Technical Highlights

Reducing Greenhouse Gas Emissions from the Transportation Sector through Climate Planning

This information sheet highlights the transportation sector's contribution to greenhouse gas (GHG) emissions in the United States, discusses the development of GHG emissions inventories for the transportation sector, and provides insight into state and local government climate planning based on research that was conducted in 2023.[1]

Many state, local, and tribal governments have conducted climate planning exercises in the past and have assessed their contribution to GHG emissions as well as identified measures to reduce them. A variety of plans have been developed by these governments to accomplish this, including GHG plans, climate plans, and energy plans. The focus of this information sheet will be on state and local climate plans, comprehensive plans that provide a detailed framework for reducing GHG emissions in a specific state or local jurisdiction.

The Transportation Sector's Contribution to Greenhouse Gases

While there are many ways to categorize sources of GHG emissions, the following six major economic sectors are commonly used in reporting:

- Electricity generation;
- Transportation/mobile;
- Commercial and residential buildings;
- Industry;
- Agriculture/natural and working lands; and
- Waste and materials management.

The transportation/mobile sector (herein referred to as "transportation") includes emissions from both onroad and nonroad sources. Onroad sources include emissions

[1] This research was completed based on a review of public websites for state and local plans in 2023, prior to the plans developed for EPA's Climate Pollution Reduction Grants (CPRG) program. For more information on CPRG, see EPA's CPRG website (https://www.epa.gov/inflation-reduction-act/climate-pollution-reduction-grants).

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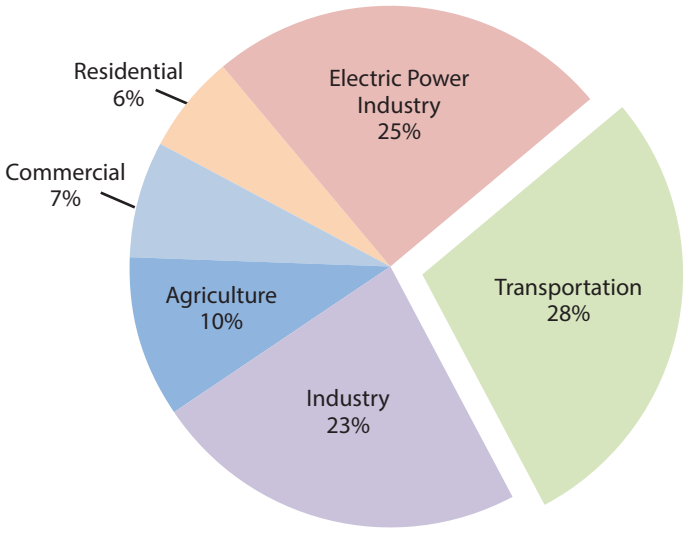
from light-, medium-, and heavy-duty vehicles and nonroad sources include off-road mobile sources such as construction equipment, lawn and garden equipment, aircraft ground support equipment and aircraft engine emissions, locomotives, and commercial marine vessels.[2]

As of 2022, transportation, electric power, and industry were the highest emitting sectors in the U.S, with transportation contributing the most at 28% (see Figure 1).[3] Despite increases in vehicle efficiency, transportation emissions increased 22% between 1990 and 2019, largely due to increased vehicle miles traveled (VMT). After a reduction in transportation emissions during the COVID-19 pandemic, transportation demand has returned to near pre-pandemic levels and is projected to continue growing.

Figure 1. Share of U.S. GHG Emissions by Economic Sector, 2022



In the United States, the majority of transportation emissions result from on-road vehicles powered by internal combustion engines using motor gasoline and diesel fuels. Light-duty vehicles contribute the most emissions (57%), followed by medium- and heavy-duty trucks (23%). Figure 2 shows the share of transportation emissions by source for the U.S,[4] however, the distribution of transportation emissions by source will vary for each state, tribe, territory, or local government.

Nationwide, carbon dioxide (CO2) makes up most of the GHG emissions from the transportation sector at 97.7%, followed by hydrofluorocarbons (HFCs), methane (CH4), and nitrous oxide (N2O). CO2, CH4, and N2O are emitted from the combustion of fossil fuels, while HFCs are emitted due to leaks and disposal of air conditioners used in vehicles.[5]

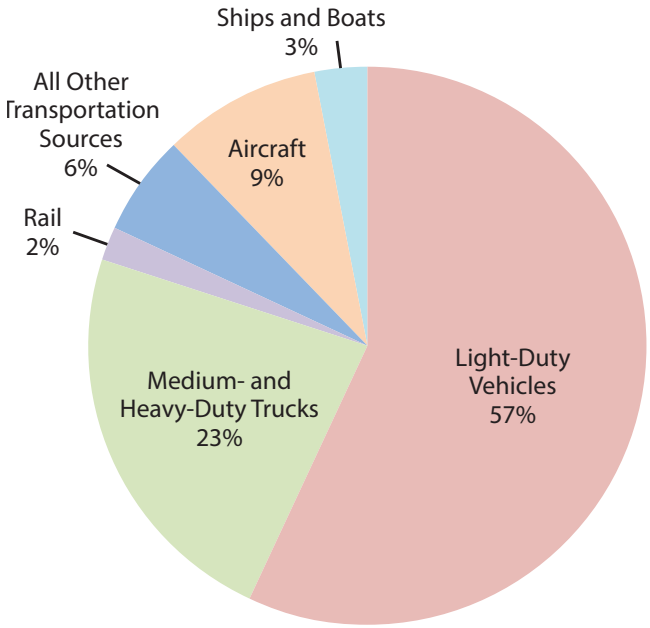
[2] For more information on EPA's National Emissions Inventory (NEI), see EPA's NEI website (https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei).

[3] Fast Facts: U.S. Transportation Sector Greenhouse Gas Emissions, 1990-2022, EPA-420-F-24-022, May 2024.

[4] Fast Facts: U.S. Transportation Sector Greenhouse Gas Emissions, 1990-2022, EPA-420-F-24-022, May 2024. "All other transportation sources" include buses, motorcycles, pipelines, and lubricants.

[5] Ibid.

Figure 2. Share of U.S. Transportation Sector GHG Emissions by Source, 2022



Research Overview

In 2023, EPA reviewed 13 state and 20 local climate plans that were published at that time to learn about the elements most commonly found in them, particularly those relevant to the transportation sector. Elements researched include:

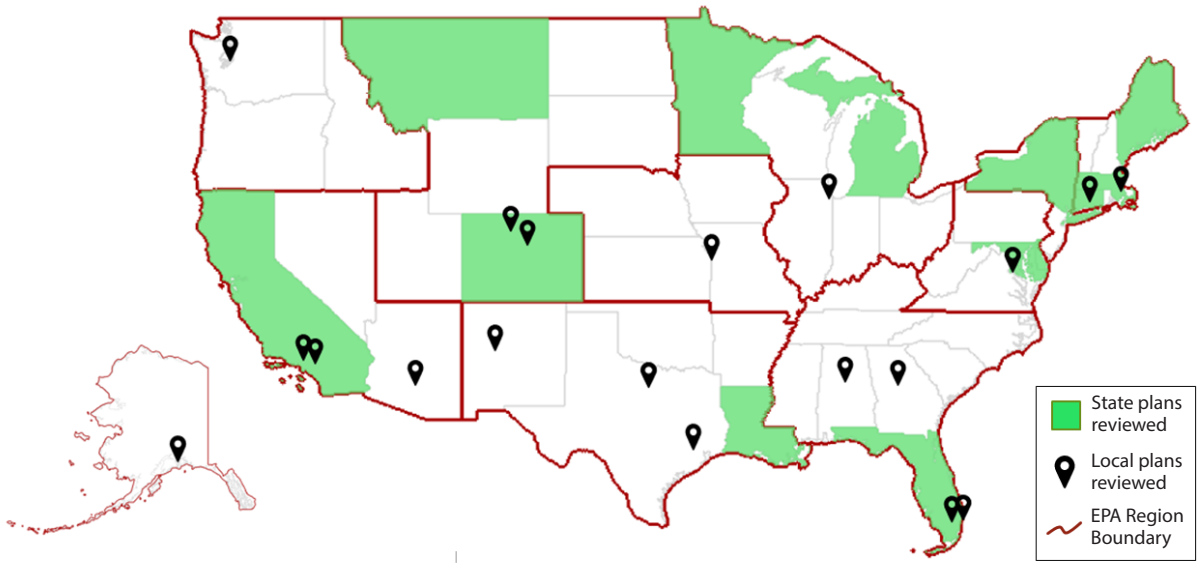
- Economy-wide and transportation-specific GHG inventories;
- GHG projections;
- GHG reduction targets;
- GHG reduction measures for the transportation sector; and
- Analysis of benefits, including benefits specific to low-income and disadvantaged communities, that resulted from GHG reduction measures.

This research project also aimed to catalog and categorize transportation measures for easier comparison between plans.

The plans reviewed reflect diversity in geographic distribution, population size, and experience in climate planning. For geographic diversity, at least one plan was reviewed from every EPA Region. Figure 3 displays a map of all state and local plans reviewed.

Population size varied substantially between the plans reviewed. Populations ranged from 120,000 to 39 million, with a variety of populations in between. Lastly, we determined whether the plan reviewed was the first plan released by the state or local government, or a subsequent plan, which we used as an indicator of the agency's experience in climate planning. Half of the reviewed plans were the first plans released while the other half had at least one plan released before it.

Figure 3. State and Local Plans Reviewed



Elements of State and Local Plans

Greenhouse Gas Inventories

An emissions inventory is a database that lists, by source, the amount of air pollutants discharged into the atmosphere during a year or other time period. Governments use emissions inventories to help determine significant sources of air pollutants and to prioritize and target regulatory and other actions.[6] Thus, developing a transportation sector inventory to identify major sources and volumes of emissions for a particular area is an important step to reduce GHG emissions from this sector.

The overall purpose, or end use, of a transportation sector GHG inventory is the primary factor for determining the scope and level of detail of the inventory. The scope of an inventory includes what sources and pollutants to include, the geographical area to be covered, and the timeframe of the inventory. The level of detail refers to the type of activity data underlying the inventory calculations and how refined these data are.[7] Different methods can be used to develop an inventory depending on these considerations. Methods include using:

- Mobile source emission models, such as EPA's MOtor Vehicle Emission Simulator (MOVES).[8]
- VMT-based estimates, which can be used to calculate onroad emissions by multiplying a GHG emission factor by the total vehicle miles traveled; and
- Fuel-based estimates, which involves multiplying a fuel-specific emission factor by the quantity of fuel used.

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[6] For more background, see EPA's Managing Air Quality – Emissions Inventory website (https://www.epa.gov/air-quality-management-process/managing-air-quality-emissions-inventories).

[7] For more information on developing an emissions inventory, see Section 2 of the Port Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, EPA-420-B-22-011, April 2022.

[8] For more information on EPA's MOVES model, see EPA's MOVES website (https://www.epa.gov/moves). In California, EMFAC is used, and this model estimates emissions from onroad mobile sources in California.

Given the diversity of emission sources that are part of a transportation sector inventory, it is important for lead agencies to coordinate with other stakeholder groups and the public when developing climate plans and the elements within them.

GHG Inventories in State and Local Plans in 2023

Of the climate plans researched, all but two plans include an economy wide GHG inventory, and roughly half of plans have a transportation sector inventory. Figures 4 and 5 provide examples of GHG inventories found in two of the climate plans reviewed.

Figure 4. Massachusetts 2020 Economy-wide Inventory[9]

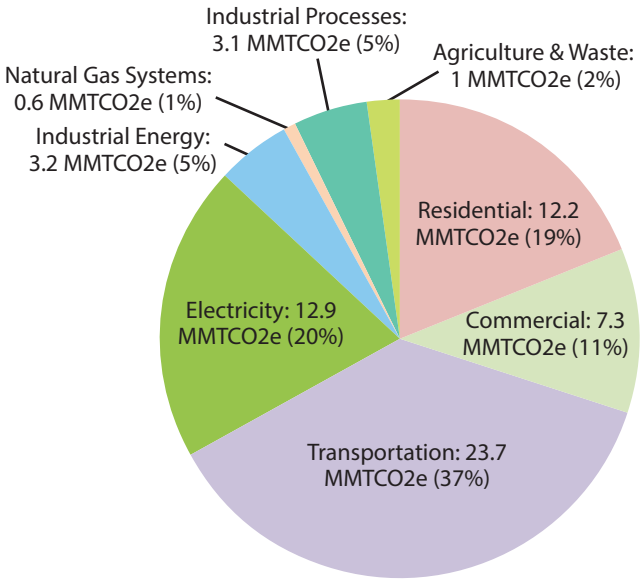
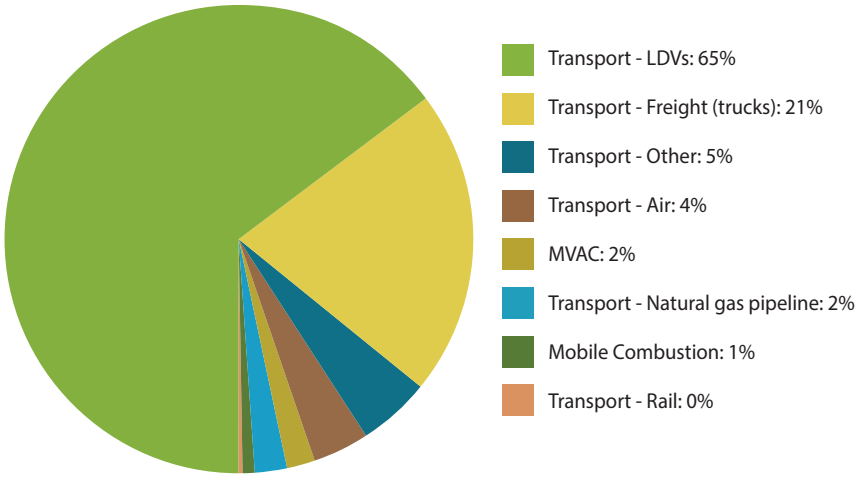


Figure 5. Michigan 2019 Transportation Sector Inventory[10]



[9] Massachusetts Clean Energy and Climate Plan for 2025 and 2030, Executive Office of Energy and Environmental Affairs, June 2022.

[10] MI Healthy Climate Plan, Michigan Department of Environment, Great Lakes, and Energy, April 2022.

Some plans during the timeframe of this research also mentioned the tools and protocols used for developing inventories, including the Global Protocol for Community-Scale GHG Inventories, EPA's State Inventory Tool, C40 Cities' City Inventory Reporting and Information System Tool, Stockholm Environmental Institute's Long-range Energy and Alternatives Planning Framework, and E3's PATHWAYS model.

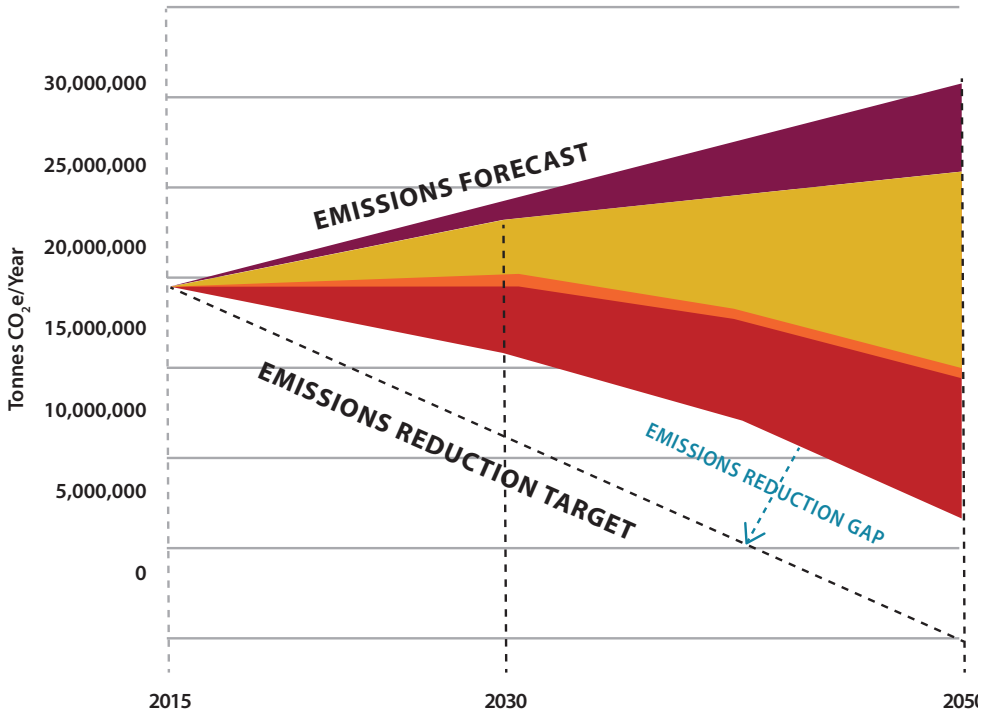
Greenhouse Gas Emissions Projections and Targets

Projections of GHG emissions can be used to understand future emissions in the absence of measures to reduce them, known as a "business-as-usual" (BAU) projection, and under a scenario when GHG reduction measures are expected to be implemented. Projections can be estimated for the near-term (e.g., 2030) or long-term (e.g., 2050). Similarly, GHG reduction targets can be developed to set goals for future emissions for both the near- and long-term. Both projections and targets can be developed for the whole economy, or for individual sectors.

GHG Projections and Targets in State and Local Plans in 2023

We assessed both types of GHG emissions projections in the plans reviewed. Two-thirds of plans contained both types of projections, while 15% of plans only contained projections of emissions reductions under measures identified in the plan. The remaining plans did not contain GHG emission projections. GHG reduction targets analyzed were broken up into short-term (i.e., 2030) and long-term (i.e., 2050) targets. Nearly all plans had at least one type of target, and the majority of plans (70%) contained both near- and long-term targets. Figure 6 displays an example of an emissions forecast from one of the climate plans reviewed. The graph displays emissions under a BAU scenario and as a result of GHG reduction measures identified in the plan, as well as near- and long-term GHG reduction targets.

Figure 6. Dallas, TX Emissions Projections and Targets[11]



[11] Dallas Comprehensive Environmental and Climate Action Plan, City of Dallas, May 2020.

Benefits Analysis

Benefits resulting from GHG reduction measures can include reductions in co-pollutants (i.e., particulate matter, nitrogen oxides) and a wider range of benefits including improved health, economic, and environmental outcomes. Analysis of benefits can also be extended to low income and disadvantaged communities.

Benefits Analysis in State and Local Plans in 2023

Nearly all reviewed plans had a qualitative assessment of the benefits resulting from reductions in GHG emissions. These benefits focused primarily on improved health, air quality, and equity. Only a few plans also provided a quantitative assessment of benefits from the reductions (i.e., quantified avoided economic costs or reductions in criteria pollutants). Less than half of plans included an analysis of benefits that extended to low-income and disadvantaged communities. Similar to the overarching benefits analysis, only a few plans that included benefits for low-income and disadvantaged communities included a quantitative analysis; the rest simply included a qualitative statement of benefits.

GHG Reduction Measures

We also examined the GHG reduction measures found in climate plans. We define measures as programs, policies, or projects that will achieve or facilitate the reduction of GHG emissions. Measures were grouped into two broad categories: travel efficiency and transition to clean vehicles and fuels. Within these categories, we further organized each measure into sub-categories. Examples of travel efficiency sub-categories include transit, transportation pricing, and bicycle and pedestrian improvements. Examples of transition to clean vehicles and fuel subcategories include electric vehicles, refueling infrastructure, and low carbon fuel standards. Tables 1 and 2 list all subcategories and their descriptions.

Table 1. Categories of Travel Efficiency Measures

Measure Subcategory	Description
Transit	Improve and increase transit and transit ridership such as through providing free or reduced fares, increasing transit frequency or coverage, and improving safety and facilities
Land Use	Alter land use patterns, e.g., by increasing density and prioritizing transit-oriented development
Bicycle and Pedestrian Improvements	Improve and create bicycle and pedestrian infrastructure such as bike lanes, bike repair stations, and sidewalk improvements
Employer-based Travel Demand Management Programs	Reduce single-occupancy vehicle (SOV) commutes, e.g., by offering subsidies for alternative modes of travel, telework, and guaranteed ride home
Unspecified Alternative Modes	Reduce VMT through alternative modes of transportation that are not explicitly stated
Vehicle Sharing and Carpooling	Increase vehicle sharing, such as car sharing, carpooling, and high-occupancy vehicle lanes
Transportation Pricing	Disincentivize SOV use through parking pricing, VMT fees, and tolls

Measure Subcategory	Description
Education and Outreach	Education and outreach surrounding alternative modes of transportation and publishing emissions data to influence emissions reductions
Freight Route Optimization and Efficiency	Improve the efficiency of freight routes and promote best practices for freight movement

Table 2. Categories of Transition to Clean Vehicles and Fuel Measures

Measure Subcategory	Description
Electric Vehicles	Transition vehicles (passenger, fleet, transit, medium- and heavy-duty) to electric through policies and practices such as purchase incentives and sales requirements
Refueling Infrastructure	Increase availability of refueling infrastructure, especially electric vehicle (EV) charging; improve accessibility through increasing public charging and/or policies to make EV charging more equitable
Zero- and Low-Emission Vehicles	Transition vehicles (passenger, fleet, transit, medium- and heavy-duty) to low or zero emissions through incentives, sales requirements
Low Carbon Fuel Standard	Adopt a Low Carbon/Clean Fuel Standard
Clean Rail, Freight, and Aviation	Reduce emissions from rail, aviation, and freight through policies and practices, such as electric and low-emission rail and freight trucks
Alternative Fuel Vehicles	Transition vehicles to alternative fuels, such as biofuel/biodiesel and natural gas through policies and incentives
California Standards	Adoption (or continuation) of California vehicle standards under Clean Air Act section 177
Zero- and Low-Emission Equipment	Transition gas- and diesel-powered equipment to electric or low-emission fuels

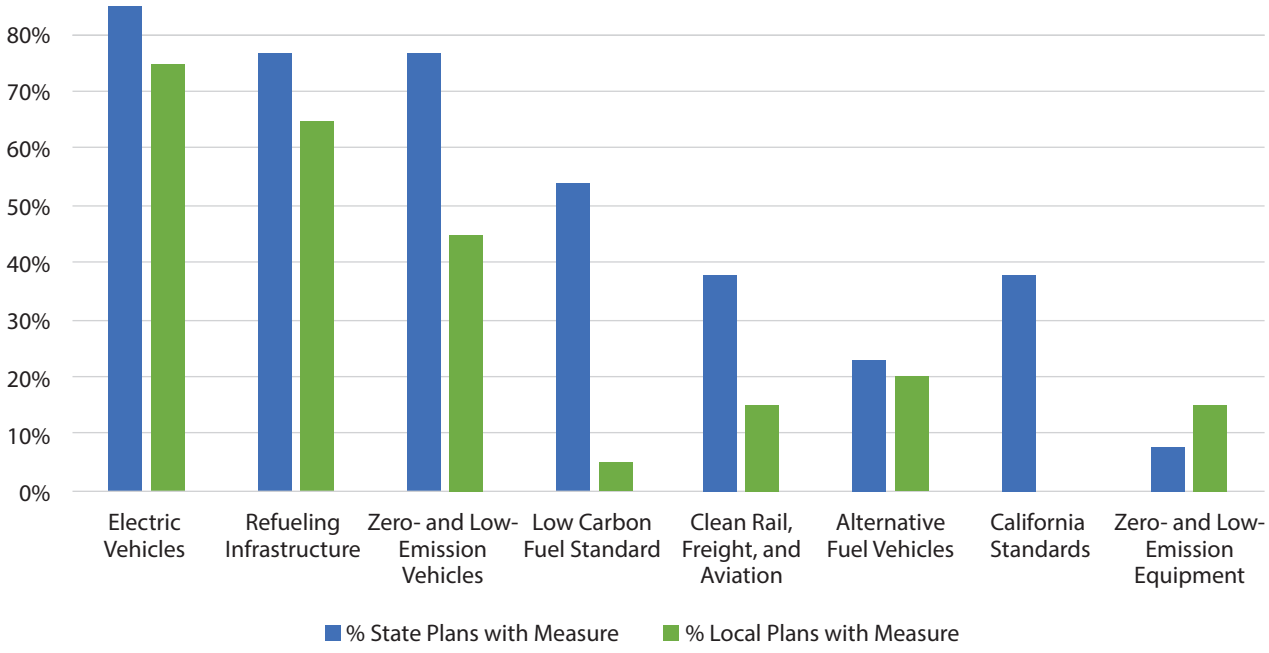
Travel Efficiency Measures in State and Local Plans in 2023

Of the climate plans reviewed, nearly all contained measures related to the first category of travel efficiency, which we describe as measures that affect how often, how far, and by what mode people choose to travel. These measures reduce emissions by reducing VMT and vehicle start emissions. The most common measures in this category are focused on transit, land use, and bicycle and pedestrian improvements. Within the land use sub-category, measures focused on transit-oriented development, such as increasing both density and multi-family housing near transit stations, were the most common in state and local plans. For transit, measures centered around expanding transit coverage or frequency were most common.

There are some differences in the measures found in state and local climate plans, in part due to their different jurisdictions and statutory authority. For example, almost every local climate plan reviewed contained measures on bicycle and pedestrian improvements, land use, and transit, but these measures were only found in about half of state climate plans.

Figure 7 illustrates the frequency of travel efficiency measures found in the state and local climate plans reviewed.

Figure 7. State vs Local Travel Efficiency Measures in 2023



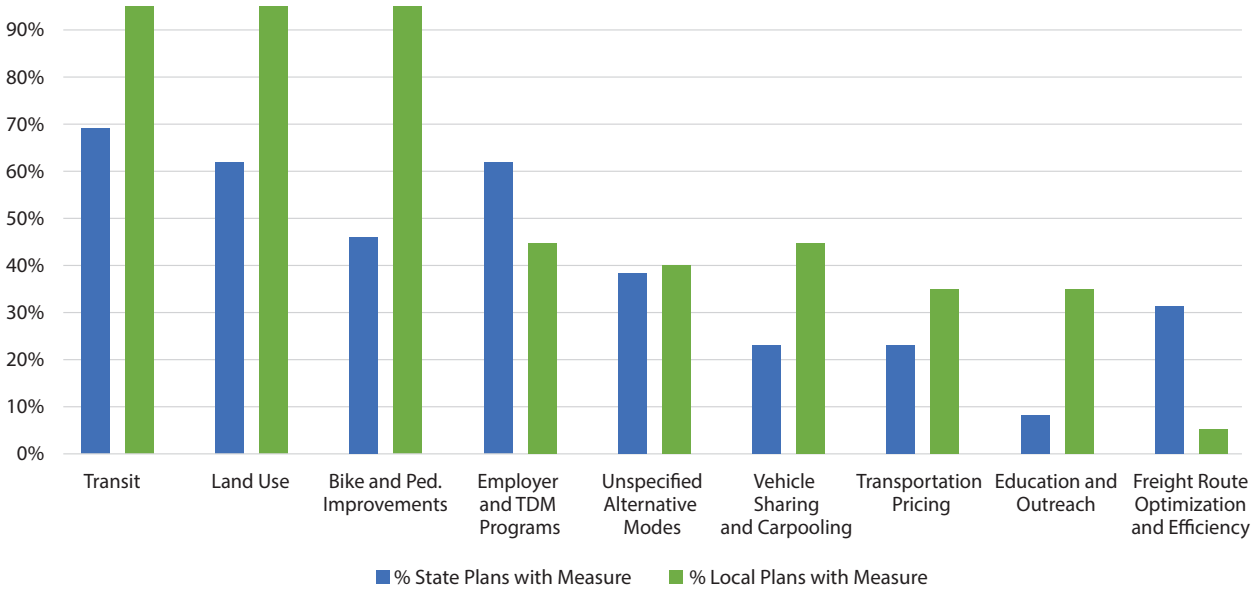
Transition to Clean Vehicles and Fuel Measures in State and Local Plans in 2023

Nearly all plans reviewed also contained measures in the second broad category, transitioning to clean vehicles and fuels. All state and 19 of the 20 local plans reviewed had at least one measure in this category. The most common subcategories were electric vehicles (EVs), refueling infrastructure, and zero- and low-emission vehicles (ZEV/LEV). The EV subcategory includes measures such as electrifying public and private fleets and increasing consumer adoption of EVs through purchase incentives. The refueling infrastructure subcategory contains measures primarily focused on EV charging, such as expanding public charging and charging for electric buses. The ZEV/LEV category includes measures to transition to low- and zero-emission fleets, consumer purchase incentives for ZEV/LEV, and increased fuel economy. There may be some overlap in the type of vehicles targeted in the EV and ZEV/LEV subcategories since electric vehicles can be designated as zero- or low-emission, but for the purpose of this research, measures were grouped according to the state or local plan's specific wording.

Although there were more similarities between state and local governments on the measures they included in their plans, there were some differences. For example, only states can adopt California's vehicle standards, which reflects why this measure was only found in state climate plans.

Figure 8 illustrates the frequency of clean vehicle and fuel measures found in the state and local climate plans reviewed.

Figure 8. State vs Local Transition to Clean Vehicles and Fuel Measures in 2023



For More Information

In addition to the information cited in this document, there are the following additional resources: EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks, an annual report that tracks U.S. GHG emissions and sinks by source, economic sector, and greenhouse gas.

- The most recent annual report was published in 2024: EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2022, EPA-430-R-24-004, April 2024.
- For more information, see EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks website (https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks).

EPA's National Emissions Inventory, a comprehensive and detailed estimate of air emissions and criteria pollutants, criteria precursors, and hazardous air pollutants from air emissions sources.

- The most recent report was published in 2023 based on 2020 data: EPA's 2020 National Emissions Inventory and Trends Report, July 2023.
- For more information, see EPA's National Emissions Inventory website (https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei).

For the latest version of EPA's guidance for using MOVES to create onroad and nonroad GHG inventories, see EPA's website on Estimating Greenhouse Gas Emissions (https://www.epa.gov/state-and-local-transportation/estimating-greenhouse-gas-emissions).

For more information on travel efficiency strategies and estimating emission reductions from them, please see EPA's Travel Efficiency website (https://www.epa.gov/state-and-local-transportation/estimating-emission-reductions-travel-efficiency-strategies), which includes links to:

- Travel Efficiency Assessment Method (TEAM) User Guide: Analyzing Passenger Travel Impacts and Emission Reductions from Travel Efficiency Strategies, EPA-420-B-21-036, September 2021,
- A series of fact sheets highlighting different travel efficiency strategies intended for use by state, tribal, and local agencies, non-governmental organizations, and others interested in learning more about specific travel efficiency strategies, implementation approaches, and implementation examples,
- A series of case studies done in partnership with state and local agencies, where TEAM was used to assess the impact of adopting specific, unique travel efficiency strategies, and
- A Key Takeaways fact sheet where we highlight the lessons learned in these case studies.