# DOT REPORT TO CONGRESS: DECARBONIZING U.S. TRANSPORTATION

July 2024

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA

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# EXECUTIVE SUMMARY

**The transportation sector accounts for about one third of U.S. greenhouse gas (GHG) emissions, more than any other individual sector of the economy. Decarbonizing transportation is critical to addressing the climate crisis and meeting the national goal of net-zero GHG emissions by 2050 and the interim target of 50-52 percent below 2005 levels by 2030.**

This report responds to congressional direction to outline U.S. Department of Transportation (DOT) strategy and actions for reducing GHG emissions in line with our international commitments. It draws on the U.S. National Blueprint for Transportation Decarbonization (Blueprint), published by DOT, DOE, EPA and HUD and other Federal agencies in January 2023. The Decarbonization Blueprint provides a framework to transition to a net-zero GHG transportation system while improving safety, equity, and affordability.[1] It includes three groups of strategies: increasing convenience by making it practical to take fewer or shorter trips, improving efficiency, and transitioning to clean mobility options.

DOT is deploying all three of the Blueprint strategies. DOT is increasing convenience by leveraging the transportation planning process, supporting transit-oriented development, and filling gaps in walking and biking networks. DOT is improving efficiency by investing in highly efficient modes such as public transit, rail, and marine transportation; developing fuel economy standards; and advancing operational efficiencies. DOT is transitioning to clean options by investing in electric vehicle chargers and alternative fuel infrastructure, deploying zero-emission transit vehicles, developing lower emission aviation and maritime fuels, and reducing emissions at ports and airports.

Cross-cutting DOT actions that advance all three Blueprint strategies include integrating climate change considerations in the environmental review process, including GHG criteria in discretionary grants, providing broad eligibilities for GHG reduction strategies in formula programs, implementing the Carbon Reduction Program, and conducting research and technical assistance. DOT is also working to reduce life-cycle GHG emissions from constructing and maintaining transportation infrastructure.

Through the 2021 Bipartisan Infrastructure Law (BIL), the 2022 Inflation Reduction Act (IRA), and the 2022 CHIPS and Science Act, Congress has provided unprecedented funding and incentives to support GHG reductions across the economy including the transportation sector. Of the $660 billion in transportation funding that BIL authorized for DOT over a five-year period, $27 billion is specifically for programs to reduce GHG emissions, including the Carbon Reduction Program ($6.4 billion), National Electric Vehicle Infrastructure program ($5 billion), Low or No Emission Bus Program ($5 billion), Congestion Relief Program ($250 million), Reduction of Truck Emissions at Port Facilities Program ($400 million), Transportation Alternatives Set-Aside ($7.2 billion), and Transit Oriented Development Planning Program ($68 million).

In addition, the IRA established a $2 billion Low Carbon Transportation Materials Program. DOT is successfully implementing these programs and is committed to using its current authorities and funding to reduce GHG emissions. The DOT actions described in this report play a critical role in reducing U.S. transportation GHG emissions. However, given the scale of the problem, more is needed for us to meet our emissions reduction goals.

This report concludes by identifying the following opportunities for driving further reductions in U.S. transportation GHG emissions:

- Continued investments in GHG reduction strategies
- Deployment of micromobility projects
- Local congestion pricing initiatives
- Further coordination between DOT and HUD
- Technical assistance for local government land use planning
- Expanded public transportation service
- Reduced customization of federally funded buses
- Prioritizing intermodal investments in discretionary grants
- Multi-modal freight planning
- Reduced methane leaks
- Clean maritime transportation
- Market-based international aviation measures
- Increased training and workforce development.

# 1 INTRODUCTION

**The impacts of climate change from rising temperatures, sea level rise, and extreme weather events are already disrupting and damaging critical infrastructure, human health, property, and the vitality of our communities.[2] Climate change impacts are projected to worsen, and inaction would result in substantial costs. These include a $2.2 trillion annual loss in Federal revenue (in 2022 dollars) and a reduction in the growth potential in U.S. GDP of 10 percent by 2100.[3] In response, DOT has committed to rapidly decarbonizing the transportation sector while achieving a clean, safe, secure, accessible, affordable, and equitable transportation system for everyone.**

The Fiscal Year (FY) 2022 House Transportation, Housing, and Urban Development Appropriations Full Committee Report (HR Report 117-99) directed DOT to submit a report to the House and Senate Committees on Appropriations outlining its plans to reduce GHG in line with the United States Nationally Determined Contribution under the UN Framework Convention on Climate Change.

This report responds to the request in HR Report 117-99 by documenting efforts by DOT to reduce transportation sector GHG emissions. The report draws on strategies to advance transportation decarbonization outlined in the U.S. National Blueprint for Transportation Decarbonization,[4] jointly developed by the departments of Energy, Transportation, Housing and Urban Development, and the Environmental Protection Agency.

This report begins in Section 1 by providing background on current and projected GHG emissions in the transportation sector and outlining GHG emissions reduction goals. Section 2 describes DOT actions towards decarbonization. The report concludes in Section 3 by identifying additional opportunities to further reduce transportation GHG emissions. While this report focuses on GHG reduction, DOT is also taking action to improve resilience to climate impacts.

## 1.1 U.S. Emissions Reduction Goals

The U.S. has committed to ambitious GHG emissions reduction targets to limit global average temperature increases to 1.5°C above pre-industrial levels. Specifically, under the United Nations Paris Agreement, the U.S. committed to reduce GHGs by:

- 50-52 percent below 2005 levels by 2030 across all sectors and GHGs.[5]

Additionally, under the Long-Term Strategy of the United States, the U.S. set targets for

- 100 percent carbon pollution-free electricity by 2035, and
- Net-zero emissions no later than 2050. [6]

U.S. GHG emissions fell by 17 percent between 2005 and 2021, mostly due to a decrease in $CO_2$ intensive electricity generation and a rapid proliferation of renewable energy.[7] During that same time period, transportation emissions fell by 8.5 percent.[8] Given that transportation is the largest source of U.S. GHG emissions, it is impossible to meet the net-zero goal without driving transportation emissions down to near zero. Additional action is needed to achieve these ambitious national goals.

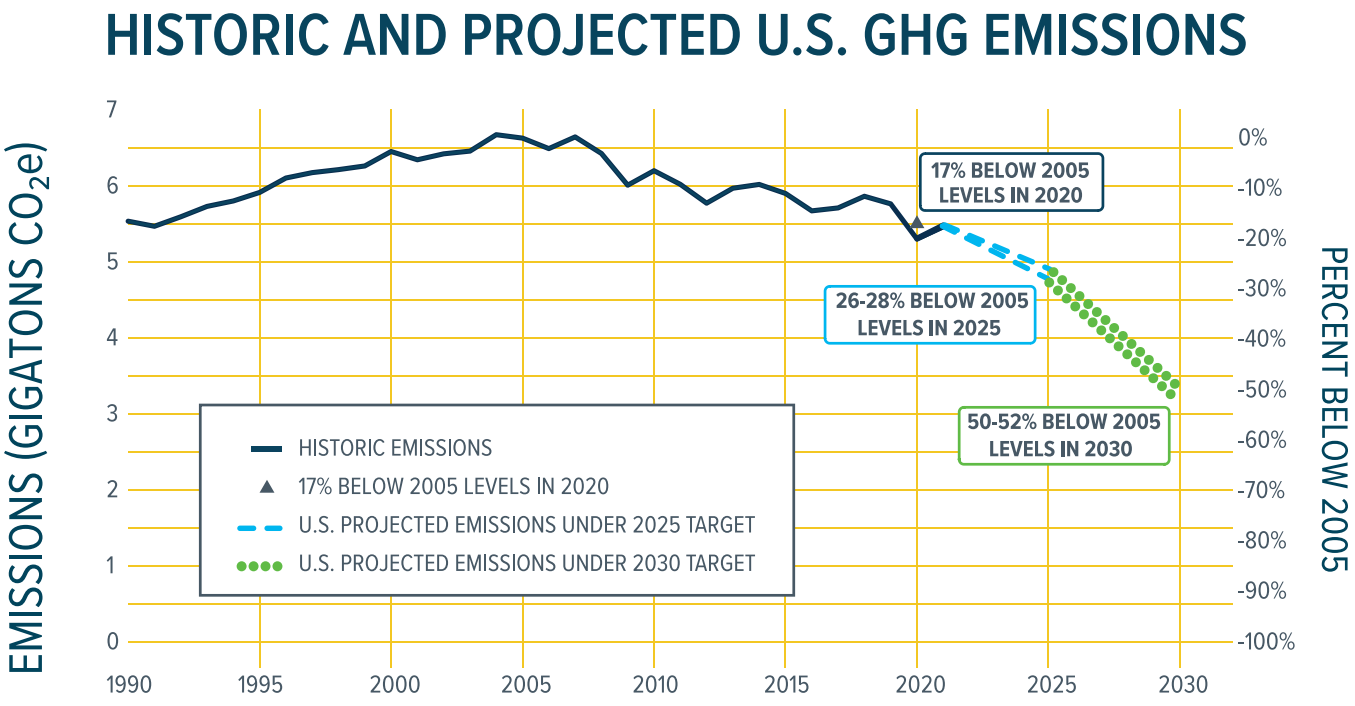


Figure 1: This figure shows the historical trajectory of U.S. net GHG emissions from 1990 to 2019, the projected pathway to the 2030 Nationally Determined Contribution (NDC) of 50-52% below 2005 levels, and the 2050 net-zero goal.[9]

## 1.2 State of Transportation Sector Emissions

The transportation sector represents the largest source of U.S. GHG emissions, accounting for 33 percent of the total[a],[10] (see Figure 2).

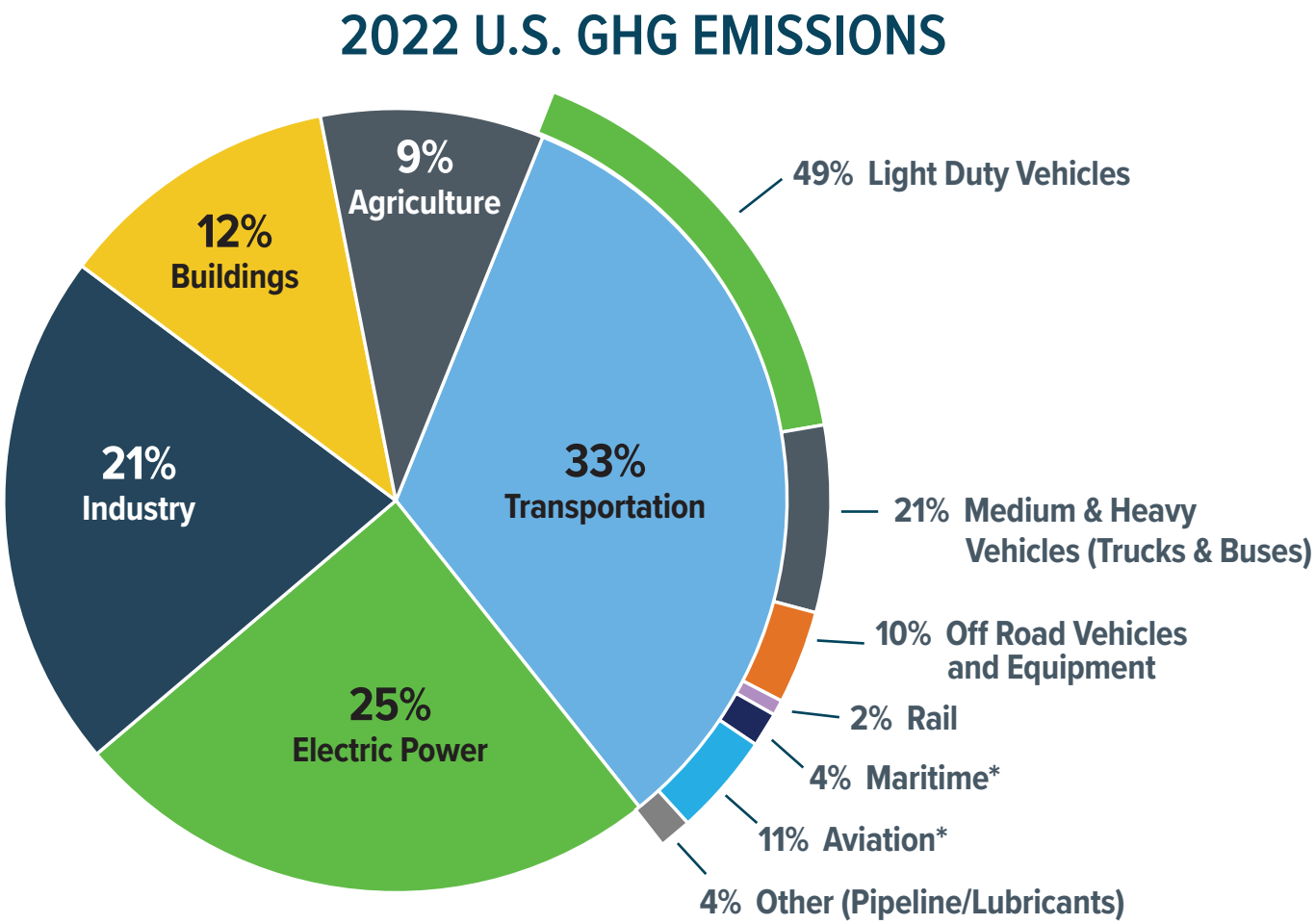


Figure 2: Total 2022 U.S. GHG emissions with transportation and mobile sources breakdown. Data derived from the EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks.

Half of transportation emissions are from light duty vehicles (LDVs), which include cars, SUVs, and pick-up trucks. Twenty-one percent are from medium- and heavy-duty vehicles (MHDVs), which include freight trucks, delivery and work vans, trash trucks, and buses. The remainder are from aviation, marine, rail, pipelines, and off-road mobile sources (tractors, bull dozers, excavators, etc.).

a This figure includes mobile source emissions in the off-road category and fuels for international travel. It does not include emissions from producing and refining fuels, manufacturing and maintaining vehicles, or constructing transportation infrastructure.

The majority of transportation GHG emissions (97 percent) are carbon dioxide ($CO_2$) from burning fossil fuel. The remainder are hydrofluorocarbons (HFCs) from air conditioning or refrigeration systems, and methane ($CH_4$) and nitrous oxide ($N_20$), which are byproducts of combustion.[11]

Different modes of transportation have different emissions intensities (measured as GHG emissions per mile traveled). A Federal Railroad Administration (FRA) analysis determined that passenger travel by rail or bus had substantially lower operational GHG emissions than single-occupancy vehicles or air.[12] On the freight side, rail and maritime GHG emissions per ton-mile are substantially lower than those from trucking.[13, 14]

GHG emissions from freight transportation across all modes represents 31 percent of total transportation emissions. Freight emissions grew five times as much as passenger emissions in the U.S. between 1990 and 2021.[b] The growth has been entirely led by increases in freight trucking, which grew 83 percent during that same period (see Figure 3).

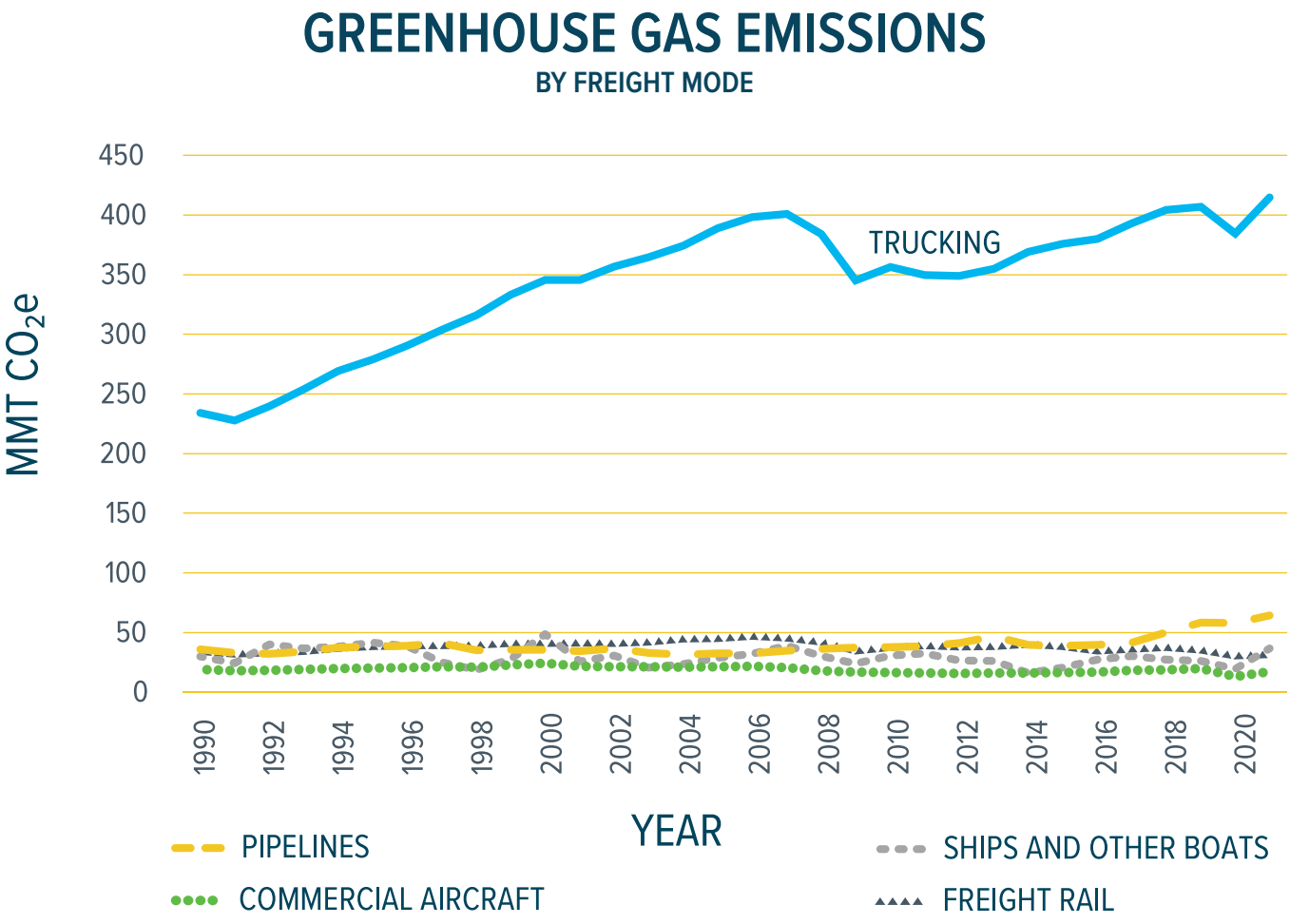


Figure 3: GHG emissions by mode of freight transport, 1990-2021. (Tailpipe only.) [15]

b GHG emissions from domestic freight transportation in the US grew by 59 percent between 1990 and 2021, compared to a 12 percent increase in passenger travel GHG emissions. Calculated from https://www.bts.gov/browse-statistical-products-and-data/freight-facts-and-figures/us-greenhouse-gas-emissions-domestic.

Life-cycle Emissions: The transportation sector depends on an array of supporting processes that produce additional GHG emissions beyond tailpipe emissions from fuel combustion. These include the production and distribution of fuel, manufacture of vehicles, and construction and maintenance of transportation infrastructure (also called embodied carbon). These processes are not included in the U.S. transportation sector GHG estimates in Figure 2 because they fall under the industry and electric power sectors. However, they are important elements of the transportation life-cycle and must be taken into account to decarbonize the sector. As shown in Figure 4, tailpipe emissions make up most emissions, but these other emissions are significant. Life-cycle emissions for ships, aircraft, rail, public transportation, and other vehicle types are also available and similarly show tailpipe as the largest component of emissions, but not the only significant category.[16,17]

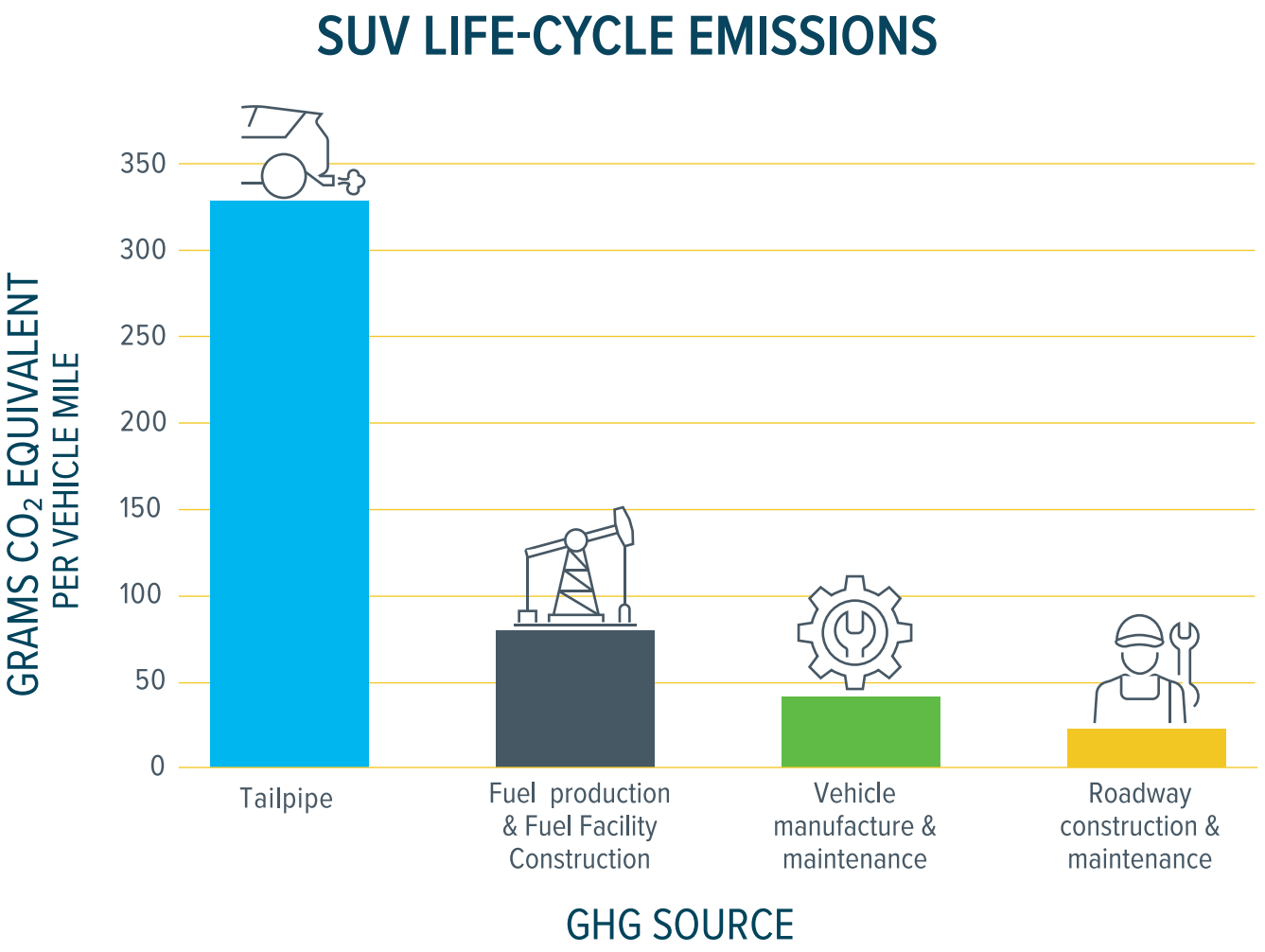


Figure 4: Life-cycle GHG emissions for a small SUV with a fuel economy of 26.5 miles per gallon. This chart uses an SUV to illustrate passenger vehicle life-cycle emissions because they represent the largest share of new car sales in the United States.[18] The life-cycle analysis was conducted by Argonne National Laboratory using the R&D GREET model.[19]

## 1.3 GHG Emissions Projections

The Energy Information Administration (EIA), an independent statistical agency under the U.S. Department of Energy, publishes a reference case in its Annual Energy Outlook (AEO) that serves as a helpful baseline projection. The reference case assumes that no new policies are put into place beyond those existing at the time of the analysis. The 2023 AEO finds that total U.S. energy related $CO_2$ emissions will fall 25 percent by 2030, a 38 percent drop below 2005 overall emissions levels. The AEO finds that emissions reductions will be driven by increased electrification, equipment efficiency, and zero-carbon electricity generation. However, longer-term projected growth in U.S. transportation and industrial activity, with associated growth in emissions from those sectors, will offset some of the emissions reductions. AEO projections show a steady increase in U.S. passenger vehicle-miles traveled, growing 23 percent between 2022 and 2050, with LDV GHG emissions falling through early 2040s as a result of fuel economy improvements and greater deployment of electric vehicles, including as a result of the clean vehicle and alternative fuel refueling property tax credits in the Inflation Reduction Act (IRA). However, the AEO reference case then shows transportation GHG emissions increasing until 2050 due to increasing vehicle miles traveled for both passengers and freight.[20] Since it only includes policies in place at the time of the analysis, the 2023 AEO does not include the updated EPA vehicle GHG regulations, which will reduce emissions further.

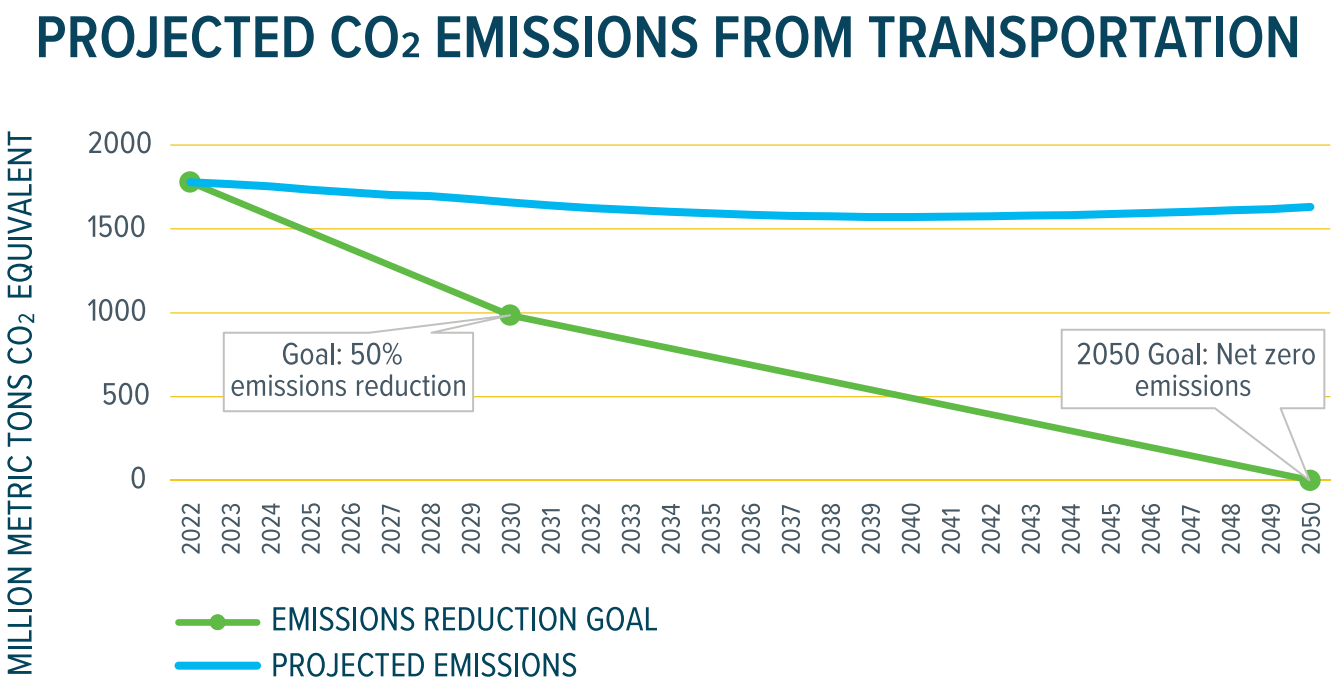


Figure 5: Transportation $CO_2$ emissions, 2022-2050 (AEO Reference Case). 2030 and 2050 emissions reduction goals extrapolated from economy-wide goals (reduction from 2005 levels). Sources: U.S. Energy Information Administration, Annual Energy Outlook 2023; The Long-Term Strategy of the United States, 2021.

While the AEO reference case provides a useful, conservative baseline, the 2023 Voluntary Supplement to the U.S. Fifth Biennial Report provides a deeper dive into emissions reductions that may be possible with BIL, IRA and other recent policies.

That report models a 2023 Policy Baseline showing economy-wide GHG emission reductions of 33 to 41 percent below 2005 levels in 2030, putting the U.S. closer to its 50-52 percent reduction target.

It shows transportation GHG emissions declining to 12 to 25 percent below 2005 levels in 2030 and 20 to 35 percent below 2005 levels in 2035.

In some of these model scenarios, transportation sector emissions would already be within the range of the Long-Term Strategy (LTS) pathways in 2030, but in most scenarios additional measures would be needed to achieve the 2030 target and then drive additional reductions consistent with the long-term pathways.

The future level of transportation GHG emissions will also depend in part on how States and metropolitan regions spend the funds from BIL.

A study conducted by the Georgetown Climate Center found that if States prioritize using their highway formula funding for maintenance of existing roads and low-carbon transportation strategies such as electric vehicle charging, transit, rail, and active transportation infrastructure, emissions are projected to decrease by an additional 1.3 percent below the study's baseline emissions pathway through 2032. On the other hand, if States prioritize highway expansion, emissions are expected to increase 1.6 percent by 2032.[21]

These studies underscore the importance and challenges of reducing emissions from the transportation sector.

## 1.4 U.S. Blueprint for Transportation Decarbonization

The Blueprint provides a whole-of-government framework to transform the transportation sector and reduce emissions. Meeting our emissions reduction goals requires action from DOT along with other federal agencies, state and local governments, and private sectors, including businesses, nonprofits, and individuals.

Transportation GHG emissions are the result of three main factors (see Figure 6):

1. The total amount of activity (i.e., the distance and volume of travel)
2. The energy intensity of the transportation options (i.e., energy per mile traveled)
3. The carbon intensity of the fuels used to provide that energy

# DECARBONIZATION BLUEPRINT STRATEGIES

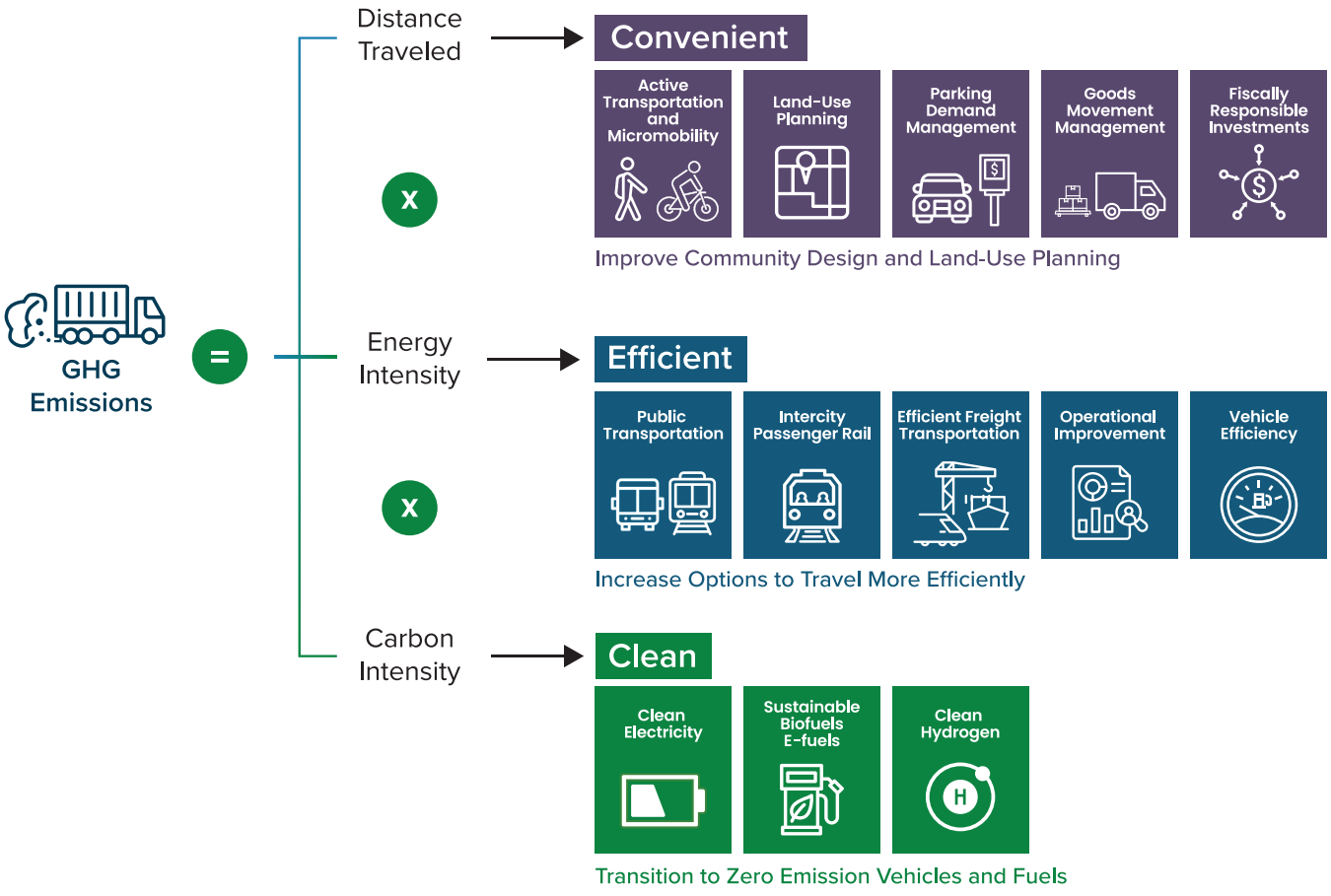


Figure 6: The Decarbonization Blueprint strategies of Convenient, Efficient, and Clean work to address the three main drivers of transportation emissions: activity, energy intensity, and carbon intensity.

The Decarbonization Blueprint provides three key strategies that directly address each of these factors to achieve decarbonization. These strategies are to **increase convenience, improve efficiency,** and **transition to clean options**.[22] These strategies must be implemented in concert to achieve the full vision of a clean, safe, secure, accessible, affordable, equitable, and decarbonized transportation system for everyone. Decarbonizing the transportation sector will involve:

**Increasing convenience** by implementing system-level design solutions that prioritize access and proximity to work opportunities, community services, and other destinations to reduce unnecessary or excess movement of people and goods. All levels of government can deploy strategies to increase convenience such as:

- Supporting active transportation and micromobility
- Improving land-use planning and transportation systems design

- Parking Demand Management
- Fiscally responsible transportation investments
- Goods movement management, such as strategic warehouse siting and routing
- Utilizing data, tools, research, and technology

**Improving efficiency** by providing options to enable shifts to more efficient vehicles and transport modes like transit, rail, marine, walking/biking, or new mobility solutions. More efficient mobility options offer better access to services and reduce reliance on energy-intensive modes of transport. Actions include:

- Improving public transportation
- Improving passenger rail transportation
- Investments in freight efficiency
- Improvements in the operation of passenger and freight transportation systems
- Improvements in the energy efficiency of vehicles

**Transitioning to clean options** by deploying zero-emission vehicles and fuels for all passenger and freight travel modes. This includes light-duty vehicles, commercial trucks, buses, off-road vehicles (such as agricultural and construction equipment), aircraft, locomotives, maritime vessels, and pipelines. Actions include:

- Supporting adoption of zero-emission vehicles, such as electric vehicles (EVs) running on electricity from wind and solar
- Supporting development of sustainable and lower carbon fuels and related infrastructure
- Developing supply chain and workforce to produce and maintain zero-emission vehicles

The Blueprint focuses on tailpipe emissions, since they account for the majority of transportation life-cycle emissions, and emissions from vehicle and infrastructure cycles are generally accounted for under the industry sector. However, the Blueprint recognizes the imperative to address full life-cycle emissions. Actions to reduce these emissions include:

- Using low carbon construction materials and methods
- Deploying renewable energy generation
- Enabling transmission of renewable energy sources along transportation corridors
- Charging electric vehicles during off-peak times
- Procuring vehicles manufactured and maintained with less carbon intensive materials
- Examining maintenance activity cycles to reduce GHG emissions from repairing, supporting, and maintaining transportation infrastructure
- Reducing GHG in sustainable transportation fuels production, such as Sustainable Aviation Fuels (SAF) and hydrogen

## 1.5 All Three Strategies are Critical

All three strategies in the Blueprint (increasing convenience, improving efficiency, and transitioning to clean options) are critical to reaching U.S. decarbonization goals.

Historically, increases in driving and goods movement have cancelled out the GHG emissions benefits of improved fuel economy in the US.[23] Focusing entirely on vehicle electrification without investing in strategies to meet household needs without long vehicle trips runs the risk of repeating this pattern.

Numerous studies find that reducing travel demand will be necessary to achieve significant transportation sector decarbonization.[24] State-level analysis in Minnesota, California, and Hawaii also demonstrate that while EV adoption is a cornerstone of emissions reductions, more action is needed to meet state

climate goals.[25] As one study put it, "a strategy focused solely on what cars we drive is incomplete."[26]

Figure 7 shows in the gray line with triangles a scenario in which electric vehicles are rapidly adopted and account for 80 percent of LDV vehicle miles traveled (VMT) by 2050. It also assumes a zero-carbon electricity grid by 2035. Even under this scenario, LDV GHG only barely reaches the 80 percent reduction mark. The dashed gray line shows that reducing VMT by 10 percent below current levels (instead of the 20 percent business as usual growth) drives emissions downward more rapidly and deeply, resulting in significantly lower cumulative emissions over time. If electric vehicle adoption and fleet turnover are slower, or it takes longer to decarbonize the electricity grid, VMT reductions are even more important. The dashed yellow line shows a scenario with 20 percent electric LDV VMT by 2050, consistent with the U.S. Department of Energy (DOE)'s reference, or baseline, scenario. The yellow line with hatch marks shows the impact of a 10 percent reduction in VMT below current levels, consistent with policy scenarios with more mixed-use development and public transportation investment.

In addition to reducing tailpipe GHG, increasing the convenience and efficiency of the transportation system also reduces life-cycle emissions. Less reliance on driving reduces the need for roadway construction and maintenance, meaning lower emissions from pavement production and construction vehicles. It also reduces upstream emissions from extracting and refining fuels. With convenient options to reach destinations by public transit or on foot or bicycle, households will not need as many vehicles, cutting emissions from vehicle manufacture and maintenance.

Focusing entirely on vehicle electrification without investing in strategies to improve the convenience and efficiency of the transportation system could continue a trend of increased driving and goods movement that undermine the GHG emissions reduction benefits of improved fuel economy and electrification. The U.S. will not be able to decarbonize the transportation sector by midcentury without addressing increased demand for vehicle travel. By providing Americans options to use more efficient modes, such as public transportation and rail, we may slow or reverse VMT growth. Making vehicles more efficient and encouraging shifts to more efficient modes reduces the demands on the electric grid and expansion of renewable energy generation necessary to power EVs. For example, a recent study found that electricity demand could be reduced by up to 800 TWh in 2050 by effectively implementing efficiency and convenience strategies[27]. As such, the convenience and efficiency strategies in the Blueprint that provide options and incentives to reduce VMT are very important to ensure the U.S. can more easily supply decarbonized energy to the transport sector and the economy as a whole.

The Blueprint strategies of increasing convenience and improving efficiency enable households to meet their mobility needs while reducing vehicle miles travelled. Reforming zoning to allow for compact mixed-use development, investing in frequent and high-quality public transit service, and providing safe walking and biking routes means shorter, more efficient trips and lower GHG emissions. For instance, a study of three high growth U.S. metropolitan areas found that local zoning reforms to accommodate housing growth along public transportation corridors and on underutilized urban land closer to the core would reduce VMT by up to 13 percent and GHG emissions by up to 14 percent.[28] In addition, providing incentives to reward travelers for finding alternatives to driving can be very effective, according to FHWA studies.[29] [30] [31]

Efficiency strategies are critical not only to passenger travel but to the freight sector as well. For much of the freight sector, switching to battery electric vehicles is more challenging given the weight of the cargo and the

## PASSENGER VEHICLE GREENHOUSE GAS EMISSIONS SCENARIOS[A]

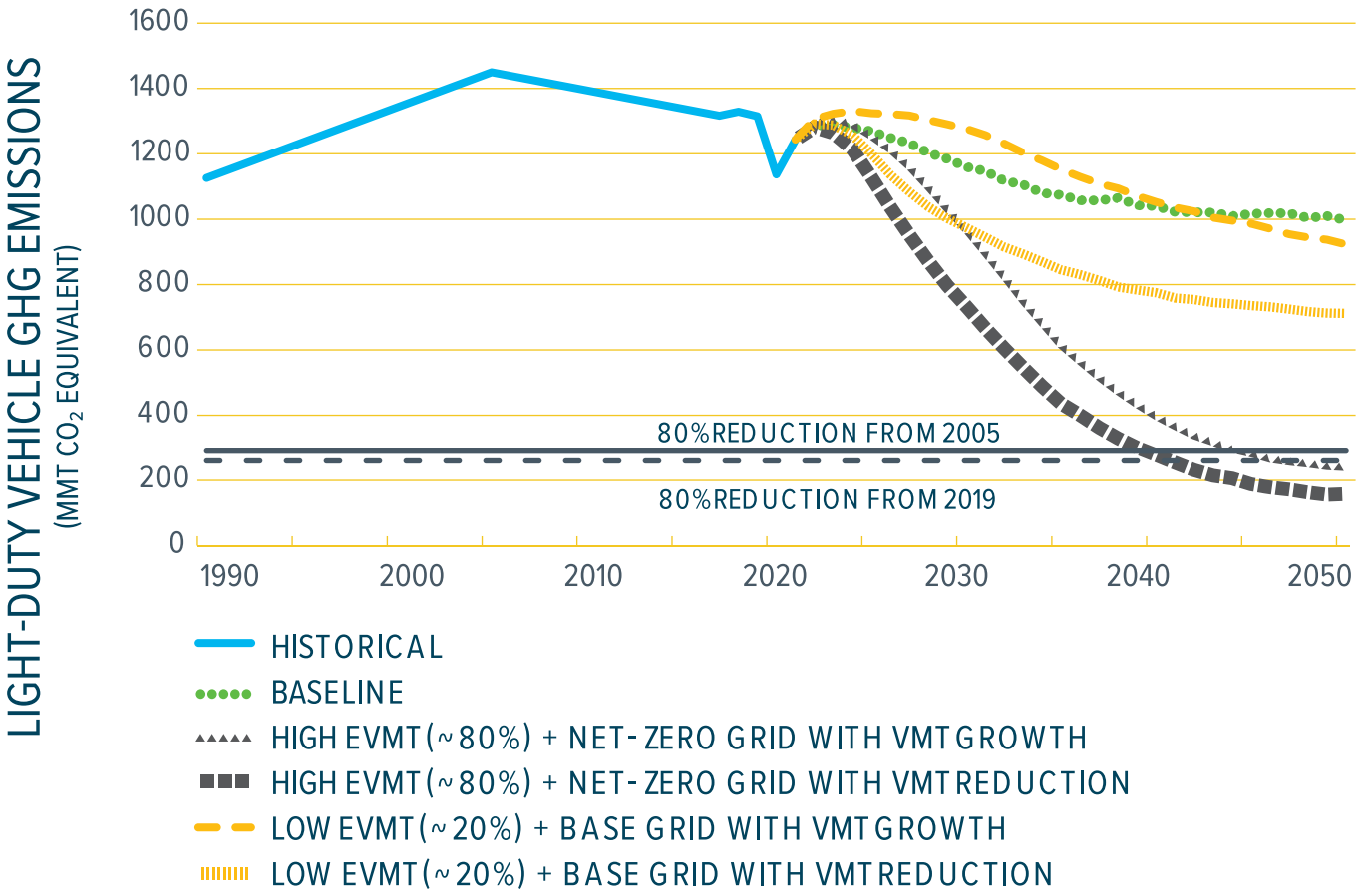


Figure 7: GHG emissions scenarios depend on EV adoption as well as VMT change. (Source: Hoehne, C., Muratori, M., Jadun, P., Bush, B., Yip, A., Ledna, C., Vimmerstedt, L., Podkaminer, K. and Ma, O., 2023. Exploring decarbonization pathways for USA passenger and freight mobility. Nature Communications, 14(1), p.6913.)

distances traveled. Zero emission freight trucks such as hydrogen fuel cell and battery electric are under development for freight movement but are not as advanced in deployment for freight as battery electric is for light duty vehicles. As such, efficiency options are all the more important.

Shifting freight to more energy efficient modes such as rail and maritime can reduce emissions substantially. An analysis of rail and ocean-going vessels in California found that their life-cycle GHG emissions per ton mile are 78 percent and 82 percent lower than trucking emissions, respectively.[32] A separate study found that barge GHG emissions are 89 percent lower per ton mile than trucking.[33]

Research also shows that data-driven operational efficiencies at ports can reduce GHG emissions by 22 percent while at the same time lowering shipping costs.[34]

a Scenarios modeled using TEMPO: https://www.nrel.gov/transportation/tempo-model.html; Greenhouse gas (GHG) emissions are for passenger light-duty vehicles (LDVs) including private auto, Mobility as a Service, and motorcycles; VMT = vehicle miles traveled; eVMT = electrified miles traveled. Each trajectory shows mean emissions across scenarios extracted from 2,000 simulations exploring decarbonization pathways; Scenario VMT change and eVMT calculated as mean trend from 2040-2050 across at least 12 simulations each; Electric vehicle (EV) WTW emissions consider bounding electricity generation scenarios of a base grid (-46% in 2050) and net-zero by 2035 grid; Baseline is aligned with Annual Energy Outlook 2019 Reference and assumes low EV adoption and ~20% VMT growth by 2050; Historical emissions (derived from EPA-420-F-23-016) and Baseline emissions assume a well-to-tank factor of 1.18 fossil fuels

# EXAMPLE STRATEGIES TO IMPROVE TRANSPORTATION CONVENIENCE

## Smart Growth

Smart growth strategies promote vibrant communities and increased density through mixed land uses, while preserving open space. This can result in a significant reduction in VMT as high as 5 to 20 percent, as more daily destinations are easily accessible by walking, biking, and transit.

## Complete Streets

Redesigning streets for all users and enhancing the safety of bike lanes and sidewalks creates more options for all and reduces the need for car-based trips.

## Transportation Demand Management

This strategy includes adding High Occupancy Vehicle (HOV) lanes, "cash out" programs for employee parking spaces, employer-sponsored transit passes, carpooling, and more. Using strategies like these, Seattle recently reduced their single occupancy vehicle use to only 25% of trips.

## Pricing

Congestion pricing, gas taxes, and fees for driving each have their own advantages. Transportation can also be 're-priced' in an equitable manner to save travelers money while encouraging more efficient travel choices, including by making prices such as for insurance mileage-based and by unbundling parking from housing rents. Fees for driving have been shown to have the largest impact with an estimated 15 percent VMT reduction linked to a $.25 per mile tax in a regional Massachusetts study.

## Fix Existing Highways Before Building New Ones

Though highway expansion may appear to decrease congestion, it has been shown to induce demand in the long-term, as drivers become reliant on more lanes instead of traveling by other means or moving to denser areas. Prioritizing maintenance and efficiency of existing highways over highway expansion projects avoids inducing additional driving and emissions.

Finally, while all three strategies improve air quality, increasing convenience and efficiency have additional co-benefits, including improving safety, equity, health, and quality of life. Public transit and walking and biking networks create more and safer access to opportunity for those who cannot drive, such as the young, the elderly, and people with disabilities, as well as those who can't afford personal vehicles. American households spend $11,000 per year on average on transportation-related costs.[35] Greater efficiency and convenience can reduce that transportation cost burden.[36] Further, convenient, multimodal transportation systems and compact mixed-use development can lead to more vibrant, walkable communities. Walking, biking, and other forms of active transportation also have positive health benefits. Finally, allowing more development in neighborhood centers, or allowing for the creation of new mixed-use neighborhood centers via infill development, reduces sprawl and increases community resilience by incentivizing infill development rather than pushing new development into flood and wildfire zones.

# 2 DOT DECARBONIZATION ACTIONS

**DOT is taking action to move towards net zero emissions by 2050. These actions support the Decarbonization Blueprint strategies of increasing convenience, improving efficiency, and transitioning to clean transportation options. Many DOT actions are also cross-cutting and address all three strategies. In addition, DOT is working to reduce transportation infrastructure life-cycle emissions.**

## 2.1 Major Cross-cutting Actions

### INTEGRATING CLIMATE CONSIDERATIONS INTO NEPA

DOT and all federal agencies are statutorily obligated to consider the environmental impacts of projects receiving federal funding through the National Environmental Policy Act (NEPA) process. In January 2023, the Council on Environmental Quality (CEQ) issued interim guidance to assist agencies in analyzing GHG and climate change effects of their proposed actions under NEPA.[37] According to the guidance, NEPA reviews should quantify proposed actions' GHG emissions, place GHG emissions in appropriate context, disclose relevant GHG emissions and relevant climate impacts, and identify alternatives and mitigation measures to avoid or reduce GHG emissions. DOT is using funds from the Inflation Reduction Act allocated to improve permitting to develop departmental guidance and tools consistent with CEQ's guidance.

### CARBON REDUCTION PROGRAM

The BIL established the Carbon Reduction Program (CRP) to support state and local efforts to reduce GHG emissions. The program provides $6.4 billion in formula funding to states for projects designed to reduce emissions. States are required to prepare Carbon Reduction Strategies identifying projects and strategies to reduce transportation GHG emissions. States submitted the first round of these Strategies in November 2023. They must be updated every four years. States are encouraged to use CRP funding for projects that support the Strategies. States are using CRP funds for a variety of projects to reduce emissions, such as:

- Intelligent Transportation System and Traffic Management Center (Wyoming)
- Bicycle and pedestrian paths (Alabama)
- Modernized traffic signals (Michigan)

### INTEGRATING CLIMATE CHANGE CONSIDERATIONS IN DISCRETIONARY GRANT PROGRAMS

Many of DOT's discretionary grant programs – such as Rebuilding American Infrastructure with Sustainability and Equity (RAISE), the Nationally Significant Multimodal Freight & Highway Projects program (INFRA), the Mega Grant Program, and the Port Infrastructure Development Program – include criteria to prioritize projects that advance climate change goals. DOT has developed a Checklist for a Strong Climate Change Mitigation, Adaptation and Resilience Grant Application to help applicants develop strong grant applications that address climate change.

### BROAD ELIGIBILITIES FOR GHG REDUCTION STRATEGIES IN GENERAL FORMULA FUNDING PROGRAMS

DOT's formula programs have broad eligibilities and can be used to fund projects that reduce GHG emissions. Because the majority of funding allocated through DOT is formula-based, there are many opportunities for recipients to use annual transportation funding towards climate goals.

## 2.2 Actions towards a Convenient Transportation System

A convenient transportation and land use system supports community design and land-use planning that ensures access to job centers, shopping, schools, entertainment, and essential services near where people live. Convenience means shortened commute times, ability to use public transit and other low-carbon transportation modes, improved walkability and quality of life, and thriving, vibrant communities with plentiful housing options for all. It applies to rural main streets along with urban communities and suburban neighborhoods. Convenience also means optimizing the movement of goods through improvements to supply chains and freight delivery.

### INCREASING CONVENIENCE THROUGH SYSTEM PLANNING

The design of our cities, towns, suburbs, and neighborhoods and investments in transportation infrastructure like highways, streets, bike lanes, and railways heavily influence travel behavior and mode choices, which in turn impacts total miles traveled and resulting emissions. Historical system-level decisions have led to an over-reliance on driving, contributing to poor air quality, outsized GHG emissions from transportation, and significant household expenditures to purchase and maintain private vehicles.[38]

The transportation planning process offers a key opportunity for reducing GHG emissions because it is during this process that states and metropolitan planning organizations (MPOs) determine the vision for their transportation system and which projects to prioritize, including weighing the costs and benefits of expanding either highway systems or low carbon alternatives such as public transit and active transportation networks.

States and MPOs must follow Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) transportation planning regulations to receive federal transportation funds. These regulations require states and MPOs to consider a set of planning factors when developing transportation plans. These factors include two directly related to the Decarbonization Blueprint strategy of increasing convenience:

- "Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns;" and
- "Emphasize the preservation of the existing transportation system."[39]

BIL included several changes to the planning process that provide new opportunities to align investments in transportation and housing.[40] These include provisions for MPOs to consider projects and strategies that promote consistency between transportation improvements and state and local housing patterns; to increase consultation with housing officials and opportunities for comment by affordable housing organizations; and to address the integration of housing, transportation, and economic development strategies through a housing coordination plan.

Figure 8: Integrated land use, transportation, and economic development planning supports vibrant communities where residents can get where they need to go without long car trips. The rural town of Wilson, NC, pictured above, has invested in mixed-use development in its historic downtown, allowing residents to meet multiple needs with fewer car trips. In addition, DOT awarded a $10 million grant to North Carolina DOT to launch on-demand microtransit in eleven communities in the state, including Wilson.
(Photo Credit: discoverwilson.com)

The performance-based nature of the planning process can also be leveraged to reduce GHG emissions. FHWA and FTA planning regulations require that states and MPOs to the maximum extent practicable, must include a description of the anticipated effect of their respective Statewide Transportation Improvement Programs/Transportation Improvement Programs toward achieving their performance targets, linking investment priorities to those performance targets.[41] Many of the strategies that support performance measures on roadway condition and safety, such as fixing existing highway assets before building new ones and investing in public transportation, also help reduce GHG emissions. In November 2023, FHWA finalized a regulation adding a GHG performance measure to measure progress on GHG reduction, better integrate GHG considerations into transportation decision-making, and provide transparency and ensure accountability. Prior to implementation, Federal courts in Texas and Kentucky found that the rule exceeded the Department's statutory authority, and the rule was vacated nationwide. The Biden Administration submitted a notice of appeal in May 2024. Litigation remains ongoing at the time of publication of this report.

DOT provides extensive technical assistance on the transportation planning process through the Transportation Planning Capacity Building Program. This includes assistance to help states and MPOs integrate land use and transportation planning. BIL also contains provisions on coordinating transportation planning with housing planning.

DOT is evaluating travel demand forecasting accuracy and exploring ways to support states in developing more accurate and effective travel demand projections. This will allow for a more complete accounting of emissions from transportation projects.

## INCREASING CONVENIENCE THROUGH ACTIVE TRANSPORTATION

Walking, biking, and rolling—often together referred to as active transportation—are zero-emission forms of transportation that can also improve human health, encourage economic prosperity, and reduce roadway congestion. Americans rely on connected networks for safe and convenient travel by car or plane, yet many lack access to such networks for active transportation. Instead, pedestrians and cyclists often face dead ends, miles without sidewalks or bicycle striping, and other network gaps that make it hard to move conveniently and safely. DOT seeks to alleviate these active transportation barriers. The Fiscal Year 2022-2026 DOT Strategic Plan commits to increasing the percentage of person trips by transit and active transportation modes by 50 percent from 2020 levels, from 4 to 6 percent.

Several DOT programs support the deployment of safe active transportation infrastructure networks that provide convenient transportation options while reducing emissions. Active transportation projects are eligible under multiple general purpose and safety related DOT formula programs. In addition, BIL established the Safe Streets for All (SS4A) discretionary grant program with $5 billion in funding over five years (FY 2022-2026). SS4A funds local initiatives at both the planning and implementation phases to prevent roadway deaths and serious injuries. The Surface Transportation Block Grant (STBG) program includes a Transportation Alternatives set-aside of $7.2 billion to support the delivery of pedestrian and bicycle infrastructure projects. BIL also established the Active Transportation Infrastructure Investment Program (ATIIP), a competitive grant program that will support projects to fill gaps in active transportation networks within and between communities. The program received $45 million in funding for FY23. Additionally, several DOT initiatives support active transportation, such as Every Day Counts, Safe Routes to School, and Complete Streets.

## INCREASING CONVENIENCE THROUGH TRANSIT-ORIENTED DEVELOPMENT

Transit-oriented development means co-locating high-quality transit with housing, economic opportunities, downtown districts, and other key amenities. Transit-oriented development reduces GHG emissions by providing transportation system users with the option to use public transit and active transportation for a greater proportion of their trips, while also reducing the distances between origins and destinations for automobile travel that still occurs.

The FTA Pilot Program for Transit-Oriented Development Planning Grants supports local community strategies to increase transit access and encourage ridership through mixed-use development near public transit. The program helps communities plan for opportunities created near new transit stations, such as affordable housing and convenient connections to economic opportunities and travel destinations.

Figure 9: FTA's Transit-Oriented Development Planning Grant program supported the creation of a Transit-Supportive Development Plan for areas surrounding the planned Chicago Transit Authority (CTA) Red Line extension, including 111th Street and Michigan Avenue.[42] BIL provides a total of $68.9 million in funding for the Transit-Oriented Development Planning Program through 2026, a 38 percent increase over the prior five years of funding. BIL also expanded transit-oriented development project eligibility through the Transportation Infrastructure Finance and Innovation Act (TIFIA) 49 Initiative and the Railroad Rehabilitation & Improvement Financing (RRIF) program.[43]

FTA's Joint Development Guidance enables transit agencies to partner with local governments and the private sector to build transit-oriented development using land purchased or improved with FTA funds. In addition, recent legislation allows transit agencies to transfer land purchased with FTA funds to local government authorities, non-profit organizations, or other third-party entities if it will be used for transit-oriented development and includes affordable housing.[44] This way, the transit agency does not need to retain ownership and does not need to reimburse FTA for any federal interest that remains

in the property. This makes it easier and cheaper for communities to pursue transit-oriented development with affordable housing.

### INCREASING CONVENIENCE THROUGH RECONNECTING COMMUNITIES

Historically under-resourced and disadvantaged communities are disproportionately adversely affected by environmental, climate, and health impacts. DOT is committed to advancing equity, racial justice and environmental justice. This includes addressing national legacies of discrimination in community planning and resources administration.

BIL established the Reconnecting Communities Pilot grant program with $1 billion from FY22-26. It is the first-ever federal program dedicated to reconnecting communities previously cut off from economic opportunities by transportation infrastructure. In FY22, the program awarded $185 million to 45 communities. Many of the awarded projects included new connections for transit, walking, and biking. The IRA established the Neighborhood Access and Equity Grant Program, which provides $3 billion in grants to states and localities, prioritizing disadvantaged communities. In March 2024, DOT announced $3.3 billion in grant awards for 131 projects in 41 states and D.C. through the Reconnecting Communities & Neighborhoods Grant Program.

## 2.3 Actions towards an Efficient Transportation System

Improving transportation efficiency means providing options to enable shifts to more energy efficient vehicles and transport modes. It also means improving the efficiency of operations.

### INVESTMENTS IN PUBLIC TRANSIT

Research shows that public transit saved 63 million metric tons of carbon dioxide equivalent emissions in 2018, which is approximately the equivalent of taking 16 coal power plants offline for a year.[45] Public transportation offers a low-emission alternative to driving and further decreases emissions by enabling denser land development, with less space needed for parking and roadways.

Figure 10: Portland's Aerial Tram connects a light rail station with one of the city's largest employers, Oregon Health & Science University, which is located on top of a 500-foot hill. (Photo Credit: Portland Aerial Tram, http://www.gobytram.com/)

BIL provides $91 billion in guaranteed public transportation funding over five years – the largest investment in transit in American history.[46] DOT and the FTA are working to maximize the impact of this historic investment. The FTA Capital Investment Grants Program funds the construction of new or expanded public transportation.[47] FTA also maintains numerous formula grant programs, many of which were reauthorized or expanded through BIL. These include Formula Grants for Rural Areas, Tribal Transit, State of Good Repair Grants, and Urbanized Area Formula Grants.

Flexible Funding for Transit and Highway Improvements is another DOT policy to reduce emissions by providing mode choice. Many FHWA programs allow recipients to spend funds on public transportation projects and bicycle and pedestrian improvements around bus stops and rail stations. While these activities can be funded through FHWA programs, some state DOTs, cities, and Tribes may not easily be able to make use of these funds for public transportation projects or small-scale safety and access improvements due to processes and requirements more suitable to large-scale highway projects. To remedy this, recipients can transfer, or "flex," funds from FHWA programs to FTA public transportation programs. "Flexing" funds to FTA programs facilitates federal investments at the local level for measurably improving access to low and zero emission travel. From FY 2018 through FY 2022, flexed funds increased overall from year to year, with more than $8 billion total transferred in contract authority from FHWA to FTA. Though most transit agencies focus on traditional transit modes like bus, light rail, and metro systems, FTA has broad authority to fund all modes of public transit. Modes like monorails and people-movers are specifically included in the statute of the Capital Investment Grants Program and are eligible under other FTA programs as well. Incorporation of novel transit modes into existing transit networks can be very effective at providing commuter options and overcoming topography or other challenges (see Figure 9).

## PASSENGER RAIL TRANSPORTATION

BIL provides $66 billion in guaranteed funding to expand FRA programs and rail travel nationwide, with the majority allocated toward Amtrak and the Federal-State Partnership for Intercity Passenger Rail. This $36 billion grant program funds capital projects that expand or establish new intercity passenger rail service, improve performance, or reduce the state of good repair backlog, including privately operated intercity passenger rail service. The FRA Corridor ID program will identify and develop plans for new or improved intercity passenger rail services. Expanded, reliable and convenient nation-wide intercity passenger rail service promotes modal shift to a more efficient mode of transportation and provides access to communities that previously may not have had intercity rail as an option for travel.

DOT is providing funding for the Gateway program, a comprehensive rail investment program that will improve the Northeast Corridor, the most heavily used passenger rail line in the country. The Gateway program involves large rail infrastructure projects between Newark, New Jersey, and Penn Station in New York City. This large, long-term investment will reduce single occupancy vehicle trips on Interstate 95. Rural communities also benefit from investments in passenger rail. A DOT grant to provide passenger rail service for the Gulf Coast provides more options for smaller communities to get access and spur economic development and station area development.

## VEHICLE EFFICIENCY

Fuel economy standards provide a major opportunity to help consumers save money at the pump and reduce harmful emissions. In June 2024, the National Highway Traffic Safety Administration (NHTSA) finalized new Corporate Average Fuel Economy (CAFE) standards for passenger cars and light trucks and new fuel efficiency standards for heavy-duty pickup trucks and vans.

In this final rule, fuel economy will increase 2% per year for model years 2027-2031 for passenger cars, while light trucks will increase 2% per year for model years 2029-2031. These increases will bring the average light-duty vehicle fuel economy up to approximately 50.4 miles per gallon by model year 2031, saving passenger car and light truck owners more than $600 in fuel over the lifetime of their vehicles.[48]

Heavy-duty pickup truck and van fuel efficiency will increase 10% per year for model years 2030-2032 and 8% per year for model years 2033-2035. This will result in a fleetwide average of approximately 35 miles per gallon by model year 2035, saving heavy-duty pickup and van owners more than $700 in fuel over the lifetime of their vehicles.

The Federal Aviation Administration (FAA) is working to develop aircraft and engines that burn less fuel. The Continuous Lower Energy, Emissions, and Noise (CLEEN) program partners with industry to accelerate technological developments that will decrease fuel consumption, emissions, and noise. The Fueling Aviation's Sustainable Transition via Low-Emissions Aviation Technology (FAST-Tech) program provides grants for aviation technologies that will increase aircraft efficiency and reduce greenhouse gas emissions. Additionally, the FAA supports university research on aircraft efficiency through the ASCENT Aviation Sustainability Center.

In February 2024, the FAA released a final rule to reduce carbon pollution emitted by most large airplanes flying in U.S. airspace. The rule requires incorporating improved fuel-efficient technologies for airplanes manufactured after January 1, 2028, and for subsonic jet airplanes and large turboprop and propeller airplanes that are not yet certified.[49]

## RAIL AND MARITIME FREIGHT SHIPPING

Rail and maritime shipping remain a vital part of the U.S. freight cargo system, accounting for 10.8 and 101.5 trillion tonne-kilometers of freight respectively. However, while maritime freight accounted for nearly three times the number of tonne-kilometers as trucks, $CO_2$ emissions from trucks were around four times as much. Truck shipping is similarly about four times more polluting than rail shipping.[50] Therefore, shifting freight transport from trucks to rail and maritime freight will reduce GHG emissions from the transport of goods.

The Consolidated Rail Infrastructure and Safety Improvements (CRISI) Program managed by the Federal Railroad Administration was allocated $5 billion in BIL. The program funds more efficient, lower-emission locomotive purchases. In 2023, the program awarded funds to projects in Maryland, South Carolina, and Washington to purchase battery electric switcher locomotives, proving the availability of this transformative technology and the interest by railroads to purchase zero-emission locomotives. The program encourages multimodal transportation and aims to reduce chokepoints that slow the travel of goods and people while providing a lower-emission method of travel as compared to heavy trucks and personal vehicles.

Figure 11: FRA's Consolidated Rail Infrastructure and Safety Improvements Program awarded funding to the Alaska Railroad Corporation to replace an aging bridge along the main rail route between Anchorage and Fairbanks, AK. (Photo Credit: Alaska Railroad Corporation)[51]

In FY22, FRA announced $570 million in Railroad Crossing Elimination (RCE) Grant Program funding for projects in 32 states. This funding will address more than 400 at-grade crossings nationwide, improve safety, and make it easier to get around railroad tracks. Preventing blocked crossings and collisions improves safety and convenience, reduces emissions from idling, and reconnects communities.

The INFRA program and the Port Infrastructure Development Program (PIDP) provide funding for infrastructure projects that improve the safety, efficiency, or reliability of freight movement. The Marine Highway Program supports maritime freight shipping by developing and broadening crucial shipping corridors, as well as promoting integration with the United States' surface transportation system. The 31 Marine Highways are eligible for Marine Highway Grants and help to move goods quickly and cleanly. The 2022 Marine Highway program awarded 12 grants for a total of $38.6 million to support expansion, modernization, and increased efficiency of marine services including low emissions port equipment and projects that improve freight flow and logistics efficiencies.

At the United Nations Climate Change Conference in November 2022, the U.S. and Canada jointly announced their intention to facilitate the development of a Green Shipping Corridor Network (GSCN) on the Great Lakes St. Lawrence Seaway System as part of the Green Shipping Challenge. Since then, the U.S. Great Lakes St. Lawrence Seaway Development Corporation (GLS) in cooperation with the Canadian St. Lawrence Seaway Management Corporation (SLSMC) have convened two international forums for stakeholders regarding the creation of the GSCN within the Seaway System. The forums supported discussions between governments, ports, operators, and others to accelerate the measurable decarbonization of ports, the shipping sector, and its fuel supply within the Seaway System.

## OPERATIONAL EFFICIENCY IMPROVEMENTS

DOT is pursuing technical innovations to decrease carbon emissions through improvements to operational efficiency. FAA is optimizing aircraft trajectories for reduced fuel use and exploring the optimization of operations to minimize contrail formation and associated climate impacts.

The Federal Motor Carrier Safety Administration (FMCSA) is exploring electronic screening technologies for commercial motor vehicle roadside safety inspections. These electronic screening technologies are expected to decrease the wait time at inspection stations and lead to lower emissions from idling vehicles awaiting inspection.

Initiatives like the Reduction of Truck Emissions at Port Facilities Grant Program, the National Highway Freight Program (NHFP), and the Accelerated Innovation Deployment Demonstration Program have supported technologies that enhance operational and intermodal efficiency at ports. For example, the Reduction of Truck Emissions at Port Facilities Program provides $400 million in competitive funding over five years to reduce truck idling and emissions at ports.

The Pipeline and Hazardous Materials Safety Administration (PHMSA) has advanced and continues to develop rules to reduce emissions by improving the operational safety of pipelines. These rulemakings include the Gas Pipeline Leak Detection and Repair Proposed Rule, the Safety of Gas Distribution Pipelines Proposed Rule, the Safety of Gas Gathering Pipelines: Extension of Reporting Requirements, Regulation of Large, High-Pressure Lines, and Other Related Amendments rule, the Requirement of Valve Installation and Minimum Rupture Detection Standards rule, and the Amendment to LNG Facilities rule under development. Additionally, PHMSA announced it is taking steps to implement new measures which would strengthen its safety oversight of carbon dioxide ($CO_2$) pipelines. PHMSA also issued an advisory bulletin that informs pipeline owners and operators of their responsibility to address hazardous leaks and minimize natural gas releases. This builds on the 2020 Protecting Our Infrastructure of Pipelines and Enhancing Safety (PIPES) Act, which directed pipeline operators to revise plans to address replacement and remediation of pipeline facilities. PHMSA also offers grant funding through the Natural Gas Distribution Infrastructure Safety and Modernization grant program to fund the repair, rehabilitation or replacement of natural gas distribution pipeline systems to improve their safety and efficiency.

PHMSA is also charged with oversight of the existing, and aging, energy pipeline infrastructure and is using $1 billion in BIL grant funds, research investments, regulatory development, and enforcement to incentivize replacement of leak-prone pipe – resulting in greater public safety, reduction of GHG releases and preparation of the infrastructure to transport clean energy.

## 2.4 Actions towards a Clean Transportation System

Transitioning to clean options involves deploying zero-emission and low-carbon vehicles and fuels for all passenger and freight travel modes.

### INFRASTRUCTURE FOR ELECTRIC AND ALTERNATIVE FUEL VEHICLES

Building out a national network of electric vehicle charging stations will help facilitate market shifts to EVs by giving drivers the confidence that they will be able to charge their vehicles when needed. Similarly, alternative fuel availability is critical to transitioning to the vehicles running on those fuels. FHWA is implementing two new programs established under BIL to this end:

- The National Electric Vehicle Infrastructure (NEVI) Formula Program provides $5 billion in formula funding to states to build out a national electric vehicle charging network, an important step towards making electric vehicle charging accessible to all Americans. The program is also funding the repair or replacement of existing chargers that are broken or non-operational.
- The Charging and Fueling Infrastructure (CFI) Discretionary Grant Program provides $2.5 billion in competitive funding to states and local governments to deploy EV charging and hydrogen, propane, and natural gas fueling infrastructure along designated alternative fuel corridors and in communities.

EV chargers for freight trucks are eligible under the NEVI and CFI programs so long as they are publicly accessible.

In February 2023, FHWA issued a regulation requiring that federally funded electric vehicle chargers be

interoperable, compatible, and functional at least 97 percent of the time. The regulation also requires that federally funded chargers make data on their location, availability, and pricing accessible to third party software developers, free of charge, to enable drivers to easily access this information. This regulation provides reliable expectations for EV travel across the United States[52].

BIL created the Joint Office of Energy & Transportation, which is run by the DOT and the DOE. The Joint Office offers a unique opportunity to deliver the technical assistance that state, Tribal, and local transportation agencies need to deploy electric vehicles and charging infrastructure. DOT is tracking performance measures on progress towards deploying electric vehicle charging infrastructure under BIL as part of its priority goals.

FHWA designates Alternative Fuel Corridors to support installation of EV chargers and alternative fueling stations along major national highways. FHWA updates and redesignates the corridors on an annual basis by soliciting nominations from state and local officials. This process responds to the rapidly evolving state of vehicle technology, increased market adoption of EVs and alternative fuel vehicles, and installation of alternative fuel infrastructure. Both the NEVI and CFI programs prioritize locating charging and fueling facilities along Alternative Fuel Corridors.

In March 2024, the Joint Office of Energy and Transportation released a strategy to accelerate zero-emission freight infrastructure deployment. Concurrently, FHWA designated national freight electric vehicle corridors.

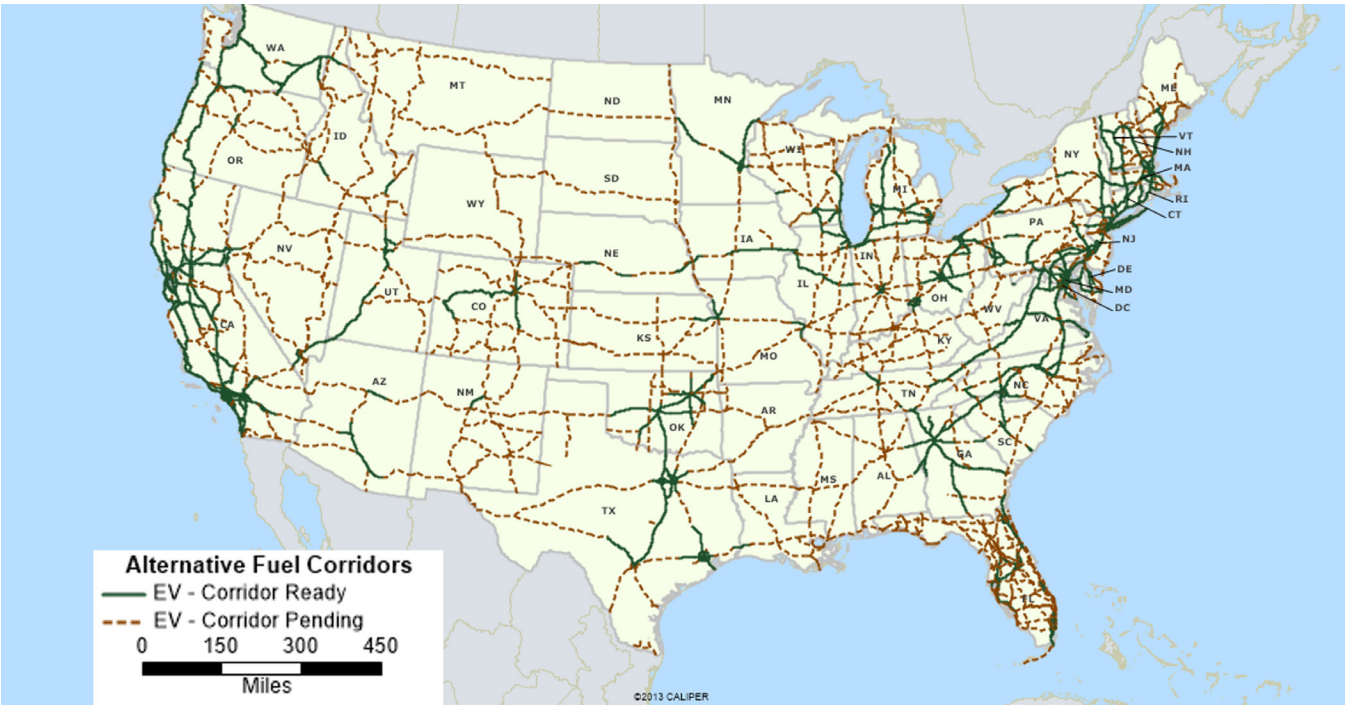


Figure 12: Map of EV corridors as of January 23, 2023, under FHWA's Alternative Fuel Corridors Program.

## ZERO-EMISSION TRANSIT VEHICLES

FTA is advancing efforts to transition the nation's transit fleet to zero-emission vehicles that are made in America. It has set a target of increasing the number of zero-emission bus vehicles in the national transit fleet by 450 percent to 7,500 vehicles by 2030. Table 1 shows the expected GHG emissions from transit if this target is met.

## TABLE 1: TRANSIT GHGs (ALL UNITS ARE MMT $CO_2e$).[C]

| | *Estimated Total U.S. Transit GHGs, 2018* | *Projected Total U.S. Transit GHGs, 2030* |
|---|---|---|
| **Bus** | 6.77 | 6.14 |
| **Commuter Rail** | 1.84 | 1.41 |
| **Ferry** | 0.52 | 0.52 |
| **Heavy Rail** | 1.31 | 0.33 |
| **Light Rail** | 0.39 | 0.10 |
| **Van** | 1.49 | 1.49 |
| **TOTAL** | **12.32** | **9.99** |

FTA has numerous funding programs, resources, and tools to support the transition to electric and zero emission transit vehicles. Discretionary grant programs, including the Low and No Emission Vehicle Competitive Program and the Buses and Bus Facilities Competitive Program, provide funding to states and transit agencies for the purchase or lease of zero-emission and low-emission transit buses and supporting facilities.

## SUSTAINABLE MARITIME FUELS AND PORTS

Decarbonizing maritime shipping will require vessels to use zero and near-zero GHG emission fuels and technologies that are currently in development. To support the development of sustainable maritime fuels, the Maritime Administration (MARAD) plans to engage with stakeholders, support pilot and demonstration programs for alternative fuels and ship construction, and lead on domestic and international low and zero-carbon fuel standard ambitions. DOT, in consultation with DOE and the Environmental Protection Agency (EPA), is developing a cross-government ports decarbonization strategy that attempts to align funding efforts, as appropriate and allowable under the law, from various DOT, EPA, and DOE funding programs.

The Port Infrastructure Development Program awarded $653 million to fund 41 projects in 22 states and one territory in 2022 and included projects that reduce GHGs, support the deployment of clean energy, and avoid adverse environmental impacts. These include projects that procure battery electric yard equipment and associated charging infrastructure, installation of microgrids and solar panels, and the development of scalable plans for transitioning the port and local maritime industry to zero-emission technologies.

C 2030 numbers based on the Transit Cooperative Research Program (TCRP) Research Report 226 Scenario Tool, assuming that 10 percent of US transit buses are electric in 2030 and that the carbon intensity of the grid declines by 75 percent. This estimate does not include GHG emissions embodied in the existing vehicles and infrastructure, nor does it include GHGs associated with construction of new transit systems.

Figure 13: Electric cargo handling equipment at the Port of Oakland. (Photo Credit: Port of Oakland).

## SUSTAINABLE AVIATION FUELS (SAF) AND AIRPORTS

Emissions from the aviation sector comprised 11 percent of U.S. transportation sector emissions in 2022.[53] In recognition of the need to reduce emissions and address climate change, FAA released the United States Aviation Climate Action Plan in 2021.[54]

Sustainable Aviation Fuels (SAF) are liquid fuels made from biomass or waste materials that can be used with existing aircraft and have significant life-cycle GHG emissions reductions compared to petroleum-based jet fuel. SAF production and availability is limited today, with 2022 domestic uplift of roughly 15.8 million gallons, compared to annual jet fuel uplift by domestic airlines of roughly 17.5 billion gallons. To reduce costs, enhance sustainability, and expand production and use of SAF, the White House announced the SAF Grand Challenge in September 2021. This announcement included a Memorandum of Understanding signed by the Departments of Transportation, Energy and Agriculture , establishing a multi-agency effort to implement the SAF Grand Challenge. The SAF Grand Challenge has goals of supplying at least 3 billion gallons of SAF per year by 2030 in the United States and, by 2050, sufficient SAF to meet 100 percent of domestic aviation fuel demand, projected to be around 35 billion gallons per year. IRA established new tax credits for blending or producing SAF and provided funding for the Fueling Aviation's Sustainable Transition competitive grant program, which has an element focused on SAF deployment (FAST-SAF). FAST-SAF will provide $244.5 million in grants to support the build out of infrastructure

projects located in the United States related to SAF production, transportation, blending, and storage.

The United States is also a participant in the first phase of the International Civil Aviation Organization's (ICAO) global market-based measure to address the carbon dioxide emissions from aviation, known as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). CORSIA would require airline operators to reduce their emissions on certain international routes to a defined baseline, which they could do through CORSIA-eligible fuel, which include SAF and Lower Carbon Aviation Fuels (LCAF), or through CORSIA-eligible carbon offsets. As an international compliance program with obligations that can be met through the use of SAF, CORSIA is an important program for encouraging broader SAF adoption globally.

FAA's Office of Airports administers several grant programs that reduce GHG emissions from airport operations. The Voluntary Airport Low Emissions (VALE) Program funds projects such as gate electrification, charging stations for electrical ground support vehicles, geothermal systems, and solar hot water systems at commercial airports that are in "non-attainment" or "maintenance" areas under the Clean Air Act. The Zero Emission Vehicle (ZEV) Program provides grants to replace or convert on-road vehicles at airports to zero-emission vehicles. The Energy Efficiency Program provides funding for energy assessments to identify and implement energy reduction measures to reduce energy consumption across all airport operations. Once an audit has been completed, sponsors are eligible for projects including light-emitting diode (LED) lighting, renewable energy systems (e.g., solar), HVAC upgrades, or other energy efficiency measures.

## CLEAN FUELS TRANSPORT VIA PIPELINES

While pipelines primarily transport fossil fuels today among nearly 3.4 million miles of oil and gas pipelines, for decades PHMSA has also regulated the safe design, construction, operations, and maintenance of other pipelines such as pipelines that transport $CO_2$. Most of the approximately 5,300 miles in use today have been used for enhanced oil recovery. Pipelines can also be used to transport $CO_2$ to injection wells for carbon capture and sequestration and to other end users. In 2022, PHMSA established newer, stronger requirements for carbon dioxide pipeline remote and automatic shut off valves. PHMSA has announced plans to initiate a rulemaking to revise the Federal Pipeline Safety Regulations (PSR; 49 Code of Federal Regulations (CFR) Parts 190–199) in response to the anticipated significant expansion of pipeline infrastructure transporting carbon dioxide in all phases[55]. The revisions will ensure any expansion of carbon dioxide pipeline infrastructure occurs in a manner that is transparent, safe, equitable, and protective of the environment as it supports the GHG reduction potential of carbon capture and sequestration efforts. A status of target timing for the rule is available via PHMSA's PIPES Act Web Chart. PHMSA is also conducting research to strengthen safety of $CO_2$ pipelines.

Pipelines are also used to transport hydrogen via approximately 1,600 miles today, concentrated primarily in the Gulf Coast region to support petroleum refining. In the future, pipelines could also be used for other sustainable liquid fuels like SAF. PHMSA is conducting research associated to strengthen pipeline safety of hydrogen pipelines.

## 2.5 Life-cycle Emissions of Infrastructure

DOT is working to reduce GHG emissions from constructing and maintaining transportation infrastructure. As transportation agencies are large buyers of asphalt and concrete, their decisions can influence the industry considerably. In 2022, DOT issued a Buy Clean Policy Statement, committing the Department to prioritizing actions to reduce embodied carbon emissions from transportation projects. DOT is implementing the Low Carbon Transportation Materials Program, which the IRA established and provided with $2 billion for grants to states, local governments, MPOs, and others for transportation construction materials and products that have substantially lower embodied carbon than industry averages. DOT expects to release a notice of funding opportunity announcement for the Low Carbon Transportation Materials Program in early 2024.

Tools such as FHWA's Life-cycle Assessment (LCA) Pave Tool and the Infrastructure Carbon Estimator help state and local transportation agencies analyze strategies to reduce embodied carbon in pavements and a range of transportation infrastructure types, respectively. FTA's Transit Greenhouse Gas Emissions Estimator helps transit agencies evaluate GHG emissions from the construction, maintenance, and operations phases of different types of public transportation projects. These tools can be used to support decision-making under the transportation planning process and NEPA as well as in project design and materials selection.

DOT is also providing technical assistance on the use of Environmental Product Declarations (EPDs), which quantify the carbon footprint and other environmental impacts of materials. FHWA launched a Climate Challenge in 2022, providing technical assistance and $7.1 million in funding to 25 state DOTs and two local agencies to quantify the environmental impacts of pavements on 35 transportation projects using LCAs and EPDs. FHWA is also helping deploy EPDs under its Every Day Counts innovation program. Finally, DOT will continue to conduct research on green procurement methods and practices such as increased use of reclaimed, recycled materials, and industrial byproducts.

Figure 14: Using warm mix asphalt instead of standard practices produces 37 percent lower GHG emissions, according to FHWA's Infrastructure Carbon Estimator. (Photo credit: PennDOT).

**LEADING BY EXAMPLE**

## Decarbonization of DOT Buildings, Fleets, and Operations:

DOT is pursuing decarbonization at its facilities across the country. Informed by the actions and goals laid out in Executive Order 14057 and an agency-wide commitment to reducing emissions, DOT is poised to achieve 100 percent carbon free electricity by 2030 and committed to purchasing only electric light duty vehicles by 2027 before achieving all-electric vehicle purchases by 2035.

Future design and modernization of DOT facilities will also address national climate change goals. In its **2022 Sustainability Plan**, DOT required all major construction or modernization efforts to plan for net-zero emissions. The FAA launched a Sustainable Tower Design Initiative, selecting an architecture and engineering firm to design air traffic control towers of the future. The tower design will be all-electric, thermally efficient, constructed from high-recycled steel and metal products, and will include ground source heating-cooling where available.

### CLEAN ENERGY PROJECTS IN THE RIGHT-OF-WAY

The U.S. will need to increase the production of renewable energy to decarbonize the electricity sector and support a transportation sector increasingly powered by clean electricity. Land along highways and rail, also called right-of-way (ROW), can be part of the solution by hosting solar arrays in areas where it is safe to do so. Rights-of-way also provide an opportunity to cost-effectively and efficiently site power transmission lines to bring new renewable energy generation to population centers.

While States and other local governmental agencies own and control the highway ROW, DOT is facilitating these clean energy uses of the right-of-way by providing guidance on federal regulations that permit these uses, assisting with utility accommodation policies and other permitting, providing technical assistance and new research, and working closely with the DOE to ensure effective integration of EVs with the power system.[56] Installing solar arrays in highway right-of-way is eligible under the Carbon Reduction Program and undergrounding public utility infrastructure is eligible under the National Highway Performance Program. In addition, BIL tasked the Joint Office of Energy and Transportation with studying, planning, and funding electricity transmission on interstate rights-of-way.

Figure 15: Solar array on I-85 developed by Georgia Power on Georgia DOT right-of-way. (Photo credit: The Ray).

## 2.6 Research, Technical Assistance and Outreach

DOT conducts research and provides technical assistance resources to help tribal, state, local, and private sector transportation agencies reduce GHG emissions. Table 2 summarizes a selection of these resources. The U.S. DOT RD&T Strategic Plan 2022-2026 sets DOT's research agenda and includes climate change as one of five research priorities.[57] The Plan sets a "Climate and Sustainability Grand Challenge" of creating a transportation system that supports an economy with net zero GHG emissions. The Plan guides DOT's research across the Department as well as research at DOT-funded University Transportation Centers. In October 2023, DOT announced a Climate and Transportation Research Initiative, which will fund universities and other partner organizations to conduct research to support decarbonization and other transportation and climate change challenges.

| OPERATING ADMINISTRATION | EXAMPLE RESEARCH, TECHNICAL ASSISTANCE, AND OUTREACH ACTIVITIES |
|---|---|
| FHWA | The Handbook for Estimating Transportation Greenhouse Gases for Integration into the Planning Process provides information on how to analyze on-road greenhouse gas emissions at the state and regional level and how to incorporate those analyses into transportation planning efforts.<br><br>The Energy Emissions Reduction and Policy Analysis Tool (EERPAT) compares GHG emissions at the state level, given a variety of policy parameters.<br><br>Under the Every Day Counts program, FHWA chooses a handful of innovative, promising practices to promote to state and local transportation agencies. For the current round, FHWA is promoting integrating GHG assessment and reduction targets in transportation planning. |
| FRA | Hosted Getting on Track for Decarbonization, a workshop focused on incorporating new and emerging technologies to reduce the emissions of the rail sector. |
| FTA | The Transit Workforce Center (TWC) is the first FTA-funded technical assistance center to directly support public transit workforce development, including the reskill and upskill of current and future transit workers in bus electrification operations and maintenance.<br><br>The Environmental and Sustainability Management Systems (ESMS) program will provide up to 10 transit agencies nationwide tailored technical assistance in establishing their ESMS over a two-year period.<br><br>The Joint Office of Energy and Transportation provides technical assistance for transit agencies applying for or receiving funding through the FTA Low or No Emission Vehicle Program or using other FTA funds for clean buses. |
| MARAD | The Maritime Environmental and Technical Assistance (META) program supports research and demonstrations of alternative fuels and technologies and provides needed information for industry decision-making and to inform domestic and international policy.<br><br>Released a series of studies for reducing GHG emissions from ports and ships. |
| OST | Developed toolkits for planning and funding electric mobility infrastructure in rural and urban areas. |

Table 2: Sampling of DOT research, technical assistance, and outreach focused on decarbonization.

# 3 CLOSING THE GAP

DOT is committed to using its current authorities and funding to reduce GHG emissions. The DOT actions described in this report play a critical role in reducing U.S. transportation GHG emissions. However, additional actions are needed to meet our GHG reduction targets of 50-52 percent below 2005 levels by 2030 and net-zero by 2050. Sector specific actions are particularly important in the absence of an economy-wide price signal for GHG emissions. This section identifies opportunities for driving further reductions in U.S. transportation GHG emissions.

## 3.1 Strategies with Broad GHG Reduction Benefits

***Investments in GHG reduction strategies.*** BIL developed new programs focused on reducing GHG emissions, including the Carbon Reduction Program (CRP), the National Electric Vehicle Infrastructure (NEVI) program, the Charging and Fueling Infrastructure (CFI) program, and research on sustainable aviation fuels. BIL also provided historic investments in low carbon modes such as public transportation, active transportation, and rail. Oversubscription to these programs highlights a large unmet need.

## 3.2 Creating a Convenient Transportation Sector

***The following programs support active transportation and are oversubscribed:***

- The Safe Streets and Roads for All Program is oversubscribed by a factor of three. It received nearly $3 billion in requests for the $1 billion available in FY 2022.
- The Active Transportation Infrastructure Investment Program (ATIIP) will close its first funding opportunity after the drafting of this report, and like other climate related programs, we expect significant over subscription.

***Increase deployment of micromobility projects.*** These projects have strong potential to drive emissions reductions.

***Support local congestion pricing initiatives.*** Title 23 of the U.S. Code includes a general prohibition on the imposition of tolls on federal-aid highways. There are some exceptions and limited tolling pilot programs, such as the Value Pricing Pilot Program (VPPP), Congestion Relief Program, and the Strategic Innovation for Revenue Collection (SIRC) Program.[58] [59] DOT will use these programs to assist state and local governments in designing and deploying innovative pricing strategies to decrease carbon emissions and relieve congestion. Such strategies can also raise revenue for transportation investments, including new and expanded transit service on tolled corridors. Congestion pricing can also take into account the higher costs in terms of congestion and emissions produced by freight movement and can encourage more efficient operations by incentivizing consolidated truckloads and off-hour deliveries.

***Institutionalize Coordination between DOT and HUD.*** DOT and HUD have strengthened coordination through the U.S. National Blueprint for Transportation and the September 2022 Memorandum of Understanding. DOT and HUD have also worked collaboratively on the Thriving Communities Technical Assistance (TCTA) program, funded in FY 2022 with $5 million to support coordination and integration of transportation and housing in infrastructure planning

and implementation. Institutionalizing coordination between DOT and HUD would build on existing collaboration, strengthen ties, and make sure that integrating housing and transportation policies, along with the associated GHG benefits, will continue. Options include creating a coordinating council, exchanging staff detailees, and more. Such actions would align resources and expertise to enable the changes in land use planning and transportation systems design laid out in the Blueprint that make it convenient to take fewer or shorter trips, reducing GHG emissions. And they would help support local decision-making with technical assistance, resources, and aligned DOT and HUD requirements.

***Support local government actions.*** Strategies for improving the convenience of the transportation system, such as developing interconnected pedestrian infrastructure and integrating land use planning with transportation planning, are often led by local governments. DOT technical assistance and resources can support local governments in taking the lead on implementing these types of projects and advancing this important strategy under the Decarbonization Blueprint.

## 3.3 Creating an Efficient Transportation Sector

***Expand public transportation service.*** Many transit agencies are facing a fiscal cliff as a result of the pandemic and other farebox recovery-structured financial obstacles. Consequently, transit agencies are having difficulty maintaining existing services, much less expanding service. Case studies demonstrate the potential for increased emissions from transit service cuts. For example, disinvestment in Philadelphia's Southeastern Pennsylvania Transportation Authority (SEPTA) system from 2000 to 2007 led to severe and recurring system delays and suppressed ridership, even as the regional economy and population grew.[60] Both the 2024 and 2025 President's Budget have included proposals to allow large transit agencies the flexibility to temporarily use some of their federal funding for operating needs as a way to help these agencies transition to post-pandemic service models.

***Reduce customization of federally funded buses to improve efficiencies and lower costs.*** The practice of transit agencies requiring customized parts and configurations, such as camera locations, window configurations, and brand name parts, increases costs of bus manufacturing and purchase. For instance, researchers found that transit agencies paid on average $175,000 more for buses than did other purchasers of transit buses, such as airport authorities, using data available in California.[61] Analysis by the Eno Center for Transportation suggests that excess customization was a contributing factor for the withdrawal of manufacturers from the U.S. transit bus market.[62] Since June 2023, two manufacturers have announced they will stop production of U.S. transit buses. This means that just at the time the U.S. is needing to expand transit fleets and transition to low emission or zero emission buses, there are fewer manufacturers available to meet this need and costs are higher than necessary. To help lower bus costs and ensure federal investments put as many new, clean buses on the road as possible, FTA will give weighted priority consideration under certain competitive grant programs to applicants that commit to purchasing a base model bus without over customization, as well as applicants that commit to a three-agency joint procurement with a shared technical specification. FTA has also requested that Congress provide statutory authority to adjust the federal share for bus procurements to further incentivize procurement of base model buses and disincentivize over customization.

***Prioritizing intermodal investments in discretionary grants.*** Building intermodal facilities and investing in rail and maritime transportation strengthens supply chains and enables freight to take highly efficient, low carbon modes for longer stretches of the journey. There is currently a 30 percent statutory cap on INFRA funds for rail, maritime, and intermodal projects. DOT receives many more meritorious projects than fit under the cap. DOT will continue to invest up to the 30 percent statutory cap.

***Promote efforts to reduce freight-related emissions through multi-modal freight planning.*** States are required to develop State Freight Plans to obligate NHFP formula funding. As part of these plans, States are required to develop goals and strategies to reduce the impacts of freight movement on local air pollution and emissions. Encouraging States to ensure consistency between their Carbon Reduction Strategies prepared pursuant to the Carbon Reduction Program and their State Freight Plans would ensure both plans are aligned toward reducing emissions of GHGs and other pollutants. Last mile freight delivery, particularly of e-commerce goods, has increased substantially since the COVID-19 pandemic. Future State Freight Plans should address the emissions-related impacts of increased last mile deliveries in their State Freight Plans.

***Reduce methane leaks and prepare for pipeline transportation of clean energy.*** In recent years, PHMSA has gained authority to regulate underground natural gas storage, as well as rural underground natural gas pipelines – both previously unregulated and prone to leakage. PHMSA will use these new authorities to their maximum capability to prevent leakage of methane, a potent GHG. PHMSA will also prepare for transportation of clean energy.

## 3.4 Creating a Clean Transportation Sector

***Clean transportation programs that reduce emissions are oversubscribed:***

- The Low or No Emission Bus Program received $4.2 billion in requests for a $1.2 billion program.
- The Consolidated Rail Infrastructure and Safety Improvement (CRISI) program received 234 eligible applications requesting $6.1 billion for FY 2022, over four times as much as FRA was able to award. There is a particularly high need for funding for electric railyard locomotives (switchers), which are important to reduce local air pollution around railyards.

***Clean maritime transportation would help close the GHG gap.*** The Federal Ship Financing Program, also known as "Title XI," can support the construction or reconstruction of low and no emission maritime vessels, and vessels that support offshore wind developments. Title XI is critical for financing the next generation of ships, which must be lower emission than the current fleet to meet GHG goals. It is also critical for supporting the build out of the fleet needed to support offshore wind. Title XI has pending applications totaling $1.35 billion and would require additional subsidy to meet this demand. The Port Infrastructure Development Program received $684 million in FY 2022. Applications totaled $2.8 billion, or four times the available funding levels. The U.S. Marine Highway Program (USMHP) is critical to the development of U.S. green shipping corridors through supporting expansion, modernization and increased efficiency of marine services including low emissions port equipment and projects that improve freight flow and logistics efficiencies. While funded at $40 million under BIL, it is currently oversubscribed

by a factor of 12. The Small Shipyard Grant Program was most recently appropriated $20 million but similar to the USMHP is also oversubscribed. The Maritime Environmental and Technical Assistance (META) program has significant opportunities to support a clean maritime sector.

***Implement global market-based measures of the International Civil Aviation Organization (ICAO).*** To address $CO_2$ emissions growth from international aviation, ICAO created the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). CORSIA requires airline operators that engage in certain international flights to reduce their net $CO_2$ emissions to a baseline level. Operators can use CORSIA eligible fuels, which includes sustainable aviation fuel (SAF) and Lower Carbon Aviation Fuels (LCAF), or eligible carbon offsets to comply with their emissions reduction obligations. This international agreement is preferable to action by individual countries or groups of countries because it applies the same requirements across countries, thus protecting a level playing field for U.S. operators in international aviation. FAA will implement CORSIA in order to enable significant emissions reductions from international aviation.

***Encourage training and workforce development.*** Currently, 0.5 percent of transit formula funds can be used for workforce development, whereas all highway formula dollars are eligible for these activities. Many transit agencies have cited the need for zero-emissions vehicle training as a barrier to fleet electrification. Encouraging the use of the current set aside for workforce development could help transit agencies address this workforce training need.

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