gases for Integration into the Planning Process

FHWA's *Handbook for Estimating Transportation Greenhouse Gases for Integration into the Planning Process* is designed for State Departments of Transportation (DOTs) and metropolitan planning organizations (MPOs) of all sizes and capabilities to understand possible approaches for analyzing greenhouse gas (GHG) emissions in the planning process. It helps users understand:

- Factors to consider in selecting an appropriate method,
- **Strengths and limitations of different approaches,**
- **Step-by-step procedures, and**
- **Common data sources.**

The Handbook describes methods that can be used for:

- Inventory development to estimate past or current emissions levels;
- Forecasting **to predict future emissions, potentially under different scenarios; and**
- GHG strategy analysis**.**

Fuel-based Methods

Fuel-based methods typically rely on fuel sales data and involve calculating carbon dioxide (CO_2) emissions based on the carbon content of each fuel. Tools such as EPA's State Inventory Tool or State Inventory Projection Tool can be used to produce estimates of CO_2 by fuel type. Results can be refined in a variety of ways, including allocating emissions to vehicle types or geographic areas.

VMT-based Methods

Vehicle miles traveled (VMT)-based methods involve estimating the quantity of vehicle travel and then connecting this information to an estimate of emissions using emissions factors or an emissions model like EPA's Motor Vehicle Emissions Simulator (MOVES) model, which is the preferred approach. VMT estimates can be developed relying on vehicle, household, and land use data; using data from the Highway Performance Monitoring System (HPMS); or using a network-based travel model. Emissions of CO_2 and other GHGs can take into account a wide range of factors, including the mix of vehicle types, travel speeds, operating conditions, and temperature.

Alternative GHG Estimation Approaches

Other emissions estimation methods include:

- Commodity flow based methods to estimate freight emissions; and
- **The Energy and Emissions Reduction Policy Analysis Tool (EERPAT), a screening tool that analyzes effects of transportation policy and investment scenarios.**

Specific Transportation Strategy Analysis Methods

"Off-model" analyses may be used to analyze the effects of strategies that are not well accounted for in standard travel forecasting methods, such as:

- Transportation demand management strategies;
- **Land use strategies;**
- **Transportation system management and eco-driving; and**
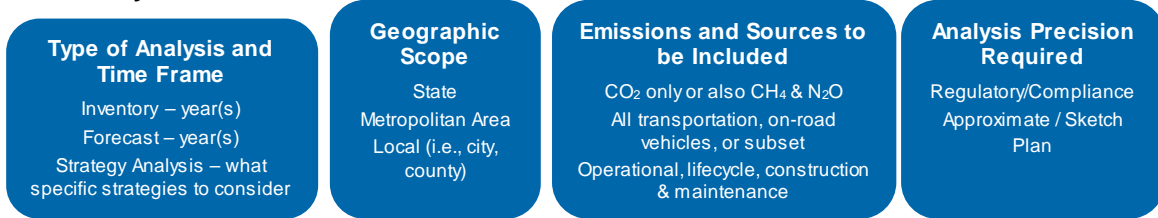- **Freight strategies.**

Additional Considerations

In addition to direct emissions from motor vehicles, planners may consider:

- Lifecycle emissions, which account for fuel processing and distribution; and
- **Emissions associated with infrastructure construction and maintenance.**
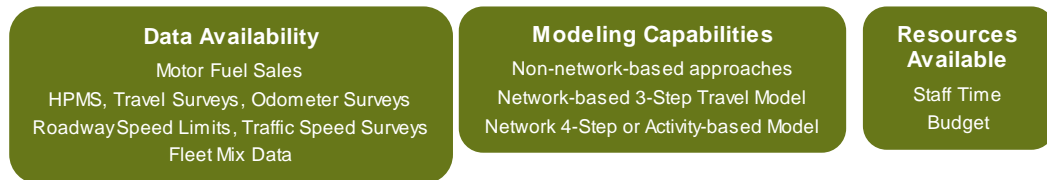
The Handbook helps the user select an appropriate GHG analysis method, considering issues such as:

What is the goal of the analysis?

Type of Analysis and Time Frame	**Geographic Scope**	**Emissions and Sources to be Included**	**Analysis Precision Required**
Inventory – year(s) Forecast – year(s) Strategy Analysis – what specific strategies to consider	State Metropolitan Area Local (i.e., city, county)	CO_2 only or also CH_4 & N_2O All transportation, on-road vehicles, or subset Operational, lifecycle, construction & maintenance	Regulatory/Compliance Approximate / Sketch Plan

What data, tools, and resources do we have available?

Data Availability	**Modeling Capabilities**	**Resources Available**
Motor Fuel Sales HPMS, Travel Surveys, Odometer Surveys Roadway Speed Limits, Traffic Speed Surveys Fleet Mix Data	Non-network-based approaches Network-based 3-Step Travel Model Network 4-Step or Activity-based Model	Staff Time Budget

What variables do we want to analyze?

Fuels and Vehicle Technologies	**Travel Demand**	**Operations and Speed Factors**
Fleet Mix Changes Vehicle Technology Changes Alternative Fuel Penetration	Land Use Changes Transportation Demand Management Freight Flow Changes	Traffic Congestion Levels Vehicle Idling Speeds and eco-driving

Cross-cutting Factors to Analyze or Consider
Fuel Prices
Population and Employment Levels
Other Demographic and Economic Factors

For each methodology, the Handbook provides references to manuals, technical resources, models, and tools, and includes examples from State DOTs and MPOs that have used these methodologies.

The Handbook and other related resources can be found at:
http://www.fhwa.dot.gov/environment/climate_change/mitigation/resources_and_publications/

More information on FHWA's climate activities is available at:
http://www.fhwa.dot.gov/environment/climate_change/