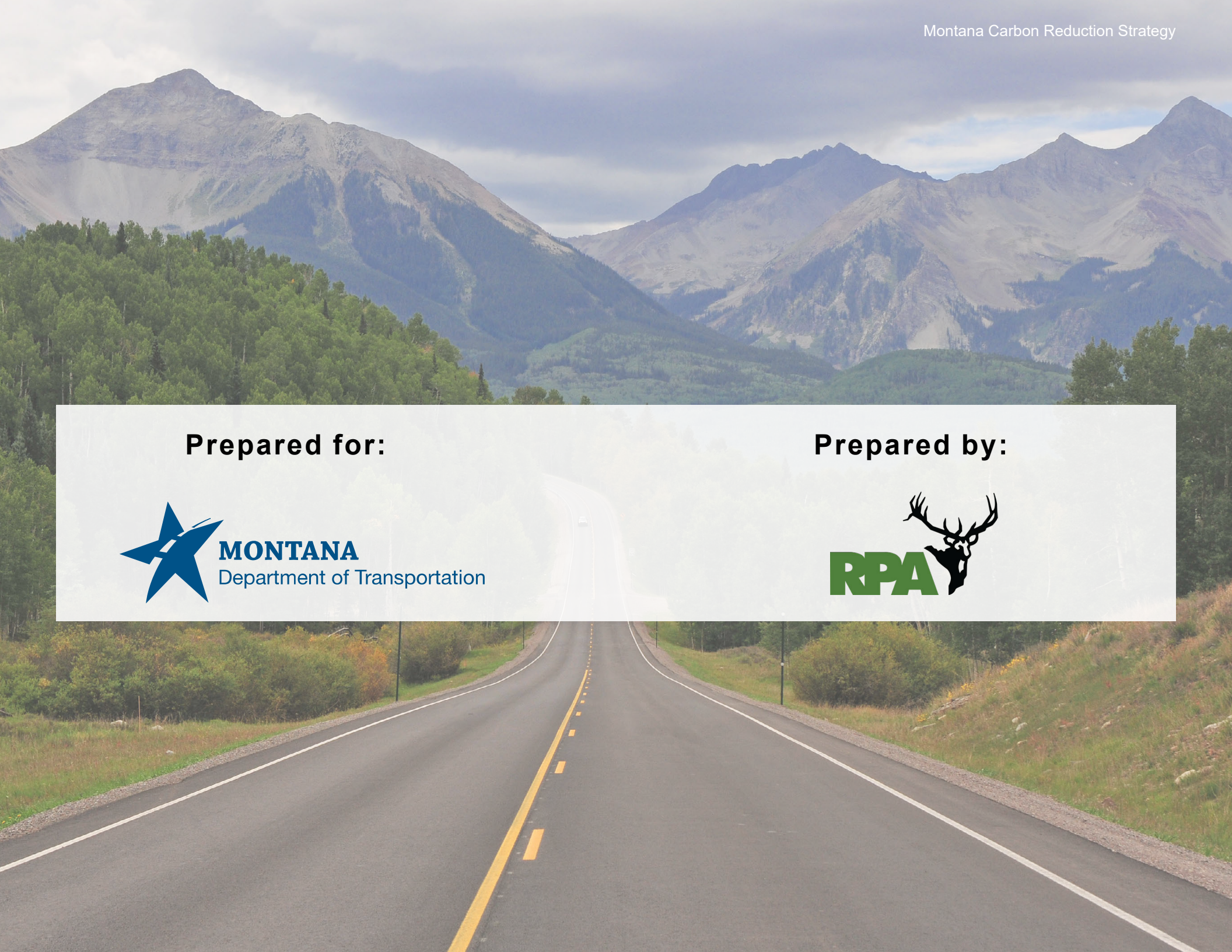


MONTANA CARBON REDUCTION STRATEGY

OCTOBER 12, 2023

MONTANA
Department of Transportation



Prepared for:

MONTANA
Department of Transportation

Prepared by:

RPA

TABLE OF CONTENTS

TABLE OF CONTENTS i
FIGURES ii
TABLES iii
APPENDIX iii
ACRONYMS AND ABBREVIATIONS iv
EXECUTIVE SUMMARY 1
ES.1 BASELINE CONDITIONS AND TRENDS 3
ES.2 STRATEGY IDENTIFICATION AND EVALUATION 3
ES.3 IMPLEMENTATION AND NEXT STEPS 3
1.0. INTRODUCTION AND BACKGROUND 7
1.1. MONTANA CARBON EMISSIONS FRAMEWORK 9
1.2. LIFE CYCLE OF EMISSIONS 10
1.3. RELEVANT SUPPORTING EFFORTS 10
1.4. GOALS AND OBJECTIVES 11
2.0. BASELINE CONDITIONS AND TRENDS 12
2.1. BASELINE CARBON EMISSIONS 13
2.1.1. Context 14
2.1.2. Users 16
2.1.3. Assets 24
2.1.4. Management 27
2.2. PROJECTED CONDITIONS 29
2.3. SUMMARY OF TRANSPORTATION CARBON EMISSIONS IN MONTANA 30

TABLE OF CONTENTS

3.0. STRATEGY IDENTIFICATION AND EVALUATION 32

3.1. OVERVIEW OF STRATEGY ATTRIBUTES 33

3.1.1. Montana Carbon Emissions Framework 33

3.1.2. Strategy Types and Potential Projects or Actions 33

3.1.3. Co-Benefits 34

3.1.4. Partnership Opportunities 34

3.1.5. Maximum Potential Effectiveness and Implementation Considerations 34

3.1.6. Resources 35

3.2. STRATEGIES 35

3.2.1. Transportation Demand Management 36

3.2.2. Mode Choice 44

3.2.3. Vehicle Alternatives 51

3.2.4. Parking 54

3.2.5. Transportation System Management and Operations 57

3.2.6. Energy Efficiency and Carbon Emissions Offsetting 62

3.2.7. Highway Construction and Maintenance 68

3.3. STRATEGY SUMMARY 79

4.0. IMPLEMENTATION AND NEXT STEPS 82

REFERENCES 84

FIGURES

Figure ES-1: Federal Goals 2

Figure ES-2: TranPlanMT Goal Areas 2

Figure 1.1: Federal Goals 8

Figure 1.2: Montana Carbon Emissions Framework 9

TABLE OF CONTENTS

Figure 1.3: Life Cycle of Emissions 10
Figure 1.4: TranPlanMT Goal Areas 11
Figure 2.1: Transportation Sector Emissions 13
Figure 2.2: Scale of Carbon Emissions by Category 13
Figure 2.3: CO_2 Emissions from Fuel Consumption 14
Figure 2.4: Population Density (by Census Block, 2020 US Census) 15
Figure 2.5: Gasoline and Diesel Fuel Consumption in Montana 16
Figure 2.6: DVMT by County (2021) 17
Figure 2.7: AVMT (2013-2022) and MVMT (2022) 18
Figure 2.8: Highway Travel and Fuel Consumption 18
Figure 2.9: Person Trips by County (2022) 19
Figure 2.10: MT and US Transportation Modes for Commuters 20
Figure 2.11: Aviation Fuel Consumption in Montana 21
Figure 2.12: Walking and Biking Activity in Montana 21
Figure 2.13: Alternative Fuel Consumption 22
Figure 2.14: CO_2 Emissions by County (2020 NEI) 23
Figure 2.15: Asphalt and Road Oil Consumption in Montana 24
Figure 2.16: Alternative Fueling Stations in Montana 26
Figure 2.17: Roadway LOS and Traffic Density (2019) 28
Figure 2.18: Predicted Fuel Consumption in the Transportation Sector 29
Figure 2.19: Estimated Average CAFE Levels under Final Rule 30

TABLES

Table ES-1: Summary of Strategies 4
Table 1.1: Previous Efforts Related to the CRS 8
Table 2.1: 2020 NEI - MT Mobile Source Emissions 22
Table 2.2: 2020 NEI - MT On-Road Mobile Source Emissions 23
Table 2.3: Estimated CO_2 Emissions by Fuel Consumption (2022) 30
Table 2.4: Estimated CO_2 Emissions by Mobile Source Emissions Modeling (2022) 31
Table 3.1: Summary of Strategies 79

APPENDIX

Appendix A: Review of Previous Efforts
Appendix B: Public Comments

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

ACS	American Community Survey
ADA	Americans with Disabilities Act
ADU	Accessory Dwelling Unit
AFC	Alternative Fuel Corridor
AFDC	Alternative Fuels Data Center
AVMT	Annual Vehicle Miles Traveled
CAFE	Corporate Average Fuel Economy
CARB	California Air Resources Board
CCPR	Cold Central Plant Recycling
CIR	Cold In-Place Recycling
CMAQ	Congestion Mitigation and Air Quality
CNG	Compressed Natural Gas
CRP	Carbon Reduction Program
CRS	Carbon Reduction Strategy
D/C	Demand/Capacity
DCFC	Direct Current Fast Charging
DOC	Diesel Oxidation Catalysts
DOT	Departments of Transportation
DPF	Diesel Particulate Filters
DVMT	Daily Vehicle Miles Traveled
eREMI	Regional Economic Models, Inc
EV	Electric Vehicle
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GHG	Greenhouse Gas
GIS	Geographic Information System
GPS	Global Positioning System
HCM	Highway Capacity Manual
HEV	Hybrid Electric Vehicle
HIR	Hot In-Place Recycling
HVO	Hydrotreated Vegetable Oil
IIJA	Infrastructure Investment and Jobs Act
INVEST	Infrastructure Voluntary Evaluation Sustainability Tool
ITC	Investment Tax Credit
ITD	Innovative Technology Deployment
ITS	Intelligent Transport Systems
LCA	Life-Cycle Assessment
LED	Light Emitting Diode
LNG	Liquified Natural Gas
LOS	Level of Service
MDEQ	Montana Department of Environmental Quality
MEPA	Montana Environmental Policy Act
MIM	Missoula in Motion
MOU	Memorandum of Understanding
MOVES	Motor Vehicle Emission Simulator
MPO	Metropolitan Planning Organization
MTP	Metropolitan Transportation Plan
MVMT	Monthly Vehicle Miles Traveled
NEI	National Emissions Inventory
NEPA	National Environmental Policy Act
NHTSA	National Highway Traffic Safety Administration
NREL	National Renewable Energy Laboratory
PHEV	Plug-in Hybrid Electric Vehicle
PHFS	Primary Highway Freight System
QPL	Qualified Product List
ROW	Right-Of-Way
SCR	Selective Catalytic Reduction
SMP	State Transit Management Plan
SOV	Single Occupant Vehicle
STIP	Statewide Transportation Improvement Program
SUP	Shared Use Path
TAMP	Transportation Asset Management Plan
TCRP	Transit Cooperative Research Program
TDM	Transportation Demand Management
TIP	Transportation Improvement Program
TMC	Transportation Management Center
TOD	Transit-Oriented Development
TSE	Truck Stop Electrification
TSMO	Transportation System Management and Operations
US	United States
USBTS	United States Bureau of Transportation Statistics
USDOT	United States Department of Transportation
USC	United States Code
USEPA	United States Environmental Protection Agency
USEIA	United States Energy Information Administration
VMT	Vehicle Miles Traveled

EXECUTIVE SUMMARY



EXECUTIVE SUMMARY

The National Carbon Reduction Program (CRP) was signed into law as part of the *Infrastructure Investment and Jobs Act* (IIJA) and authorizes funding for states to advance projects that will reduce carbon emissions from transportation and support the federal goals presented in **Figure ES-1**. Under the law, each state must develop a statewide Carbon Reduction Strategy (CRS) in consultation with local Metropolitan Planning Organizations (MPOs) and in support of federal goals. The Montana CRS represents the collaborative efforts of MDT and the MPOs of Billings, Great Falls, and Missoula and provides critical information to assist transportation officials in making project and program decisions to reduce transportation carbon emissions.

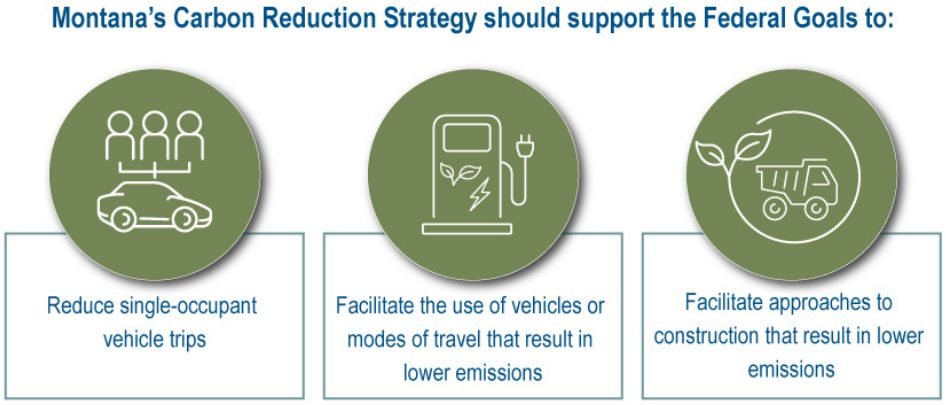


Figure ES-1: Federal Goals

The CRS is intended to align with and support Montana's existing statewide long-range transportation plan (LRTP), *TranPlanMT*, and MPOs' Metropolitan Transportation Plans (MTPs). The existing goals in the statewide and local plans already support the CRS purpose to reduce transportation carbon emissions. To ensure consistency between planning efforts, the *TranPlanMT* goals, as illustrated in **Figure ES-2**, were foundational to the development of the CRS.

Furthermore, a simple framework derived from *TranPlanMT* was used to help evaluate transportation carbon emissions. The framework consists of the overall context of the state of Montana, transportation users, MDT assets, and management of the transportation system. Under each category, several contributors to carbon emissions and other elements influence the quantity of emissions produced. In evaluating strategies to reduce transportation carbon emissions, the Montana CRS focused on on-road sources of carbon emissions, such as those from cars, trucks, and buses, although other non-road sources such as aviation, rail transport, and construction equipment also play a role in transportation emissions. Non-operating carbon emissions associated with transportation assets, including pavement, traffic signals, lighting, and rail crossings, were also considered.

The Montana CRS provides a baseline summary of carbon emissions associated with the transportation sector in Montana, presents individual strategies that could be implemented in Montana with funding under the CRP, and describes future implementation and monitoring efforts.

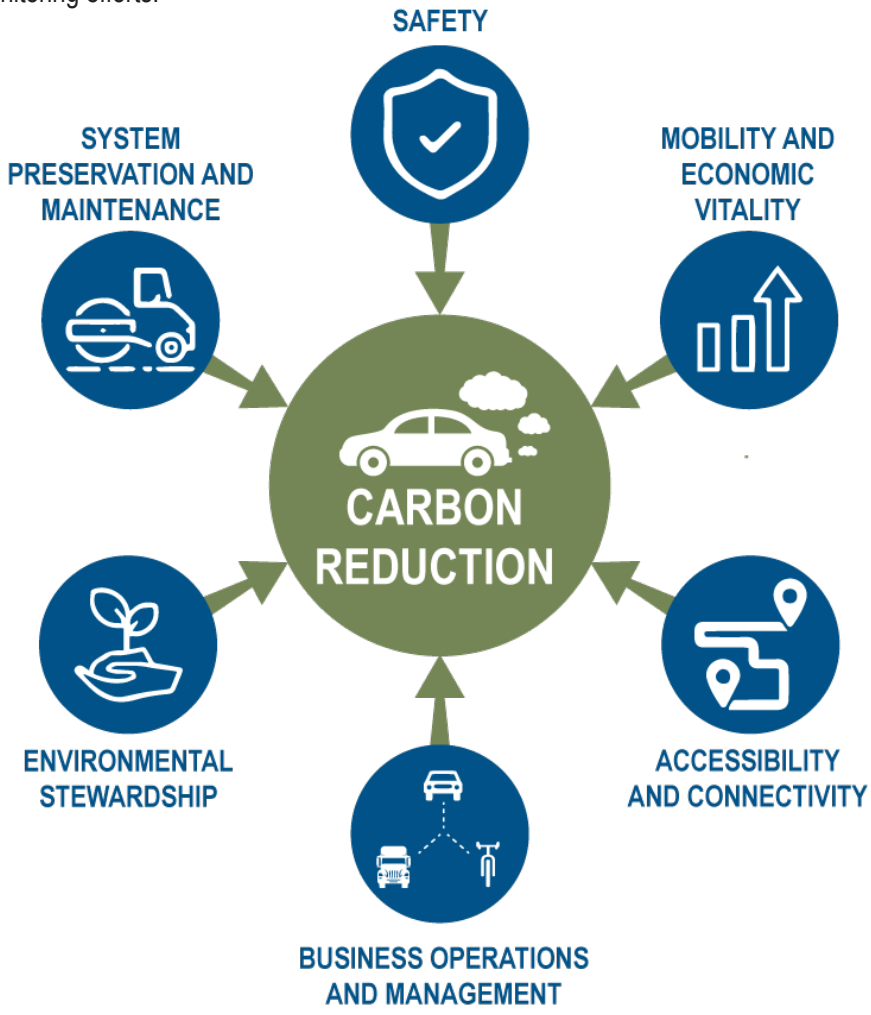


Figure ES-2: TranPlanMT Goal Areas

EXECUTIVE SUMMARY

ES.1 BASELINE CONDITIONS AND TRENDS

Several state and national data sources were consulted to document baseline conditions and trends to gain insight into the role that the transportation sector plays in the state's carbon dioxide (CO_2) emissions. Together, this research helps establish a baseline for measuring progress towards carbon reduction and helps identify opportunities for targeted transportation investments.

To calculate a baseline metric of CO_2 that can be tracked as MDT implements its CRS, fuel consumption data was converted to carbon emissions using nationally recognized conversion factors. Using the number of gallons of fuel consumed statewide in 2022, an estimated **8.1 million metric tons of CO_2** were produced from on-road mobile transportation sources.

Baseline CO_2 emissions can also be understood through emissions modeling. Using a nationwide emissions model developed by the US Environmental Protection Agency, it was estimated that approximately **7.9 million metric tons of CO_2** were produced by on-road mobile transportation sources in Montana.

On average,

8,000,000

metric tons of CO_2

are produced annually

in Montana

from on-road mobile

transportation sources.

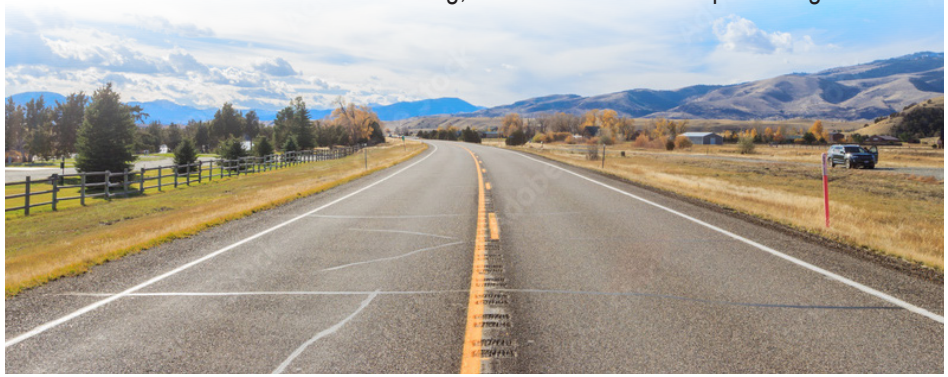
ES.2 STRATEGY IDENTIFICATION AND EVALUATION

A comprehensive set of strategies were identified to determine the most effective types of actions for reducing transportation carbon emissions in Montana. Strategy descriptions, attributes, and effectiveness determinations can be used by state and local authorities to inform investment decisions as available funding is applied to achieve CRS goals. Identified strategies include investments in infrastructure projects, new technologies, vehicle fleets, and maintenance equipment as well as development of operational and maintenance practices, policies, and service offerings to address carbon reduction from numerous angles. **Table ES-1** lists the identified strategies, partnership opportunities, effectiveness ratings, and a summary of implementation considerations.

ES.3 IMPLEMENTATION AND NEXT STEPS

In collaboration with MPOs and other partners across the state, MDT will use the Montana CRS as a guide when considering, nominating, and implementing specific projects and actions funded through the CRP to reduce transportation carbon emissions in Montana. Projects will need to be considered on a case-by-case basis, however actions supporting the identified strategies are likely eligible for CRP funding. Collectively, such efforts will reduce Montana's transportation emissions while at the same time reinforcing state and local transportation planning goals.

The Montana CRS will be updated every four years in accordance with federal regulations. Future updates will summarize continuing efforts to gather and analyze the most current emissions data, refine the effectiveness ratings of specific actions, and document progress made toward reducing transportation carbon emissions in Montana. Evaluation efforts to better understand carbon emissions produced in Montana and support future updates may include data collection and inventory, database development and management, state and local carbon emissions modeling, and collaboration with partner agencies.



Source: Gaukhar/Adobe Stock

EXECUTIVE SUMMARY

Table ES-1: Summary of Strategies

	Strategy	Partnership Opportunities	Maximum Potential Effectiveness	Implementation Considerations
Transportation Demand Management	**Land Use Development Patterns**	MPOs, Cities/ Counties/ Planning Boards, MDT, Housing Authorities, Nonprofit Organizations, Private Land Developers, Individual Residents	**Medium**	• More effective in urban areas where development is more dense. • Variable support for higher densities. • Requires coordination among all levels of government. • More effective when integrated with walking/biking/transit infrastructure. • Synergistic effects when combined with multimodal planning and incentives.
	Work Trip Efficiency	MDT, MPOs, Local Governments, Private Employers, Individuals	**Low-Medium**	• Varying participation for trip reduction strategies (employer/employee). • Flexible workplace and work schedule policies have varying degrees of effectiveness due to demand shifts. • Home energy use may partially offset savings in office energy use. • Financial incentives and provision of transportation services are more effective than outreach.
	Freight Trip Efficiency	MDT, MPOs, Local Governments, Private Freight Haulers, Individual Customers	**Low**	• MDT currently provides truck time reliability/traveler information. • Heavily dependent on decisions of private freight hauling/logistics companies. • Collection points, off-peak deliveries, and zero emission vehicles can provide the greatest emissions benefit in urban operations. • Variation in emissions benefit based on characteristics of each freight trip and prevalent traffic conditions.
Mode Choice	**Active Transportation and Micromobility**	MDT, MPOs, Local Governments, Private Companies, Individuals	**Low-Medium**	• Most effective in urban environments. • Dedicated/separated facilities with connectivity to transit facilities or schools in urban cores are most effective. • Variations in bicycle/walking activity associated with acute weather events and level of winter maintenance. • Hills/steep grades affect routing decisions. • Younger populations living close to work/away from transit have more pronounced emissions reductions. • Cars and trucks used to redistribute shared bikes/scooters decrease effectiveness.
	Public Transportation	MDT, MPOs, Local Governments, Transit Operators, Rail Providers, Employers, Individuals	**Low**	• Existing rural, urban, inter-city bus service and vanpools provide service; limited public transportation & rail options in some areas of state. • Funding is a limiting factor for adding services and routes. • Buses produce lower emissions per mile traveled. • Reduced transit fares, off-peak, and weekend service, and increased service frequency help encourage more trips. • Employer-provided transit options demonstrate large mode shifts. • Advanced traveler information systems (online maps, timetables, route planning) help increase effectiveness.

EXECUTIVE SUMMARY

Table ES-1: Summary of Strategies

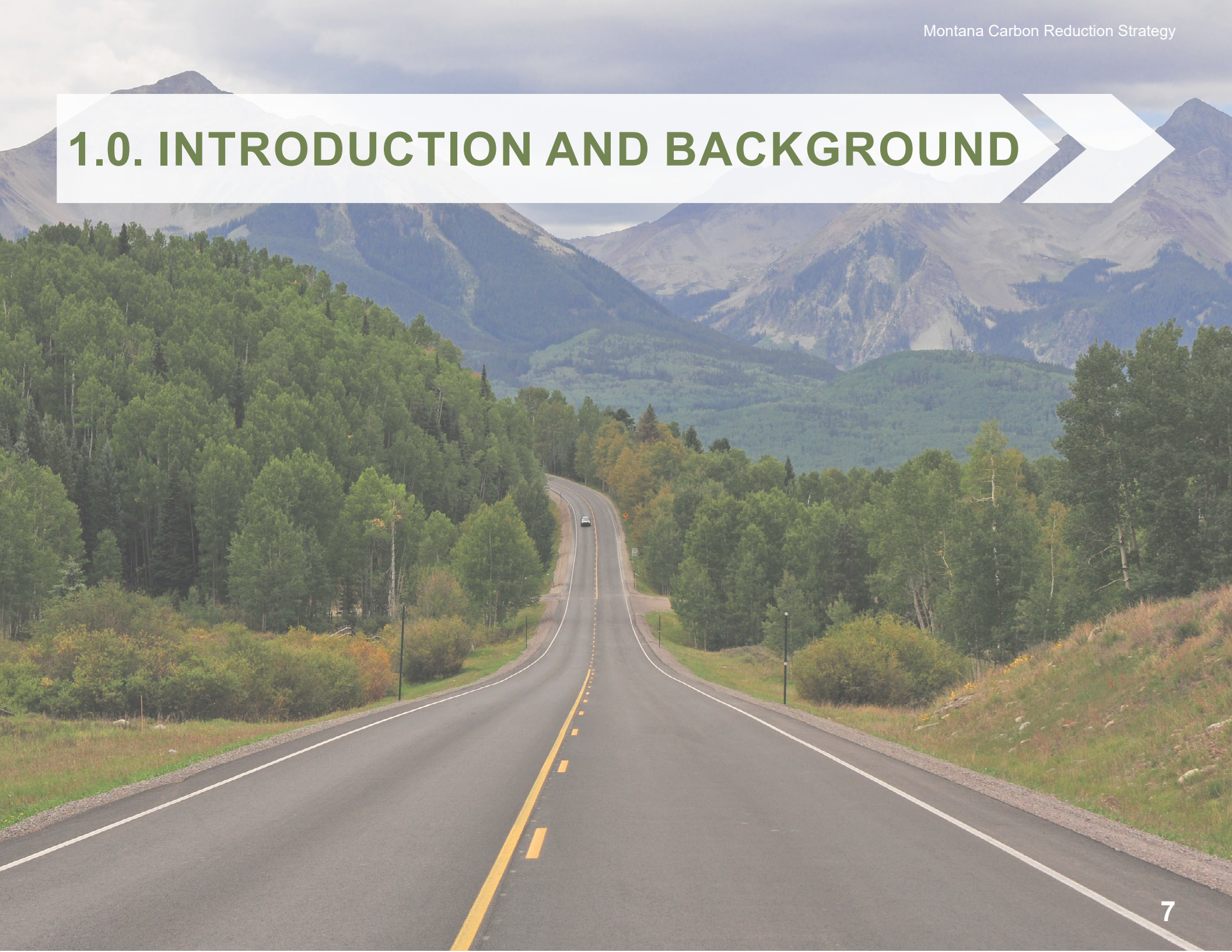
	Strategy	Partnership Opportunities	Maximum Potential Effectiveness	Implementation Considerations
Mode Choice	**Shared Rides**	MDT, MPOs, Local Governments, TDM Programs, Private Employers, Private Businesses, Individuals	**Low-Medium**	• More effective for large numbers of people traveling to common destination (e.g., work site). • Desire shift from COVID-19 pandemic reduced ridership levels. • Empty travel by shared vehicles (distance to pick up passengers) offsets emissions benefits. • Lower effectiveness since trips are often offset from walking/public transportation vs. private vehicles. • Unintended effects (encouraging more driving, out-of-direction travel, urban sprawl).
Vehicles	**Vehicle Alternatives**	MDT, MPOs, Local Governments, Private Companies, Transit Operators, School Districts, Individuals	**Medium-High**	• Revenue from fuel taxes may be reduced; alternative taxes can be leveraged. • Location-specific effectiveness (rural vs. urban). • Cold weather performance limitations of electric batteries. • Availability of fueling and charging stations impacts effectiveness. • Air quality effects of alternative vehicles should be considered.
Parking	**Parking**	MDT, MPOs, Local Governments, Freight Haulers	**Low**	• Truck Stop Electrification (TSE) is effective, however, truck idling is a small percentage of total freight emissions. • Effectiveness of parking demand management depends on scale, scope, and combination with other strategies. • Land use and parking requirement policies can support parking demand management strategies.
Transp System Mnmgt & Operations	**Management Techniques and Technology Solutions**	MDT, MPOs, Local Governments, Private Companies, Individuals	**Low-Medium**	• Effectiveness is variable based on strategy type, induced demand, scale and scope, baseline deployment levels. • Bus-managed lanes can be effective, although benefits may be offset by system congestion impacts. • Deployment of traffic signal synchronization on arterial streets can be effective, particularly in cities. • Techniques that improve vehicular traffic flow on arterial streets can have a negative impact on non-motorized traffic flow, convenience, comfort, and safety. • Emissions impacts from corridor may be negligible when considering total network effects. • Effectiveness of eco-driving technologies depends on vehicle types, context of environment, and other vehicle maintenance. • Integrated corridor management, ramp metering, incident management, and implementation of travel information systems (high to low effectiveness).
	Intersection Design	MDT, MPOs, Local Governments	**Low-Medium**	• Potential for induced demand from improved traffic flow. • Emerging effectiveness research on alternative intersection designs. • Roundabout relative effectiveness varies with demand/capacity ratios. • Intersection designs that minimize heavy truck braking can help reduce emissions. • Adaptive traffic signals provide potential carbon reduction benefits.

EXECUTIVE SUMMARY

Table ES-1: Summary of Strategies

	Strategy	Partnership Opportunities	Maximum Potential Effectiveness	Implementation Considerations
Energy	**Electric Infrastructure Upgrades**	MDT, MPOs, Local Governments	**Low**	• Adaptive lighting approach can produce energy savings and eliminate over-lighting while still maintaining safe driving conditions. • Current MDT practice to install LED fixtures and electrical components. • Energy usage benefits dependent on source of energy generation.
Energy	**Alternative Uses of Highway ROW**	MDT, Utility Companies	**Medium**	• Does not reduce on-road transportation carbon emissions. • Potentially substantial right-of-way for energy generation through renewable sources and biologic carbon sequestration. • Suitability of public right-of-way for alternative uses varies - clear zone, proximity to electrical grid, solar/wind exposure, adjacent development, access, land area. • Coordination with utility companies required. • Potentially more effective through public-private partnerships, with access to tax incentives. • May require FHWA approval.
Construction/Maintenance	**Pavement Preservation**	MDT, MPOs, Local Governments	**Low**	• Carbon reduction effectiveness varies based on pavement mix design, layers, treatment activities, and life cycles. • Life-cycle assessment (LCA) required to demonstrate carbon reduction for CRP funding. • Continuation of MDT asset management approach. • Lower carbon reduction effect compared to strategies targeting tailpipe emissions.
Construction/Maintenance	**Construction Materials**	MDT, MPOs, Local Governments, Contractors, Producers/Suppliers	**Low**	• Effectiveness varies based on material source availability, suitability, and performance levels. • LCA required to demonstrate carbon reduction for CRP funding. • Could be added to MDT specifications through consideration by MDT Standards Committee. • Lower carbon reduction effect compared to strategies targeting tailpipe emissions.
Construction/Maintenance	**Construction Practices**	MDT, MPOs, Local Governments, Contractors	**Low**	• Potential for implementation varies based on applicability/suitability, risk factors, and costs. • Potential carbon reduction expected to be comparatively low. • Continuation of current MDT practice (Alternative Contracting program).
Construction/Maintenance	**Construction and Maintenance Equipment Alternatives**	MDT, MPOs, Local Governments, Contractors	**Low**	• Potential for implementation varies based on applicability/suitability, risk factors, and costs. • Lower carbon reduction effect compared to strategies targeting tailpipe emissions. • Continuation of MDT current practice (MDT Equipment Program). • Extreme temperature sensitivity of alternative fuels. • Operating duration of electric batteries is limited.
Construction/Maintenance	**Alternative Maintenance Practices and Technologies**	MDT, MPOs, Local Governments	**Low**	• Potential for implementation varies based on applicability/suitability, cost, and overall performance • Lower carbon reduction effect compared to strategies targeting tailpipe emissions • Continuation of MDT current practice (MDT Maintenance Program).

1.0. INTRODUCTION AND BACKGROUND



1.0. INTRODUCTION AND BACKGROUND

The National Carbon Reduction Program (CRP) was signed into law as part of the *Infrastructure Investment and Jobs Act* (IIJA) on November 15, 2021. Under 23 United States Code (USC) 175(d)(2), IIJA authorizes new funding for states to advance projects that will reduce transportation emissions and support the federal goals presented in **Figure 1.1** which include reducing single occupant vehicle (SOV) trips, facilitating travel by lower emission transportation modes, and implementing lower-emission construction practices.

Under the law, each state must develop a statewide Carbon Reduction Strategy (CRS) in consultation with local Metropolitan Planning Organizations (MPOs) and in support of federal goals. The US Census Bureau defines MPOs based on a population threshold of 50,000. Results of the 2020 Census indicate that there are now five MPOs in Montana, including Billings, Great Falls, Missoula, Bozeman, and Helena. Prior to the 2020 Census, the three MPOs in the state were Billings, Great Falls, and Missoula. Since Bozeman and Helena are not yet required to have their MPOs established, only the three previous MPOs were considered and consulted for the development of the CRS. Future updates to the CRS will include consideration of Bozeman and Helena as MPOs.

Federal regulations and guidance outline specific requirements for the contents of the CRS. In general, the CRS must support efforts to reduce transportation emissions. To do so, the CRS must identify specific carbon reduction projects and strategies that are appropriate to the population density and context of the state. In fulfillment of these requirements, **Chapter 1** outlines the carbon emissions framework used in the CRS and presents an overview of existing statewide and local policies, procedures, and plans to establish a basic understanding of goals and initiatives related to transportation carbon reduction in Montana. **Chapter 2** provides a baseline summary of carbon emissions associated with the transportation sector in Montana in comparison to national trends and outlines the current status of transportation services, assets, and management practices that influence carbon emissions. **Chapter 3** presents individual strategies that could be implemented in Montana and are likely eligible for funding under the CRP. Strategy attributes, including potential projects and implementation actions, anticipated carbon reduction effects, co-benefits, partnership opportunities, qualitative maximum potential effectiveness ratings, implementation considerations, and additional resources, are provided to assist decision makers in making investment choices. **Chapter 4** discusses implementation and next steps for the Montana CRS.

Montana's Carbon Reduction Strategy should support the Federal Goals to:

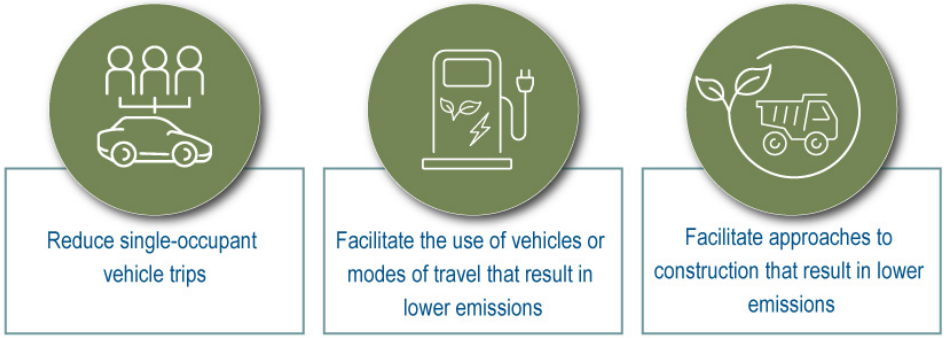


Figure 1.1: Federal Goals

The Montana CRS represents the collaborative efforts of MDT and the MPOs of Billings, Great Falls, and Missoula, and provides critical information to assist transportation officials in making project and program decisions. As part of the coordination effort, MDT met with the MPOs through the process by hosting three sets of virtual meetings that were held at key project milestones. The meetings provided the opportunity for MDT and the MPOs to share ideas, coordinate strategies, provide input on development of the CRS, discuss work task progress, and review deliverables. Additionally, the MPOs had the capability to share information at their respective policy committee meetings, which are open to the public, throughout the project process and share any comments or ideas with MDT.

Information presented in the Montana CRS is ultimately intended to help inform funding allocation decisions for individual projects and implementation actions to achieve the greatest reduction in carbon emissions given available funding, contextual considerations, and alignment with federal, state, and local goals.

1.1. MONTANA CARBON EMISSIONS FRAMEWORK

A simple framework derived from Montana's statewide long-range transportation plan (LRTP), *TranPlanMT*, was used to help evaluate transportation carbon emissions. As illustrated in **Figure 1.2**, the framework consists of the overall context of the state of Montana, transportation users, MDT assets, and management of the transportation system. Under each category, several contributors to carbon emissions and other elements influence the quantity of emissions produced. Federal law (23 USC 175 (a)(2)) requires the state's CRS to focus on "transportation emissions," which are defined as "carbon dioxide emissions from on-road highway sources of those emissions within a State." Accordingly, on-road sources of carbon emissions are the focus of the Montana CRS, although other non-road sources such as aviation, rail transport, and construction equipment also play a role in transportation emissions. MDT has the most control over the management of on-road sources and can consequently make the greatest impact on reducing carbon emissions through strategies that focus on these sources.

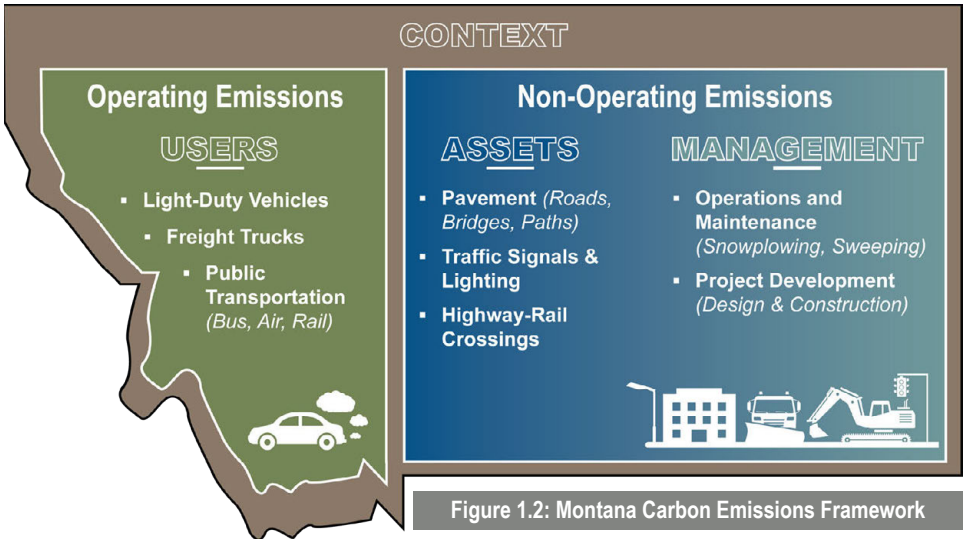


Figure 1.2: Montana Carbon Emissions Framework

CONTEXT

When understanding carbon emissions in Montana it is important to first acknowledge Montana's context. Federal law (23 USC 175 (d)(2)(E)) explicitly states that projects and strategies identified in the CRS should "be appropriate to the population density and context of the State." The CRS includes strategies that are effective for Montana's unique rural and frontier setting, considers various elements of Montana's environment affecting travel demand, and notes other factors influencing the development and management of the transportation network.

USERS

In terms of CO_2 emissions, user emissions are the most commonly considered form. Otherwise known as direct, operating, or tailpipe emissions, these emissions are produced when vehicles burn gasoline, diesel, and other fossil fuels. The term "vehicle" includes personal vehicles, freight trucks, and public transportation modes such as buses, aircraft, and rail locomotives. Cars, buses, and trucks are considered on-road mobile sources whereas airplanes, boats, trains, machinery, and other equipment are considered non-road mobile sources. Strategies in this category target changes in how transportation users make choices about their trips, including the frequency, length, and transportation mode.

ASSETS

Non-operating carbon emissions are associated with transportation infrastructure including pavement, traffic signals, lighting, and rail crossings which all require energy to produce, transport, construct, and operate. Asset strategies address material type and source location as well as energy usage and potential generation associated with non-road and on-road transportation infrastructure.

MANAGEMENT

The production, transport, and use of materials and equipment contributes to carbon emissions when MDT constructs new infrastructure and maintains the existing transportation system through sweeping, snow plowing, and repairs. Consideration of alternate materials or methods that emit less carbon can be considered in the project development process to help reduce overall CO_2 emissions. Furthermore, the decisions MDT makes about funding, monitoring, maintaining, and operating the transportation network influence carbon emissions across the state. Management strategies include optimization of construction and maintenance activities, use of alternative fuels, and investments in low-carbon equipment technologies to help reduce overall CO_2 emissions.

1.2. LIFE CYCLE OF EMISSIONS

Contributors of carbon emissions in the transportation sector include operating (or direct) emissions from fuel combustion required to move a vehicle, along with non-operating, (or embodied) emissions associated with fuel production, construction and disposal of the vehicles and materials, and infrastructure construction and maintenance. Considering both operating and non-operating emissions together results in an overall understanding of the life-cycle emissions as illustrated in **Figure 1.3**. The CRS focuses primarily on operating emissions, although strategies that address upstream non-operating emissions are also considered in some cases.

Life Cycle of Emissions

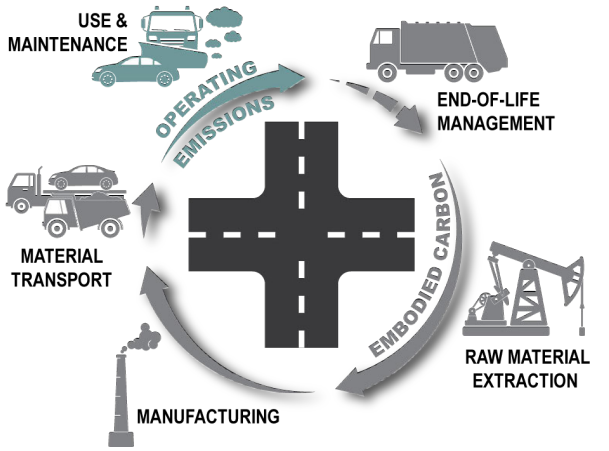


Figure 1.3: Life Cycle of Emissions

1.3. RELEVANT SUPPORTING EFFORTS

To ensure the Montana CRS aligns with and reflects statewide and local strategic frameworks, relevant state and local policies, procedures, and plans were reviewed, including existing goals, strategies, methods, and guidelines to support development of the CRS. **Table 1.1** summarizes each plan as it relates to the federal goals of reducing SOV trips, facilitating lower emission travel modes, and implementing lower carbon construction strategies. A detailed review of each document is contained in **Appendix A**, including a summary of how each document is relevant to the CRS effort.

Table 1.1: Previous Efforts Related to the CRS

**2023 updates of the Billings and Great Falls MPO MTPs are currently pending completion.*

Plans	Year	Agency	Federal Goals		
			Reduced Single Occupant Vehicle Trips	Vehicles/Trips with Lower Emissions	Construction Approaches with Lower Emissions
TranPlanMT	2017	MDT	✓	✓	✓
Billings Urban Area Metropolitan Transportation Plan*	2023	MPO	✓		✓
Great Falls Area Metropolitan Transportation Plan*	2023	MPO	✓		
Missoula Urban Area Metropolitan Transportation Plan	2021	MPO	✓	✓	✓
Statewide Transportation Improvement Program	2022	MDT	✓	✓	✓
Transportation Asset Management Plan	2022	MDT			✓
Montana Freight Plan	2022	MDT		✓	✓
ADA Transition Plan	2021	MDT	✓	✓	
Montana State Transit Management Plan	2020	MDT	✓	✓	
Montana Pedestrian and Bicycle Plan	2019	MDT	✓	✓	
SUP Inventory and Detailed Maintenance Plan	2018	MDT	✓	✓	
Pavement Design Manual	2018	MDT			✓
Rest Area Plan	2014	MDT		✓	
Montana State Rail Plan	2010	MDT	✓	✓	
Electric Vehicle Infrastructure Prioritization Study	2022	MDEQ		✓	
Electric Vehicle Charging Infrastructure Deployment Plan	2022	MDEQ & MDT		✓	
Regional Electric Vehicle Plan for the West and Progress Report	2017/2021	AZ, CO, ID, MT, NV, NM, UT		✓	

1.4. GOALS AND OBJECTIVES

MDT's mission to plan, build, operate, and maintain safe and resilient transportation infrastructure, with specific focus on efficient, connected, and accessible facilities, results in a transportation system supporting low-carbon mode choices and trips, as well as construction, operation, and maintenance methods. Further, the goals in Montana's statewide LRTP and MPOs' local MTPs support the CRS purpose to reduce transportation carbon emissions. **Figure 1.4** identifies how *TranPlanMT*, Montana's statewide LRTP, aligns with the CRS intent. **Appendix A** provides additional details about how specific *TranPlanMT* strategies and Billings, Great Falls, and Missoula MPO MTP goals are directly supportive of the CRS.

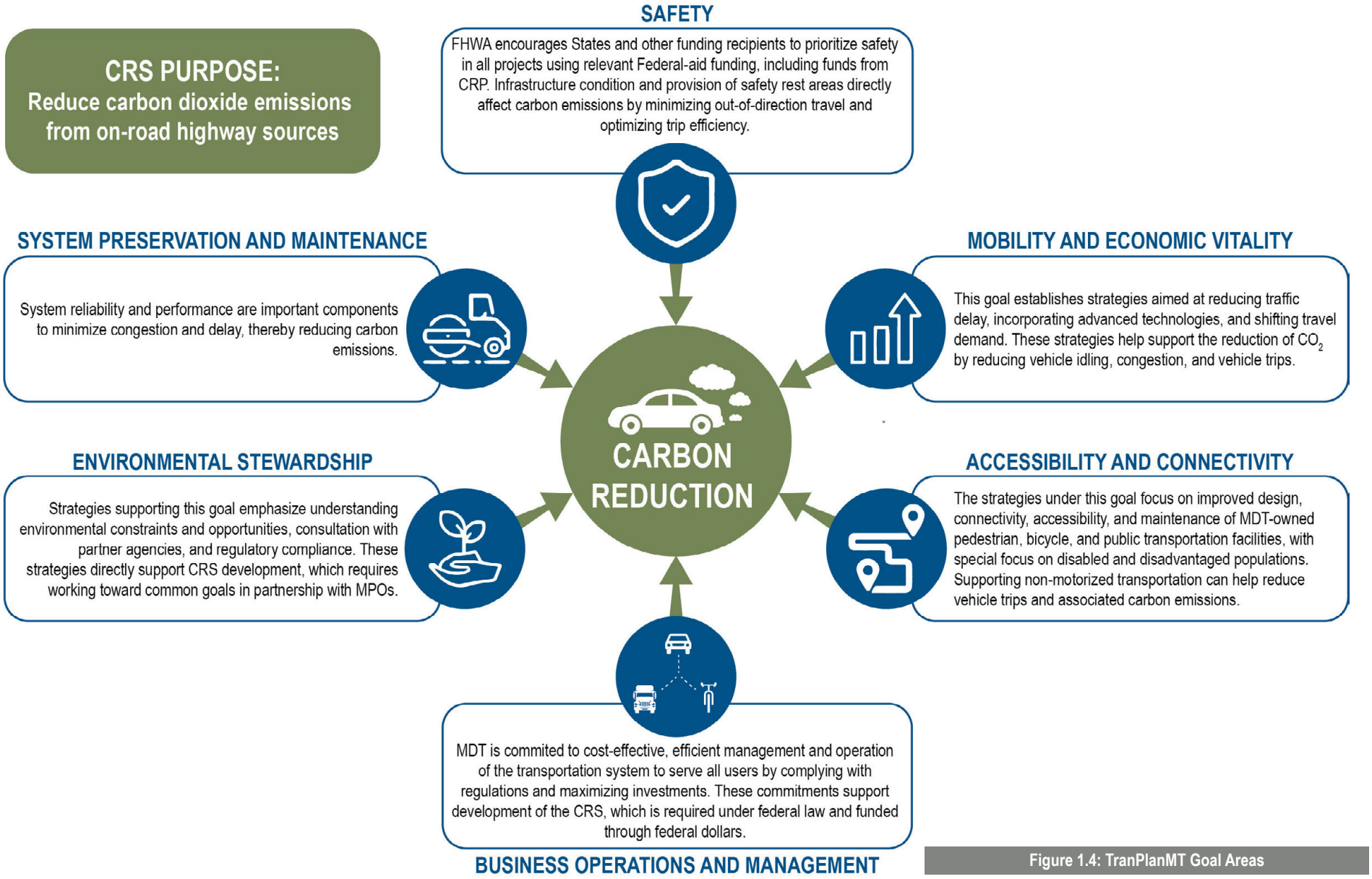


Figure 1.4: TranPlanMT Goal Areas

2.0. BASELINE CONDITIONS AND TRENDS



2.0. BASELINE CONDITIONS AND TRENDS

Extensive research was conducted to document baseline conditions and trends to gain insight into the role that the transportation sector plays in the state's CO_2 emissions. This data is available through several national sources such as the US Census Bureau, US Environmental Protection Agency (USEPA), US Energy Information Administration (USEIA), US Bureau of Transportation Statistics (USBTS) and Federal Highway Administration (FHWA). More detailed data specific to Montana was also gleaned from existing MDT data sources such as state traffic data, asset and condition data, and congestion-related metrics. Compilation of this research helps establish a baseline for measuring progress towards carbon reduction and helps identify areas of improvement and opportunities for targeted investment.

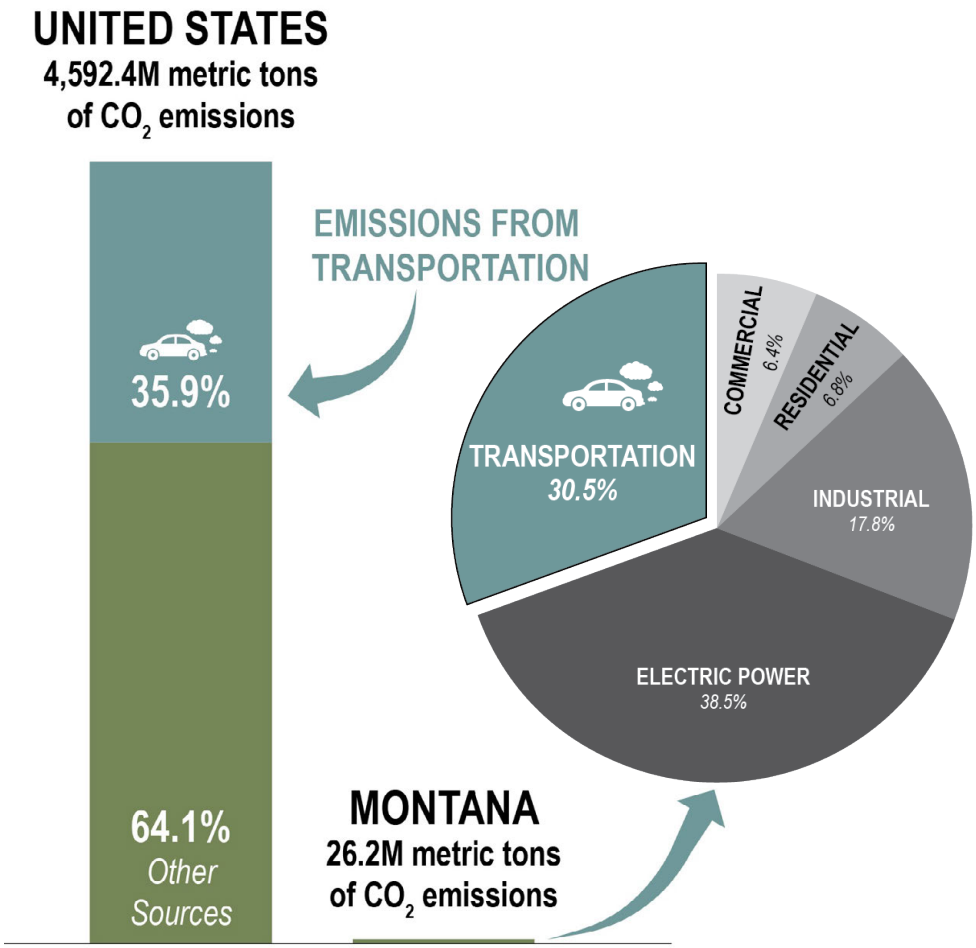


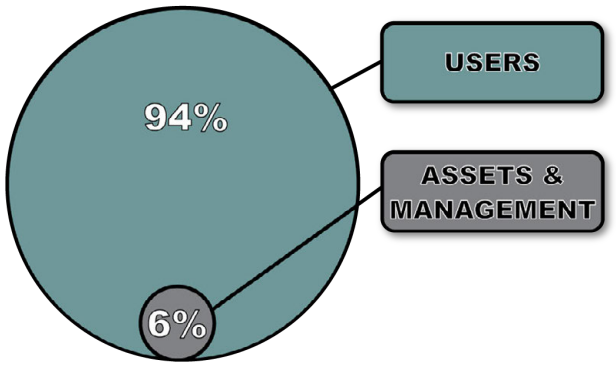
Figure 2.1: Transportation Sector Emissions

2.1. BASELINE CARBON EMISSIONS

In 2020, the USEIA reported that 4,592.4 million metric tons of carbon dioxide emissions were produced in the United States (**Figure 2.1**).[1] Of that, about 36% of all carbon emissions were generated by the transportation sector as a result of fuel combustion. This includes fuel used by personal vehicles, freight vehicles, rail locomotives, aircraft, watercraft, and other vehicles whose primary purpose is to transport people and/or goods. Non-road vehicles whose primary purpose is not transportation (e.g., construction cranes and bulldozers, farming vehicles, and warehouse forklifts) were classified in the sector of their primary use. The carbon emissions generated by the transportation sector are derived from petroleum products (97%) and natural gas (3%), however, the Montana CRS focuses primarily on carbon emissions as a byproduct of gasoline and diesel combustion.

Montana contributes a very small share (approximately 0.6%) toward the national total, producing about 26.2 million metric tons per year. Of that, approximately 30.5 percent, or about 8 million metric tons, of emissions are generated by the transportation sector. In perspective, Montana's transportation emissions account for about 0.17% of total emissions nationwide, or 0.48% of the nation's transportation emissions.

Figure 2.2 provides a comparative scale of emissions from users and assets/management activities in locations around the country. The figure indicates that emissions for transportation system users, or tailpipe emissions from the combustion of gasoline and diesel fuels in vehicles, make up the vast majority of transportation emissions (approximately 94%). Upstream emissions associated with fuel production and distribution are also considered in this figure. The remaining 6% of carbon emissions are generated from the materials and fuels used in the construction, maintenance, and operation of transportation infrastructure and operations.



Source: Reducing Greenhouse Gas Emissions: A Guide for State DOTS, TRB and NCHRP, Updated March 8, 2022. Based on data from Florida, Maine, Massachusetts, Minnesota, Maryland, Oregon, Vermont, Washington, and Texas DOTs.

Figure 2.2: Scale of Carbon Emissions by Category

These values are derived from a study conducted by consulting firm Good Company that considered the system use and typical activities of nine state Departments of Transportation (DOT).[2] At the time, each DOT reported having a largely built out state transportation system so the majority of DOT activities were maintenance related as opposed to construction related. Considering the life-cycle contribution of all roadways, including new construction, could result in a much greater share of emissions in the assets and management categories. Other data considered in the calculations included vehicle miles traveled (VMT), population, lane miles, fuel mix, and information from states' budget documents. Although not specific to Montana, this information is helpful to broadly understand the relative scale of carbon emissions associated with the transportation sector.

The chart in **Figure 2.3** shows how carbon emissions generated from the consumption of fossil fuels in Montana have fluctuated since 1970. Overall, emissions in Montana trended upward between 1970 and 2007 and have trended downward in the last decade. The transportation sector, however, has held relatively steady with little fluctuation. **Figure 2.3** also shows a large dip in overall state emissions in 2020, likely due to consequences of the global COVID-19 pandemic.

The following sections present the state's transportation emissions based on the carbon emissions framework categories including context, users, assets, and management.

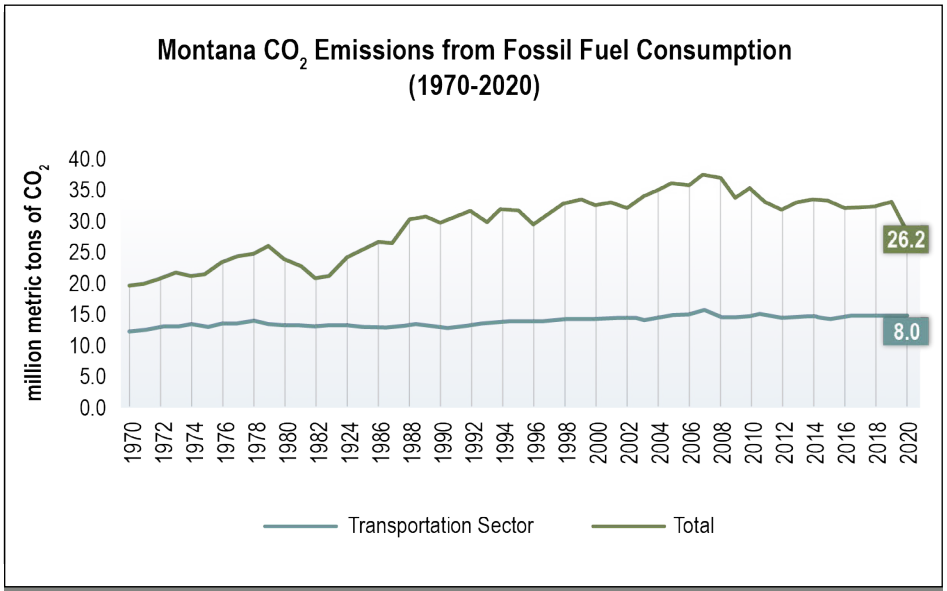
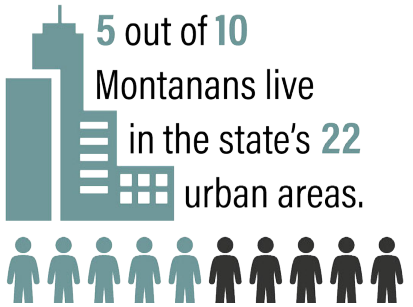


Figure 2.3: CO_2 Emissions from Fuel Consumption

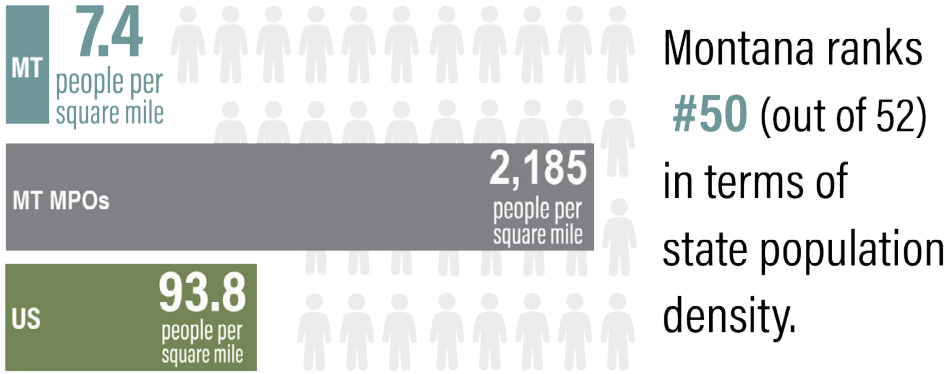
2.1.1. Context

Understanding Montana's context can help MDT select the most effective carbon reduction strategies for the state and determine the best way to prioritize investments. Montana has one of the lowest population densities in the country, ranking 50 out of 52 states (including the District of Columbia and Puerto Rico).[3] Compared to the United States as a whole, Montana has approximately 90 percent fewer people per square mile, spread out across hundreds of miles. The state's population is heavily concentrated in urban areas as shown in **Figure 2.4**.



The US Census Bureau defines urban areas as those encompassing at least 5,000 people or at least 2,000 housing units. Per state statute (Montana Code Annotated [MCA] Title 60), MDT defines urban areas only as those encompassing at least 5,000 people. Accordingly, the US Census Bureau identifies 22 urban areas in Montana, while MDT only recognizes 20, which excludes Libby and Dillon. Since the majority of available information is published based on US Census Bureau definitions and boundaries of urban areas, all 22 Census-designated urban areas were considered during the development of the CRS.

Based on results of the 2020 Census, about 53 percent of Montanans live in Montana's 22 urban areas. On average, the state's urban areas have an average population density of about 1,800 people per square mile while the three MPOs have an average density of about 2,185 people per square mile. Although the population centers are comparatively dense, the state's large geographic footprint means that people often drive many miles between destinations, influencing the types of strategies that are appropriate for the state.



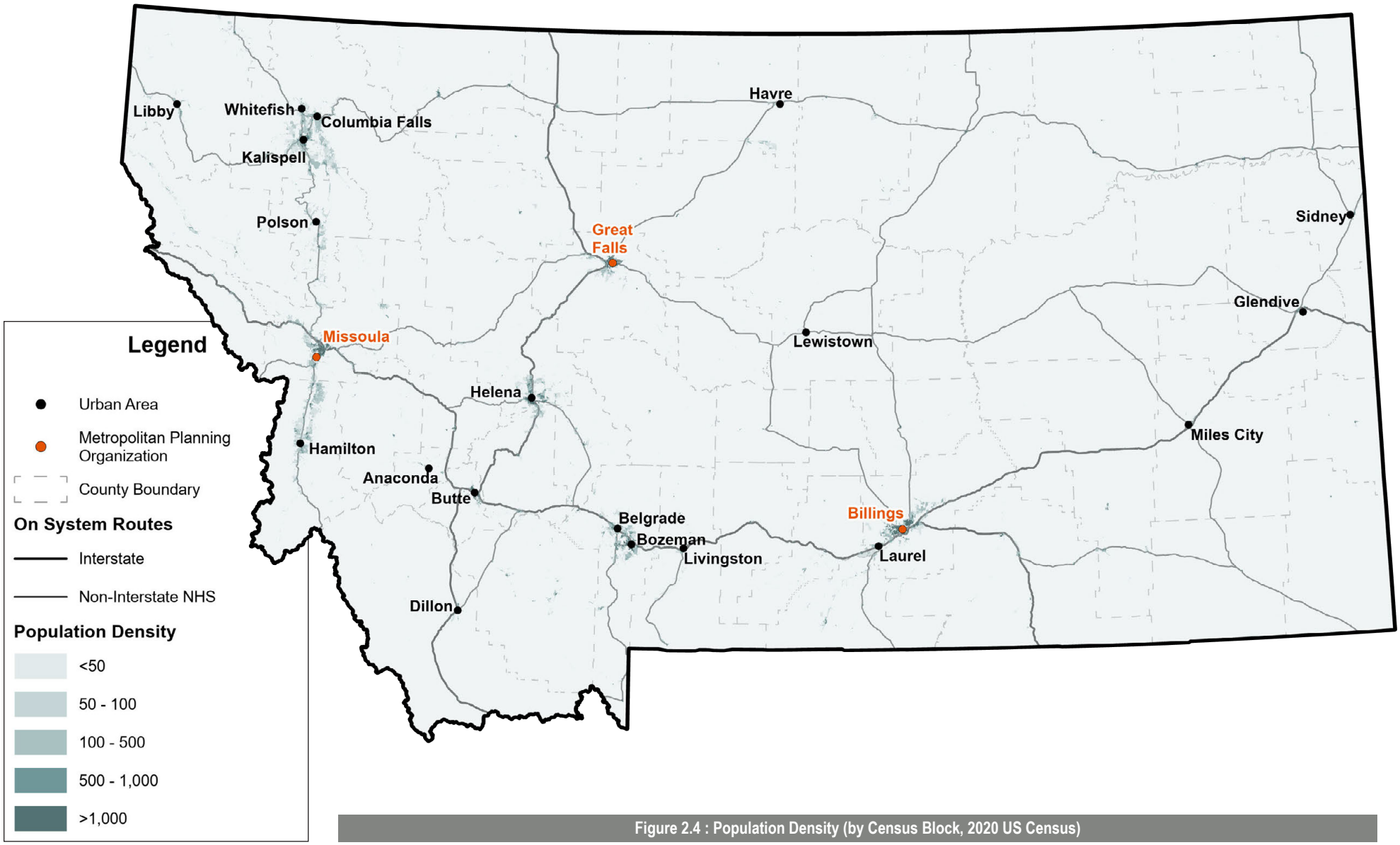


Figure 2.4 : Population Density (by Census Block, 2020 US Census)

2.1.2. Users

This section documents how and where emissions are occurring within the state and how Montanans travel to help MDT target strategies that are appropriate for the state's transportation system users and personal travel habits.

Fuel Consumption

Figure 2.5 shows trends in gasoline and diesel consumption in Montana since 1960 as reported by the USEIA's State Energy Data System. The data is reported in thousands of barrels, and there are approximately 42 gallons of fuel per barrel. As shown in the figure, more gasoline is consumed in Montana than diesel, and the majority (96%) of gasoline is consumed by the transportation sector, whereas about 81% of the state's diesel fuel is consumed by the transportation sector. Both gasoline and diesel fuel consumption have been increasing overall within the state over the past several decades. However, there was a noticeable decrease in gasoline consumption in 2020, likely due to the COVID-19 pandemic. MDT reported a total of approximately 564 million gallons of gasoline and 307 million gallons of diesel were consumed in Montana in 2022. These figures represent a 7 percent and 8 percent increase in gasoline and diesel fuel consumption, respectively, over the 2020 to 2022 period.[4]

Between **2020** and **2022**, gasoline consumption increased by almost **7%** and diesel consumption increased by over **8%**.

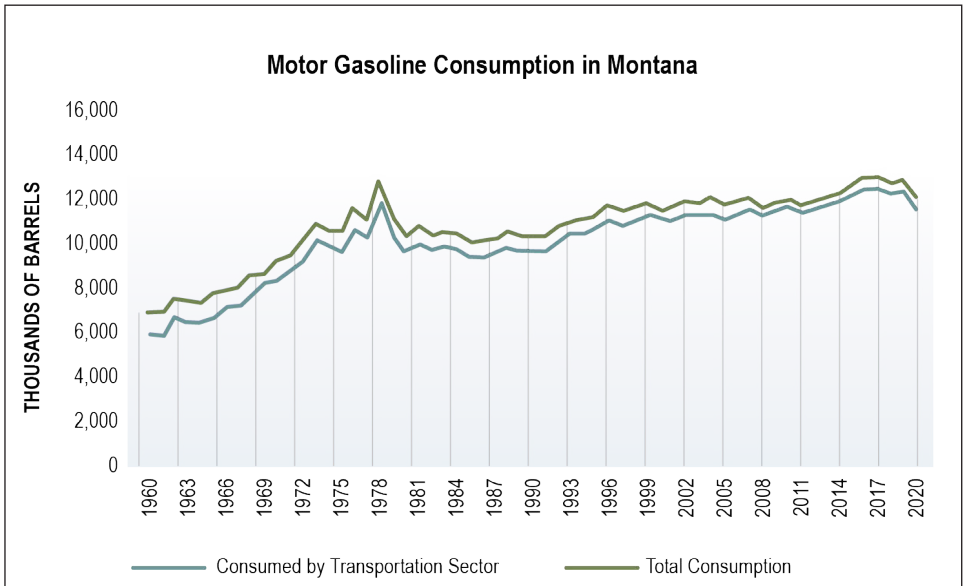
Trips and Vehicle Miles Traveled

Another factor in emissions is the length and quantity of trips made by vehicles. **Figure 2.6** presents Daily Vehicle Miles Traveled (DVMT) in 2021 reported by MDT at the county level with darker areas showing higher values. These values generally correspond to earlier figures, indicating that more DVMT occurs where population is most concentrated in our state, such as in the Billings, Bozeman, Missoula, and Kalispell areas. Higher DVMT can indicate either longer trips, more frequent trips by individuals, or more individuals taking trips in general.



Source: Nady/Adobe Stock

In 2022, **564,828,269** gallons of gasoline and **307,035,342** gallons of diesel **were consumed in Montana.**



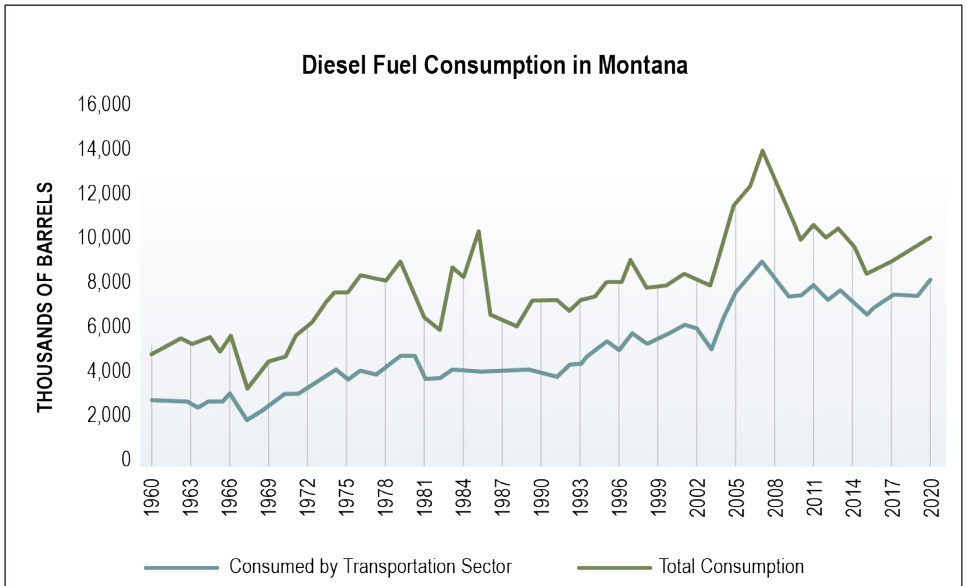
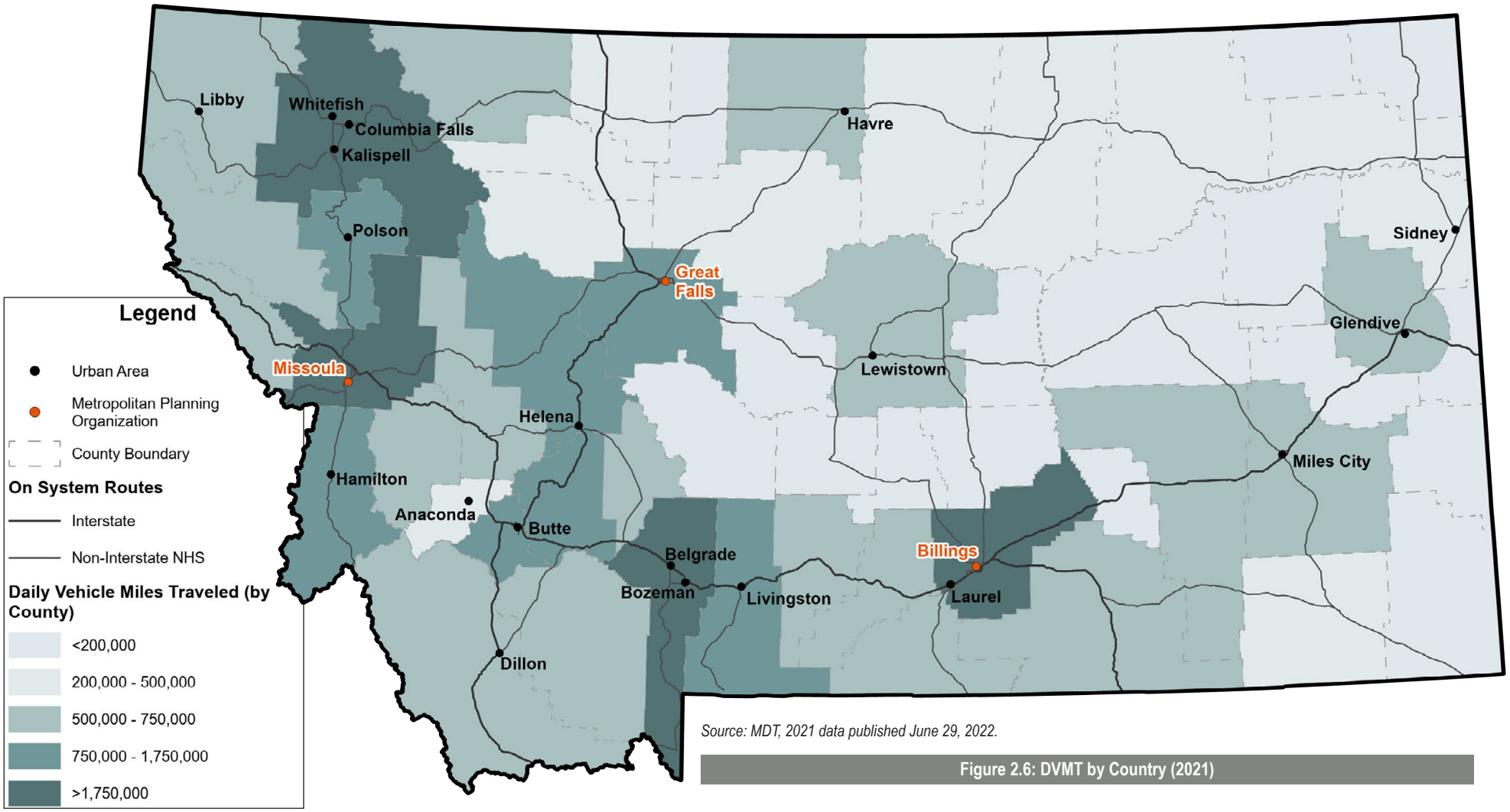


Figure 2.5: Gasoline and Diesel Fuel Consumption in Montana



Source: MDT, 2021 data published June 29, 2022.

Figure 2.6: DVMT by Country (2021)

MDT also reports VMT on an annual (AVMT) and monthly (MVMT) basis.[5] In 2022, vehicles traveled 13.34 billion miles on Montana roadways. Approximately 70 percent of those miles occurred on rural roadways and about 76 percent of the total AVMT in Montana occurred on MDT-owned routes. Travel on arterials accounted for the majority of VMT (43%) followed by local roads (31%) and interstates (26%). These arterials include US Highways, Montana Highways, and other Secondary Highways. When comparing 2022 VMT to previous years (**Figure 2.7**), total AVMT has been increasing at an average rate of about 1.5% per year since 2013, with the exception of a drop in 2020, most likely due to the COVID-19 pandemic. This growth doesn't necessarily correspond to more trips by individuals but may indicate increased population and tourism. From 2013 to 2021, Montana's population increased at a rate of approximately 1.1% per year[6] and non-resident visitation increased by 1.9% per year.[7]



In **2022**, vehicles traveled **13.34 billion miles** on Montana roadways.

Figure 2.7 also presents 2022 MVMT for urban and rural roadways. When reported on a monthly basis, MVMT on urban roadways shows relatively little fluctuation throughout the year. Conversely, MVMT on rural roads shows a peak during summer months, which is when a majority of tourism occurs, with about 57% of non-resident visitation occurring between June and September in Montana in 2022.[7]

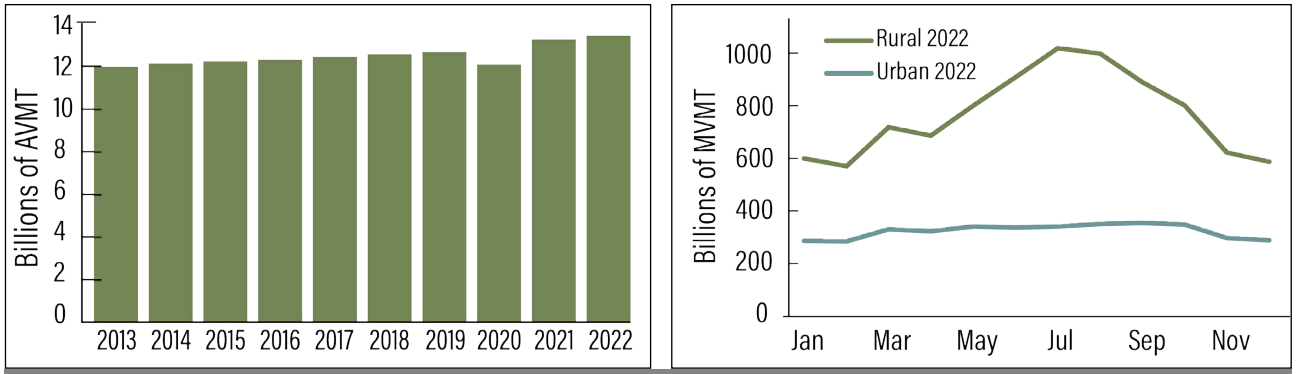


Figure 2.7: AVMT (2013-2022) and MVMT (2022)

As discussed previously, fuel consumption has historically been increasing, apart from the 2020 decrease likely related to travel changes resulting from the COVID-19 pandemic. The chart in **Figure 2.8** illustrates the last 10 years, showing highway use of gasoline in blue and highway VMT in green as reported by the USBTS.[8] From 2010 to 2019, VMT increased while gasoline use peaked in 2013 and has started decreasing in more recent years. Although more people are traveling more often and for potentially further distances, increased fuel efficiency of vehicles and the adoption of alternative fuel sources in recent years have helped reduce gasoline consumption. However, as a testament to the large geographic expanse of the state, Montana ranks among the top five in the nation in both per capita AVMT and per capita gasoline expenditures.[9,10]

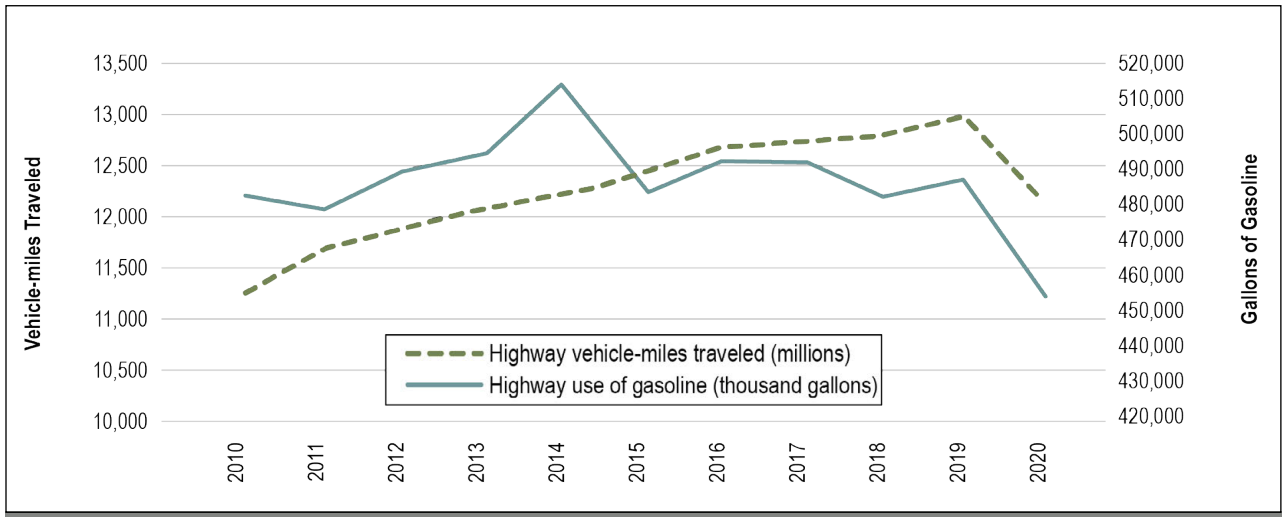
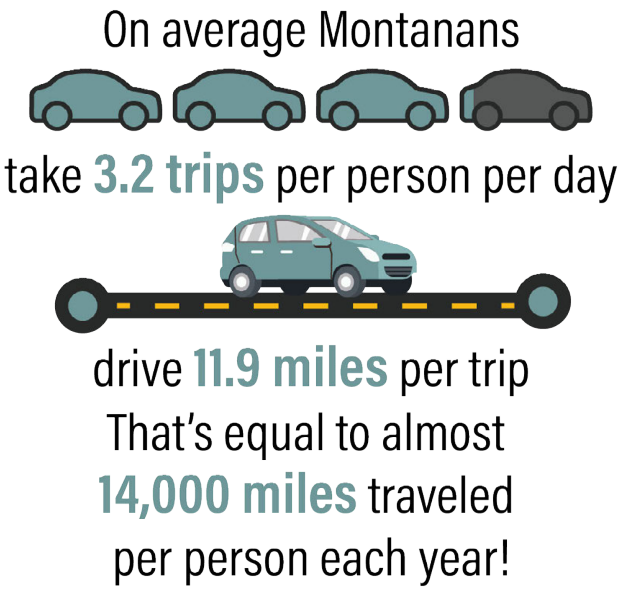


Figure 2.8: Highway Travel and Fuel Consumption

In addition to VMT, person trips, or trips made by any person in any mode of transportation, are instructive. Data published by the National Household Travel Survey in 2017 indicates Montanans took 7.8 billion person trips and traveled 92.7 billion miles over the course of one year.[11] This translates to an average of 3.2 trips per person per day with an average of 11.9 miles per trip, or approximately 14,000 miles traveled per person per year. These values represent a 4 percent decrease in person trips since the last survey was conducted in 2009, despite an overall increase in population of 22 percent. Results from the 2017 survey indicate that the majority of trips for Montanans are for family or personal business (38%) or social and recreational purposes (23%). About 22 percent of trips are made for work or work-related purposes and 10 percent of trips are made for school or religious activities.



Annual person trips are mapped spatially by county in **Figure 2.9**. The average number of daily trips per person in each county is also included on the map. The figure shows that the counties with larger urban areas generate more person trips. They also tend to generate more trips per person compared to the statewide average of 3.2. Similarly, more rural areas with fewer annual person trips also tend to generate fewer trips per person than the statewide average. These statistics are generated based on mobile device data and capture travel by all modes of transportation including driving, rail, transit, and air. The data also indicates the length of trips made by people in each county. On average, approximately 57 percent of trips in Montana are less than 5 miles in length with shorter trips being more prevalent in urban areas compared to rural areas.

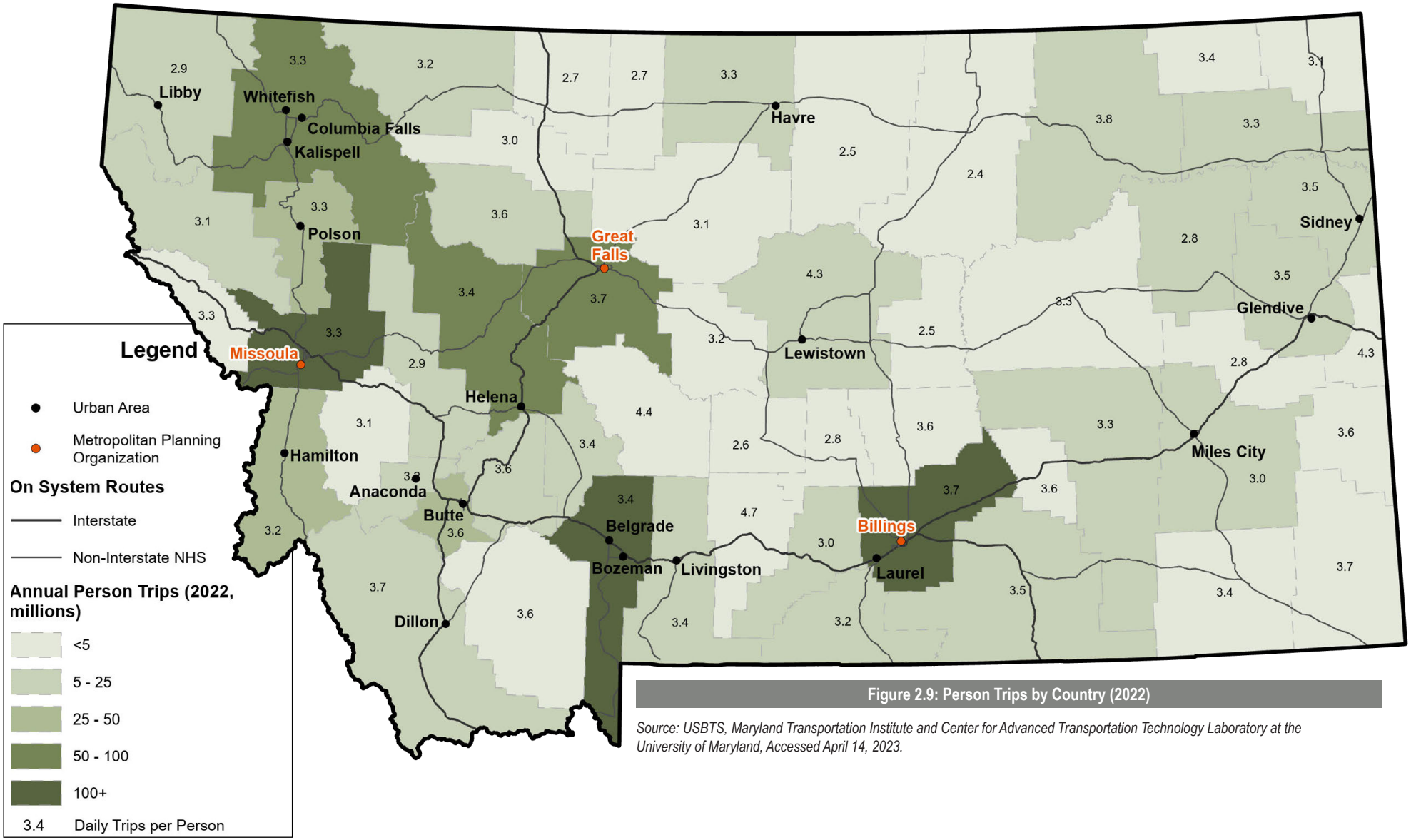


Figure 2.9: Person Trips by Country (2022)

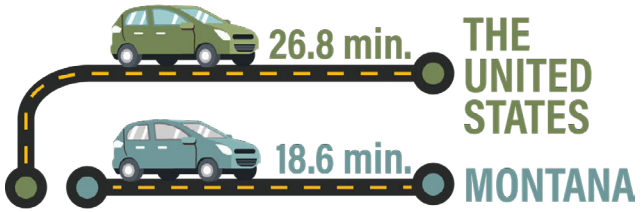
Source: USBTS, Maryland Transportation Institute and Center for Advanced Transportation Technology Laboratory at the University of Maryland, Accessed April 14, 2023.

Mode Choice

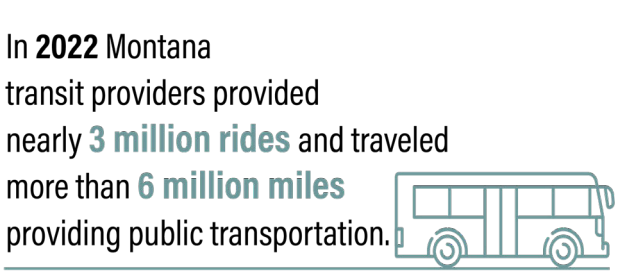
The American Community Survey (ACS) conducted by the US Census Bureau provides estimates of the transportation modes used by commuters and mean travel times to work (**Figure 2.10**).[12] Based on ACS Profile Report for the 2017-2021 period, about 74 percent of Montanans commute to work by driving alone in a personal vehicle, which is generally aligned with the national average. A slightly higher share of Montanans carpool, bike, and walk to work, compared to the nation as a whole. However, transit ridership is lower in Montana compared to other parts of the country. Approximately 9.4 percent of Montana residents work from home, which represents an increase in recent years. When considering commute statistics for MPOs, all three MPOs were found to have smaller percentages of workers who carpool compared to the rest of the state. Both Great Falls and Missoula have higher transit ridership than the state. Missoula also has higher percentages of residents who walk, bike, or work from home while Billings and Great Falls both have lower percentages of commuters by these modes compared to the rest of the state.



In Montana, commute times are shorter than the rest of the US, with travel times of about 18.6 minutes in Montana compared to 26.8 minutes for the country. Although Montanans often drive longer stretches, there is generally less congestion compared to other locations in the country. Commute times are often shorter in Montana's urban areas where development is more concentrated and there are smaller distances between work and home. Great Falls and Missoula both have commute times of approximately 15 minutes, while the average commute time in Billings is around 17 minutes.



Although a small number of Montanans commute by bus, people take public transportation for reasons other than just to get to work. In 2022, the 40 transit providers across the state provided 2,994,597 rides to passengers, traveling more than 6 million miles along local and inter-city transit routes.[4] These ridership statistics reflect decreased ridership due to the COVID-19 pandemic. In 2019, there were nearly 4.3 million transit rides provided in Montana.[8] The University of Montana Institute of Tourism & Recreation Research tracks travel and tourism trends within the state including how visitors arrive in Montana. Available data for 2022 indicates that most of Montana's 12.1 million visitors arrived by private vehicle (89%) while approximately 10 percent arrived via airplane. Fewer than one percent of visitors arrived by train, bus, or other mode.[13]



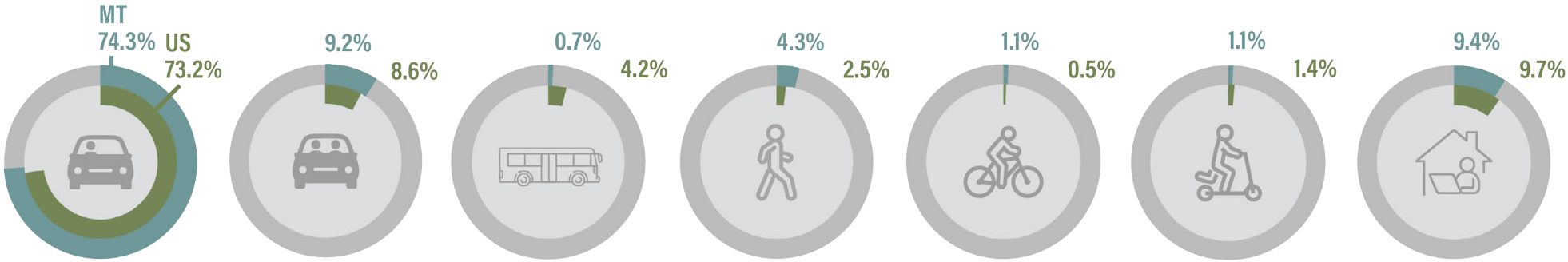


Figure 2.10: Montana and US Transportation Modes for Commuters

In 2021, Montana had approximately 3,135 miles of active mainline railroad tracks including Amtrack's Empire Builder passenger rail service across northern Montana. The daily service runs east-west across the state with 12 Montana stations. In 2021, the Empire Builder recorded 67,066 boardings and alightings in Montana with the Whitefish station accounting for 45% of those passengers.[4] Passenger rail ridership has been steadily declining since its peak in 2008 (approximately 107,000 riders) with a significant drop in 2020 due to the COVID-19 pandemic.[8] Preliminary reports from Amtrack's 2022 fiscal year indicate that ridership is rebounding but has not yet reached pre-pandemic levels.

The number of Amtrak riders in Montana has decreased by 60% from **2008** to **2021**.



In **2021**, scheduled airlines carried nearly **4.8 million** passengers to and from Montana.

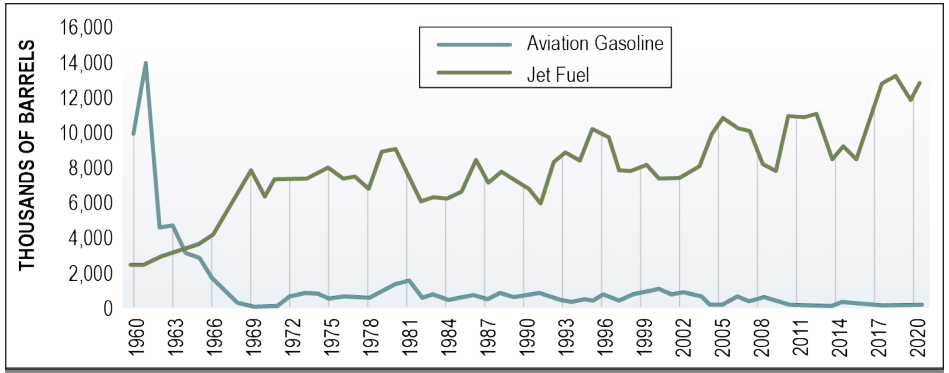
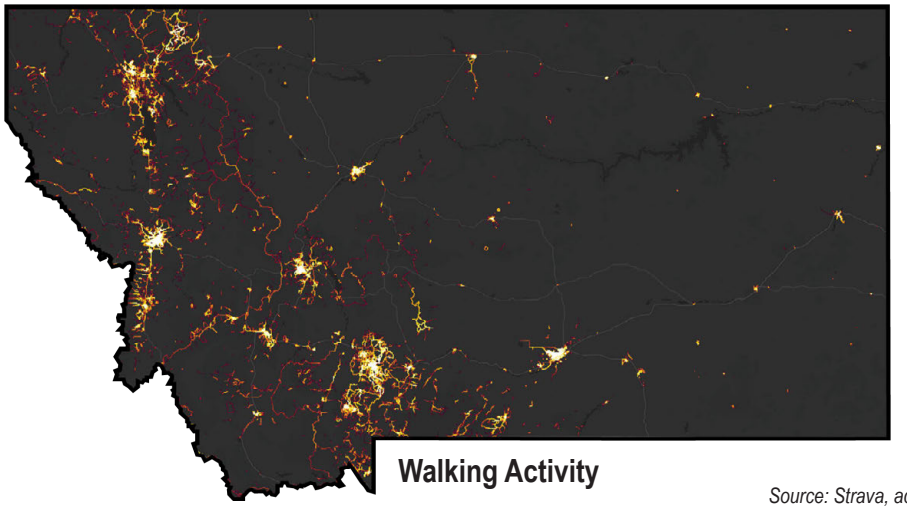
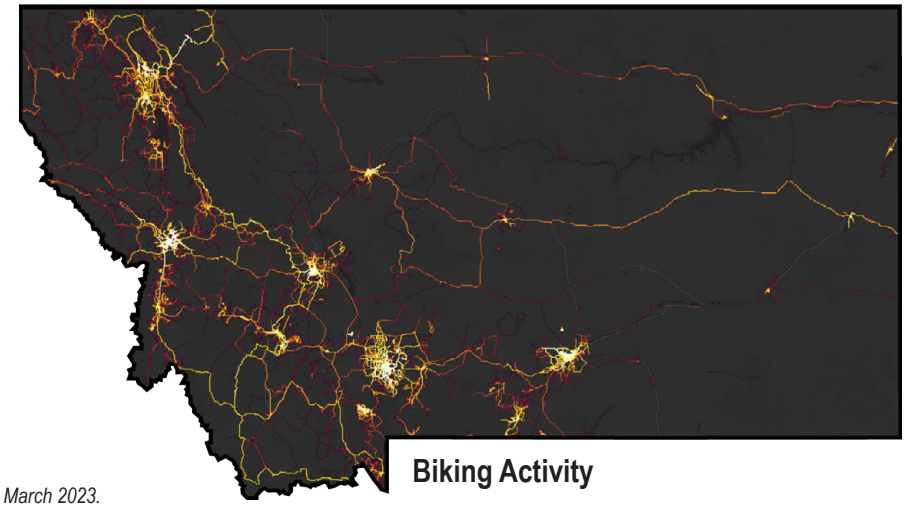


Figure 2.11: Aviation Fuel Consumption in Montana

Similarly, residents and tourists travel by airplane to reach destinations within and outside of Montana. In 2021, scheduled airlines carried nearly 4.8 million passengers to and from Montana.[4] This value also reflects a decrease since the COVID-19 pandemic. Several private airplanes in the state make trips that aren't reflected in this value. The smaller planes typically use aviation fuel, while the larger commercial aircraft use jet fuel. As shown in **Figure 2.11**, the use of aviation gasoline in the state rapidly decreased between 1960 and 1970 and has remained fairly constant since then. Consumption of jet fuel has steadily increased since 1960 with some fluctuations over the years.[15]

Biking and walking are the lowest carbon transportation modes. Although data on pedestrian and bicycle use across the state is not readily available, several localities, such as Missoula and Billings, maintain databases of pedestrian and bicycle infrastructure as well as activity counts within their jurisdictions. These counts help local governments target investments in the pedestrian and bicycle transportation system where they will be most useful to residents. **Figure 2.12** provides a map of pedestrian and bicycle activity across Montana available through Strava.[16]





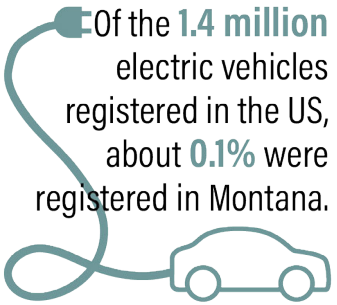
Source: Strava, accessed March 2023.

Figure 2:12: Walking and Biking Activity in Montana

Strava is an internet service that tracks users' physical exercise, primarily running and bicycling, using global positioning system (GPS) data. As such, the information primarily captures walking and biking activity as it relates to recreation. However, it is still helpful to understand where walking and biking may be most prevalent as transportation modes as well. As seen in **Figure 2.12**, the highest activity is found in and around Montana's urban centers and in the western part of the state where national forest lands support corresponding recreational activity. Walking or running activity appears to occur in shorter distances while biking activity appears to cover several miles along Montana highways.

Alternative Vehicles

Availability and adoption of vehicles that use alternative fuels such as electricity, biofuel, and propane are becoming more commonplace across the country and in Montana. **Figure 2.13** shows the amount of fuel consumed by alternative fuel sources including ethanol, biodiesel, and propane in Montana over the 1960 to 2020 period provided by the USEIA State Energy Data System. The chart shows greater adoption of alternative fuel vehicles in the past decade as technologies have advanced and vehicles supporting these fuels have become more widely available. Data available from the Alternative Fuels Data Center (AFDC), a resource from the US Department of Energy, indicates that approximately 15 percent of registered vehicles in Montana use alternative fuels compared to about 11 percent nationwide. For both geographies, ethanol is the most common alternative fuel source.[17]



According to the AFDC, about 1.7 percent of registered vehicles in Montana are considered electric, including fully electric vehicles (EV), plug-in hybrid electric (PHEV), or hybrid electric (HEV). In the US, approximately 2.8 percent of registered vehicles are electric. *The Montana Electric Vehicle Infrastructure Deployment Plan* indicates that 4,555 electric vehicles were registered in Montana in 2022.[100] Of those, approximately 24 percent were registered in the counties where the state's three MPOs are located (Cascade County [Great Falls] – 109 EVs, Yellowstone County [Billings] – 457 EVs, and Missoula County [Missoula] – 523 EVs).[18]

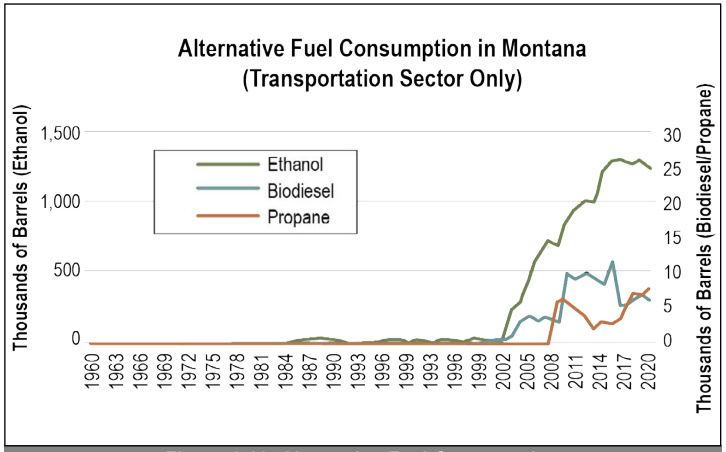


Figure 2.13: Alternative Fuel Consumption

Table 2.1: Montana Mobile Source Emissions

Emissions Inventory System Sector	Metric Tons of CO_2
Mobile - On-Road non-Diesel Light Duty Vehicles	4,597,436
Mobile - On-Road non-Diesel Heavy Duty Vehicles	164,629
Mobile - On-Road Diesel Light Duty Vehicles	466,422
Mobile - On-Road Diesel Heavy Duty Vehicles	2,636,455
All On-Road Sources	**7,864,942**
Mobile - Non-Road Equipment - Other	30,781
Mobile - Non-Road Equipment - Gasoline	245,545
Mobile - Non-Road Equipment - Diesel	1,273,816
All Non-Road Sources	**1,550,142**
Mobile - Locomotives	**899,072**
ALL MOBILE (NON-POINT) SOURCES	**10,314,156**

Note: Note: Due to rounding, numbers presented in this table may not add up precisely to the totals provided by the NEI.

Source: USEPA, 2020 NEI, Released 2023.

User Emissions

USEPA's Motor Vehicle Emission Simulator (MOVES) is an industry-recognized emissions modeling system that estimates emissions for mobile sources at the national, county, and project level for air pollutants, including carbon dioxide.[19] The model relies on area-specific data such as local temperature profiles, vehicle registration data, VMT, speed distributions, roadway types, fuel types, and other local data to more accurately model local vehicle, road, and weather conditions influencing carbon emissions. The Montana Department of Environmental Quality (MDEQ) and MDT are considering a potential partnership to develop a state-specific MOVES model to understand the types, sources, and locations of emissions within the state.

USEPA also publishes the National Emissions Inventory (NEI) which is a comprehensive estimate of emissions based upon data provided by state, local, and tribal agencies and supplemented with data developed by the USEPA. The NEI provides emissions estimates from point, non-point, on-road, and non-road sources. The on-road source outputs are derived primarily using the national MOVES model maintained by USEPA. The NEI on-road sources include emissions from on-road vehicles that use gasoline, diesel, and other fuels such as light- and heavy-duty vehicle emissions from operation on roads, highway ramps, and during idling. NEI non-road sources include mobile sources such as construction equipment, lawn and garden equipment, aircraft ground support equipment, locomotives, and commercial marine vessels. The NEI is released every three years, with the most recent dataset representing 2020 conditions. A summary of the NEI outputs for all mobile, or non-point, sources in the state is provided in **Table 2.1**.

Table 2.1 shows that on-road mobile sources, or those which can move and are not in a fixed location, yield approximately **7.9 million metric tons of CO_2** in Montana in 2020. A breakdown of the emissions by vehicle type for on-road sources only is provided in **Table 2.2**.

The data in **Table 2.2** indicates that passenger trucks account for most CO_2 emissions in Montana (3.4 million metric tons) followed by combination long-haul trucks, combination short-haul trucks and passenger cars, which each produce approximately 1.1 million metric tons of CO_2 annually. Refuse trucks and transit buses produce the lowest amount of CO_2 in the state, likely due to their limited numbers statewide.

NEI data is available at the county level. A map showing the total CO_2 emissions from on-road sources in each county is shown in **Figure 2.14**. The counties which produce the most CO_2 emissions from mobile on-road sources from largest to smallest emissions include Yellowstone, Gallatin, Missoula, Flathead, Cascade, and Lewis and Clark. These counties contain the state's largest urban areas, including the three MPOs.

Table 2.2: Montana On-Road Mobile Source Emissions

Vehicle Type	Metric Tons of CO_2
Motorcycle	44,771
Passenger Car	1,141,115
Passenger Truck	3,435,119
Motor Home	26,129
School Bus	56,944
Transit Bus	16,962
Intercity Bus	48,208
Refuse Truck	2,127
Light Commercial Truck	442,852
Single Unit Short-haul Truck	413,740
Single Unit Long-haul Truck	68,960
Combination Short-haul Truck	1,015,106
Combination Long-haul Truck	1,152,909
TOTAL CO_2 EMISSIONS (ON-ROAD SOURCES)	**7,864,942**

Note: Due to rounding, numbers presented in this table may not add up precisely to the totals provided by the NEI.

Source: USEPA, 2020 NEI, Released 2023.

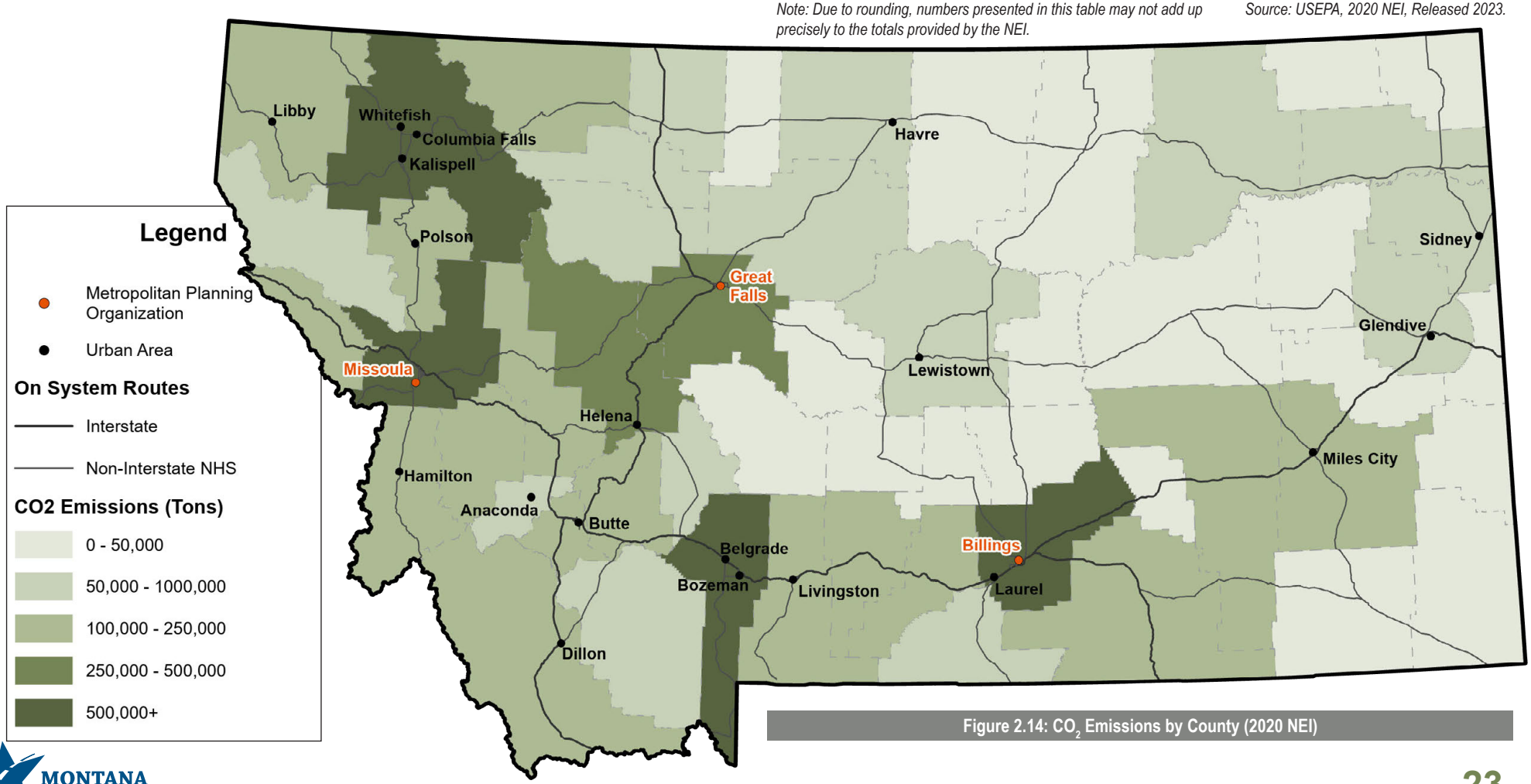


Figure 2.14: CO_2 Emissions by County (2020 NEI)

2.1.3. Assets

The information in this section summarizes the current transportation system in Montana and identifies assets owned and operated by MDT. These assets all involve life-cycle carbon emissions, and some assets such as traffic signals and rail crossings also play a role in how Montanans move within the transportation system.

Transportation Infrastructure

The transportation system in Montana consists of over 73,000 miles of public roads. About 18 percent, or about 13,000 miles, are owned and maintained by MDT. The remaining 60,000 miles are owned by local governments including cities, counties, federal agencies, and tribal entities. Approximately 53 percent of the nearly 4,500 bridges in Montana are owned by MDT.[4]

There are also numerous miles of pedestrian and bicycle facilities within the state including sidewalks, trails, paths, and bike lanes. Montana is one of only five states in which it is lawful for bicyclists to travel on all public roads. A statewide inventory of non-motorized facilities does not exist; however, many localities maintain their own inventories and are investing heavily in these types of facilities. MDT does, however, maintain a database of shared use paths (SUPs) within state-maintained right-of-way. In 2021, MDT reported that there were 209.4 miles of SUPs within state right-of-way, of which about 18 percent (37 miles) are maintained by MDT and the remaining 82 percent (172.4) are maintained by others.[20] The majority of paths are located in urban areas with the greatest number of miles located in the Missoula, Bozeman, and Kalispell divisions of MDT.

Emissions are associated with the material extraction, manufacturing, and transport of materials necessary to construct new assets and to rehabilitate and reconstruct existing assets. **Figure 2.15** shows asphalt and road oil consumption in Montana from the USEIA State Energy Data System. The dataset assigns all consumption of asphalt and road oil to the industrial sector since it is mostly used in construction activity. The estimates are based on state-level production of hot-mix asphalt and warm-mix asphalt, excluding reclaimed asphalt pavement, and the sale and consumption of asphalt and road oil within each state. The chart shows variable consumption within the state over the past 60 years, but with a general increase overall. Some of the large fluctuations, especially between 1980 and 2008, may be a result of inconsistencies in data reporting from manufacturers.[21]



There are 4,452 bridges in Montana.
2,405 are state-owned.

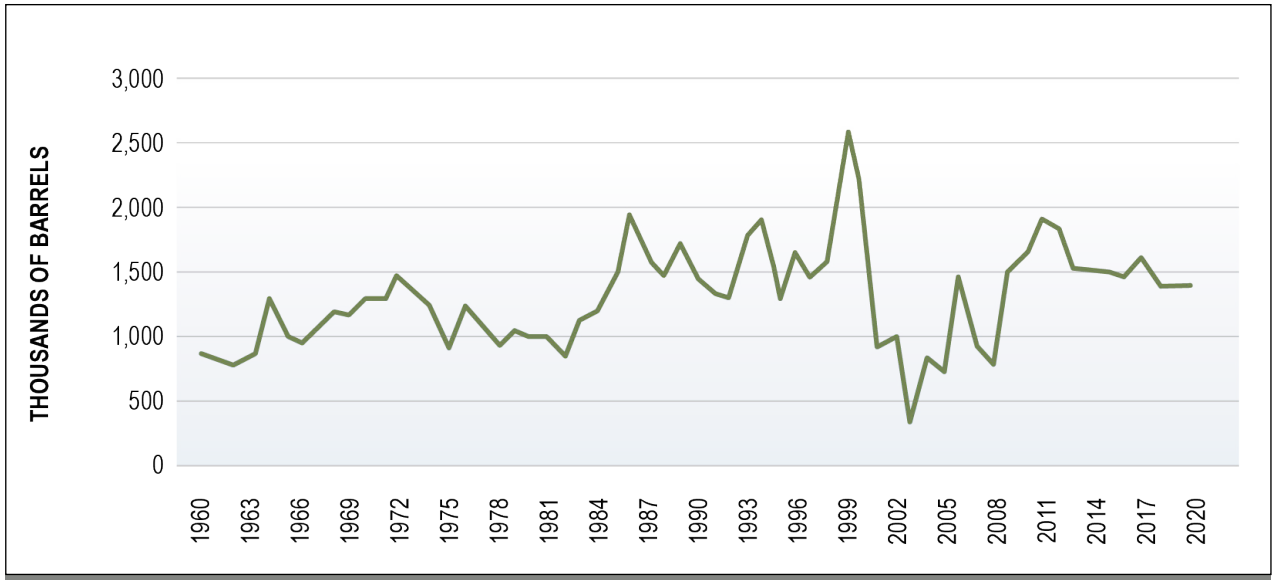
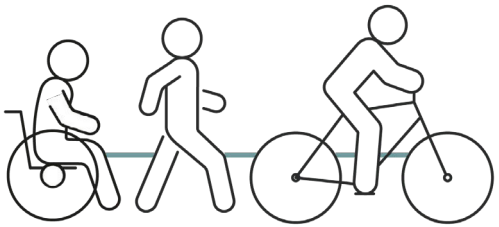


Figure 2.15: Asphalt and Road Oil Consumption in Montana

There are **209.4 miles** of shared use paths in Montana.



There are **73,571 miles** of public roads in Montana. MDT routes make up **12,916 miles.**



At intersections of these transportation systems, various forms of traffic control are used. At lower-volume intersections, stop signs, yield signs, or no controls may suffice. As volumes increase, higher forms of traffic control are needed to keep traffic moving safely and efficiently. Currently, 468 traffic signals are installed at intersections across the state, with the majority concentrated in urban areas. Additionally, 66 roundabouts are currently constructed on Montana roadways, with several more in design or under construction.[23] Roundabouts are also concentrated more heavily in urban areas and are becoming increasingly more common on state routes.

Additionally, 1,352 at-grade rail crossings across the state and approximately 400 grade-separated crossings are open to public travel.[24] A total of 490 of the at-grade rail crossings include flashing lights, gates, cantilevers, and other warning devices.[25] Like traffic signals, these assets have electric components that are necessary for proper operation. More importantly from a carbon reduction standpoint, long delays at railroad crossings can result in lengthy vehicle idling while trains pass.

Roundabouts do not require electricity and can reduce vehicle delay compared to traditional signalized intersections when operating properly. However, roundabouts typically require additional winter maintenance compared to traditional traffic signals.

66 roundabouts installed on Montana roadways

468 traffic signals installed on Montana roadways

490 of the **1,352** at-grade rail crossings across the state require electricity.



Source: Naypong Studio/Adobe Stock

Alternative Fueling Infrastructure

Various infrastructure is required to support alternative fuel vehicles on Montana roadways. Data available from the US Department of Energy AFDC indicates that Montana has a total of 75 public electric vehicle charging stations, with 153 total ports, and 16 propane fueling stations.[26] About 27 percent of these stations are located within Montana's three MPOs (Missoula – 11 EV stations, Great Falls – 1 propane and 5 EV stations, and Billings – 8 EV stations). The station data is gathered and verified through a variety of methods, and it is possible there are additional alternative fueling stations within the state not captured by this source.

As of March **2023**, Montana has...

ELECTRIC VEHICLE CHARGING STATIONS **259**

PROPANE FUELING STATIONS **17**

FHWA is also working with states to establish Alternative Fuel Corridors (AFCs), which provide enough fueling stations along the route to accommodate alternative fuel vehicles. In Montana, several high-use corridors, including I-15, I-90, I-94, US 93, and US 2, are designated AFC corridors although their status is pending until full build out is completed. To meet FHWA criteria, AFC corridors must meet minimum requirements for distances between fuel stations. The maximum allowable distance between stations varies by fuel type. For EV charging, a corridor is required to have direct current fast charging (DCFC) EV stations with at least four ports located less than one mile from the highway at least every 50 miles along the corridor. The spacing between propane stations should be no greater than 150 miles.[27] There are no public hydrogen, liquefied natural gas, or compressed natural gas corridors fuel stations in Montana at this time, though there are in other parts of the country. **Figure 2.16** shows the alternative fuel stations along the designated AFCs in Montana.

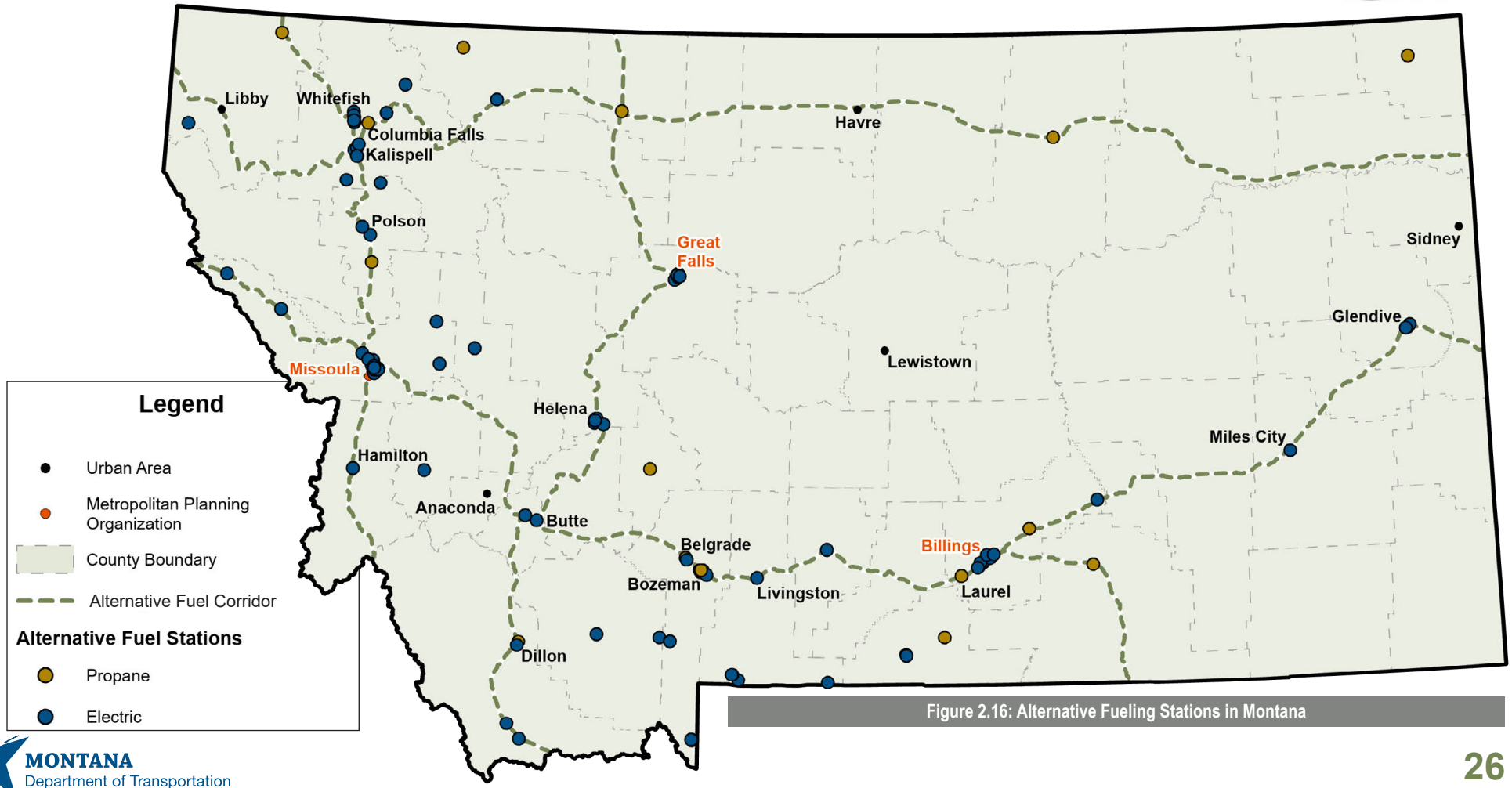


Figure 2.16: Alternative Fueling Stations in Montana

2.1.4. Management

This section discusses information related to the condition of MDT's assets and MDT's maintenance strategy. Understanding the condition of the assets within the transportation system helps MDT make management decisions about how to preserve and maintain the transportation network. Keeping the system maintained improves efficiencies for vehicles and reduces the need for new construction.

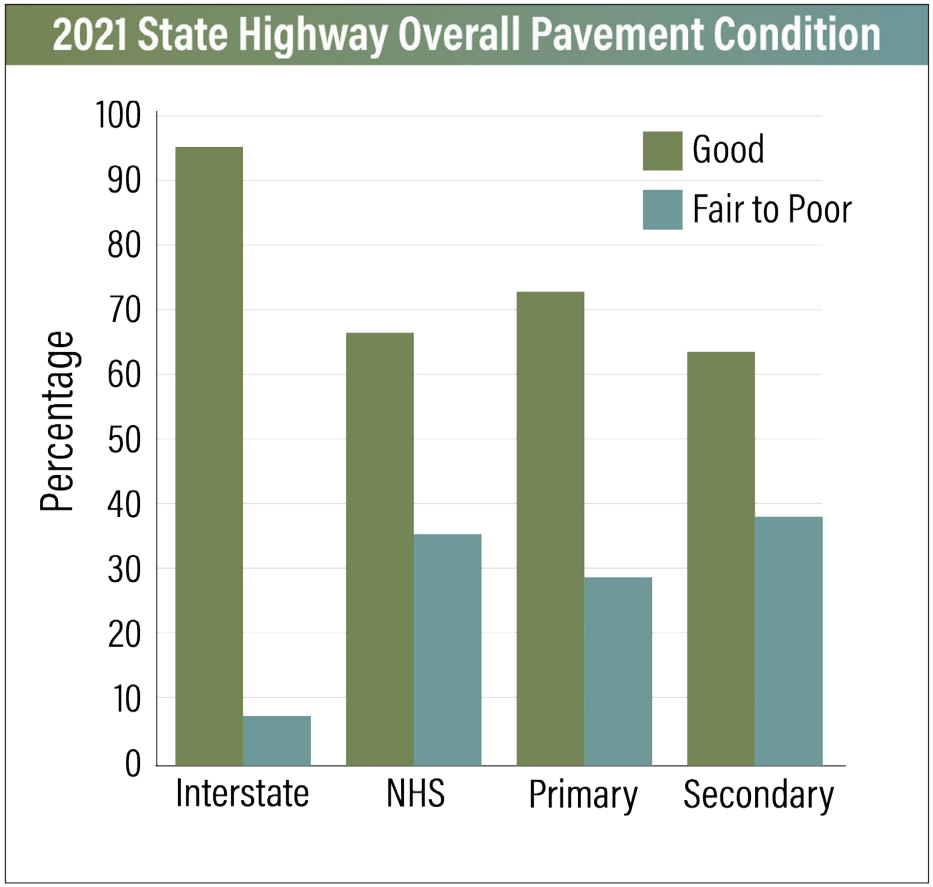
Asset Condition and Maintenance

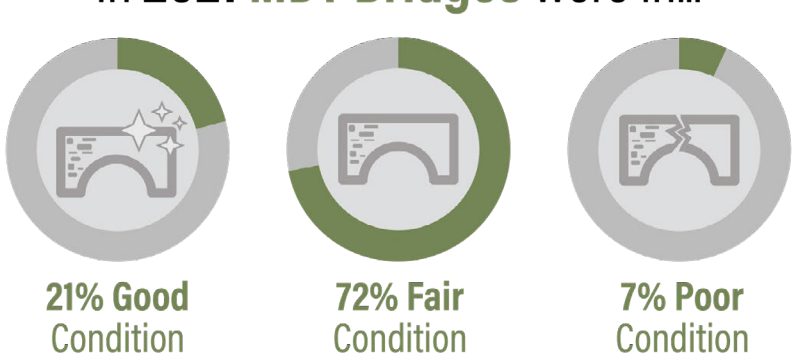
MDT is responsible for maintaining all of the assets described in the previous section. Maintaining infrastructure assets, such as roads, bridges, sidewalks, and paths, involves sweeping, plowing, and preservation treatments. The maintenance vehicles involved in these operations all burn fuel and consequently produce carbon emissions. In total, MDT is responsible for maintaining 25,066 lanes miles of highways (accounting for multiple lanes on the nearly 13,000 miles of MDT-owned roads).[4] Heavy snowfall during Montana's harsh winters requires MDT to plow these roadways regularly. Each year, MDT estimates that their maintenance crews plow over 3.8 million miles across the state.[4]

Investment decisions directly affect the condition of our roads and bridges, which in turn affects the fuel efficiency of vehicles traveling on that infrastructure and the carbon emitted through maintenance activities. MDT regularly tracks the condition of roadways and bridges to inform investment decisions including the level of preservation or reconstruction needed to keep assets in proper working conditions. In 2021, MDT reported that less than 10 percent of the interstate system, about 35 percent of the non-interstate national highway system, 29 percent of the primary highway system, and about 40 percent of the secondary highway system are in good condition. The remaining portions of the highway system are in fair to poor condition. Most MDT bridges are in fair condition (72%), with 21 percent in good condition and only 7 percent of bridges in poor condition. By comparison, 35 percent of locally owned bridges are in good condition, 59 percent are in fair condition, and 6 percent are in poor condition.[4]

MDT maintains over
25,000 lane miles
of highway and plows
on average over
3.8 million miles
per year statewide.







System Reliability

MDT identifies areas with recurring traffic delay and congestion by calculating a level of service (LOS) index based on Highway Capacity Manual (HCM) methodologies. LOS measures the quality of vehicle traffic service and is reported on a scale of A to F, with A being free-flow traffic and F being severe congestion. MDT targets LOS B for interstates and LOS C for other arterials. Across the state, 97 percent of roadways operate at LOS A, 2 percent at LOS B, and less than 1 percent at LOS C or D. None of MDT's on-system roadways operate at LOS E or F, as shown in **Figure 2.17**.[28] Lower levels of service are primarily located within heavily populated urban centers, such as Billings, Bozeman, Missoula, Kalispell, and Great Falls.

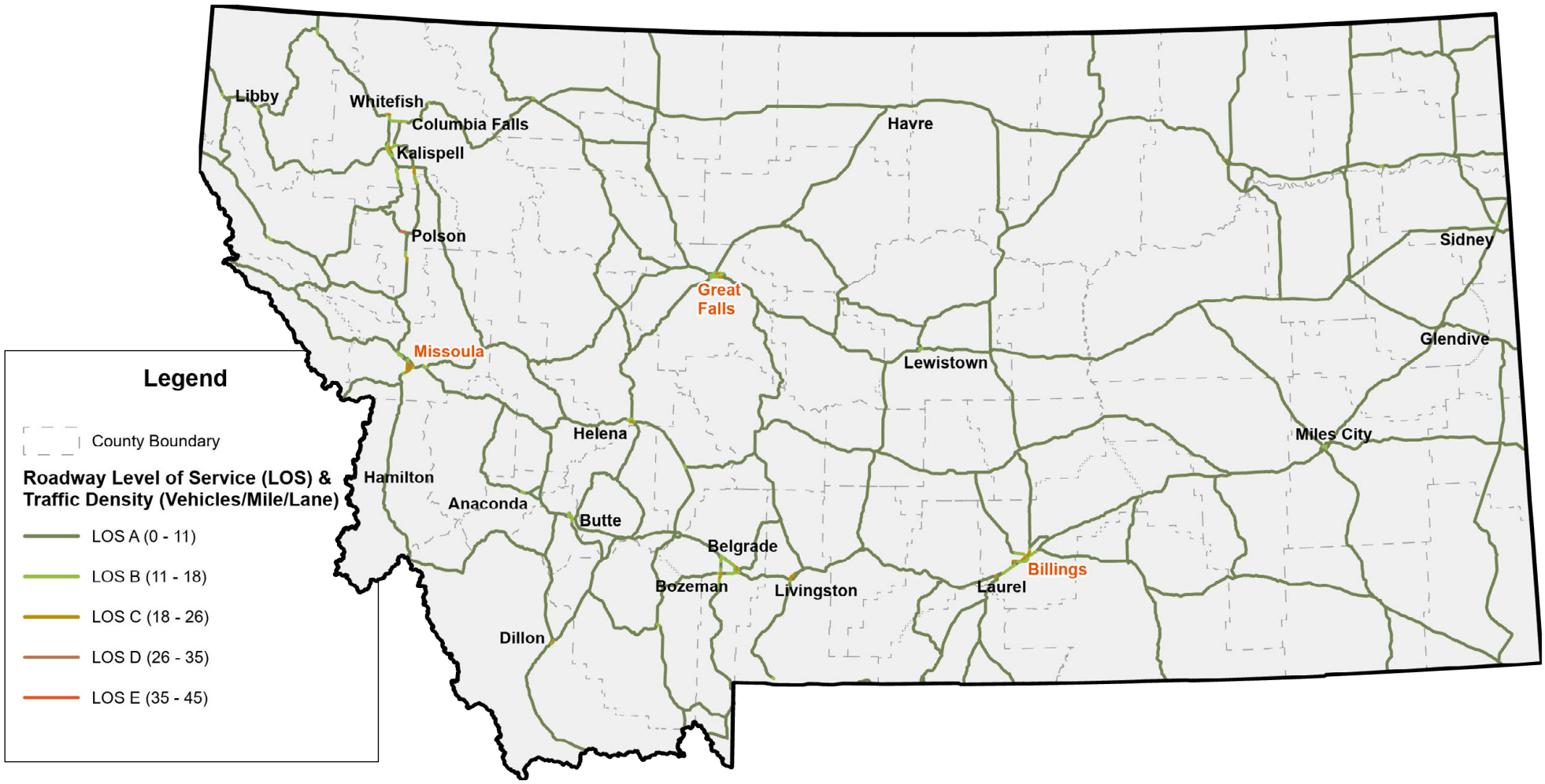
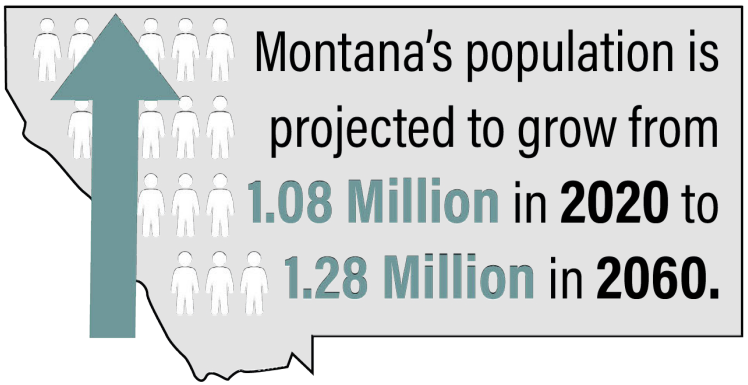


Figure 2.17: Roadway LOS and Traffic Density (2019)

2.2. PROJECTED CONDITIONS

The Montana Census and Economic Information Center projects the state's population using data from Regional Economic Models, Inc (eREMI).[30] The model projects that Montana's population will be 1,277,648 in 2060. When compared to the population estimate from the 2020 Census (1,084,225), Montana's population is anticipated to grow at a rate of 0.4 percent per year over the 40-year period. Montana's urban areas, specifically MPOs, are anticipating faster growth than the state as whole. In their respective transportation plans, the Missoula MPO anticipates a growth rate of 1.5 percent per year, Billings anticipates 1.2 percent per year growth, and Great Falls predicts that the MPO's population will grow at a rate of 0.61 percent per year.



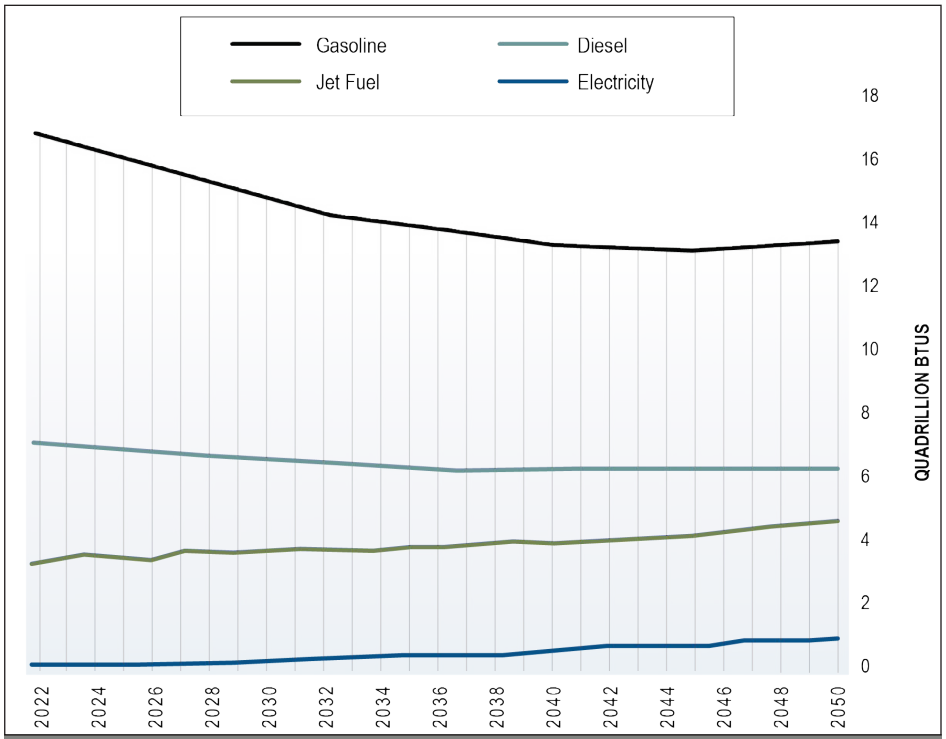
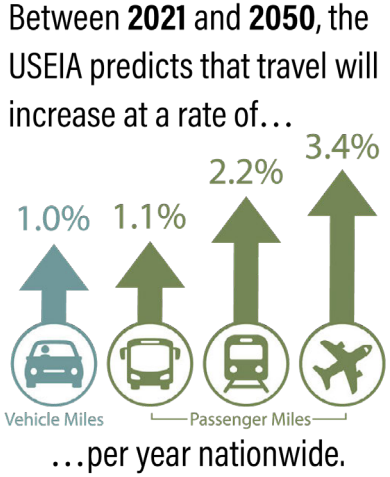


Figure 2.18: Predicted Fuel Consumption in the Transportation Sector

As the population increases, it is reasonable to expect that VMT will also increase as more people are traveling within the state. The USEIA Annual Energy Outlook predicts that VMT will increase by 1.0 percent per year across the nation between 2021 and 2050. The USEIA also predicts that greater adoption of public transportation modes will occur over the next 30 years with an increase in transit passenger miles of 1.1 percent per year and an increase of 2.2 percent per year in passenger miles traveled on passenger rail lines. Airline travel is also expected to increase, with passenger miles traveled by airplane increasing at a rate of 3.4 percent per year over the 30-year period. Rates for Montana may vary considerably compared to the rest of the nation depending on the availability and convenience of these types of modes.



The USEIA projects anticipated fuel consumption by fuel source out to 2050.[28] The predictions for fuel consumption by the transportation sector in the United States as a whole, including gasoline, diesel, jet fuel, and electricity, are presented in **Figure 2.18**. The chart shows that gasoline consumption is projected to decrease through 2050 while consumption of electricity as fuel is projected to increase. Diesel fuel consumption is expected to remain steady with a slight decline. Consumption of jet fuel is projected to increase. Although some increases in fuel consumption are projected, it is important to consider the increase in passenger miles traveled by public transportation modes. For example, although increased bus or airplane use may consume more fuel, the number of passenger miles traveled per gallon of fuel consumed is much higher than that of an SOV.

It is also important to consider increases in vehicle fuel efficiency as technology advances. In 1975, US Congress enacted the Corporate Average Fuel Economy (CAFE) standards to improve the average fuel economy of cars and light trucks (trucks, vans and sport utility vehicles) produced for sale in the US. CAFE standards are administered by the Secretary of Transportation via the National Highway Traffic Safety Administration (NHTSA) to help make vehicle miles per gallon more efficient, save consumers money, and reduce transportation emissions.

On March 31, 2022, NHTSA announced new vehicle fuel economy standards for future year 2024 – 2026 vehicle models.[32] NHTSA also estimates the required fuel economy through model year 2029 as well as the expected compliance, or achievement of the manufacturing industry, as presented in **Figure 2.19**. NHTSA estimates that the industry-wide average fuel economy achieved in model year 2029 could increase to 50 mpg under the final rule's standards. Manufacturers do not strictly adhere to every standard for every model year. Instead, they concentrate their compliance efforts when and where it's most economically viable. As a result, the "estimated achieved" fuel economy levels vary slightly from the "estimated required" levels for each fleet and each year. These more stringent CAFE standards, together with government incentives, are intended to encourage the manufacturing industry to continue improving the fuel economy of cars and accelerate the adoption of electric vehicles.

In general, focusing on reducing SOV trips, improving fuel efficiency, and switching to lower carbon modes will be key to reducing carbon emissions in Montana.

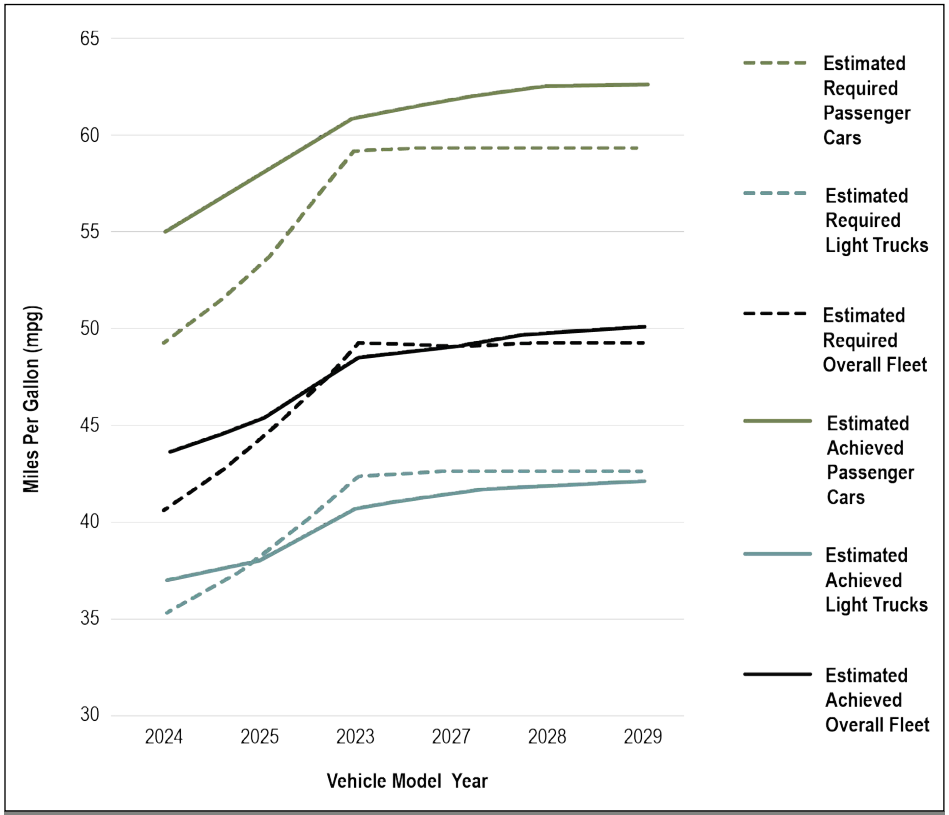


Figure 2.19: Estimated Average CAFE Levels Under Final Rule

2.3. SUMMARY OF TRANSPORTATION CARBON EMISSIONS IN MONTANA

The previous sections of this report summarize existing conditions data relating to how and where Montanans travel and how transportation infrastructure consumes energy over its life cycle. This information helps provide a baseline understanding of factors that contribute to carbon emissions in Montana's transportation system. The data also helps to identify opportunities for improvement to consider as carbon reduction strategies are developed and implemented. All of the statistics presented previously can be tracked to help provide a broad understanding of how the state is working towards reducing carbon emissions either through reducing single occupancy trips, increasing the use of lower carbon modes, and/or implementing lower carbon emission construction methods.

As presented previously, the state's total CO_2 emissions come from a variety of sources. CO_2 emissions from the transportation sector are primarily derived from its users, or direct tailpipe emissions from on-road sources. To calculate a baseline metric of CO_2 that can be tracked as MDT implements its CRS, fuel consumption data was converted to carbon emissions using nationally recognized conversion factors. On May 7, 2010, the USEPA and USDOT released a joint rulemaking establishing a national program for fuel economy standards for vehicle model years 2012 through 2016. In the rulemaking, the agencies agreed to use common conversion factors of 8,887 grams of CO_2 emissions per gallon of gasoline consumed and 10,180 grams of CO_2 emissions per gallon of diesel consumed.[33] **Table 2.3** summarizes estimated CO_2 emissions using these factors for the number of gallons of fuel consumed statewide as reported by MDT in 2022, resulting in an estimate of **8.1 million metric tons of CO_2.** This metric provides a baseline datapoint to track progress towards carbon reduction. This figure is based solely on fuel consumption data derived from state fuel tax records and does not include consumption of fuel purchased outside of the state or fuels exempt from the tax. Additionally, the figure accounts for all fuel purchased within the state, including consumption by non-road sources.

Table 2.3: Estimated CO_2 Emissions by Fuel Consumption (2022)

Fuel Type	Fuel Consumed in Montana (Gallons)	Co_2/Gallon (Metric Tons)	Metric Tons of CO_2
Gasoline	564,828,269	8.887×10^3	5,019,628
Diesel	307,035,342	10.180×10^3	3,125,620
		TOTAL	**8,145,248**

Source: USEPA, Greenhouse Gases Equivalencies Calculator - Calculations and References, Updated April 4, 2023.

Another way to understand baseline CO_2 emissions in relation to a variety of other state-specific data is through emissions modeling. Although Montana does not have a state-specific emissions model developed, the USEPA maintains a nationwide emissions model that can be used to help estimate the quantity of emissions from various sources in Montana. **Table 2.4** summarizes the outputs from the USEPA model which indicates that on-road sources yield approximately **7.9 million metric tons of CO_2.** This value is slightly less than the figure provided in **Table 2.3**, which likely accounts for some fuel purchased and consumed by non-road sources such as construction equipment, agricultural equipment, lawn and garden equipment, and recreational vehicles such as watercraft. These modeling outputs provide a helpful baseline of CO_2 emissions across the state and help identify locations where investments can have the greatest impact.

Table 2.4: Estimated CO_2 Emissions by Mobile Source Emissions Modeling (2022)

Emissions Inventory System Sector	Metric Tons of CO_2
All On-Road Sources	**7,864,942**
All Non-Road Sources	1,550,142
Mobile - Locomotives	899,072
TOTAL MOBILE (NON-POINT) SOURCES	**10,314,156**

Note: Due to rounding, numbers presented in this table may not add up precisely to the totals provided by the NEI.

Source: USEPA, NEI with on-road source data derived from USEPA MOVES model, 2022.

On average,

8,000,000

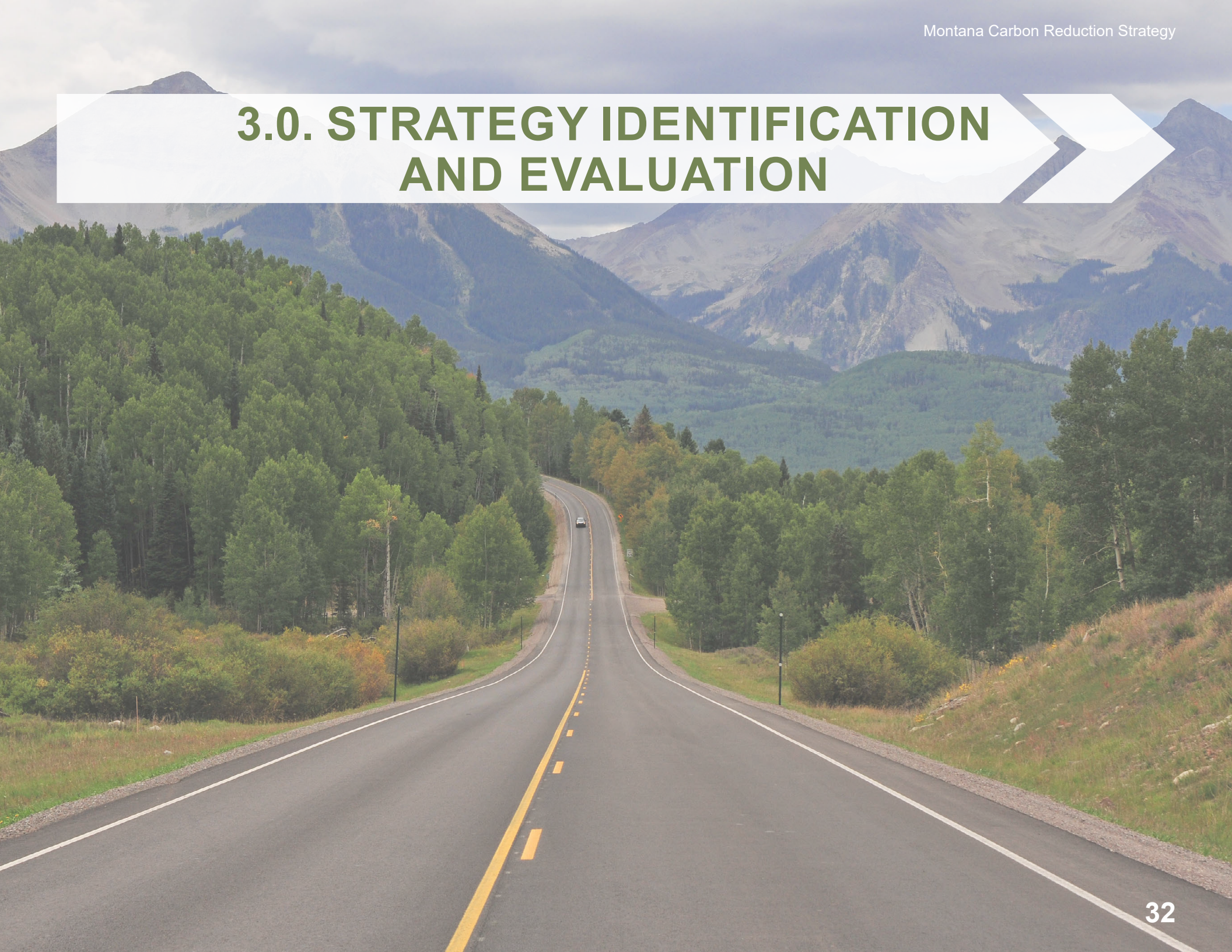
metric tons of CO_2

are produced annually in Montana from on-road mobile transportation sources.



Source: Vit/Adobe Stock

3.0. STRATEGY IDENTIFICATION AND EVALUATION



3.0. STRATEGY IDENTIFICATION AND EVALUATION

By definition, a strategy is a plan or approach to achieve a specific goal. Individual strategies were identified with the intention of determining the most effective types of actions for reducing transportation carbon emissions in Montana. The strategies were selected, in part, based on their potential to address opportunities for improvement identified in **Chapter 2** and based on potential funding eligibility under the CRP. The descriptions, attributes, and effectiveness determinations associated with each strategy can be used by state and local authorities to inform investment decisions as available funding is applied to achieve CRS goals. Although this chapter does not outline specific implementation actions, it does include potential projects, programs, and purchases for reference. This supporting information can be used to assist in the future identification, development, and implementation of specific projects.

3.1. OVERVIEW OF STRATEGY ATTRIBUTES

Strategies were categorized according to multiple attributes. The following sections provide an overview of the attribute categories which are intended to help inform project identification and development as the CRS is implemented.

3.1.1. Montana Carbon Emissions Framework

To define the role that transportation plays in carbon emissions across the state, strategies are categorized according to the TranPlanMT framework addressing **users**, **assets**, and **management**. All strategies presented are considered appropriate for the unique **context** of Montana and offer implementation considerations relating to individual subarea contexts such as urban or rural communities.

Montana Carbon Emissions Framework : CONTEXT

Montana Carbon Emissions Framework : USERS

Montana Carbon Emissions Framework : ASSETS

Montana Carbon Emissions Framework : MANAGEMENT

3.1.2. Strategy Types and Potential Projects or Actions

The CRS primarily focuses on a range of strategy types to reduce on-road mobile source transportation emissions in Montana, while also considering potential strategies for non-road mobile and infrastructure sources. From investments in infrastructure projects, new technologies, vehicle fleets, and maintenance equipment to development of operational and maintenance practices, policies, and service offerings, strategies are intended to address carbon reduction from numerous angles. Additionally, education campaigns and behavioral changes can also lead to important emissions reductions on an individual and collective basis.



Potential project types and actions are provided to indicate how funding could be applied to achieve CRS goals. This list is meant to be illustrative as opposed to exhaustive. Other projects and actions not listed could be eligible for funding through the program if it can be demonstrated that the project/action has a carbon reduction benefit. The listed projects and actions are generally found to support the reduction of transportation emissions and therefore would likely qualify for funding under 23 USC 175(c)(1). Other projects not directly listed in 23 USC 175(c)(1) may be eligible for CRP funds if they can demonstrate reductions in transportation emissions over the project's life cycle. At the time of nomination, the project sponsor would need to demonstrate CRP funding eligibility for any individual project or action. Funding eligibility would need to be confirmed at the time of nomination, and project sponsors are encouraged to coordinate with FHWA on eligibility questions for specific projects. Additionally, partners are encouraged to consider and implement strategies beyond those listed in the CRS that would reduce carbon emissions but may not be eligible for CRP funding.

3.1.3. Co-Benefits

The primary purpose of strategies identified in the CRS is to reduce transportation carbon emissions. However, carbon reduction strategies may result in a host of co-benefits, including but not limited to those listed below. Co-benefits may be permanent or temporary depending on multiple factors.

- ✔ Reduced time, delay, and frustration for drivers
- ✔ Reduced congestion on roadways
- ✔ Improved safety
- ✔ Improved air quality
- ✔ Improved habitat, stormwater, snow, and slope management
- ✔ Improved accessibility and connectivity for disabled and disadvantaged users
- ✔ Improved health outcomes
- ✔ Economic growth through increased revenues and job creation
- ✔ Fuel and other cost savings
- ✔ Overall improved quality of life
- ✔ Climate Resiliency

3.1.4. Partnership Opportunities

Although MDT is serving as the lead agency for development of the CRS, implementation of transportation carbon reduction strategies across the state will require cooperation and support from multiple partners. In addition to MDT, supportive efforts from partners including MPOs, other state and local governing bodies including cities, counties, and tribal governments, nonprofit organizations and associations, transit providers and ride-share companies, passenger rail providers, freight logistics and operating companies, private developers, contractors and suppliers, employers, school districts, and individuals will be needed to successfully reduce Montana's transportation emissions. Additionally, partners are encouraged to consider and implement strategies beyond those listed in the CRS that would reduce carbon emissions but may not be eligible for CRP funding.

3.1.5. Maximum Potential Effectiveness and Implementation Considerations

All strategies are intended to address the primary CRS purpose of reducing transportation carbon emissions. Strategies accomplish this purpose by reducing the number of vehicle trips, reducing the duration/distance of vehicle trips, replacing SOV trips with shared trips, replacing vehicle trips with lower-emission modes, replacing gasoline/diesel trips with other fuel types, reducing vehicle idling, reducing energy used to construct, transport, maintain, and operate transportation infrastructure, and by generating renewable energy to offset energy produced through coal and natural gas combustion. These carbon reduction benefits may take varying periods of time to be realized depending on funding availability, the level of adoption/buy-in, and the speed of wide-spread implementation.

The Montana CRS uses a qualitative rating system to define the maximum potential effectiveness of each strategy in terms of its ability to reduce transportation carbon emissions in Montana. Baseline estimates indicate a total of **approximately 8 million metric tons of CO_2** is produced annually in Montana as a result of fuel consumption or modeled user-generated tailpipe emissions. Baseline carbon emissions estimates were not developed for transportation assets and management, such as life-cycle energy usage associated with pavements or non-road mobile transportation sources such as construction and maintenance equipment, although these sources also contribute to transportation emissions in Montana.



Ratings represent the maximum potential effectiveness if implemented on a large scale throughout the state and are relative to total baseline estimated emissions in Montana according to comparative emissions in other states, known factors, and available research.[36]

- A **high** rating indicates the strategy could have a substantial carbon reduction effect if implemented widely, due to high relative effectiveness and/or a comparatively high target share of the state's baseline estimated transportation carbon emissions.
- A **medium** rating indicates the strategy could result in moderate reduction of transportation carbon emissions.
- A **low** rating indicates the strategy is anticipated to produce a minor reduction in transportation carbon emissions, even if implemented widely, due to low relative effectiveness and/or a comparatively low target share of the state's baseline estimated transportation carbon emissions. However, these strategies still provide a carbon reduction benefit and may warrant funding allocation, depending on various implementation considerations. Bundling multiple strategies may improve the effectiveness level.

For a strategy to be effective, it must be practical and reasonable to implement. While some strategies may be effective in more densely populated locations within the largest urban areas of Montana, they may be less effective in rural parts of the state with comparatively lower population densities and large geographic expanses. Implementation considerations reflect Montana's unique context and variety of conditions across the state, including geography, population, weather patterns, vehicle mix, and other transportation system and land use characteristics, along with partnership opportunities, coordination, or support required from external parties and individuals, scope and scale of the strategy, and the potential to implement a combination of multiple strategies. During planning and project development activities for individual implementation actions, additional challenges will need to be considered including technological feasibility, level of coordination/approval needed from other parties, likelihood of support/adoption by external partners/individuals, political acceptance, cost, and complexity.

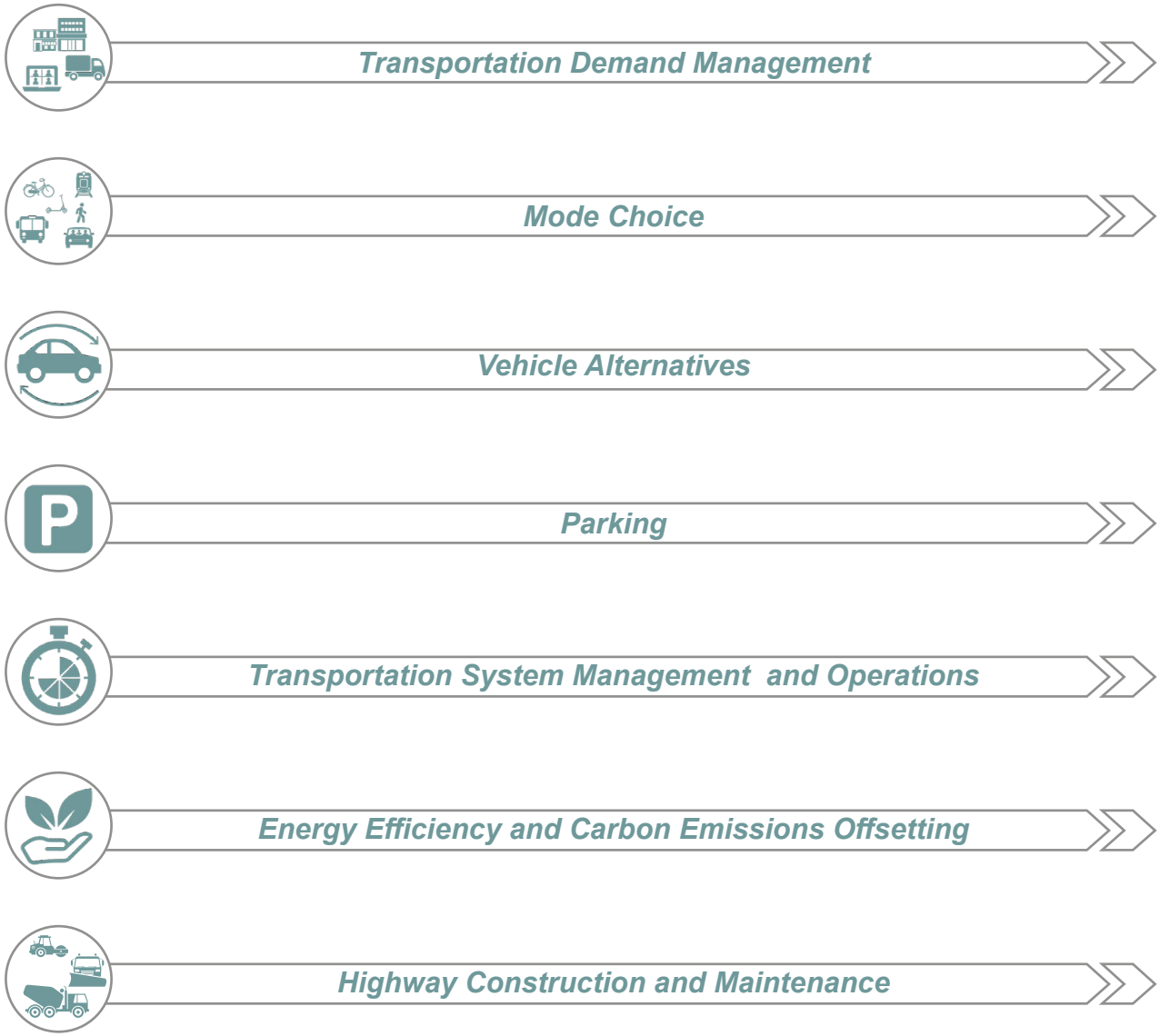
Ratings are ultimately intended to help inform funding allocation decisions for individual projects and implementation actions to achieve the greatest reduction in carbon emissions given available funding and other considerations. Future refinements of these ratings may be aided by emissions modeling, asset inventories, energy usage and energy source audits, cost-benefit analyses, and other efforts to provide more detailed estimates of strategy effectiveness specific to conditions in Montana.

3.1.6. Resources

Various external resources are provided to assist partner agencies with implementation efforts. Potential tools that could be used to help MDT quantify emissions reductions from individual projects are also included. See **Appendix A** for reference to relevant MDT and MPO documents.

3.2. STRATEGIES

A range of potential carbon reduction strategies were considered for the Montana CRS. Based on coordination with MDT and Montana MPOs, the following strategies selected for inclusion in the CRS are likely to be feasible and appropriate for Montana's unique context.



Transportation Demand Management

3.2.1. Transportation Demand Management

The transportation demand management (TDM) category includes strategies to optimize traveler choices in terms of the number, types, and timing of roadway trips to improve travel reliability and efficiency. Projects and implementation actions designed to support shifting demand to nonpeak hours or otherwise reducing demand for roads including travel demand management programs are eligible for CRP funding under 23 USC 175(c)(1)(H). Efforts to reduce the environmental and community impacts of freight movement qualify under 23 USC 175(c)(1)(I).

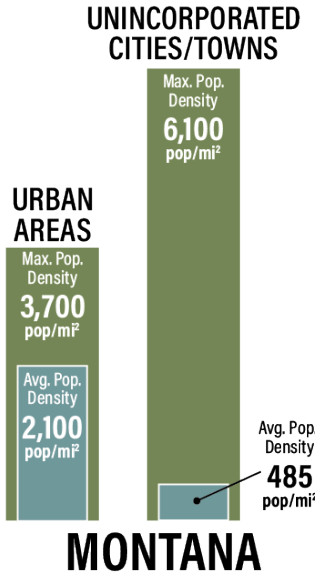


LAND USE DEVELOPMENT PATTERNS

Strategy: **Encourage high-density mixed-use developments to enable access to destinations by walking, cycling, transit, and shorter vehicular trips.**

Land use development in Montana has a direct effect on transportation choices. Low-density, rural developments typically require residents to drive farther to reach work, shopping, medical, education, and service centers. Active modes of transportation such as walking and bicycling are more challenging due to longer distances, and transit services may not be available in rural areas. By contrast, high-density mixed-use developments and infill projects within existing communities can reduce vehicular trip lengths, offer amenities within reasonable walking and biking distance, provide improved access to transit services, and reduce impacts from urban sprawl. Transit-oriented development (TOD) specifically aims to concentrate housing and key services near transit routes to enable residents to use public transportation instead of personal vehicles.

In Montana, counties zone unincorporated areas, while municipalities are authorized but not required to zone the land within their respective jurisdiction. While rural areas are often thought to be vast open spaces, rural communities are often punctuated by small, compact, walkable downtowns with mixed-use developments typical of urban areas. Often, rural communities can have higher population densities than large urban areas.



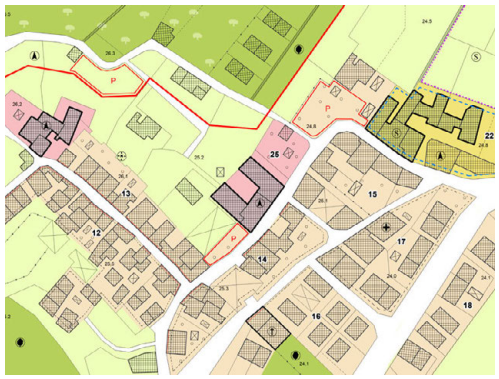
The USEPA has researched the impacts of various land use and development decisions on community health and economy for many decades. Through this research, the USEPA has developed an approach to development that encourages a mix of building types and uses, diverse housing and transportation options, development within existing neighborhoods, and robust public engagement in support of sustainable community growth. The approach and its guiding principles have continued to evolve as they have been implemented across the country.[38]

Carbon Reduction Effect:

High-density mixed-use development can reduce carbon emissions through reduced vehicular trip length and replacement of vehicular trips with walking, biking, and transit trips.

Co-Benefits:

- *Reduced driving time/delay*: High-density mixed-use developments can reduce the time spent traveling to reach destinations within a community.
- *Reduced roadway congestion*: By reducing the number and distance of vehicular trips, high-density mixed-use development can reduce congestion on roadways.
- *Improved safety*: Fewer vehicles on the roadway traveling shorter distances can translate to reduced user conflicts and crashes.
- *Improved air quality*: A reduction in the number and duration of vehicular trips can improve air quality through reduced tailpipe emissions.
- *Improved quality of life*: Active transportation opportunities and access to community amenities within a shorter distance can improve the enjoyability of living within a community.
- *Improved sustainability*: Increased development densities in municipalities can yield increased property taxes to support municipal services, infrastructure development, and maintenance.



Source: Francesco Scatena/Adobe Stock

Strategy Type:

Education

Policies and Decision Making

Potential Projects or Implementation Actions

- Zoning and code allowing high-density mixed-use development, accessory dwelling units (ADUs), reduced setbacks/lot coverage requirements, reduced/removed parking minimums
- Subdivision regulations requiring pedestrian and bicycle infrastructure and transit stops where applicable to be constructed in new developments to ensure active, multimodal neighborhoods
- Technical assistance to support compact, mixed use, and transit-oriented development



Source: Jacob/Adobe Stock

Partnership Opportunities:

- MPOs have an opportunity to support local governing bodies such as cities, counties, and planning boards through participation in long-range planning efforts including growth policies, development of zoning ordinances, and municipal code updates.
- MDT can provide support for this strategy through partnerships with MPOs, cities, and counties and by sharing resources and tools developed through MDT research efforts (including MDT's Land Use Resources for Growing Communities). Additionally, MDT can consider land use context when constructing and rehabilitating transportation infrastructure to support walking, cycling, and transit trips.
- Other Partners: Housing authorities, nonprofit organizations, private land developers, and individual residents play a role in promoting, funding, constructing, and purchasing housing and commercial developments within proximity to services and amenities.



Source: Jonbilous/Adobe Stock

Maximum Potential Effectiveness:

LOW — HIGH

MEDIUM

Implementation Considerations:

- High-density mixed-use development can be harder to implement in rural areas where bus service, jobs, shopping, and other amenities may not be available.
- There is variable support for increasing development densities.
- There are multiple levels (state vs. local) of control for changing land use policies. Several Montana organizations are working to address this issue.
- Increasing development densities in already compact urban areas has been shown to have the greatest carbon reduction effect, however, increasing density in less compact suburban areas also shows promising results for carbon emission reductions.
- Increasing land use density is more effective in reducing carbon emissions when integrated with good walking/biking infrastructure and public transportation options. Land use efficiencies reduce the number and length of driving trips and help promote trips by foot, bike, or public transit.
- Synergistic effects of multimodal planning, parking incentives, travel demand incentives, increased density, and other development policies can greatly reduce vehicle travel and associated emissions.[39]

Resources

- FHWA Advancing a Sustainable Highway System
- CDOT GHG Mitigation Measures Policy Directive
- Smart Growth Fixes for Climate Adaptation and Resilience
- Mixed-Use Trip Generation Model
- Measuring the Air Quality and Transportation Impacts of Infill Development
- Improving Air Quality Through Land Use Activities
- Driving Down Emissions Transportation, land use, and climate change
- Driving Down Emissions – Minnesota Case Study
- Rapid Policy Analysis Tool (RPAT)
- Impacts 2050

WORK TRIP EFFICIENCY

Strategy: **Encourage alternative work schedule and travel policies.**

Workers in Montana generally travel an average of 20 minutes to reach their job site.[40] Standard work hours and work week schedules create times of peak travel demand during morning and evening commute times, with added travel delays due to congestion. Additionally, travel during the day for work meetings can add to the number of vehicles on Montana roadways. Policies enabling flexible work schedules can alleviate peak hour travel by allowing earlier or later start and end times, reducing the amount of time idling in congested roadway conditions. Telework options, compressed work week policies, and video conferencing technology can minimize the number of vehicular trips to accomplish work tasks. Employers can also play a role in trip reduction by implementing trip reduction or travel demand management programs which aim to provide alternative modes of transportation to and from workplaces (i.e., vanpool or subsidized transit service), encourage the use of lower carbon modes, and educate employees on the benefits of travel demand management.

Carbon Reduction Effect:

Shifting trips to off-peak hours and reducing or eliminating vehicular work trips can reduce carbon emissions.

Strategy Type:

- Education
- Behavior Changes
- Policies and Decision Making
- Technology

Potential Projects or Implementation Actions

- MDT/MPO policies enabling telework/flexible work schedules/compressed work weeks for staff and encouraging virtual participation in meetings
- MDT/MPO investment in video conferencing/telework technology/equipment
- Education/marketing campaigns/events targeting employers (PSAs, advertisements, partner agency coordination)
- State or local trip reduction ordinances/laws

Co-Benefits:

- *Reduced driving time/delay:* Driving during off-peak hours, working from home, and participating in meetings virtually can reduce the time spent traveling.
- *Reduced roadway congestion:* Flexible work schedules and working from home can result in a reduction in peak hour traffic volumes, thereby temporarily easing congestion during peak periods.
- *Improved safety:* Fewer vehicles on the roadway during the most congested times of the day can translate to reduced user conflicts and crashes.
- *Improved air quality:* A reduction in the number and duration of vehicular trips can improve air quality through reduced tailpipe emissions.
- *Improved employee retention, satisfaction, and quality of life:* Employees value flexible work schedules and reduced commute times.
- *Reduced building facility costs:* Expansion of telework and flexible work policies could reduce the need for office space and potentially reduce lighting, heating, and cooling costs.



Source: RPA

Partnership Opportunities:

- MDT and MPOs can develop and implement flexible workforce policies and other travel demand management policies in coordination with the State of Montana and local governments.
- Local governments including cities, counties, and local parking commissions can implement trip reduction ordinances or other incentives to require or encourage employers within their jurisdictions to operate trip reduction or other travel demand management programs.
- Private employers can offer flexibility to workers, implement travel demand management programs, offer incentives to employees, and provide alternative transportation services (carpool, vanpool, bus passes) to employees.
- Individuals can take advantage of available policies and technologies to adjust work hours, work remotely, or otherwise reduce peak-hour commute trips.



Source: RPA

Maximum Potential Effectiveness:

LOW — MEDIUM — HIGH

LOW-MEDIUM

Implementation Considerations:

- State of Montana personnel policies are not necessarily set directly by MDT. Current state policy allows agencies to authorize telework for specified employees when it is in the state's best interest as determined and documented by the agency.[41]
- Flexible work schedules are likely to be used by employees. Other trip reduction strategies may have varying participation based on employer and employee characteristics.
- Research shows that flexible workplace policies (i.e., remote work) are not as effective at reducing carbon emissions as originally thought. More and more, employees are choosing to work from alternative locations (public spaces, co-working spaces, friends' homes, etc.), creating additional trips to travel to these locations for work.[42]
- Although energy can be saved by reducing the number of office spaces, home energy use also increases for remote workers.
- Studies show that financial incentives and provision of transportation services are generally more effective at reducing commute trips than outreach or flexible work schedules.[43] (*also see Section 3.2.2 – Shared Rides*)

Resources

- CDOT GHG Mitigation Measures Policy Directive
- Impacts of Employer-Based Trip Reduction Programs and Vanpools on Passenger Vehicle Use and Greenhouse Gas Emissions
- Reference Sourcebook for Reducing GHG Emissions from Transportation Sources
- Smart Location Calculator
- Impacts 2050
- Missoula in Motion Program

FREIGHT TRIP EFFICIENCY

Strategy: **Support improved efficiency for freight trips**

Freight trips play a crucial role for the Montana economy in moving and delivering goods within and through the state. T*he Montana Freight Plan* noted that in 2020, commercial vehicles traveled approximately 3.35 million vehicle miles daily on Montana roadways, with freight transportation by truck forecasted to grow the most out of all freight modes by 2050. Efforts to address mobility, delays, routing, and delivery logistics can help improve overall freight efficiency and reduce freight emissions.

Globally, maritime and rail offer the cleanest freight transportation options, followed by trucks and aviation, which results in the highest emissions. While nearly three-quarters of the world's cargo is carried by ships, road vehicles (trucks and vans) make up 65% of freight emissions worldwide. Road freight, however, can emit more than 100 times as much CO_2 as ships to carry the same amount of freight the same distance. E-commerce and home delivery have contributed to rapid growth in road freight and associated diesel consumption.[44]

Over time, land use practices have moved logistics facilities away from urban centers, which has resulted in increased driving distances and associated emissions. Improvements to supply chain management involve strategies to improve vehicle and infrastructure utilization and efficiency through minimizing empty miles, delivering during off-peak periods, utilizing consolidated pick-up points, and optimizing freight vehicle loads. Advanced computing and data analytics also have the potential to improve supply chains by optimizing truck routing and freight logistics. Utilizing light freight delivery modes, such as cargo bikes, delivery drones, and small electric vehicles (EVs) can be encouraged for local last-mile deliveries in more compact areas. The continuing growth of e-commerce creates new opportunities for improvement. Although increasing direct delivery of goods to consumers can offset personal travel, the demand for fast, on-time deliveries and returns presents new challenges.

Carbon Reduction Effect:

Improving freight efficiency, consolidating freight trips, and improving freight fuel economy can directly reduce tailpipe emissions from fuel combustion.

Strategy Type:

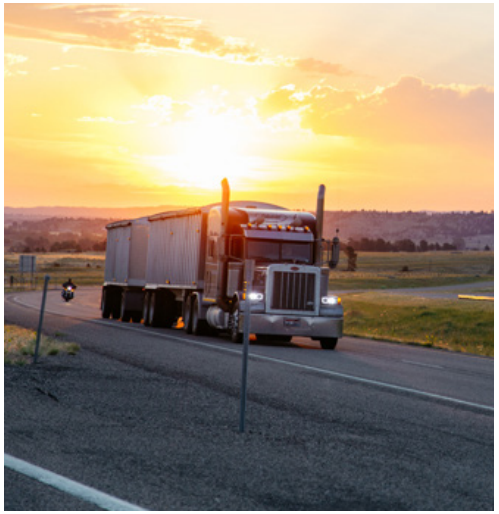
Education | Behavior Changes | Policies and Decision Making | Technology

Potential Projects or Implementation Actions

- Route optimization technologies
- Increased freight capacity/decreased empty loads
- Freight consolidation centers, alternate pickup/delivery options, light freight delivery modes, and off-peak delivery for local deliveries
- Reduced truck speed limits
- Alternative fuels/enhanced fuel economy technologies (*also see Section 3.2.3*)

Co-Benefits:

- *Reduced driving time/delay*: Efficient freight trips can reduce time spent driving and idling.
- *Reduced roadway congestion*: Consolidated and off-peak freight trips can reduce the number of large trucks on the roadway, reducing congestion for other vehicles during some travel periods.
- *Improved safety*: Fewer large trucks traveling on the highway and in cities can reduce the potential for user conflicts, increase comfort for pedestrians and bicyclists, and improve safety for all users.
- *Improved air quality*: A reduction in the number and duration of truck trips can improve air quality through reduced tailpipe emissions and reduced tire and brake wear.
- *Reduced costs*: Efficient freight movements can help reduce fuel and other costs for carriers and customers.



Source: MDT

Partnership Opportunities:

- MDT and MPOs can invest in infrastructure and technology to maintain freight routes and bridges in good condition, address recurring and non-recurring congestion on freight routes, provide accurate and timely traveler information, coordinate incident management, and ensure efficient operation of weigh stations.
- Local governments can implement policies addressing freight delivery times, locations, truck sizes, delivery vehicle types, and locations or use of redistribution centers.
- Private freight haulers can consolidate freight trips, access traveler information to plan efficient routes, and invest in technologies to improve fuel economy.
- Individual customers can consolidate purchases and minimize individual deliveries.



Source: RPA

Maximum Potential Effectiveness:

LOW — MEDIUM — HIGH

Implementation Considerations:

- Long-haul interstate truck trips typically produce lower carbon emissions per ton mile compared to short-haul trips used for local and regional deliveries.[45]
- MDT is already working to address truck time reliability and provide timely traveler information.
- The most effective strategies are highly dependent on the decisions of private freight hauling and logistics companies.
- Some freight efficiency policies, such as supply chain sustainability and freight capacities, will need to be addressed at the state and national levels.
- Systemic improvements in freight logistics, followed by vehicle efficiencies, then alternative fuels show the most promising reductions in carbon emissions. Promoting the use of collection points, off-peak deliveries and zero emission vehicles in urban operations will contribute the most to emissions savings. Significant variation in CO_2 emissions can result based on characteristics of each freight trip and the prevalent traffic conditions at the time of delivery.
- Coordinating the development of freight-related land uses to specific areas within a metropolitan region can reverse "logistics sprawl," reducing the distances travelled for freight transport and resulting CO_2 emissions. Logistics hubs are convenient spaces for providing fueling/charging infrastructure to promote the use of zero- or low-emission delivery vehicles.

Resources

- Decarbonizing Intraregional Freight Systems with a Focus on Modal Shift
- National Freight Pathways
- Idling Reduction Savings Calculator
- Diesel Emissions Quantifier (DEQ)
- Towards Road Freight Decarbonisation: Trends, Measures and Policies
- High Capacity Transport: Smarter policies for smart transport solutions
- FHWA Advancing a Sustainable Highway System
- Reference Sourcebook for Reducing GHG Emissions from Transportation Sources

Mode Choice

3.2.2. Mode Choice

The mode choice category includes strategies to offer alternatives to trips using personal vehicles. Options discussed include travel by walking, biking, micromobility, transit, and passenger rail. Strategies designed to support shifting demand to other transportation modes or increasing vehicle occupancy rates are eligible for CRP funding under 23 USC 175(c)(1)(H). Projects involving the construction, planning, and design of on-road and off-road trail facilities for pedestrians, bicyclists, and other non-motorized forms of transportation are eligible under 23 USC 175(c)(1)(C) while public transportation projects are eligible under 23 USC 175(c)(1)(B).



ACTIVE TRANSPORTATION AND MICROBMOBILITY

Strategy: Support active and micromobility modes of transportation.

As noted in the *Montana Pedestrian & Bicycle Plan*, walking and bicycling as modes of transportation have been steadily increasing throughout many of Montana's communities. Approximately 3 percent of Montana residents commuted to work by walking or bicycling as of the 2020 Census. In 2022, MDT published Bicycling the Big Sky, which maps rumble strips, shoulder widths, grades, rest areas, parking areas, and average daily traffic volumes on Montana highways as well as equipment and medical services and daytime/overnight stopping locations.[46] This informational map can help bicyclists select routes and plan trips using Montana highways. Additionally, micromobility modes such as electric scooters, skateboards, e-bikes, and segways are becoming more common in some Montana communities. Choosing walking, bicycling, or micromobility modes to reach a destination instead of taking a personal vehicle can directly reduce carbon emissions that would have otherwise been produced. These forms of personal transportation offer an alternative to vehicle trips and often rely on shared infrastructure. Constructing and maintaining dedicated facilities for these modes can help enhance the comfort and convenience of walking or bicycling for daily transportation purposes.

Carbon Reduction Effect:

Shifting trips to active transportation and micromobility modes can directly reduce carbon emissions that otherwise would have been produced from vehicular trips.

Strategy Type:

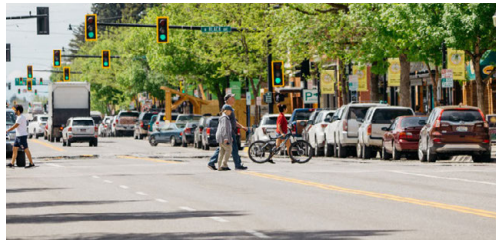
Education | Behavior Changes | Policies and Decision Making | Infrastructure Investments

Potential Projects or Implementation Actions

- Adoption of design standards that reflect accessible, safe, and connected designs for all modes of transportation
- Construction and maintenance of dedicated pedestrian and bicycle facilities, including signage and striping, sidewalks, crosswalks, bike lanes, and SUPs
- Accessibility and safety improvements at intersections including curb ramps, sidewalks, crosswalks, enhanced crossings, and pedestrian beacons/push buttons
- Safe Routes to Schools
- Bike/scooter share programs
- Rehabilitation of existing pedestrian/bicycle facilities to ensure compatibility with micromobility modes
- Multimodal safety improvements to ensure safe travel conditions for all users
- Education campaigns encouraging active transportation and micromobility

Co-Benefits:

- *Improved accessibility, connectivity, and equity for disabled and disadvantaged users*: Accessible, connected facilities enable disabled individuals to reach desired destinations without reliance on a personal vehicle.
- *Improved health outcomes*: Physical activity from active transportation modes can help reduce obesity and other diseases and lower healthcare costs.
- *Reduced roadway congestion and travel delay*: Shifting to active transportation modes can reduce the number of vehicles traveling on the roadway, resulting in reduced travel times and congestion.
- *Improved safety*: Fewer vehicles on the roadway can translate to reduced user conflicts and crashes.
- *Improved air quality*: A reduction in the number of vehicular trips can improve air quality through reduced tailpipe emissions.
- *Improved quality of life*: Walking and bicycling are enjoyable activities and can improve the experience of living in a community.
- *Fuel cost savings*: Using active modes of transportation can eliminate or reduce the need to purchase fuel for a personal vehicle.



Source: MDT

Partnership Opportunities:

- MDT, MPOs, and local governments can invest in the construction of dedicated and shared infrastructure for pedestrians, bicyclists, and micromobility modes and require these facilities as part of new developments to ensure connections on high-use travel corridors, enable travel for individuals with disabilities, and provide a safe experience for users. Additionally, maintenance activities including sweeping and snow removal ensure facilities are available and safe for use year-round. They can also sponsor education campaigns to encourage active transportation and micromobility options.
- Localities can work with private companies to provide and enhance micromobility programs and ensure the programs are implemented and managed effectively.
- Individuals can choose to walk, cycle, or use a micromobility mode to reach their destinations instead of driving in a personal vehicle.



Source: MDT

Maximum Potential Effectiveness:



Implementation Considerations:

- MDT and many Montana communities are already investing in active transportation networks and supporting micromobility trips. Implementation and use of these modes is most realistic and effective in urban environments where origins and destinations are more closely spaced.
- Dedicated or separated facilities with higher degrees of protection and greater connectivity in urban cores demonstrate the highest likelihood of use for utilitarian trips and, therefore, the highest potential for CO_2 reduction. Facilities located within high-density mixed-use districts and close to transit facilities or schools are generally more effective at encouraging non-motorized trips.
- Montana's harsh winters may deter walking and bicycling activity for some users during parts of the year. However, although research has documented a decline in bicycle activity in areas with strong climate differences, the most pronounced variations in bicycle or walking activity are most closely tied to acute weather events and the level of winter maintenance during cold or wintery months.[47] User age, ability, and interest also play a role in walking and bicycling activity during adverse conditions.
- Several studies have also demonstrated that hills and steep grades have a negative impact on walking or bicycling.[13]
- Changes to commuting emissions have been more pronounced for younger populations and those who live closer to work but further from public transit.[48]
- Many shared micromobility trips can replace car trips, or provide access that was previously time-consuming by foot, or difficult on transit by making it easier to reach the "first or last mile".[49]
- Bike and e-scooter share companies use cars and trucks to redistribute the bikes/scooters in their service area, which can make them less environmentally friendly.

Resources

- CDOT GHG Mitigation Measures Policy Directive
- CMAQ Toolkit – Bicycle and Pedestrian Improvements
- ITF: Good to go? Assessing the environmental performance of new mobility in cities
- First and Last Mile Connections: New Mobility
- Quantifying Reductions in Vehicle Miles Traveled from New Pedestrian Facilities
- Quantifying Reductions in Vehicle Miles Traveled from New Bike Paths, Lanes, and Cycle Tracks
- Evaluating Active Transport Benefits and Costs
- Toward Accurate and Valid Estimates of Greenhouse Gas Reductions from Bikeway Projects
- FHWA Advancing a Sustainable Highway System

PUBLIC TRANSPORTATION

Strategy: **Support public transportation service.**

Bus service provides an important transportation connection within and between Montana communities. In 2022, the 40 transit providers across the state provided 2,994,597 rides to passengers, traveling more than 6 million miles along local and inter-city transit routes.[4] These ridership statistics reflect decreased ridership due to the COVID-19 pandemic. In 2019, there were nearly 4.3 million transit rides provided in Montana.[8] Additionally, existing passenger rail service provided by Amtrak enables travel between Montana Hi-Line communities. The daily service runs east-west across the state with 12 Montana stations, recording 67,066 boardings and alightings in Montana in 2021.[50] These modes can help travelers reach their desired destinations without or with reduced reliance on personal vehicles. By aggregating multiple travelers in a single bus or rail car, carbon emissions per person per mile traveled can be reduced.

Calculations by the Transit Cooperative Research Program (TCRP) indicate that operations of existing urban transit agencies (Billings, Great Falls, and Missoula) emitted 5,756 metric tons of CO_2-equivalent in 2018.[51] The tool estimates that 1,231 metric tons of CO_2-equivalent were saved from transportation efficiencies and 6,360 metric tons were saved from land use efficiencies, for a net savings of 1,825 metric tons from Montanans choosing to use public transit over personal vehicle use in 2018. The calculations indicate that a 25 percent increase in ridership would yield a reduction of 3,375 metric tons of CO_2-equivalent per year while a 25 percent shift of VMT from diesel to electric buses would yield a reduction of 2,903 metric tons of CO_2.

Carbon Reduction Effect:

Use of public transportation can directly reduce carbon emissions that otherwise would have been produced from SOV trips.

Strategy Type:

- Education
- Behavior Changes
- Policies and Decision Making
- Infrastructure Investments
- Service Investments
- Fleet/Equipment Investments

Potential Projects or Implementation Actions

- Expanded inter- and intra-city bus service through fleet purchases and staffing to increase frequency and range on existing routes and offer new routes
- Construction of bus stops/shelters and increased connectivity and integration with active transportation facilities
- Free/reduced-fare bus pass programs through employers and agencies
- Expansion of passenger rail service

Co-Benefits:

- *Improved accessibility, connectivity, and equity for disabled and disadvantaged users*: Public transportation provides an option for disabled and disadvantaged individuals to reach desired destinations without reliance on a personal vehicle.
- *Reduced roadway congestion and travel delay*: Using public transportation can reduce the number of vehicles traveling on the roadway, resulting in reduced travel times and congestion.
- *Improved safety*: Fewer vehicles on the roadway can translate to reduced user conflicts and crashes.
- *Improved air quality*: A reduction in the number of SOV trips can improve air quality through reduced tailpipe emissions.
- *Fuel cost savings*: Using public transportation can eliminate or reduce the need to purchase fuel for a personal vehicle.



Source: RPA

Partnership Opportunities:

- MDT, MPOs, and local governments can support public transportation by constructing bus stops and shelters on roadway corridors, administering state and federal transit programs to increase service offerings and fund the purchase of transit vehicles, and offering bus fare programs to their employees.
- Transit operators can seek funds to increase their service offerings and expand service areas.
- Rail Providers can continue to study and advocate for expansion of passenger rail service in Montana.
- Employers can offer incentives such as free/reduced-fare bus passes or other monetary bonuses to encourage use of public transportation.
- Individuals can choose to travel by bus or passenger rail to reach their destinations instead of driving in a personal vehicle.

Maximum Potential Effectiveness:



Implementation Considerations:

- In Montana, there are 36 rural public transit providers, 3 public urban transit providers, 7 inter-city providers, and several specialized agencies providing elderly and disabled transit and intercity bus vanpools.
- The COVID-19 pandemic has reduced the desire for riding public transportation.
- Amtrak's passenger rail service provides long, intra-city travel options. The Big Sky Passenger Rail Authority is working to restore passenger rail on existing and past rail lines across Montana, but no current plans or projects are in place at this time.[52]
- There are several transit funding programs to help support rural and urban providers, however, funds are limited.
- Generally, transportation options that move greater volumes of people or goods (buses, trains, carpooling) result in lower emissions per mile traveled. For local passenger travel, large personal vehicles with low occupancy have the highest emissions, while buses and transit rail offer the cleanest options other than walking or biking. For longer passenger trips, buses and cars with multiple occupants offer the lowest emissions option, followed by rail, aviation, and large passenger vehicles with low occupancy.[11]
- Reduced transit fares have the potential to reduce emissions depending on the strategy's scale and scope. Rider sensitivity to fare changes appears to decrease with increasing city size. Off-peak transit ridership is generally twice as sensitive to fare changes as peak period ridership. Research indicates that increasing off-peak and weekend service frequency results in significant increases in total number of transit trips.[53]
- Increasing service days, times, and frequency can have a positive result on increased ridership.[54]
- Employer-provided transit benefits have demonstrated large increases in the number of employees using transit for their daily commute as well as increases in the number of employees making non-work transit trips.[55]
- Transit passenger surveys show that about one-third of transit passenger miles would otherwise be replaced by personal vehicle miles. Implementing advanced traveler information systems (online maps, timetables, route planning, etc.) can help increase the use of public transportation. The CO_2 emission impacts of such mode shifts will depend on what alternative modes of transportation are avoided by taking public transit.

Resources

- TCRP Report 226: An Update on Public Transportation's Impacts on Greenhouse Gas Emissions
- Greenhouse Gas Emissions from Transit Projects: Programmatic Assessment
- CDOT GHG Mitigation Measures Policy Directive
- CMAQ Toolkit – Transit Bus Service and Fleet Expansion
- Reference Sourcebook for Reducing GHG Emissions from Transportation Sources

SHARED RIDES

Strategy: **Support shared rides.**

Nationwide, the U.S. average private vehicle occupancy for commute trips was 1.18 passengers, and for all trips was 1.67 passengers.[57] Sharing rides to a common destination can help increase the average vehicle occupancy and reduce carbon emissions that would have been produced from SOV trips. Shared rides can be formalized through a government- or employer-sponsored program or arranged through informal private networks of individuals. Shared rides can provide transportation for a one-time trip for a special event or a continuing need such as commuting to work or for recreation. As an example, the City of Missoula operates successful vanpool and carpool programs through Missoula in Motion and the Missoula Ravalli Transportation Management Association, which also offer resources to others interested in developing similar programs.[58] Some companies also offer car share services which allow people to rent cars on demand for short periods of time, often by the hour, though these options are currently limited in Montana.

Carbon Reduction Effect:

Use of shared rides can directly reduce carbon emissions that otherwise would have been produced from SOV trips.

Strategy Type:

- Education
- Behavior Changes
- Policies and Decision Making
- Infrastructure Investments
- Fleet/Equipment Investments

Potential Projects or Implementation Actions

- Vanpool/rideshare program development and administration
- Fleet purchases
- Park-and-ride facilities
- Car share programs
- Education campaigns to encourage use of rideshare programs

Co-Benefits:

- *Reduced roadway congestion and travel delay*: Shared rides can reduce the number of vehicles traveling on the roadway, resulting in reduced travel times and congestion.
- *Reduced parking demand*: Increasing the occupancy of vehicles helps reduce demand for additional parking spaces at the intended destination, which can be helpful especially in condensed urban areas with limited parking opportunities and other constrained spaces.
- *Improved safety*: Fewer vehicles on the roadway can translate to reduced user conflicts and crashes. Shared rides often provide an alternative for impaired driving.
- *Improved air quality*: A reduction in the number of SOVs can improve air quality through reduced tailpipe emissions.
- *Fuel cost savings*: Sharing rides can reduce the amount of fuel needed to fuel multiple personal vehicles.



Source: Susan Montgomery/Adobe Stock

Partnership Opportunities:

- MDT, MPOs, local governments, and other programs such as Missoula in Motion (MIM) can offer shared rides to employees through carpool/vanpool programs and support other shared ride opportunities through construction of park-and-ride facilities. Additionally, they can sponsor education campaigns to encourage development and participation in rideshare programs.
- Private employers can sponsor shared rides from common pickup points to work sites and offer incentives to encourage participation.
- Private businesses can offer shared rides from convenient pickup points to special event venues or heavily trafficked recreation areas.
- Individuals can choose to participate in government-, employer-, or private-sponsored ride share programs or develop informal ride-share networks.



Source: RPA

Maximum Potential Effectiveness:

LOW — MEDIUM — HIGH

LOW-MEDIUM

Implementation Considerations:

- Shared rides are most effective when large numbers of people need to travel to a common destination, such as a work site.
- The COVID-19 pandemic has reduced the desire for sharing trips and rides.
- Shared cars can decrease carbon emissions if the shared vehicle replaces individually owned vehicles. However, potential empty travel by shared vehicles—the additional distance traveled to pick up passengers—may cause emissions to increase. Empirical studies show that taxi rides and ride-sourcing services also travel significantly more than the intended (or served) travel distance.[59]
- Many shared ride trips are transferred from walking or public transportation trips, not private vehicles.
- Car share companies indicate that their members drive fewer miles, have higher vehicle occupancy rates, and that their members walk, bike, scooter, or take public transit to access a shared car. Car sharing has been shown to be most effective in major metropolitan areas and college towns.
- In practice, park-and-ride facilities may contribute to emissions more than they curb emissions. Lowered traffic, thanks to increased carpooling/public transit use, can encourage others to drive. People still rely on their cars to drive to park-and-ride locations, perhaps driving out of their way, or creating a new trip to access higher occupancy modes.[61] Park-and-ride facilities may also encourage urban sprawl by making it more convenient to live further away from work, shopping, and other destinations.

Resources

- CDOT GHG Mitigation Measures Policy Directive
- CMAQ Toolkit – Carpooling and Vanpooling
- The Benefits of Carpooling
- Reference Sourcebook for Reducing GHG Emissions from Transportation Sources
- Impacts 2050

Vehicle Alternatives

3.2.3. Vehicle Alternatives

In some cases, using a personal vehicle or taking a SOV trip to reach a destination in Montana is the only reasonable option due to distance, safety considerations, lack of public transportation, or lack of pedestrian/bicycle/micromobility facilities. Additionally, shared rides providing transportation to a common destination often are not a convenient or available option. Electric vehicles and other fueling options offer an alternative to gasoline and diesel-powered vehicles, and fuel-efficient vehicles can reduce the amount of gasoline or diesel fuel required to reach a destination.

Strategies designed to support deployment of alternative fuel vehicles—including acquisition, installation, or operation of alternative fueling infrastructure or the purchase or lease of zero-emission construction equipment and vehicles—are eligible for CRP funding under 23 USC 175(c)(1)(J).

VEHICLE ALTERNATIVES

Strategy: Support use of electric vehicles, alternative fuel options, fuel-efficient vehicles, and right-sized vehicles.

Availability and adoption of vehicles that use alternative fuels such as electricity, biofuel, and propane are becoming more commonplace across the country and in Montana. Electric vehicles have zero tailpipe emissions, but electricity production, such as power plants, may generate emissions which add to the life-cycle emissions of these vehicles. In geographic areas that use relatively low-polluting energy sources for electricity generation, electric vehicles typically have an especially large life-cycle emissions advantage over similar conventional vehicles running on gasoline or diesel. In areas with higher-emissions electricity, electric vehicles may not demonstrate as strong a life-cycle emissions benefit.[62] Similarly, propane and hydrogen fuel sources have the lowest life-cycle emissions when produced from renewable energy sources.[63] The availability of charging and fueling infrastructure for vehicles operating on alternative fuels can limit their effectiveness and overall use. In some circumstances, right-sizing vehicles can also ensure functional needs are met while reducing the amount of fuel consumed by a larger vehicle, depending on the vehicle function and the circumstances for use.

Carbon Reduction Effect:

Electric vehicles, vehicles using alternative fuels, and highly fuel-efficient vehicles can reduce carbon emissions that otherwise would have been produced from gasoline- and diesel-powered vehicles and vehicles with lower fuel efficiencies.

Strategy Type:

- Education
- Behavior Changes
- Policies and Decision Making
- Infrastructure Investments
- Fleet Investments

Potential Projects or Implementation Actions

- Studies to determine appropriate placement/type of electric vehicle charging/alternative fuel infrastructure
- Purchase of electric vehicle/alternative fuel/fuel-efficient fleets
- Education campaigns to encourage private purchase of electric vehicles and spread awareness of available financial incentives
- Collaboration with utility partners to support grid improvements

Co-Benefits:

- *Improved air quality:* A reduction in the number of gasoline- and diesel-powered vehicles can improve air quality through reduced tailpipe emissions.
- *Cost savings:* Use of electric/alternative fuel vehicles and vehicles with higher fuel efficiencies can reduce the cost of gasoline and diesel purchases. These vehicles also require less maintenance than gasoline- and diesel-powered engines.



Source: RPA



Source: graja/Adobe Stock

Partnership Opportunities:

- MDT, MPOs, and local governments can support construction of electric vehicle charging and alternative fuel infrastructure on private property. They can also set policies to purchase electric/alternative fuel/fuel-efficient vehicles for public fleets (including transportation agency maintenance and fleet vehicles, law enforcement, and fire departments), deploy right-sized vehicles when possible, and develop education campaigns to encourage private purchases of electric/alternative fuel/fuel-efficient vehicles.
- Private companies can construct electric vehicle charging and alternative fuel infrastructure within private right-of-way and purchase electric/alternative fuel/fuel-efficient vehicles.
- Transit operators and school districts can purchase electric/alternative fuel/fuel-efficient vehicles for their fleets.
- Individuals can choose to purchase electric/alternative fuel/fuel-efficient vehicles for their personal use.

Maximum Potential Effectiveness:



Implementation Considerations:

- The State of Montana collects taxes on fuel purchases to support and maintain a safe transportation system across Montana. As fuels become more efficient, revenues from fuel sales decrease. In May 2023, a bill was passed to impose a tax on electric vehicle charging stations in the state with a rated capacity of 25 kW or greater. Similarly, Montana recently passed a bill requiring an additional registration and renewal fee for electric vehicles based on the weight of the vehicle. The fees are deposited into the same account as fuel taxes.[65]
- Adoption of electric vehicle technology shows the most promise in reducing overall carbon emissions. In rural areas where it is more difficult to make trips by lower or zero-emission modes, such as walking and biking, or where automobile trips cannot otherwise be avoided, electric vehicles can help reduce CO_2 emissions. It is however important to consider the availability of fueling infrastructure, as long distances between fueling/charging stations may make longer journeys more difficult via electric vehicle.
- In 2023, legislation was adopted that imposes a 3 cent/kilowatt-hour tax on electricity sold at public DCFC stations. This may require owners/operators of electric vehicle charging stations to install additional electric metering infrastructure.
- Alternative fuel sources are likely to be most effective in urban settings where fueling/charging infrastructure can be implemented in common spaces such as freight logistics centers, workplaces, and other high frequency locations.
- Cold weather performance is a limitation of battery electric buses today, but operational solutions can extend vehicle range, including preheating vehicles at the garage and deploying charging stations along routes. Conversely, propane performs well in cold weather climates because the fuel's mixture (propane and air) is completely gaseous when it enters the combustion chamber.[66]
- Battery-electric buses produce lower emissions than hybrid diesel/electric buses.
- Propane and hydrogen fuel sources can be as fuel efficient, if not more, than gasoline and diesel, and emit lower emissions, especially if the fuels are produced from renewable energy sources. However, the availability of fueling stations can limit their use and effectiveness.
- Air quality effects should be considered for EVs and diesel/gasoline-fueled vehicles.

Resources

- Alternative Fuel Toolkit
- CDOT GHG Mitigation Measures Policy Directive
- TCRP Report 226: An Update on Public Transportation's Impacts on Greenhouse Gas Emissions
- Argonne National Laboratory's VISION Model
- Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) Tool
- Reference Sourcebook for Reducing GHG Emissions from Transportation Sources
- CMAQ Toolkit - Alternative Fuel Vehicles and Infrastructure; Diesel Truck and Engine Retrofit and Replacement; Electric Vehicles and EV Charging Infrastructure; Transit Bus Upgrades & System Improvements

Parking

3.2.4. Parking

Parking areas play an important role in providing safe stopping locations along highway corridors, especially for freight drivers who are mandated to stop and rest. Within localities, parking is provided to enable access to businesses, schools, residences, and more for those who travel by vehicle. While provision of sufficient parking is necessary, strategic and effective planning, siting, and management of parking areas can help improve traffic flow and reduce carbon emissions.

Under 23 USC 175(c)(1)(A), Truck Stop Electrification (TSE) systems are eligible for CRP funding. Advanced transportation and congestion management technologies, including traveler information systems and parking reservation or variable pricing systems, are eligible for funding under 23 USC 175(c)(1)(D). Projects supporting parking as a travel demand management technique may be eligible under 23 USC 175(c)(1)(H).



PARKING

Strategy: **Provide adequate parking areas that are appropriately spaced, sized, and equipped to meet traveler needs.**

MDT strives to provide approximately one hour of travel time or a distance of 70 miles between stopping opportunities on highway corridor segments. MDT also aims to provide enough parking spaces to accommodate demand at each location. Privately owned truck stops provide additional parking opportunities that complement the state network. Based on a survey conducted in 2019, Montana ranked in the top five states with the most spaces relative to truck vehicle miles traveled.[67] Decisions to rehabilitate, upgrade, or construct new safety rest areas and truck parking areas are guided by the Montana Rest Area Plan.

Truck drivers typically idle their vehicles during mandated rest periods to maintain access to air conditioning, heat, and electricity. TSE can allow truckers to enjoy these auxiliary systems by plugging into the electric grid instead of running their engines, thereby reducing carbon emissions from idling. Other idle-reduction technologies are available to install on individual trucks to provide services, such as HVAC, which would otherwise be powered by engine idling.

To help drivers plan their trips efficiently and identify available parking locations in advance, the Montana Freight Plan noted that MDT is seeking to implement an Innovative Technology Deployment (ITD) project to deploy truck parking stall identification and availability systems. MDT is also working with surrounding jurisdictions to provide an integrated and standardized platform for truck parking information. Parking demand may evolve over time as future deployment of autonomous fleets could reduce the need for drivers to stop and rest. Potential future uses for parking areas may be considered as needs warrant. (*see Section 3.2.6 – Alternative Uses of Highway ROW*).

Additionally, strategies to reduce idling of light-duty vehicles in search of parking can help lower emissions in urban areas. Drivers burn a large amount of fuel while navigating in search of parking. Managing parking supply, enhancing wayfinding from parking areas to destinations, and increasing the efficiency of parking spot identification can help reduce emissions created through extra trips and from reduced congestion in dense downtown districts.

Carbon Reduction Effect:

Parking areas enable drivers to stop and rest along their intended route. These facilities can reduce carbon emissions through reduction of idling. In urban areas, vehicles can expend large amounts of fuel, and accompanying emissions, while navigating in search of parking.

Co-Benefits:

- *Improved safety:* Safety rest areas and truck parking areas serve an important safety purpose by allowing drivers to stop, rest, and potentially avoid fatigued, drowsy, or distracted driving and hazardous roadside parking.
- *Improved air quality:* Parking areas can improve air quality through reduced tailpipe emissions from idling.
- *Reduced congestion:* Improving parking management can help reduce the number of vehicles driving around trying to find a parking space, thereby reducing congestion.



Source: clsdesign/Adobe Stock



Source: vit/Adobe Stock

Strategy Type: Policies and Decision Making | Technology | Infrastructure Investments

Potential Projects or Implementation Actions

- Safety Rest Area & Truck Parking Area preservation, rehabilitation, and construction
- Parking availability systems
- Advanced TSE systems
- Investment in idling reduction technologies for fleets
- Parking demand management



Source: Ava_Marie/istock

Partnership Opportunities:

- MDT can construct and maintain safety rest areas and truck parking areas on highway corridors across the state and consider innovative technologies that improve rest area experiences for trucks and other users.
- MPOs and local governments can collaborate with MDT to site parking facilities in appropriate locations within their jurisdictional areas and implement parking demand management strategies.
- Freight haulers can provide feedback on parking needs and equip their vehicles with idling reduction technologies.

Maximum Potential Effectiveness:

LOW | MEDIUM | HIGH

Implementation Considerations:

- Although truck idling for extended periods of time can create a significant amount of emissions, idling accounts for a very small portion of emissions generated by freight vehicles.[69,70]
- The effectiveness of parking demand management will depend on the scale and scope of the program and how it is bundled with other strategies such as incentives or increased transit availability. While potentially negligible in the short term, increases in carbon reductions benefits are realized over time as users adjust to the program.[71]
- Policies governing land use and parking requirements may need to be changed to effectively implement parking demand strategies.

Resources

- CMAQ Toolkit – Diesel Idle Reduction Strategies
- Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity
- Parking Spaces / Community Places: Finding the Balance through Smart Growth Solutions
- Reference Sourcebook for Reducing GHG Emissions from Transportation Sources

Transportation System Management and Operations

3.2.5. Transportation System Management and Operations

Transportation System Management and Operations (TSMO) is an approach using technology, management techniques, and design methods to improve the performance of an existing transportation system. Research has found that capacity expansion generally provides limited-to-no congestion reduction benefits over the long-term, due primarily to induced demand which ultimately leads to increases in overall travel. Instead of adding capacity, a variety of management techniques and technologies can be implemented to reduce congestion and emissions without requiring travelers to change their behavior or purchase different types of vehicles. Projects involving advanced transportation and congestion management technologies and TSMO projects or programs aimed at improving traffic flow without resulting in the construction of new capacity are eligible for CRP funding under 23 USC 175(c)(1)(D) and 23 USC 175(c)(1)(L), respectively.



MANAGEMENT TECHNIQUES AND TECHNOLOGY SOLUTIONS

Strategy: Apply innovative management techniques and technologies to improve transportation system performance.

Effective management of the transportation system is critical to safe and efficient travel on Montana roadways. Transportation officials play an important role in ensuring roads and bridges serve the needs of the traveling public, freight haulers, emergency service workers, and law enforcement. Optimized management techniques and implementation of innovative technologies help address system elements that can cause travel inefficiencies or adversely affect operations during peak travel periods, when weather, road, and crash incidents occur, and through work zones and other highly congested areas.

Transportation Management Centers (TMCs) are a potential management tool that can be employed to optimize operations. TMCs serve as a hub for systems data collection, analysis, and response. Information gained through ongoing performance monitoring can enable real-time system modifications, coordination with law enforcement and emergency response partners, and communication to the media and the traveling public to optimize traffic flows in the event of incidents and emergencies. Coupled with staging for response and mobilization, TMCs can quickly help address interruptions to traffic flow and accelerate a return to normal operations. TMCs can serve an important role in integrating systems data across jurisdictions with multiple stakeholders.

Other advances in transportation technologies continue to offer opportunities for improved travel experiences and system performance. Travelers and transportation officials benefit from real-time information, apps, tools, software, and other innovations that help us make better decisions about how to travel and how to manage transportation facilities. Technologies provide the ability to detect, analyze, control, and communicate transportation conditions, leading to improved travel reliability and efficiency. For example, Intelligent Transport Systems (ITS) technologies can provide drivers with real-time feedback and directly control vehicle speed to improve traffic flow and reduce the incidence and severity of collisions. These technologies can also help reduce carbon emissions, especially when combined with speed management measures and reduced congestion.

Carbon Reduction Effect:

Improved efficiency and operation of the transportation system can result in reduced congestion, delays, and detours, leading to reduced carbon emissions from fuel combustion.

Co-Benefits:

- *Reduced roadway congestion and travel delay*: Transportation management techniques and technologies can improve operations during off-peak and peak periods of travel and during incidents, leading to reduced recurring and non-recurring congestion and delays.
- *Improved safety*: Improved transportation operations can result in fewer user conflicts and improved safety performance.
- *Improved air quality*: Reduced congestion and delay can improve air quality through reduced tailpipe emissions.



Source: RPA

Strategy Type:

Education | Policies and Decision Making | Technology | Infrastructure Investments

Potential Projects or Implementation Actions

- Intelligent Transportation Systems (ITS)
- Traveler Information Apps/Dynamic Signs
- Connected/Autonomous Vehicle Deployment and Infrastructure Support
- Incident Management
- Work Zone Management
- Corridor/Speed Management
- Transportation Management Centers (TMCs)
- Lane Management (Bus Only)

Partnership Opportunities:

- MDT, MPOs, and local governments can implement management techniques and test or deploy new technologies to improve operational performance of the transportation system.
- Private companies can research and develop new technologies for use by transportation officials.
- Individuals can purchase vehicles equipped with advanced technology solutions and engage with traveler information systems deployed by the state and localities.

Maximum Potential Effectiveness:



Implementation Considerations:

- The Billings and Missoula MPOs have expressed interest in exploring the feasibility of bus-only managed lanes to better serve transit operations. Estimating the impact of bus priority treatments (transit signal priority, queue jump lanes, exclusive bus lanes, etc.) is difficult especially when considering impacts to other traffic. For instance, exclusive bus lanes may result in increased congestion for other vehicles.[72]
- The effectiveness of ITS strategies varies depending on which strategies are included, how induced demand is considered, the strategies' scale and scope, and assumptions about baseline deployment levels.
- Improving traffic signal operations, particularly through traffic signal synchronization on arterial streets, has powerful areawide impacts especially in large cities with high populations and traffic volumes. However, substantial benefits are also demonstrated in medium and small cities.[73]
- Transportation management techniques that improve vehicular traffic flow on arterial streets can have a negative impact on non-motorized traffic flow, convenience, comfort, and safety.
- Although CO_2 reductions from traffic management measures could be substantial on one particular road, they may have wider impacts across the transport network as a whole. For example, signal timing optimization can increase delay or fuel consumption on side streets to improve flow along the arterial network. However, these increases in delay or fuel consumption often prove negligible in terms of total network improvement.[37]
- Better communication among vehicles and with infrastructure can smooth traffic flow and reduce congestion. Connectivity and automation, such as eco-approach and departure at traffic lights and platooning, enable reductions in energy consumption.
- The size of efficiency gains for vehicles with eco-driving technologies depends on the general energy efficiency of the vehicles concerned and the context of the surrounding environment. Proper vehicle maintenance, sensible driving, efficient speeds, removing excess weight, avoiding idling, and minimizing AC can have similar benefits for emissions reduction.[74]
- Integrated corridor management, followed by ramp metering, incident management, and implementation of travel information systems are shown to have the highest to lowest impact on carbon emissions.[75]

Resources

- CMAQ Toolkit – Travel Advisories; Managed Lanes
- CDOT GHG Mitigation Measures Policy Directive
- Traffic Incident Management Benefit-Cost (TIM-BC) Tool
- Reference Sourcebook for Reducing GHG Emissions from Transportation Sources

INTERSECTION DESIGN

Strategy: **Design intersections to optimize operations.**

Design choices can directly influence congestion levels and the amount of delay experienced at intersections. Optimized operations at intersecting roadways can reduce time spent idling while waiting to make a desired traffic movement. In the right circumstances, roundabouts can allow vehicles to proceed through an intersection with minimal delay compared to the delay experienced at a traffic signal. Where traffic signals are determined to be the most appropriate configuration, optimized traffic signal timing, actuation, and adaptive signals can reduce the time spent waiting for a green light, leading to reduced carbon emissions. Furthermore, signals can improve the efficiency and convenience of sustainable transportation modes like public transit, walking, and bicycling. For example, signals can reduce the need to brake and accelerate for buses or cyclists, shortening travel times and reducing energy use. Shifts to more sustainable modes may be achieved as a result.

Carbon Reduction Effect:

Reduced congestion and delays at intersections can reduce the amount of fuel used to reach a destination, resulting in overall lower tailpipe emissions.

Strategy Type:

Policies and Decision Making

Infrastructure Investments

Potential Projects or Implementation Actions

- Roundabouts, RCUT, Green-T, and other alternative intersection designs
- Optimized signal timing
- Actuation and adaptive signals

Co-Benefits:

- *Improved safety*: Roundabouts and other alternative intersection designs can reduce the number of conflict points at an intersection and have been proven to result in fewer and less severe crashes compared to other intersection configurations. Optimized traffic signals can reduce driver frustration and improve safety performance.
- *Reduced delay and congestion*: Alternative intersection designs allow vehicles to process through intersections more efficiently, often without stopping, thereby reducing queuing and delay. Optimizing signal timings along high-use corridors can also help process vehicles through intersections more efficiently, reducing overall congestion at individual intersections and along corridors.
- *Improved air quality*: Optimized intersections can result in reduced time spent idling, thereby improving air quality through reduced tailpipe emissions.
- *Utility cost savings: Some alternative* intersection designs, such as roundabouts, require less energy to operate compared to traditional traffic signals. However, potential utility costs savings may be offset by increased equipment fuel consumption associated with more extensive winter maintenance.



Source: RPA

Partnership Opportunities:

- MDT, MPOs, and local governments can optimize the timing and function of existing traffic signals and consider construction of new roundabouts where appropriate.

Maximum Potential Effectiveness:



Implementation Considerations:

- Roundabouts are shown to significantly reduce delays and associated carbon emissions. However, the effect of induced demand from improved traffic flow is understudied.[77]
- The winter maintenance effort required to clear and keep clear roundabouts can be 2 to 10 times the level of effort required for a standard intersection due to blowing and drifting snow. Increased maintenance efforts can be contrary to carbon reduction benefits.[101]
- The use of other alternative intersection designs is emerging and research on the effectiveness of such intersections on carbon emission reductions is currently limited.
- At intersections with demand/capacity (d/c) ratios of less than 0.7, roundabouts produce fewer emissions. At d/c ratios between 0.7 and 1.0, signals have a greater effect on carbon reduction. Once the d/c ratio exceeds 1.0, however, roundabouts are shown to experience less emissions than signalized intersections.[78]
- Intersection designs that minimize heavy truck braking, especially at urban signalized intersections, can help reduce emissions. Empirical studies also indicate carbon reduction potential from implementation of adaptive traffic signals.[79,80]

Resources

- CDOT GHG Mitigation Measures Policy Directive
- CMAQ Toolkit – Adaptive Traffic Control Systems; Congestion Reduction and Traffic Flow Improvements



Source: RPA

Energy Efficiency and Carbon Emissions Offsetting

3.2.6. Energy Efficiency and Carbon Emissions Offsetting

In 2015, MDT participated in a case study to apply FHWA's Infrastructure Voluntary Evaluation Sustainability Tool (INVEST). Under the Operations and Maintenance Module for Electrical Energy Efficiency and Use (OM-2), the study found that MDT scored 5 out of 15 relating to reducing consumption of fossil fuels during operation and maintenance of agency-owned and/or operated facilities through improvements in efficiency and the use and/or generation of renewable energy sources. The following strategies can assist MDT in building upon current sustainability practices with the goal of reducing or offsetting carbon emissions across the state. Projects to replace street lighting and traffic control devices with energy-efficient alternatives are directly eligible for CRP funding under 23 USC 175(c)(1)(F). Projects involving alternative uses of highway right-of-way (ROW), such as renewable energy generation facilities and biologic carbon sequestration practices within highway right-of-way, are also eligible.[82]



ELECTRIC INFRASTRUCTURE UPGRADES

Strategy: **Install energy-efficient fixtures and features to reduce energy consumption**

When considering life-cycle carbon emissions of the transportation system, the use of energy by transportation assets such as roadway lighting, traffic signals, and rail crossings can translate to carbon emissions, depending on the source of electricity production. Upgrades including light emitting diode (LED) fixtures, solar-powered electrical components, and installation of adaptive systems that adjust as conditions change can help reduce energy consumption, potentially leading to indirect reduction of carbon emissions.

Carbon Reduction Effect:

Reducing the energy consumed by transportation infrastructure can indirectly lead to reduced carbon emissions.

Strategy Type:

Technology

Infrastructure Investments

Potential Projects or Implementation Actions

- Roadway Lighting/Traffic Signal/Rail Crossing Electrical Upgrades
  - Energy-efficient LED lamps
  - Dimmable fixtures
  - Solar-powered components
  - Adaptive lighting/control systems

Co-Benefits:

- *Improved safety*: The light emitted by LED lamps can improve visibility in dark conditions, potentially leading to improved safety on roadways.
- *Improved air quality*: A reduction in energy needed to operate transportation assets can indirectly lead to improved air quality benefits by offsetting electricity generated by coal and natural gas.
- *Improved sustainability*: Energy-efficient fixtures require reduced consumption of electricity, providing sustainability benefits.
- *Utility cost savings*: Reduced energy consumption translates to reduced utility costs to operate transportation infrastructure.



Source: RPA

Partnership Opportunities:

- MDT, MPOs, and local governments can issue guidance and policies to direct installation of energy-efficient lighting, signals, and other features within public right-of-way for new and upgraded components.

Maximum Potential Effectiveness:



Implementation Considerations:

- A roadway lighting, traffic signal, and rail crossing inventory was not conducted for the Montana CRS. The number of conventional lamps/electrical fixtures within public right-of-way, associated energy usage, and source of energy generation was not determined. However, it is anticipated that carbon reduction from energy savings would be relatively low compared to strategies targeting user emissions.
- Although the MDT Traffic Engineering Manual (2007)[83] does not provide wattage or other guidance for the design of LED fixtures, MDT's current practice is to install LED lamps for new and upgraded fixtures and electrical components, including stand-alone retrofit projects where appropriate. This strategy would represent a continuation of MDT current practice.
- Additional MDT guidance may need to be issued to provide parameters for fixture selection to support designers and project managers during the project development process.
- FHWA research suggests that in some circumstances, an adaptive lighting approach with reduced/temporarily dimmed light reflecting variable roadway usage can produce energy savings and eliminate over-lighting while still maintaining safe and comfortable driving conditions.[84]

Resources

- FHWA INVEST
- Design Criteria for Adaptive Roadway Lighting
- AVoided Emissions and geneRation Tool (AVERT)

ALTERNATIVE USES OF HIGHWAY ROW

Strategy: Consider alternative uses of highway right-of-way.

The Federal Highway Administration (FHWA) has provided guidance on ways to leverage alternative uses of the highway right-of-way (ROW), including for the purpose of renewable energy generation such as solar arrays and wind turbines. FHWA advises that these types of projects can "better utilize the full value and productivity of the existing asset while also …create[ing] new revenue opportunities through participation in public-private-partnerships to develop renewable energy projects and negotiating agreements that include land lease or land license payments and power purchase agreements that reduce the States' energy costs."[85]

In 2006, MDT conducted an experimental project at the Anaconda Rest Area to determine the cost-effectiveness of developing a tower-mounted wind turbine to provide supplemental power supply to the facility and reduce grid-powered service.[86] A 2011 status report indicated the unit supplied about 20 percent of the annual rest area power consumption.[87]

More recently, multiple states have implemented pilot projects to install solar panels at rest areas, on maintenance facilities, and within highway right-of-way, and the Oregon DOT has developed a Guidebook for Departments of Transportation interested in pursuing these types of projects.[88] A 2008 ODOT project installed a ground-mounted solar array at the intersection of Interstate 5 and Interstate 205, with renewable energy production from the project offsetting about one-third of the energy needed for freeway illumination at the site.[89] And in 2022, MDT received a proposal for a research project to conduct Geographic Information System (GIS) and cost analyses to determine the feasibility for renewable energy generation within MDT right-of-way.[90]

Additionally, FHWA supports biologic carbon sequestration maintenance and management practices, such as increased mowing heights, planting native grasses and other perennials, and in some cases planting and maintaining woody vegetation such as trees and shrubs to increase the amount of carbon that is absorbed from the atmosphere and stored in the soil.[91] Treatments should be consistent with ROW maintenance and safety requirements, including visibility and consideration of hazards within the roadway clear zone.

In 2008, FHWA conducted a pilot project in collaboration with 10 DOTs across the country to identify suitable right-of-way, revenue potential, and decision support tools for state consideration of carbon sequestration. In Montana, 12 random sites along NHS routes were selected for review. Pavement, vegetation widths, and land cover attributes were determined to provide extrapolations of suitable ROW acreage.[92] Information gained from this pilot effort could be useful to support implementation of an enhanced carbon sequestration program within highway right-of-way in Montana.

Co-Benefits:

- *Improved air quality*: Production of renewable energy can indirectly lead to improved air quality benefits by offsetting electricity generated by coal and natural gas. Biologic carbon sequestration practices can reduce dust.
- *Improved sustainability and security*: Renewable energy production can help improve sustainability and improve security by diversifying energy generation and delivery.
- *Utility and fuel cost savings*: Agreements with utility companies for alternative uses of highway right-of-way can offset or reduce utility costs and/or provide a source of revenue. Modified mowing frequency and intensity can reduce maintenance fuel consumption and associated costs.
- *Improved climate resiliency and protection*: Solar arrays can provide shade and shelter from the weather when used as overhead structures for parking and trail facilities, and trees and other vegetation can provide a cooling effect, offsetting high temperatures near pavements and buildings.
- *Improved stormwater, snow, and slope management*: Biologic carbon sequestration practices can reduce peak flows and runoff velocity, reduce erosion, and enhance stormwater infiltration. Vegetation management and enhancement practices can also provide living snow fences and protect steep slopes from risk of landslide.
- *Improved habitat*: Vegetation management and enhancement can support habitat and forage for butterflies, bees, other native pollinators, and bird species.

Carbon Reduction Effect:

Leveraging the highway right-of-way to generate renewable energy can indirectly reduce carbon emissions by offsetting energy production through coal or natural gas. Additionally, biologic carbon sequestration within the highway right-of-way can offset transportation carbon emissions.

Strategy Type:

- Policies and Decision Making
- Technology
- Infrastructure Investments

Potential Projects or Implementation Actions

- Photovoltaic solar arrays
- Wind turbine projects
- Geothermal energy technologies
- Biologic carbon sequestration



Source: RPA



Source: RPA

Partnership Opportunities:

- MDT can partner with utility companies to install energy generation facilities within the highway right-of-way and pursue options to increase biologic carbon capture through modified management and maintenance practices. MDT can also evaluate existing plans and policies to ensure they are not prohibitive to improvements that could support carbon reduction efforts. Additionally, MDT can work with other agencies to research technologies and carbon sequestration techniques with the highest carbon reduction potential within existing MDT safety and operational parameters.
- Utility companies can develop and install renewable energy projects in partnership with MDT.

Maximum Potential Effectiveness:

LOW — HIGH

MEDIUM

Implementation Considerations:

- This strategy would not reduce on-road transportation carbon emissions, however it could be used to generate energy through renewable sources, potentially offsetting carbon emissions produced by coal- and natural gas-powered plants.
- An inventory of public right-of-way in Montana was not conducted for the CRS. However, it is anticipated that substantial renewable energy could be generated through full use of suitable right-of-way, and substantial right-of-way would likely be suitable for enhanced biologic carbon sequestration.
- To be suitable for energy generation, undeveloped public right-of-way must be outside the roadway clear zone and in proximity to the electrical grid while ensuring adequate solar/wind exposure, lack of competing development efforts, adequate access, and sufficient land area.
- The Montana Department of Environmental Quality estimates that Montana's solar resource is 26 percent greater than the national average due to typically sunny winter days.[93]
- This strategy would require coordination with utility companies to negotiate power purchase agreements.
- There may be opportunities to pursue public-private partnerships by leasing public right-of-way to a private-sector entity that would finance, design, construct, operate, and maintain energy-generation projects. A private entity would have access to tax incentives such as the federal Investment Tax Credit (ITC) that are not available to public agencies, potentially increasing project cost effectiveness.
- In some cases, reducing emissions through modified management practices, such as reduced mowing, can contribute more to meeting GHG goals than carbon sequestration.[94]
- FHWA approval may be required for alternative uses of highway right-of-way.

Resources

- FHWA Alternative Uses of Highway Right-of-Way
- FHWA Renewable Energy Generation in the Highway Right-of-Way
- FHWA Quick Guide: FHWA Requirements for Renewable Energy Projects in Highway Right-of-Way
- National Renewable Energy Laboratory System Advisor Model (SAM)
- ODOT Guidebook for DOTs to Develop Solar Photovoltaic Systems in the Highway Right-of-Way
- Highway Carbon Sequestration Estimator
- US Forest Service/US Department of Agriculture Tree Carbon Calculator
- NCHRP Guidebook for Designing and Managing Rights-of-Way for Carbon Sequestration and Biomass Generation

Highway Construction and Maintenance

3.2.7. Highway Construction and Maintenance

Multiple variables contribute to the production of carbon emissions associated with highway construction and maintenance. Considering life-cycle contributions, carbon is emitted during the extraction and production of construction materials, from transport of those materials to a construction site, and through operation of vehicles and equipment during construction and maintenance activities. In general, using local and recycled materials, maintaining smooth riding surfaces, extending the life of assets, streamlining construction and maintenance practices, and using alternative equipment can all help reduce transportation carbon emissions. Section 23 USC 175(d)(2)(B)(iii) allows the CRS to identify projects or strategies which facilitate approaches to the construction of transportation assets that result in lower transportation emissions as compared to existing approaches. The deployment of alternative fuel vehicles, including construction and maintenance equipment, is eligible under 23 USC 175(c)(1)(J) while the deployment of advanced technologies related to infrastructure maintenance, monitoring, and condition assessment is eligible under 23 USC 175(c)(1)(D).

PAVEMENT PRESERVATION

Strategy: **Preserve existing pavements to extend their useful life.**

Pavement preservation is a strategy to extend the useful life of roadway surfacing. Studies have shown that smooth riding surfaces can improve fuel efficiency for vehicles.[95] Additionally, extending the life of roadways reduces the production and transport of materials needed for reconstruction efforts.

Carbon Reduction Effect:

Providing a smooth roadway surface can improve fuel efficiency and delay the need for production and transport of materials needed for reconstruction, resulting in an indirect reduction of carbon emissions.

Strategy Type:

Technology

Infrastructure Investments

Potential Projects or Implementation Actions

- Crack/joint/fog/sand/scrub/chip/cape sealing
- Blading/grading
- Concrete panel repair/replacement
- Dowel bar retrofit
- Diamond grinding
- Microsurfacing
- Hot in-place/cold in-place recycling (HIR/CIR), cold central plant recycling (CCPR)
- White topping
- Mill/fill
- Overlay
- Full-depth reclamation

Co-Benefits:

- *Improved safety*: Pavement maintained in good condition reduces road hazards for vehicles.
- *Improved air quality*: Smooth riding surfaces improve fuel efficiency, leading to reduced combustion of gasoline and diesel fuels and improved air quality.
- *Fuel cost savings*: Smooth riding surfaces improve fuel efficiency, leading to reduced cost of gasoline and diesel purchases.



Source: RPA



Source: RPA

Partnership Opportunities:

- MDT, MPOs, and local governments can conduct pavement preservation activities on public roadways throughout the state.

Maximum Potential Effectiveness:



Implementation Considerations:

- Multiple variables would influence the potential carbon reduction effect from this strategy, including pavement mix design, layer depths, treatment activities, and life cycles.
- To qualify for CRP funding, a life-cycle assessment (LCA) would be required to demonstrate a reduction in CO_2 compared to typical or other potential pavement-related practices or materials.
- MDT currently uses an asset management approach to measure pavement and bridge condition and apply life-extending treatments to achieve a state of good repair through effective investments.[96] This strategy would be a continuation of current MDT practice.
- Life-cycle carbon emissions associated with infrastructure assets are substantially lower than user-generated tailpipe emissions, resulting in a comparatively lower target share of the state's total transportation carbon emissions.

Resources

- FHWA - Towards Sustainable Pavement Systems
- LCA Pave Tool
- Pavement Life-cycle Assessment Tool (PaLATE)
- MICE Etool v2.1
- FHWA Advancing a Sustainable Highway System
- Reference Sourcebook for Reducing GHG Emissions from Transportation Sources

CONSTRUCTION MATERIALS

Strategy: **Use lower-carbon materials in construction projects.**

Highway construction materials such as concrete, steel, and asphalt require energy-intensive processes to extract raw materials, transport to a manufacturing site, convert into products, route to a construction site, and ultimately install. In terms of life-cycle carbon emissions, these materials traditionally have high levels of embodied carbon reflecting the energy used in these processes. Reductions in embodied carbon can be realized by using products involving less energy-intensive mining and manufacturing processes, with longer lifespans, alternative additives or components, from material sources closer to construction sites to minimize transport emissions, and that require less energy-intensive processes to install. Additionally, carbon reduction can be achieved through the use of products containing recycled components or applying in-place recycling processes at project sites.

Carbon Reduction Effect:

Using high-performance, recycled, and local construction materials reduces the carbon emissions produced through mining, transport, manufacturing, installation, and maintenance processes.

Strategy Type:

- Policies and Decision Making
- Technology
- Infrastructure Investments

Potential Projects or Implementation Actions

- Low-carbon materials (with lower embodied carbon produced during life cycle)
- High-performance materials with longer design life
- Recycled construction materials/in-place recycling processes
- Locally sourced materials

Co-Benefits:

- *Improved sustainability*: Lower-carbon materials reduce energy consumption over the life cycle of a product.
- *Reduced cost*: There may be opportunities to reduce costs, depending on the material type, source, lifespan, and other factors.



Source: RPA



Source: RPA

Partnership Opportunities:

- MDT, MPOs, and local governments can encourage, support, and incentivize the use of low-carbon materials on highway construction projects.
- Contractors can select low-carbon materials when bidding and constructing projects.
- Producers/suppliers can submit products for inclusion on the MDT Qualified Product List (QPL).

Maximum Potential Effectiveness:



Implementation Considerations:

- Multiple variables would influence implementation of this strategy, including material source location and availability, suitability, and performance levels of lower-carbon materials compared to traditional materials.
- To qualify for CRP funding, an LCA would be required to demonstrate and quantify a reduction in CO_2 compared to typical or other potential pavement-related practices or materials.
- MDT encourages identification of cost effective and innovative products to meet the needs of the traveling public. Products not currently addressed or requiring changes to MDT specifications can be submitted to the MDT Standards Committee for consideration.
- MDT Design Memos[97, 98] provide guidance on recycled surfacing options and use of cold millings from federal-aid projects. This strategy would be a continuation of current MDT practice.
- Life-cycle carbon emissions associated with infrastructure assets are substantially lower than user-generated tailpipe emissions, resulting in a comparatively lower target share of the state's total transportation carbon emissions.

Resources

- Embodied Carbon in Construction Calculator (EC3) – EC3 Tool
- LCA Pave Tool
- FHWA - Towards Sustainable Pavement Systems
- Pavement Life-cycle Assessment Tool (PaLATE)
- FHWA Infrastructure Carbon Estimator / MICE Etool v2.1
- FHWA Advancing a Sustainable Highway System
- Reference Sourcebook for Reducing GHG Emissions from Transportation Sources

CONSTRUCTION PRACTICES

Strategy: Apply construction innovations to reduce project delivery timeframes.

The construction industry is continuing to evolve, with innovations in construction practices and methods streamlining project delivery. By applying these innovations and integrating and optimizing design and construction activities, construction schedules can be accelerated, minimizing the time spent operating construction equipment, producing traffic delays, and requiring out-of-direction traffic detours, thereby reducing carbon emissions from construction equipment and vehicles traveling through work zones.

Carbon Reduction Effect:

Reduced time spent constructing projects can result in reduced carbon emissions from equipment operation, traffic delays, and detours.

Strategy Type:

- Policies and Decision Making
- Technology

Potential Projects or Implementation Actions

- Optimized workflow including artificial intelligence, predictive analytics, machine learning
- Alternative delivery and optimization methods including accelerated bridge construction, prefabrication, and pilot/ experimental projects

Co-Benefits:

- *Improved safety*: Streamlined construction schedules can minimize the exposure duration of hazardous work zone conditions for construction workers and the traveling public.
- *Improved project quality*: Innovations in construction practices can enhance the quality of constructed projects.
- *Improved air quality*: Schedule reductions can translate to improved air quality from reduced equipment operation, traffic delays, and detours.
- *Cost savings*: Reduced time spent constructing projects can translate to reduced labor and equipment costs, as well as reduced opportunity costs from traffic delays and detours.



Source: MDT



Source: MDT

Partnership Opportunities:

- MDT, MPOs, and local governments can seek opportunities for innovation and encourage incorporation of innovative practices and methods for construction projects through contract requirements, incentives, and other practices.
- Contractors can incorporate innovative practices in their construction operations.

Maximum Potential Effectiveness:



Implementation Considerations:

- Multiple variables would influence the likelihood of implementation and the associated potential carbon reduction effect from this strategy, including practice or approach applicability and suitability, risk factors, and costs compared to traditional approaches and methods.
- A detailed Montana construction practice assessment was not conducted for the CRS. However, potential carbon emissions reduction is expected to be comparatively low.
- MDT has embraced innovation in construction practices through its Alternative Contracting program. This strategy would represent a continuation of MDT current practice by encouraging consideration of innovative methods when appropriate.

Resources

- Sustainable Highway Construction Guidebook

CONSTRUCTION AND MAINTENANCE EQUIPMENT ALTERNATIVES

Strategy: **Support emissions reductions for construction and maintenance equipment.**

Traditionally, highway construction and maintenance equipment has been powered by diesel fuel. Newer equipment options powered by electric batteries, hydrogen, biodiesel sources such as hydrotreated vegetable oil (HVO), liquified natural gas (LNG), compressed natural gas (CNG), and propane (which produce less carbon dioxide compared to diesel) are continuing to enter the market. Ranging from small-scale landscaping equipment to larger-scale excavators and snowplows, equipment powered by alternative means can reduce carbon emissions from diesel combustion, while right-sizing vehicles can ensure functional needs are met while reducing the amount of fuel consumed by a larger vehicle.

Carbon Reduction Effect:

Use of retrofitted and alternative-fuel vehicles and equipment reduces or eliminates carbon emissions from the operation of traditional diesel-fueled models.

Strategy Type:

Policies and Decision Making

Technology

Equipment Investments

Potential Projects or Implementation Actions

- Retrofit technologies such as diesel oxidation catalysts (DOC), diesel particulate filters (DPF), and selective catalytic reduction (SCR)
- Alternative fuel and right-sized equipment and fleet purchases, where appropriate, depending on the function and circumstances of use
- Policies encouraging use of alternative-fuel equipment on construction projects and maintenance activities

Co-Benefits:

- ✔ *Improved air quality*: A reduction in tailpipe emissions from diesel-powered construction and maintenance equipment can improve air quality.
- ✔ *Fuel cost savings*: Use of electric/alternative fuel construction and maintenance equipment can reduce the cost of diesel purchases.



Source: MDT



Source: MDT

Partnership Opportunities:

- MDT, MPOs, and local governments can retrofit or purchase new maintenance equipment for their fleets and encourage or incentivize the use of reduced-emissions equipment on construction projects.
- Contractors can upgrade their fleets and use alternative equipment on highway construction projects.

Maximum Potential Effectiveness:



Implementation Considerations:

- Multiple variables would influence the likelihood of implementation and the associated potential carbon reduction effect from this strategy, including the availability, suitability, cost, and overall performance of retrofit technologies and alternative-fuel options compared to traditional vehicles and equipment.
- An MDT construction and maintenance equipment inventory was not conducted for the CRS, and the number of conventional construction vehicles/equipment used for transportation projects was not determined. However, the carbon reduction impact from this strategy is anticipated to be low since the carbon emissions associated with non-road equipment is substantially lower than on-road user-generated tailpipe emissions, resulting in a comparatively lower target share of the state's total transportation carbon emissions.
- The MDT Equipment Program aims to provide economical equipment that is multi-functional, safe, and accomplishes the required tasks. The program is responsible for policy for fleet administration, budgets, purchasing vehicles and equipment, and allocating them to field operations. This strategy would represent a continuation of MDT current practice by encouraging consideration of equipment alternatives when appropriate.
- Diesel retrofit technologies and alternative-fuel vehicles and equipment continue to be developed, with increasing availability of options. However, availability is still limited for certain equipment types.
- Some fuel types are sensitive to extreme temperatures and may not operate as effectively in hot- or cold-weather conditions compared to traditional diesel-powered models.
- The operating duration of electric batteries may require frequent recharging, with more limited range compared to diesel-powered equipment.

Resources

- FHWA INVEST
- Argonne Heavy-Duty Vehicle Emissions Calculator (HDVEC)
- USEPA NONROAD
- CARB OFFROAD
- CMAQ Toolkit – Non-Road Construction Equipment

ALTERNATIVE MAINTENANCE PRACTICES AND TECHNOLOGIES

Strategy: **Optimize maintenance practices to reduce time spent operating diesel-powered equipment.**

MDT conducts a wide range of maintenance activities throughout the year. Activities include maintenance of asphalt and concrete pavement on roadways and pedestrian/bicycle facilities, bridges and structures, signage, pavement markings/striping, traffic signals and luminaires, delineators, roadways/roadsides including slopes, shoulders, vegetation/landscaped areas, and fences/gates, in addition to snow plowing and snow removal. The operation of traditional diesel-powered maintenance equipment to conduct these activities directly results in carbon emissions from fuel combustion. Opportunities to streamline routing and maintenance practices can reduce time and fuel spent to achieve maintenance objectives. In addition to policies and procedures addressing idling and routing, technologies can be employed to optimize maintenance activities. For example, route optimization software coupled with supporting hardware such as dash cameras can be helpful to provide real-time location tracking and route editing, route progress updates, performance analytics, fuel diagnostics, and predictive arrival time estimates. Additionally, technologies and equipment such as GPS and tow/wing plows can reduce total miles traveled.

Carbon Reduction Effect:

Adopting optimized maintenance procedures and technologies can reduce carbon emissions by minimizing the operation of traditional diesel-powered maintenance equipment.

Strategy Type:

Education | Policies and Decision Making | Technology

Potential Projects or Implementation Actions

- Equipment operation/maintenance procedures (anti-idling policy, employee training)
- Maintenance route optimization software/hardware
- Alternative snow removal policies and technology/equipment (GPS, tow/wing plows, snow fencing)
- Alternative vegetation management (alternative mowing, integrated roadway/vegetation management

Co-Benefits:

- ✔ *Improved safety*: Optimized maintenance practices can improve safety for highway workers as well as the traveling public through enhanced infrastructure preservation and improved response to weather and road conditions.
- ✔ *Improved air quality*: A reduction in time spent operating diesel-powered maintenance equipment can improve air quality through reduced tailpipe emissions.
- ✔ *Fuel cost savings*: Reduced operating time can reduce the cost of diesel purchases.



Source: MDT



Source: RPA

Partnership Opportunities:

- MDT, MPOs, and local governments can implement optimization procedures and technologies to streamline use of public maintenance equipment.

Maximum Potential Effectiveness:



LOW-MEDIUM

Implementation Considerations:

- Multiple variables would influence the carbon reduction effect of this strategy, including the availability, suitability, cost, and overall performance outcomes of alternative options and technologies compared to traditional practices.
- A detailed Montana maintenance practice and technology assessment was not conducted for the CRS. However, the carbon reduction impact from this strategy is anticipated to be low since the carbon emissions associated with management activities is substantially lower than user-generated tailpipe emissions, resulting in a comparatively lower target share of the state's total transportation carbon emissions.
- MDT has embraced innovation in maintenance practices and technologies through its Maintenance Program. This strategy would represent a continuation of MDT current practice by encouraging consideration of innovative maintenance practices when appropriate.

Resources

- FHWA INVEST
- FHWA Advancing a Sustainable Highway System

3.3. STRATEGY SUMMARY

In alignment with federal goals, individual strategies target a reduction in the number and duration of trips, reduction of SOV trips, use of alternative vehicles/equipment, modes and fuels, and alternative construction materials and construction/maintenance practices.

Strategy categories are intended to represent the most effective types of actions for reducing transportation carbon emissions in Montana. The descriptions, attributes, and effectiveness determinations associated with each strategy can be used by state and local authorities to inform investment decisions as available funding is applied to achieve CRS goals. CRP strategies are intended to serve as a toolbox reference to assist in the future project identification, development, and implementation. **Table 3.1** lists individual strategies, partnership opportunities, effectiveness ratings, and a summary of implementation considerations. Potential projects and implementation actions associated with each strategy include but are not limited to those listed throughout **Section 3.2**.

Table 3.1: Summary of Strategies

	Strategy	Partnership Opportunities	Maximum Potential Effectiveness	Implementation Considerations
Transportation Demand Management	**Land Use Development Patterns**	MPOs, Cities/ Counties/ Planning Boards, MDT, Housing Authorities, Nonprofit Organizations, Private Land Developers, Individual Residents	**Medium**	• More effective in urban areas where development is more dense. • Variable support for higher densities. • Requires coordination among all levels of government. • More effective when integrated with walking/biking/transit infrastructure. • Synergistic effects when combined with multimodal planning and incentives.
Transportation Demand Management	**Work Trip Efficiency**	MDT, MPOs, Local Governments, Private Employers, Individuals	**Low-Medium**	• Varying participation for trip reduction strategies (employer/employee). • Flexible workplace and work schedule policies have varying degrees of effectiveness due to demand shifts. • Home energy use may partially offset savings in office energy use. • Financial incentives and provision of transportation services are more effective than outreach.
Transportation Demand Management	**Freight Trip Efficiency**	MDT, MPOs, Local Governments, Private Freight Haulers, Individual Customers	**Low**	• MDT currently provides truck time reliability/traveler information. • Heavily dependent on decisions of private freight hauling/logistics companies. • Collection points, off-peak deliveries, and zero emission vehicles can provide the greatest emissions benefit in urban operations. • Variation in emissions benefit based on characteristics of each freight trip and prevalent traffic conditions.
Mode Choice	**Active Transportation and Micromobility**	MDT, MPOs, Local Governments, Private Companies, Individuals	**Low-Medium**	• Most effective in urban environments. • Dedicated/separated facilities with connectivity to transit facilities or schools in urban cores are most effective. • Variations in bicycle/walking activity associated with acute weather events and level of winter maintenance. • Hills/steep grades affect routing decisions. • Younger populations living close to work/away from transit have more pronounced emissions reductions. • Cars and trucks used to redistribute shared bikes/scooters decrease effectiveness.

Table 3.1: Summary of Strategies

	Strategy	Partnership Opportunities	Maximum Potential Effectiveness	Implementation Considerations
Mode Choice	**Public Transportation**	MDT, MPOs, Local Governments, Transit Operators, Rail Providers, Employers, Individuals	**Low**	• Existing rural, urban, inter-city bus service and vanpools provide service; limited public transportation & rail options in some areas of state. • Funding is a limiting factor for adding services and routes. • Buses produce lower emissions per mile traveled. • Reduced transit fares, off-peak, and weekend service, and increased service frequency help encourage more trips. • Employer-provided transit options demonstrate large mode shifts. • Advanced traveler information systems (online maps, timetables, route planning) help increase effectiveness.
Mode Choice	**Shared Rides**	MDT, MPOs, Local Governments, TDM Programs, Private Employers, Private Businesses, Individuals	**Low-Medium**	• More effective for large numbers of people traveling to common destination (e.g., work site). • Desire shift from COVID-19 pandemic reduced ridership levels. • Empty travel by shared vehicles (distance to pick up passengers) offsets emissions benefits. • Lower effectiveness since trips are often offset from walking/public transportation vs. private vehicles. • Unintended effects (encouraging more driving, out-of-direction travel, urban sprawl).
Vehicles	**Vehicle Alternatives**	MDT, MPOs, Local Governments, Private Companies, Transit Operators, School Districts, Individuals	**Medium-High**	• Revenue from fuel taxes may be reduced; alternative taxes can be leveraged. • Location-specific effectiveness (rural vs. urban). • Cold weather performance limitations of electric batteries. • Availability of fueling and charging stations impacts effectiveness. • Air quality effects of alternative vehicles should be considered.
Parking	**Parking**	MDT, MPOs, Local Governments, Freight Haulers	**Low**	• TSE is effective, however, truck idling is a small percentage of total freight emissions. • Effectiveness of parking demand management depends on scale, scope, and combination with other strategies. • Land use and parking requirement policies can support parking demand management strategies.
TSMO	**Management Techniques and Technology Solutions**	MDT, MPOs, Local Governments, Private Companies, Individuals	**Low-Medium**	• Effectiveness is variable based on strategy type, induced demand, scale and scope, baseline deployment levels. • Bus-managed lanes can be effective, although benefits may be offset by system congestion impacts. • Deployment of traffic signal synchronization on arterial streets can be effective, particularly in cities. • Techniques that improve vehicular traffic flow on arterial streets can have a negative impact on non-motorized traffic flow, convenience, comfort, and safety. • Emissions impacts from corridor may be negligible when considering total network effects. • Effectiveness of eco-driving technologies depends on vehicle types, context of environment, and other vehicle maintenance. • Integrated corridor management, ramp metering, incident management, and implementation of travel information systems (high to low effectiveness).

Table 3.1: Summary of Strategies

	Strategy	Partnership Opportunities	Maximum Potential Effectiveness	Implementation Considerations
TSMO	**Intersection Design**	MDT, MPOs, Local Governments	**Low-Medium**	• Potential for induced demand from improved traffic flow. • Emerging effectiveness research on alternative intersection designs. • Roundabout relative effectiveness varies with demand/capacity ratios. • Intersection designs that minimize heavy truck braking can help reduce emissions. • Adaptive traffic signals provide potential carbon reduction benefits.
Energy	**Electric Infrastructure Upgrades**	MDT, MPOs, Local Governments	**Low**	• Adaptive lighting approach can produce energy savings and eliminate over-lighting while still maintaining safe driving conditions. • Current MDT practice to install LED fixtures and electrical components. • Energy usage benefits dependent on source of energy generation.
	Alternative Uses of Highway ROW	MDT, Utility Companies	**Medium**	• Does not reduce on-road transportation carbon emissions. • Potentially substantial right-of-way for energy generation through renewable sources and biologic carbon sequestration. • Suitability of public right-of-way for alternative uses varies - clear zone, proximity to electrical grid, solar/wind exposure, adjacent development, access, land area. • Coordination with utility companies required. • Potentially more effective through public-private partnerships, with access to tax incentives. • May require FHWA approval.
Construction/Maintenance	**Pavement Preservation**	MDT, MPOs, Local Governments	**Low**	• Carbon reduction effectiveness varies based on pavement mix design, layers, treatment activities, and life cycles. • Life-cycle assessment (LCA) required to demonstrate carbon reduction for CRP funding. • Continuation of MDT asset management approach. • Lower carbon reduction effect compared to strategies targeting tailpipe emissions.
	Construction Materials	MDT, MPOs, Local Governments, Contractors, Producers/Suppliers	**Low**	• Effectiveness varies based on material source availability, suitability, and performance levels. • LCA required to demonstrate carbon reduction for CRP funding. • Could be added to MDT specifications through consideration by MDT Standards Committee. • Lower carbon reduction effect compared to strategies targeting tailpipe emissions.
	Construction Practices	MDT, MPOs, Local Governments, Contractors	**Low**	• Potential for implementation varies based on applicability/suitability, risk factors, and costs. • Potential carbon reduction expected to be comparatively low. • Continuation of current MDT practice (Alternative Contracting program).
	Construction and Maintenance Equipment Alternatives	MDT, MPOs, Local Governments, Contractors	**Low**	• Potential for implementation varies based on applicability/suitability, risk factors, and costs. • Lower carbon reduction effect compared to strategies targeting tailpipe emissions. • Continuation of MDT current practice (MDT Equipment Program). • Extreme temperature sensitivity of alternative fuels. • Operating duration of electric batteries is limited.
	Alternative Maintenance Practices and Technologies	MDT, MPOs, Local Governments	**Low**	• Potential for implementation varies based on applicability/suitability, cost, and overall performance • Lower carbon reduction effect compared to strategies targeting tailpipe emissions • Continuation of MDT current practice (MDT Maintenance Program).

4.0. IMPLEMENTATION SUMMARY AND NEXT STEPS



4.0. IMPLEMENTATION SUMMARY AND NEXT STEPS

MDT is committed to supporting national goals to reduce transportation carbon emissions. Under the CRP, **$68.1 million will be apportioned to Montana** through fiscal year 2026. Federal regulations require 65% of Montana's CRP apportionment to be obligated to areas in proportion to their relative shares of the Montana's population, while the remaining 35% of the apportionment may be obligated in any area of the state.

In partnership with current and new MPOs and other partners across the state, MDT will use the Montana CRS as a guide when considering, nominating, and implementing specific projects and actions funded through the CRP to reduce transportation carbon emissions in Montana. Projects will need to be considered on a case-by-case basis, however actions supporting transportation demand management, mode choice, vehicle alternatives, parking, transportation system management and operations, energy efficiency and energy generation, and highway construction and maintenance are likely eligible for CRP funding. Leveraging technological advancements as well as multi-agency and public-private partnerships will provide key opportunities to lessen Montana's carbon impact. Collectively, such efforts will reduce Montana's transportation emissions while at the same time reinforcing MDT's mission to plan, build, operate, and maintain safe and resilient transportation infrastructure, with specific focus on efficient, connected, and accessible facilities serving all users.



Source: Tarasov/Adobe Stock



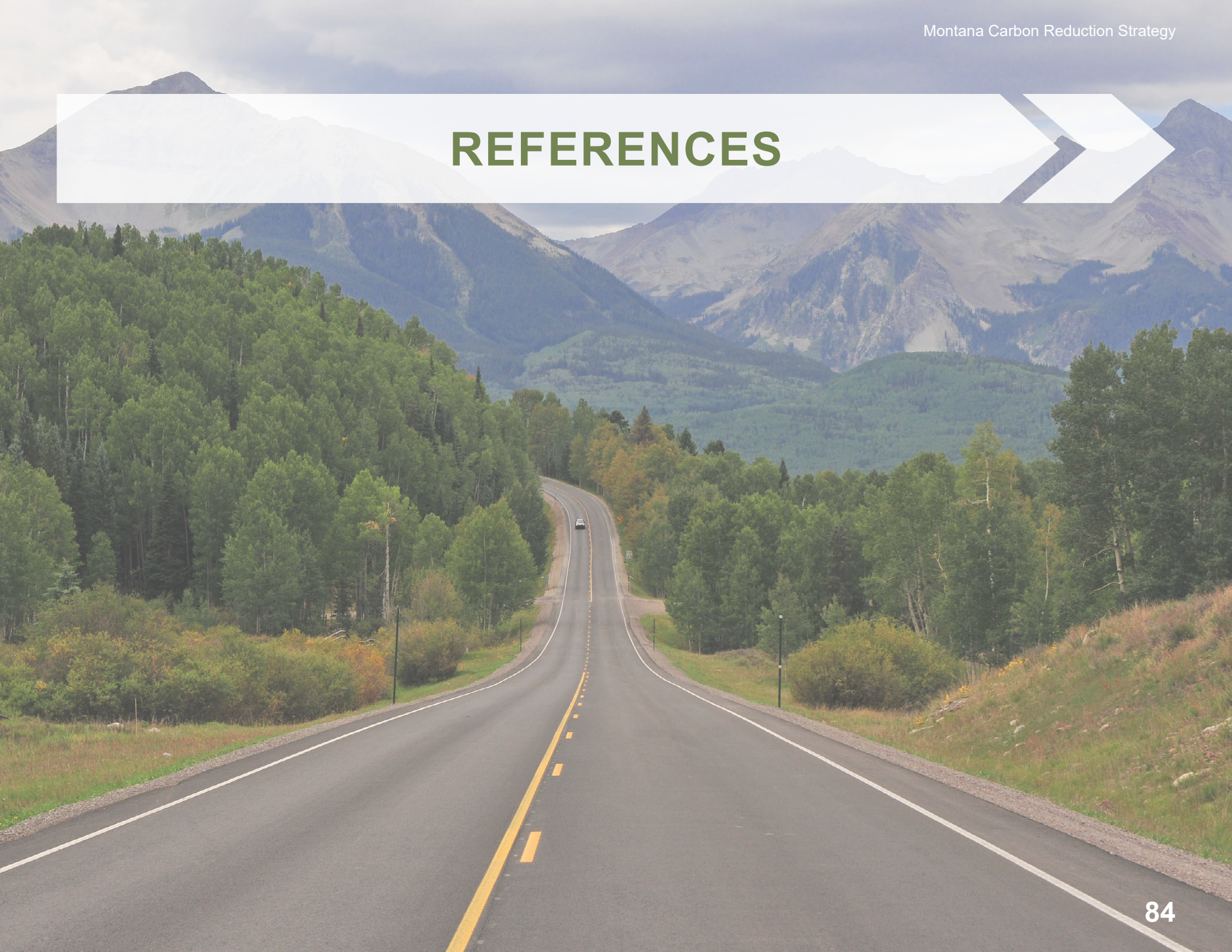
Source: RPA/Tell Media, LLC

As projects and actions are implemented, it will be important to evaluate their effectiveness and update assumptions used in the CRS. CRP Implementation Guidance notes that states are encouraged to incorporate program evaluation including associated data collection activities from the outset of their program design and implementation to meaningfully document and measure their progress toward meeting carbon reduction goals. Additionally, the guidance notes that evaluation costs are eligible for CRP funds and may include expenses such as personnel and equipment needed for data infrastructure and expertise in data analysis, performance, and evaluation.[34]

Future evaluation efforts including data collection and inventory, database development and management, state and local carbon emissions modeling, and collaboration with partner agencies may be desirable to better understand carbon emissions produced in Montana. Currently, MDEQ and MDT are considering a potential partnership to develop a state-specific MOVES model to understand the types, sources, and locations of emissions within the state. Emissions data specific to conditions in Montana can help MDT and MPOs assess the overall effectiveness of CRP strategies, projects, and implementation actions and inform CRP funding allocation decisions.

The Montana CRS will be updated every four years in accordance with federal regulations. Future updates will summarize continuing efforts to gather and analyze the most current emissions data, refine the effectiveness ratings of specific actions, and document progress made toward reducing transportation carbon emissions in Montana.

REFERENCES



REFERENCES

[1]USEIA, Energy-Related CO_2 Emission Data Tables, 2020 Data, Release October 11, 2022, https://www.eia.gov/environment/emissions/state/

[2]NCHRP, Project 25-56, Reducing Greenhouse Gas Emissions: A Guide for State DOTs, March 8, 2022, https://crp.trb.org/nchrpwebresource1/

[3]US Census Bureau, Population of the 50 States, the District of Columbia, and Puerto Rico: 1910 to 2020, https://www2.census.gov/programs-surveys/decennial/2020/data/apportionment/population-density-data-table.pdf

[4]MDT, 2022 Fact Book, https://www.mdt.mt.gov/publications/docs/brochures/factbook.pdf

[5]MDT, Montana's Estimated Monthly Vehicle Miles Traveled, Reviewed in February 2023, https://www.mdt.mt.gov/other/webdata/external/Planning/traffic_reports/mvmt_table.pdf

[6]US Census Bureau, PEP Population Estimates, https://datacommons.org/tools/timeline#&place=geoId/30&statsVar=Count_Person

[7]University of Montana Institute for Tourism & Recreation Research, ITRR's Interactive Data: Nonresident Visitation Report, https://tableau.mus.edu/t/missoula/views/TotalVisitationViz/Visitation?%3Aembed=y&%3AisGuestRedirectFromVizportal=y

[8]USBTS, State Transportation Statistics, Reviewed in February 2023, https://www.bts.gov/product/state-transportation-statistics

[9]USEIA, State Energy Data System, Table E20, Motor Gasoline Price and Expenditure Estimates, Ranked by State, 2019, as published in USEIA Montana State Energy Profile, https://www.eia.gov/state/?sid=MT

[10]USDOT, Federal Highway Administration, Office of Highway Policy Information, Highway Statistics 2020, as published in USEIA Montana State Energy Profile, https://www.eia.gov/state/?sid=MT

[11]USBTS, Montana Transportation by the Numbers, January 2020, https://www.bts.dot.gov/sites/bts.dot.gov/files/states2020/Montana.pdf

[12]US Census Bureau, American Community Survey, 2017 to 2021, Table S0801, https://data.census.gov/

[13]University of Montana Institute for Tourism & Recreation Research, ITRR's Intercept Survey Crosstabulator, Method of Entering Montana, Reviewed in March 2023, https://tableau.mus.edu/t/missoula/views/FrontendCrosstabulator/Crosstabulator2?%3Aembed=y&%3AisGuestRedirectFromVizportal=y

[14]Amtrak, Amtrak Fiscal Year 2022: The Beginning of a New Era of Rail, November 29, 2022, https://media.amtrak.com/2022/11/amtrak-fiscal-year-2022-the-beginning-of-a-new-era-of-rail/

[15]USEIA, State Energy Data System, 2021 Data, https://www.eia.gov/state/seds/seds-data-fuel.php?sid=US

[16]Strava, Global Heatmap, Reviewed in March 2023, https://www.strava.com/heatmap#7.00/-120.90000/38.36000/hot/all

[17]USDOE, Alternative Fuels Data Center, Vehicle Registration Counts by State, Reviewed in March 2023, https://afdc.energy.gov/vehicle-registration

[18]Atlas EV Hub, State EV Registration Data, Reviewed in March 2023, https://www.atlasevhub.com/materials/state-ev-registration-data/

REFERENCES

[19]USEPA, Latest Version of Motor Vehicle Emission Simulator (MOVES), Updated December 9, 2022, https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves

[20]MDT, Montana Department of Transportation GIS Data Portal, Shared Use Paths, Updated September 30, 2021.

[21]USEIA, State Energy Data 2020: Consumption Technical Notes, https://www.eia.gov/state/seds/sep_use/notes/use_technotes.pdf

[22]MDT, Junction GIS Data supplied by the MDT Geospatial Information Section on February 24, 2023.

[23]MDT, Montana Department of Transportation GIS Data Portal, Roundabouts, Updated August 24, 2021.

[24]MDT, 2016 Montana Rail Grade Separation Study, May 2016, https://www.mdt.mt.gov/publications/docs/brochures/MDT-RGSS-Final-Report-2016.pdf

[25]MDT, Montana Department of Transportation GIS Data Portal, Montana Public At-Grade Railroad Crossings, Updated August 17, 2021.

[26]USDOE, Alternative Fuels Data Center, Alternative Fueling Station Locator, Public Stations, Reviewed in February 2023, https://afdc.energy.gov/stations/#/find/nearest

[27]USDOE, Alternative Fuels Data Center, Alternative Fueling Station Locator, Fuel Corridors, Reviewed in February 2023, https://afdc.energy.gov/stations/#/corridors

[28]MDT, Road Design Manual, Appendix E: Level of Service Criteria, https://www.mdt.mt.gov/other/webdata/external/cadd/RDM/20-RDM-AppendixE-LOS-Criteria.pdf

[29]MDT, Level of Service Capacity GIS Data supplied by the MDT Geospatial Information Section on February 24, 2023.

[30]Montana Department of Commerce, Census and Economic Information Center, Regional Economic Models Inc, Montana Population Projections (2001 – 2060), v4.3.0 released July 2019, https://mslservices.mt.gov/geographic_information/maps/gallery/MapViewer.aspx?id=6a2f6f5b82d84615ad2b641a3c6fe3da

[31]USEIA, Annual Energy Outlook 2022, Table 7: Transportation Sector Key Indicators and Delivered Energy Consumption, Released March 2022.

[32]USDOT, NHTSA-2021-0053, Corporate Average Fuel Economy Standards for Model Years 2024-2026 Passenger Cars and Light Trucks, March 31, 2022, https://www.nhtsa.gov/sites/nhtsa.gov/files/2022-04/Final-Rule-Preamble_CAFE-MY-2024-2026.pdf

[33]USEPA, Greenhouse Gases Equivalencies Calculator - Calculations and References, Updated April 4, 2023, https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references

[34]FHWA, Memorandum HEP-1: Carbon Reduction Program (CRP) Implementation Guidance, April 21, 2022, https://www.fhwa.dot.gov/environment/sustainability/energy/policy/crp_guidance.pdf

[35]USEPA, Greenhouse Gases Equivalencies Calculator - Calculations and References, Updated April 4, 2023. USEPA, National Emissions Inventory (NEI) with on-road source data derived from USEPA MOVES model, 2022.

[36]TRB, Reducing Greenhouse Gas Emissions: A Guide for State DOTs, 2.10 Case Study: Relative Magnitude of Emissions from State Transportation Source, March 8, 2022, https:/crp.trb.org/nchrpwebresource1/2-0greenhouse-gas-basics/
Emissions scale for Users (94%) based on data from Florida, Maine, Massachusetts, Minnesota, Maryland, Oregon, Vermont, Washington, and Texas DOT sustainability/GHG inventory reports and system characteristics, including vehicle miles traveled (VMT), population, lane miles, and fuel mix. Emissions scale for Assets & Management (6%) based on state highway system figure data from these states' budget documents and U.S. Environmentally-Extended Input-Output

[37]Smart Growth America, Driving Down Emissions Transportation, land use, and climate change, October 2020, https://t4america.org/wp-content/uploads/2020/10/Driving-Down-Emissions.pdf

[38]Smart Growth America, What is Smart Growth, https://smartgrowthamerica.org/what-is-smart-growth/

[39]Natural Resources Defense Council, Environmental Characteristics of Smart Growth Neighborhoods, February 2003, https://www.nrdc.org/sites/default/files/charnash.pdf

[40]US Census Bureau, American Community Survey, Mean Travel Time to Work, 2017-2021.

REFERENCES

[41]State of Montana, Telework Policy, August 2022, https://hr.mt.gov/_docs/Policies/Telework_Policy.pdf

[42]Caros, Guo, and Zhao, The emerging spectrum of flexible work locations: implications for travel demand and carbon emissions, 2022, https://www.researchgate.net/publication/357580244_The_emerging_spectrum_of_flexible_work_locations_implications_for_travel_demand_and_carbon_emissions

[43]Transportation Research Board, Public Agency Guidance on Employer-Based TDM Programs and Employer Technical Memorandum Characteristics of Effective TDM Programs, December 2002, https://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_webdoc_22-a.pdf

[44]Suzanne Greene, MIT Sustainable Supply Chains Initiative, Freight Transportation, Updated February 3, 2023, https://climate.mit.edu/explainers/freight-transportation

[45]USDOE, USDOT, USEPA, USHUD, The U.S. National Blueprint For Transportation Decarbonization: A Joint Strategy to Transform Transportation, https://www.energy.gov/sites/default/files/2023-01/the-us-national-blueprint-for-transportation-decarbonization.pdf

[46]MDT, Bicycling the Big Sky, Highway Information for Bicyclists, 2022, accessed at: https://www.mdt.mt.gov/other/webdata/external/planning/maps/bike-map.pdf

[47]Kuzmyak and Dill, TR News 280 May-June 2012 Issue, Walking and Bicycling in the United States: The Who, What, Where, and Why, https://onlinepubs.trb.org/onlinepubs/trnews/trnews280www.pdf

[48]Brand et. al, The climate change mitigation impacts of active travel: Evidence from a longitudinal panel study in seven European cities, January 29, 2021, https://www.sciencedirect.com/science/article/abs/pii/S0959378021000030?dgcid=author

[49]NACTO, 136 Million Trips Taken on Shared Bikes and Scooters Across the U.S. in 2019, August 27, 2020, https://nacto.org/2020/08/27/136-million-trips-taken-on-shared-bikes-and-scooters-across-the-u-s-in-2019/

[50]MDT, 2022 Fact Book, https://www.mdt.mt.gov/publications/docs/brochures/factbook.pdf

[51]TCRP, TCRP Research Report 226: An Update on Public Transportation's Impacts on Greenhouse Gas Emissions, Spreadsheet Tool, 2021, https://www.trb.org/Main/Blurbs/181941.aspx

[52]Big Sky Passenger Rail Authority, Restoring Passenger Rail to Southern Montana and Beyond, https://www.bigskyrail.org/

[53]Oregon Sustainable Transportation Institute, Oregon Greenhouse Gas Reduction Toolkit: Strategy Report – Transit Pricing, https://www.oregon.gov/odot/Planning/Documents/SR-Transit-Pricing.pdf

[54]TransitCenter, There's a Reason Transit Ridership is Rising in These 7 Cities, February 27, 2019, https://transitcenter.org/theres-a-reason-transit-ridership-is-rising-in-these-7-cities/

[55]International Energy Agency, Saving Oil in a Hurry, 2005, https://www.iea.org/reports/saving-oil-in-a-hurry

[56]APTA, Economic Impact of Public Transportation Investment: 2020 Update, https://www.apta.com/wp-content/uploads/APTA-Economic-Impact-Public-Transit-2020.pdf

[57]USBTS, Montana Transportation by the Numbers, January 2020, https://www.bts.dot.gov/sites/bts.dot.gov/files/states2020/Montana.pdf

[58]City of Missoula Development Services, Transportation Division, Missoula in Motion, Vanpool Program and Carpool Program, https://missoulainmotion.com/

[59]Morfeldt and Johansson, Impacts of shared mobility on vehicle lifetimes and on the carbon footprint of electric vehicles, 2022, https://doi.org/10.1038/s41467-022-33666-2

[60]Zipcar, Impact Report 2021, https://media2.zipcar.com/drupal-presales/2021-11/2021-Zipcar-Impact-Report.pdf

[61]Truong and Marshall, Are Park-and-Rides Saving the Environment or Just Saving Parking Costs?: Case Study of Denver, Colorado, Light Rail System, Transportation Research Record, 2419(1), 109–117, 2014, https://doi.org/10.3141/2419-11

[62]National Renewable Energy Laboratory, Emissions Associated with Electric Vehicle Charging: Impact of Electricity Generation Mix, Charging Infrastructure Availability, and Vehicle Type, April 2016, https://afdc.energy.gov/files/u/publication/ev_emissions_impact.pdf

[63]USDOE, Case Study – Propane School Bus Fleets, August 2014, https://afdc.energy.gov/files/u/publication/case-study-propane-school-bus-fleets.pdf

[64]Montana 68th Legislature, House Bill No. 55, An Act Establishing a Tax On Electric Vehicle Charging Stations, May 19, 2023.

[65]Montana 68th Legislature, House Bill No. 60, An Act Providing for an Annual Fee on Electric Vehicles Registered in the State, May 19, 2023.

[66]AFDC, Propane Benefits and Considerations, Accessed June 15, 2023, https://afdc.energy.gov/fuels/propane_benefits.html

[67]Federal Highway Administration. (December 1, 2020). Jason's Law Commercial Motor Vehicle Parking Survey and Comparative Assessment. US Department of Transportation. https://ops.fhwa.dot.gov/freight/infrastructure/truck_parking/workinggroups/2020/mtg/jasons_law_results.pdf

REFERENCES

[68]MDT, Montana Freight Plan, p.104, 2022, https://www.mdt.mt.gov/freightplan/docs/2022-Montana-Freight-Plan.pdf?v=1

[69]American Carbon Registry, Truck Stop Electrification, https://americancarbonregistry.org/resources/truck-stop-electrification

[70]FHWA, Financing Idle-Reduction Projects, March/April 2005, https://highways.dot.gov/public-roads/marchapril-2005/financing-idle-reduction-projects

[71]Oregon Sustainable Transportation Institute, Oregon Greenhouse Gas Reduction Toolkit: Strategy Report – Parking Management, https://www.oregon.gov/odot/Planning/Documents/SR-Parking-Management.pdf

[72]ITF, Express lanes / public transport priority, 2021, https://www.itf-oecd.org/policy/express-lanes-public-transport-priority

[73]FHWA, Traffic Control Systems Handbook: Chapter 3. Control Concepts - Urban And Suburban Streets, Modified May 3, 2022, https://ops.fhwa.dot.gov/publications/fhwahop06006/chapter_3p2.htm

[74]Oregon Sustainable Transportation Institute, Oregon Greenhouse Gas Reduction Toolkit: Strategy Report – EcoDriving and Idle Reduction, https://www.oregon.gov/odot/Planning/Documents/SR-EcoDriving-Idle-Reduction.pdf

[75]TRB, Reducing Greenhouse Gas Emissions: A Guide for State DOTs, 16.0 Transportation Systems Management and Operations, March 8, 2022, https://crp.trb.org/nchrpwebresource1/16-0-transportation-system-management-and-operations/#sec16-2

[76]FHWA, Proven Safety Countermeasures: Roundabouts, https://highways.dot.gov/sites/fhwa.dot.gov/files/Roundabouts_508.pdf

[77]Mandavilli, et al, Environmental impact of modern roundabouts, February 2008, https://www.sciencedirect.com/science/article/abs/pii/S0169814106002526?via%3Dihub

[78]FHWA, Assessment of the Environmental Characteristics of Roundabouts, Updated August 2020, https://safety.fhwa.dot.gov/intersection/roundabouts/fhwasa15071.pdf

[79]ITF, Towards Road Freight Decarbonisation Trends, Measures and Policies, 2018, https://www.itf-oecd.org/sites/default/files/docs/towards-road-freight-decarbonisation_0.pdf

[80]ITF, Transport Climate Action Directory – Enhanced signalling, 2021, https://www.itf-oecd.org/policy/enhanced-signalling

[81]University of Montana, Bureau of Business and Economic Research, https://www.sustainablehighways.org/files/3326.pdf

[82]FHWA, Memorandum HEP-1: Carbon Reduction Program (CRP) Implementation Guidance, April 21, 2022, https://www.fhwa.dot.gov/environment/sustainability/energy/policy/crp_guidance.pdf

[83]MDT, Traffic Engineering Manual, Chapter 13 – Highway Lighting Design, Figure 13.5A – Lamp Data, November 2007.

[84]FHWA, Design Criteria for Adaptive Roadway Lighting, July 2014, https://www.fhwa.dot.gov/publications/research/safety/14051/14051.pdf

[85]FHWA, State DOTs Leveraging Alternative Uses of Highway Right-of-Way Guidance, April 27, 2021, Accessed on June 1, 2023, https://highways.dot.gov/research/projects/alternative-uses-right-way

[86]MDT Research Program, Experimental Project Work Plan – Evaluation of a Tower-Mounted Wind Turbine for the Generation of Supplemental Power for the Anaconda Interchange Rest Area, 2006, https://www.mdt.mt.gov/other/webdata/external/research/docs/epsl/wind_turbine/workplan.pdf

[87]MDT Research Program, Experimental Project Installation and Analysis To Date: Evaluation of a Tower-Mounted Wind Turbine for the Generation of Supplemental Power for the Anaconda Interchange Rest Area, 2011, https://www.mdt.mt.gov/other/webdata/external/research/docs/epsl/wind_turbine/eval_nov11.pdf

[88]ODOT, Solar Highway Program: From Concept to Reality, November 2016.

[89]FHWA, Spotlight on Solar Arrays, Public Roads – November/December 2012, Spotlight on Solar Arrays | FHWA (dot.gov).

[90]MDT, Renewable Energy Generation within MDT ROW, August 2022, https://www.mdt.mt.gov/research/projects/env/renewable-energy.aspx

[91]FHWA, State DOTs Leveraging Alternative Uses of Highway Right-of-Way Guidance, HEPR-40, April 27, 2021. https://www.fhwa.dot.gov/real_estate/right-of-way/corridor_management/alternative_uses_guidance.cfm

[92]FHWA, Carbon Sequestration Pilot Program, Estimated Land Available for Carbon Sequestration in the National Highway System, May 2010, Carbon Sequestration - Publications - Energy - Sustainability - Environment - FHWA (dot.gov)

[93]MDEQ, Renewable Energy Programs, Solar, Renewable Energy | Montana DEQ (mt.gov)

[94]FHWA, Carbon Sequestration Pilot Program: Implementation and Next Steps, February 2009, https://www.transportation.gov/sites/dot.gov/files/docs/FINAL_C-Seq_Report_021109.pdf

REFERENCES

[95]Rutgers University, ScienceDaily, Keeping roads in good shape reduces greenhouse gas emissions: Delaying pavement maintenance boosts emissions and costs, January 15, 2019. www.sciencedaily.com/releases/2019/01/190115124451.htm.

[96]MDT, Montana Transportation Asset Management Plan, 2022, https://www.mdt.mt.gov/publications/docs/plans/MDT-TAMP-2022.pdf

[97]MDT, Recycled Surfacing Options, March 2009 (revised February 2023), https://www.mdt.mt.gov/other/webdata/external/cadd/design_memos/2009-03-16_RECYCLE_PAVEMENT.pdf

[98]MDT, Use of Cold Millings from Federal-Aid Projects, March 2009 (revised February 2023), https://www.mdt.mt.gov/other/webdata/external/cadd/design_memos/2009-03-10_COLD_MILLINGS.pdf.

[99]FHWA, Memorandum HEP-1: Carbon Reduction Program (CRP) Implementation Guidance, April 21, 2022, https://www.fhwa.dot.gov/environment/sustainability/energy/policy/crp_guidance.pdf

[100]MDT, MDEQ, Montana 2023 Electric Vehicle (EV) Infrastructure Deployment Plan Update, July 31, 2023, https://www.mdt.mt.gov/publications/plans/ev/docs/2023-MT-NEVI-Plan.pdf

[101]MDT, Personal Communication, August 2023



APPENDIX A

REVIEW OF PREVIOUS EFFORTS

Appendix A – Review of Previous Efforts

TABLE OF CONTENTS

Table of Contents ..... **A-i**
Tables ..... A-ii
1.0. MDT and MPO Long Range Transportation Plans **A-1**
1.1. TranPlanMT (2017) A-1
1.2. Billings Urban Area Long Range Transportation Plan (2023) A-4
1.3. Great Falls Area Long Range Transportation Plan (2023) A-4
1.4. Missoula Urban Area Long Range Transportation Plan (2021) A-5
2.0. Other MDT Plans and Policies **A-6**
2.1. Statewide Transportation Improvement Program (2022) A-6
2.2. Transportation Asset Management Plan (2022) A-6
2.3. Montana Freight Plan (2022) A-7
2.4. ADA Transition Plan (2021) A-9
2.5. Montana State Transit Management Plan (2020) A-9
2.6. Montana Pedestrian and Bicycle Plan (2019) A-10
2.7. Shared Use Paths Inventory and Detailed Maintenance Plan (2018) A-12
2.8. Pavement Design Manual (2018) A-12
2.9. Rest Area Plan (2014) A-12
2.10. Montana State Rail Plan (2010) A-13
3.0. Other Montana Agencies and Organizations **A-13**
3.1. Electric Vehicle Infrastructure Prioritization Study (2022) A-13
3.2. Electric Vehicle Charging Infrastructure Deployment Plan (2022) A-14
3.3. Regional Electric Vehicle Plan for the West A-15

Tables

Table 1.1: TranPlanMT Goals and Strategies A-2
Table 2.1: Montana Freight Plan Strategies A-7
Table 2.2: ADA Transition Plan Methods A-9
Table 2.3: Montana Pedestrian and Bicycle Plan Goals and Strategies A-11
Table 2.4: Rest Area Plan Guidelines A-13
Table 3.1: Electric Vehicle Charging Infrastructure Deployment Plan Goals A-15

1.0. MDT AND MPO LONG RANGE AND METROPOLITAN TRANSPORTATION PLANS

In coordination with Metropolitan Planning Organizations (MPOs), states are encouraged to develop a Carbon Reduction Strategy as an integral part of the transportation planning processes by integrating into the state Long Range Statewide Transportation Plan and MPO's Metropolitan Transportation Plan (MTP), or by developing a separate document which is incorporated by reference into MTP.

1.1. TranPlanMT (2017)

TranPlanMT is Montana's statewide long range transportation plan that sets overarching statewide policy goals and priorities for MDT's multimodal transportation system. The plan outlines existing and projected conditions related to transportation assets, users, context, and management. The assets and users volumes discuss infrastructure and user characteristics associated with personal driving, non-motorized transportation, public transportation, and freight, in recognition of the full range of transportation modes, choices, and user needs associated with Montana's transportation system.

How is this plan relevant to carbon emissions reduction and the CRS?

- The CRS is recommended to be included as a future component of *TranPlanMT*.
- *TranPlanMT* documents infrastructure condition, mode choice and other user characteristics, environmental factors, and administration of the transportation system, which all directly influence the degree of transportation-related carbon emissions.
- The plan addresses a series of federal planning factors to protect and enhance the environment, promote energy conservation, improve quality of life, promote efficient system management and operation, and improve the resiliency and reliability of the transportation system. These factors overlap and align with carbon reduction initiatives.
- The plan identifies complimentary goals and strategies outlined in MPO plans throughout Montana. MPO consultation is a key requirement of the CRS development process.
- All *TranPlanMT* goal areas support the CRS effort, and the following statewide strategies directly relate to the CRS development process and intended outcomes.

Table 1.1: TranPlanMT Goals and Strategies

Goal	Strategy	Relationship to Carbon Reduction and the CRS
SAFETY **Goal**: Improve safety for all transportation users to achieve Vision Zero: zero fatalities and zero serious injuries.	**S1**: Maintain infrastructure condition to provide safe conditions for the traveling public. **S2:** Continue improvements to the safety rest area program to provide safe stopping locations for the traveling public.	FHWA encourages States and other funding recipients to prioritize safety in all Federal highway investments and in all appropriate projects, using relevant Federal-aid funding, including funds from CRP. Infrastructure condition and provision of safety rest areas directly affect carbon emissions by minimizing out-of-direction travel and optimizing trip efficiency.
SYSTEM PRESERVATION AND MAINTENANCE **Goal:** Preserve and maintain existing transportation infrastructure.	**SPM1:** Employ an asset management approach to monitor system performance and develop an optimal investment plan ensuring like conditions throughout state. **SPM2:** Provide the right improvements at the right time to manage infrastructure assets using cost-effective strategies. **SPM3:** Design new facilities for durability and longer life cycles using state-of-the-art materials and methods. **SPM4:** Support preservation of the existing rail, transit, and aviation systems in coordination with industry partners. **SPM5:** Perform routine repairs and maintenance to provide consistent levels of service.	System reliability and performance are important components to minimize congestion and delay, thereby reducing carbon emissions.
MOBILITY AND ECONOMIC VITALITY **Goal**: Facilitate the movement of people and goods recognizing the importance of economic vitality.	**MEV3**: Consider the influence of user characteristics and technology advancements on travel demand patterns. **MEV4**: Promote efficient traffic management and operations by implementing practices that manage travel demand, reduce delay, and enhance mobility.	The Mobility and Economic Vitality goal establishes strategies aimed at reducing traffic delay, incorporating advanced technologies, and shifting travel demand. These strategies help support the reduction of CO_2 by reducing vehicle idling, congestion, and vehicle trips.

Goal	Strategy	Relationship to Carbon Reduction and the CRS
ACCESSIBILITY AND CONNECTIVITY **Goal**: Preserve access to the transportation network and connectivity between modes.	**AC1**: Improve pedestrian, public transportation, and other MDT-owned facilities to ensure accessibility to individuals with disabilities. **AC2**: Employ an asset management system to monitor and manage public transportation capital assets. **AC3**: Implement a consistent approach for investment, design, connectivity, and maintenance of pedestrian and bicycle facilities. **AC4**: Identify and consider accessibility and connectivity needs on improvement projects. **AC5**: Coordinate use of public transportation systems through integrated planning with providers. **AC6**: Maximize efficiency of transportation options available to disadvantaged populations.	The Accessibility and Connectivity goal and strategies are focused on improved design, connectivity, accessibility, and maintenance of MDT-owned pedestrian, bicycle, and public transportation facilities, with special focus on disabled and other disadvantaged populations. By supporting non-motorized transportation, these strategies can help reduce vehicle trips and associated carbon emissions.
ENVIRONMENTAL STEWARDSHIP **Goal**: Support MDT's transportation mission through regulatory compliance and responsible stewardship of the built and natural environment.	**ES1**: Evaluate environmental constraints and cost-effective opportunities during the planning process. **ES2**: Foster positive working relationships with resource agencies and stakeholders through early coordination and consultation. **ES5**: Meet regulatory requirements.	Strategies supporting the Environmental Stewardship goal emphasize understanding environmental constraints and opportunities, coordination and consultation with partner agencies, and regulatory compliance. These strategies directly support CRS development, which requires working toward common goals in partnership with MPOs and in compliance with federal regulations.
BUSINESS OPERATIONS AND MANAGEMENT **Goal**: Provide efficient, cost-effective management and operation to accelerate transportation project delivery and ensure system reliability.	**BOM2**: Develop and implement a long-range multimodal transportation improvement program that addresses Montana's statewide transportation needs, is consistent with the statewide long-range transportation plan and management system output and maximizes the use of federal funds through the Performance Programming Process (P3) to ensure a cost-effective, efficient, and safe transportation system. **BOM5**: Invest at the appropriate level to achieve performance targets given available funding. **BOM6**: Employ proactive management strategies to ensure compliance with rules and regulations, identify risk to MDT and the transportation network, and facilitate equitable participation in MDT programs and services.	The Business Operations and Management goal and strategies outline the Department's commitment to cost-effective, efficient management and operation of the transportation system to serve all users by complying with appropriate regulations and maximizing investments including federal funds. These commitments directly support development of the CRS, which is required under federal law and funded through federal dollars.

1.2. Billings Urban Area Metropolitan Transportation Plan (2023)

The Billings MPO is currently preparing a metropolitan transportation plan (MTP) to address all transportation forms and elements (streets and highways, public transit and transportation, freight, pedestrian and bicycle, safety, and security) and meet local, state, and federal requirements. The study area encompasses the City of Billings and a planning area extending approximately 4.5 miles outside City limits in some areas. The MTP will include technical work (data gathering, future growth projections, assessment of auto, truck, rail, transit, air, pedestrian, and bicycle modes) and identification of short and long range transportation projects.

How is this plan relevant to carbon emissions reduction and the CRS?

- The CRS is recommended to be integrated in MPO transportation plans.
- The Billings MTP will address transportation forms in the Billings urban area that produce and potentially minimize transportation-related carbon emissions.
- The MTP identifies the following goal areas, which support and directly relate to the reduction of carbon emissions.
    - ***Safety***: Develop a safer transportation system for all users.
    - ***Resiliency***: Optimize, preserve, and enhance the existing transportation system to adapt with climate change, protect the natural environment, and promote a healthy and sustainable community.
    - ***Mobility***: Create a transportation system that supports the use of transit, walking, biking, shared mobility, and vehicles.
    - ***Equity and Accessibility***: Address the needs of transportation-disadvantaged populations through the provision of affordable, accessible, and reliable travel options.
    - ***Economic Vitality***: Provide transportation facilities to support the local economy and connect the Billings urban area to local, regional, and national commerce.

1.3. Great Falls Area Metropolitan Transportation Plan (2023)

The Great Falls MPO has initiated a community-wide transportation planning process focusing on the greater Great Falls area. This planning process will assist the planning partners and broader community in guiding transportation infrastructure investments based on system needs and anticipated developments over the 2045 planning horizon. The plan will integrate with and build upon past planning efforts to evaluate and address the transportation system needs of all travel modes.

How is this plan relevant to carbon emissions reduction and the CRS?

- The CRS is recommended to be integrated in MPO transportation plans.
- The 2023 MTP will provide an opportunity to respond to the changing needs and interests of the community, plan for emerging transportation technologies, advance national, state and local initiatives, and prepare Great Falls for future transportation funding opportunities. A draft plan is anticipated to be available by the end of 2023.

- The planning effort is designed to determine adverse and beneficial impacts of potential transportation improvements in the study area. Consideration of planned and ongoing land development, the environment, community values, and sound engineering standards will shape the recommendations and study findings.

1.4. Missoula Urban Area Metropolitan Transportation Plan (2021)

Missoula Connect is an update to the MTP. The 30-year plan looks at all modes of transportation and identifies priorities for projects and programs, as well as how funding should be allocated. Relying on previous planning work and extensive community outreach, Missoula Connect integrates existing plans and projects to create a sustainable transportation future that improves mobility and access for all Missoula area residents, workers, and visitors.

How is this plan relevant to carbon emissions reduction and the CRS?

- The CRS is recommended to be integrated in MPO transportation plans.
- The MTP acknowledges the challenges of a rapidly warming climate and the need to change behavior, reduce greenhouse gas emissions, and meet local mode share and climate goals.
- The MTP identifies the following goals that are directly relevant to the reduction of carbon emissions, including opportunities to connect urban and rural areas, increase active transportation mode share, integrating land use and transportation, advancing safe and local networks, and preparing for an uncertain future.
    - Improve safety and promote health to enhance quality of life
        - Improve safety for people walking and biking
        - Enhance active transportation and transit linkages to lower-income neighborhoods
        - Increase physical activity and human connections by making walking and biking convenient modes of travel
    - Advance sustainability and community resilience to protect natural resources and address climate change
        - Improve climate resilience and advance toward carbon neutrality
        - Reduce transportation-related air emissions
    - Expand mobility choices to improve efficiency and accessibility for people and goods
        - Build complete streets and increase access to multimodal options
        - Increase street, trail/greenway, and sidewalk network connectivity for all ages and abilities
        - Optimize the efficiency and accessibility of the transportation system
        - Reduce person hours of delay for people driving and improve freight movement
        - Improve access to high-quality and high-frequency transit stops and routes
    - Connect and strengthen communities to create a more equitable region
        - Develop an integrated mobility system that connects destinations with sustainable travel options
        - Integrate land use and transportation planning to support infill development and create complete neighborhoods
        - Improve access to schools, jobs, parks, essential services, affordable and senior housing, and basic life needs

  - Maintain assets and invest strategically to boost economic vitality
    - Bring existing infrastructure and transit assets into a state of good repair to support the regional economy, local industry, and goods movement
    - Provide a network that targets growth inward to support existing centers and mixed-use development

- The MTP recommended capital projects, programs, and policies which directly support the reduction of carbon emissions, including transit, active transportation, and safety improvements, as well as efforts targeting transportation equity, asset management, passenger rail and air service, emerging technologies, and compact growth.

2.0. OTHER MDT PLANS AND POLICIES

MDT has conducted a variety of planning exercises and prepared numerous statewide plans and technical documents detailing transportation programs and policies in Montana. The following efforts include projects and programming that either directly or indirectly address carbon emissions reduction and consequently support the CRS development process.

2.1. Statewide Transportation Improvement Program (2023-2027)

The *Statewide Transportation Improvement Program* (STIP) is a federally required publication outlining funding obligations over a five-year period. This program is developed through coordinated efforts of MDT, state and federal agencies, local and tribal governments, metropolitan planning organizations, public agencies, transportation providers, citizens, and other interested parties.

The STIP identifies highway, rail, aeronautic, non-motorized, and transit improvements to preserve, renovate, and improve Montana's transportation system. Although the projects and dates in the STIP are official MDT objectives, the execution of this program is contingent on a number of factors, including federal and state funding availability, right-of-way acquisition, utility relocations, environmental review, surveying, and design. Complications with one or more of these factors may delay a project.

The Transportation Improvement Programs (TIPs) from the Billings, Great Falls and Missoula metropolitan areas are incorporated into the STIP by reference. TIPs contain information about current and future transportation projects and are developed by MPOs in cooperation with area transit providers and state and local governments as part of a continuing, cooperative, and comprehensive transportation planning process.

How is this plan relevant to carbon emissions reduction and the CRS?

- Projects developed by MDT and the MPOs that address carbon emission reductions may be listed in future versions of the STIP.

2.2. Transportation Asset Management Plan (2022)

The *Transportation Asset Management Plan* (TAMP) documents MDT's commitment to managing the condition and performance of Montana's state transportation system to achieve state of good repair objectives through effectively investing limited resources. The TAMP considers life cycle planning, performance gaps, non-condition related performance, and risk in developing recommended investment strategies for pavements and bridges. The document supports MDT efforts to meet performance targets, make progress toward MDT's vision for Interstate and Non-Interstate National Highway System pavements and bridges, and achieve long-term policy goals as outlined in *Px3* and *TranPlanMT.*

How is this plan relevant to carbon emissions reduction and the CRS?

- Projects that address carbon emission reductions may support TAMP performance targets.

2.3. Montana Freight Plan (2022)

The *Montana Freight Plan* describes the state's freight transportation system, its role in the state's economy, and current and emerging industry trends. It gives an account of overall freight performance on the transportation network, highlights freight-related issues and needs, and seeks to address needs by identifying effective strategies and goals. The plan recognizes that the transportation of goods is the backbone of Montana's economy, and therefore its critical to invest in efforts that promote safe, reliable, and efficient freight movements, with transportation by truck forecasted to grow the most of all freight modes in Montana.

How is this plan relevant to carbon emissions reduction and the CRS?

- The plan identifies needs associated with the condition of Montana's bridges and roadways. Poor infrastructure condition can result in increased carbon emissions due to increased fuel consumption, tire wear, and delays associated with rough pavement surfaces.
- The plan also identifies needs associated with truck parking.
- Recognizing the impact of freight movement on air pollution, the plan provides an overview of the Congestion Mitigation and Air Quality (CMAQ) Improvement program, which MDT uses to meet transportation conformity regulations and support surface transportation projects and other related efforts that contribute to air quality improvements and provide congestion relief.
- The plan identifies a set of recommended freight system strategies, which can reduce carbon emissions as outlined below.

Table 2.1: Montana Freight Plan Strategies

Freight System Needs		Strategies	Relationship to Carbon Reduction and the CRS
Infrastructure Condition	Pavement Condition	• Preservation of the existing system • Mobility improvement projects that include major rehabilitation and reconstruction treatments to address level-of-service deficiencies by adding lanes and/or shoulder width • Maintaining pavement condition to ensure safety for the traveling public including rut-fill, chip seal, and concrete diamond grind • Applying the right pavement design	Maintaining the condition of Montana's roads and bridges ensures a reliable network for long-haul truckers that can result in reduced carbon emissions.
	Bridge Condition	• Bridge Structure Management System • Bridge Load Posting Program • New Bridge Designs • Dynamic Message Signs • Accelerated Bridge Construction • Bridge Bundling	

Freight System Needs		Strategies	Relationship to Carbon Reduction and the CRS

Freight Mobility	Recurring Congestion	• Strategies to address infrastructure bottlenecks:
		  ○ Reducing congestion to improve performance of the transportation system
		  ○ Improving safety, security, and resiliency of the transportation system
		  ○ Facilitating intermodal connectivity
		  ○ Working with freight stakeholders and partners to improve mobility in major trade gateways, multimodal freight networks and corridors
		  ○ Mitigating impacts of freight projects and movements on communities
		  ○ Supporting research and promoting adoption of new technologies and best practices
		• Strategies to address institutional/financial bottlenecks
			Broadly reducing recurring and non-recurring congestion on freight routes can result in reduced carbon emissions produced by idling trucks.

	Non-Recurring Congestion	Strategies addressing: • Crashes and Incidents • Winter Storms/Extreme Weather • Infrastructure Failure • Wildfires/Flooding • Oversized/Overweight Loads • Construction and Maintenance	
Delays Caused by Freight		Address recurring congestion associated with: • Harvest/Natural Resources • Weigh Scales • International Border Crossings • At-Grade Railroad Crossings	See above relating to congestion.
Rest Area and Truck Parking		• Emphasize rest area preservation to extend the service life of existing facilities and utility systems, and identify improvements to meet parking and building demands. • Assess and consider updates to existing rest area facilities or additions to facilities in corridor studies, when appropriate. • When conducting corridor studies or other planning studies, include freight stakeholders in the public process to help identify truck parking needs and issues, when appropriate. • Seek to implement the use of a parking availability system to notify drivers in advance of available truck parking at rest areas, through the pursuit of discretionary opportunities. • Rest area projects along the Primary Highway Freight System (PHFS) that help to address freight needs are eligible for funding consideration through the National Highway Freight Program.	Providing safe, functional stopping locations spaced regularly along highway corridors enables long-haul truckers and other drivers to take needed breaks to stop and rest. Adequate parking can prevent truckers from driving further or longer in search of safe parking, thereby reducing carbon emissions.
Freight and the Natural Environment		State and Federal Environmental Policy • The National and Montana Environmental Policy Acts (NEPA/MEPA) provide processes for sound decision-making based on thorough environmental analysis and public disclosure and review. Air Quality • MDT implements the Congestion Mitigation and Air Quality (CMAQ) Improvement program. • MDT is working to establish an interactive air quality planning process that considers air pollution reductions and transportation needs at the same time.	Efforts to broadly account for impacts to the natural environment and specifically to minimize air quality impacts can align with the goal of reducing carbon emissions.

2.4. ADA Transition Plan (2021)

The MDT *Americans with Disabilities Act (ADA) Transition Plan* directs the department's efforts to provide an accessible transportation system within the state of Montana. The purpose of the plan is to provide guidance for removal of barriers to enable equitable access to MDT's programs, facilities, and services for transportation users of all abilities. The plan provides an overview of MDT's external ADA program, outlines MDT's mission and ADA policy, and identifies methods to assist MDT in complying with ADA regulations.

How is this plan relevant to carbon emissions reduction and the CRS?

- The following ADA program methods are specifically focused on improving accessibility for disabled individuals as part of non-motorized trips, which can reduce carbon emissions associated with vehicle trips. Additional methods outlined in the plan broadly support non-motorized accessibility for disabled individuals.

Table 2.2: ADA Transition Plan Methods

Topic Area	Method		Relationship to Carbon Reduction and the CRS
Administration	**Method 2:** Conduct outreach with transportation officials.		Partner agency and stakeholder coordination is important to understand needs and barriers impacting non-motorized trips. The CRS development process offers an opportunity to continue building these relationships.
	Method 3: Coordinate with representatives of the disability community		
Rights of Way	**ADA Inventory**	**Method 11:** Maintain an inventory of existing ADA features.	Understanding the existing location and condition of ADA features can help pinpoint gaps or barriers that may hinder non-motorized trips.
	Project Identification	**Method 16:** Determine available funding sources.	Projects that support non-motorized trips and accessible infrastructure for all users may be eligible for funds available under the Carbon Reduction Program if the project reduces transportation emissions.
		Method 19: Coordinate with partner agencies to identify local projects and future development opportunities.	
	Design and Construction	**Method 23:** Design ADA improvement in accordance with applicable MDT design standards and federal regulations.	Development of the CRS in consideration of all users will aid MDT in broadly complying with federal regulations.
Rights of Way, continued	**Operations & Maintenance**	**Method 28:** Identify ADA issues during regular maintenance duties.	Routine maintenance and winter maintenance of ADA facilities are important to ensure accessibility for non-motorized trips throughout the year.
		Method 29: Conduct winter maintenance, coordinate with local jurisdictions, and enforce maintenance agreements.	

2.5. Montana State Transit Management Plan (2020)

The *Montana State Transit Management Plan* (SMP) is a comprehensive plan required by the Federal Transit Administration (FTA) that outlines how MDT administers its federal transit funding. The SMP documents the state's policies and procedures for the federal transit programs managed by the state. The SMP outlines the roles and responsibilities of state, federal, and local agencies involved in administering

transit programs and describes MDT's program management efforts, including financial management, inspection and monitoring, reporting, communications and accessibility considerations, technical assistance and training, and other responsibilities. Additionally, the SMP provides detailed information about federal transit funding programs including eligibilities, the funding application process and selection criteria, and reporting and monitoring requirements under each grant program.

How is this plan relevant to carbon emissions reduction and the CRS?

- The plan provides support for transit programs across the state. Transit trips can offset vehicular trips, leading to a direct reduction in carbon emissions.

2.6. Montana Pedestrian and Bicycle Plan (2019)

The 2019 *Montana Pedestrian and Bicycle Plan* is the first statewide effort to address the needs of non-motorized users across the state. The plan is primarily aimed at providing consistency across MDT for considering pedestrian and bicycle modes on state owned and maintained facilities, but is also intended as a resource by other agencies working to fulfill the needs of pedestrians and bicyclists in Montana.

How is this plan relevant to carbon emissions reduction and the CRS?

- The plan recognizes that walking and bicycling are important mobility options for both transportation and recreation, with the number of non-motorized trips increasing across the country and throughout Montana. Non-motorized trips can offset vehicular trips, leading to a direct reduction in carbon emissions.
- The plan outlines the current state of walking and bicycling in Montana in terms of the setting and population, facility types, transportation and socioeconomic conditions, and considerations relating to safety, accessibility, health, equity, and economic development. These factors all influence the likelihood of individuals choosing non-motorized modes for transportation purposes.
- The plan recognizes complexities and challenges that may hinder walking and bicycling trips. This includes Montana's extensive system size and maintenance requirements, funding limitations for the non-motorized transportation network, land use context and environmental factors such as weather conditions, and competing needs and design challenges relating to utilities and other transportation modes and user groups. These challenges may inhibit non-motorized trips.
- The plan identifies a set of recommended strategies to achieve the following goals in support of non-motorized trips, which can reduce carbon emissions associated with vehicle trips.

Table 2.3: Montana Pedestrian and Bicycle Plan Goals and Strategies

Goal	Strategy	Relationship to Carbon Reduction and the CRS
Goal 1: Reduce pedestrian and bicyclist fatalities and serious injuries in support of Vision Zero.	**Strategy 1A:** Improve safety at intersections through applicable design standards and new technologies. **Strategy 1B:** Periodically review and update design guidance for pedestrian and bicycle facilities. **Strategy 1C:** Improve safety on rural roadways through widened shoulders. **Strategy 1D:** Collaborate across jurisdictions to support changes to traffic laws aimed at improving the safety and predictability of walking and bicycling. **Strategy 1E:** Develop and implement non-motorized crossing treatment guidelines. **Strategy 1F:** Analyze pedestrian and bicycle crashes as well as contributing factors to identify potential safety improvements.	Improving safety for pedestrians and bicyclists can enhance their comfort and encourage individuals to use non-motorized modes for transportation instead of driving alone in a vehicle, thereby reducing carbon emissions.
Goal 2: Educate, encourage, and promote safe and responsible travel practices of motorists, pedestrians, and bicyclists.	**Strategy 2A:** Explore cost-effective mechanisms to improve the quality of data on pedestrian and bicycle activity and travel behavior **Strategy 2B:** Improve and increase safety education and encouragement programs for pedestrians, bicyclists, and motorists. **Strategy 2C:** Provide ongoing training programs for transportation engineers and planners focused on pedestrian and bicyclist needs and accommodations.	Improving predictability in travel modes as well as traveler behaviors and practices can encourage increased non-motorized transportation, thereby reducing carbon emissions.
Goal 3: Preserve and maintain the pedestrian and bicycle transportation system.	**Strategy 3A:** Develop a consistent approach for preservation and maintenance of pedestrian and bicycle facilities. **Strategy 3B**: Explore innovative viable funding alternatives for maintenance of pedestrian and bicycle facilities.	Maintaining the condition of pedestrian and bicycle facilities is an important component to encourage non-motorized trips. Projects that support non-motorized transportation may be eligible for funds available under the Carbon Reduction Program if the project reduces transportation emissions.
Goal 4: Improve mobility and accessibility for all.	**Strategy 4A:** Improve accessibility and mobility using current design guidance and modern technology when building, upgrading, and retrofitting pedestrian and bicycle facilities. **Strategy 4B:** Provide safe access to schools and areas with significant senior, minority, and low-income populations.	Employing modern technology and the most current design for pedestrian and bicycle facilities supports individuals choosing non-motorized modes, including disadvantaged groups.

Goal	Strategy	Relationship to Carbon Reduction and the CRS
Goal 5: Support walking and bicycling as important transportation modes for access to destinations, economic vitality, and health.	**Strategy 5A:** Improve community health and economic vitality by promoting walking and bicycling. **Strategy 5B:** Explore innovative viable funding alternatives for pedestrian and bicycle transportation. **Strategy 5C:** Support access to recreational, historic, cultural, downtown, and scenic destinations for improved tourism and economic vitality. **Strategy 5D:** Evaluate criteria that ensures safety and meeting relevant guidelines for bicycle route identification. **Strategy 5E:** Improve administrative efficiency, consistency, and coordination for pedestrian and bicycle transportation.	Projects that support enhancements to the non-motorized transportation system may be eligible for funds available under the Carbon Reduction Program. These investments can encourage walking and bicycling in place of carbon-producing vehicle trips, thereby improving health and economic vitality for communities.

2.7. Shared Use Paths Inventory and Detailed Maintenance Plan (2018)

As required by the Montana Legislature, the *Shared Use Paths Inventory and Detailed Maintenance Plan* provides an inventory of all multiuse trails or other paths within state-maintained federal-aid highway rights-of-way that are separated from motorized vehicular traffic and outlines a plan for maintaining and repairing these facilities.

How is this plan relevant to carbon emissions reduction and the CRS?

- The plan provides an inventory of state-maintained shared use paths (SUPs), including location, surfacing type, mileage, and condition.
- The plan also outlines maintenance needs and treatment activities, costs, responsibilities, and funding strategies.
- SUPs provide an alternative transportation option to single occupant vehicle trips, which reduces transportation carbon emissions. Walking and biking on SUPs serves as a lower-emission mode of transportation compared to vehicular modes.

2.8. Pavement Design Manual (2018)

The *MDT Pavement Design Manual* outlines fundamental principles on pavement design, detailed material information, procedures for designing pavement sections on the range of MDT roadways, and specification information.

How is this plan relevant to carbon emissions reduction and the CRS?

- Innovative pavement materials and modifications to pavement mixture specifications can reduce carbon emissions produced during the manufacturing process and incorporated during design. Future updates to this plan could provide an opportunity to implement carbon reduction strategies.

2.9. Rest Area Plan (2014, updated in 2019)

The *Montana Rest Area Plan* represents MDT's comprehensive statewide vision for the MDT Rest Area Program in the context of challenges such as aging infrastructure, high rest area demand and visibility, and limited funding. MDT recognizes the value of rest areas and truck parking areas as well as the role they play in providing safe stopping opportunities, providing shelter during weather events and road

closures, and supporting the tourism and trucking industries. The MDT Statewide Rest Area Prioritization Plan Committee meets regularly to discuss and advance the progress and priority of rest area projects and topics that affect rest area strategy. Rehabilitation, reconstruction, and new construction projects at rest areas are identified based on health index scoring, network evaluation results, program tradeoffs and risks, and input from the Committee and MDT Districts. MDT updated the health index scoring process in 2019.

How is this plan relevant to carbon emissions reduction and the CRS?

- The plan defines the following guidelines relating to and supporting carbon emissions reduction.

Table 2.4: Rest Area Plan Guidelines

Guideline	Relationship to Carbon Reduction and the CRS
Guideline 8: Encourage innovative, site-appropriate, low-maintenance, energy-efficient, cost-effective building and site designs in accordance with minimum MDT requirements.	Innovative, energy-efficient design of transportation facilities plays an important role in reducing carbon emissions through the manufacturing and operations processes.
Guideline 19: Maintain parking lots and entrance/exit ramps in safe and functional condition.	Providing safe, functional stopping locations spaced regularly along highway corridors enables long-haul truckers and other drivers to take needed breaks to stop and rest. Adequate parking can prevent truckers from driving further or longer in search of safe parking, thereby reducing carbon emissions.
Guideline 22: Allow rest area visitors to remain at state-maintained rest areas up to 12 hours.	
Guideline 27: Continue to maintain parking areas throughout the state to provide safe stopping opportunities.	

2.10. Montana State Rail Plan (2010)

The 2010 *Montana State Rail Plan* provides an overview of freight and passenger rail system components and services in Montana. The plan also identifies potential rail funding programs to acquire, improve, establish, or rehabilitate rail equipment or facilities and lists several ongoing issues affecting rail service in the state.

How is this plan relevant to carbon emissions reduction and the CRS?

- The plan outlines current passenger rail service across northern Montana and possible expansion of passenger rail service in southern Montana, connecting Billings and Missoula. Passenger rail trips can offset vehicular trips, potentially leading to a reduction in carbon emissions. Furthermore, passenger rail can provide a higher per-passenger fuel economy compared to individual vehicle trips.

3.0. OTHER MONTANA AGENCIES AND ORGANIZATIONS

3.1. Electric Vehicle Infrastructure Prioritization Study (2022)

The Montana Department of Environmental Quality (MDEQ), with support from MDT, conducted a study to identify priority locations along key travel corridors in Montana for optimal deployment of battery electric passenger vehicle (EV) direct current fast charging stations (DCFC).

Findings of the study indicate Montana is expected to have about 31,000 (3% of Montana passenger vehicle market) and 88,000 (9% of Montana passenger vehicle market) EVs registered in-state by 2030 and 2040 under a medium growth scenario, respectively. Additionally, out-of-state visitors will result in an estimated 100,000 additional EVs in 2030 and 294,000 EVs traveling on Montana roadways in 2040.

Public charging network locations were selected to align with Alternative Fuel Corridor (AFC) requirements, a United States Department of Transportation designation to develop sufficient charging infrastructure along highway corridors, and state priorities. A prioritization exercise identified Browning, Custer, Drummond, Forsyth, Havre, Livingston, Miles City, Shelby, and Three Forks as the highest priority for new locations to evaluate and begin expanding the public charging network.

How is this plan relevant to carbon emissions reduction and the CRS?

- The plan provides recommendations for siting EV charging locations, which can help encourage EV usage by reducing range anxiety associated with EV battery capacity and by providing dedicated infrastructure for EV owners who may lack at-home charging or other charging access.
- EV trips do not produce carbon emissions, and use of EVs in place of fuel combustion vehicles is a carbon-reducing strategy.

3.2. Electric Vehicle Charging Infrastructure Deployment Plan (2022, updated in 2023)

MDEQ collaborated with MDT through an interagency partnership formalized under a Memorandum of Agreement to jointly produce this plan, which establishes a framework to develop a network of EV charging stations along key travel corridors in Montana in support of the goal of the National Electric Vehicle Infrastructure (NEVI) program to facilitate a national EV charging network. The plan focuses on interstate routes and highways that are currently designated as “electric vehicle pending” AFCs.

The plans states that Montana will work to implement a program to comply with the NEVI requirements of deploying fast-charging locations no more than 50 miles apart, within one travel mile of the corridor, within walking distance of amenities, while maintaining a high operational reliability rate. In the first year, Montana will focus on filling large charging gaps with stations no more than 100 miles apart along Interstates 15, 90, and 94. After large gaps along interstates are addressed, the State will prioritize locations that fill large charging gaps along US-2 and US-93 with stations no more than 100 miles apart. After stations are built out with spacing of no more than 100 miles, the State will prioritize locations spaced no more than 50 miles apart, as required by NEVI.

How is this plan relevant to carbon emissions reduction and the CRS?

- The plan vision is to efficiently, equitably, and strategically deploy funding to support an interconnected national network that provides Montana EV users and visiting EV drivers reliable and affordable access to EV charging infrastructure. To implement this vision, the plan outlines the following goals.

Table 3.1: Electric Vehicle Charging Infrastructure Deployment Plan Goals

Goal	Relationship to Carbon Reduction and the CRS
Corridor build-out: Develop EV charging corridors along key travel routes for residents and visitors.	Development of EV charging locations across the state will support increased use of EVs, which will result in reduced carbon emissions compared to use of combustion vehicles.
Rural connectivity: Establish an EV network that helps connect rural communities with population centers and facilitates inter-regional EV travel.	
Affordability: Ensure that the charging station investments and the timing of those investments supports affordable operation, maintenance, and use of EVs in the short and long term.	
Outcome-oriented data collection: Identify specific metrics and data that will help ensure long-term success of charging station investments, including reliability, usage, equity, and affordability.	
Reliable operation: Ensure that the charging network operates reliably by establishing strict requirements for measuring and reporting charging station uptime.	

3.3. Regional Electric Vehicle Plan for the West

In 2017 and 2019, Montana served as a Signatory State to a Memorandum of Understanding (MOU) providing a framework to establish a Regional Electric Vehicle Plan for the West and create an Intermountain West Electric Vehicle (EV) Corridor to make it possible to drive an electric vehicle across the Signatory States' major transportation corridors, including Interstates 15, 90 and 94 in Montana. The Signatory States agreed to coordinate actions and support the successful implementation of a robust EV charging station network within their respective state and connected between the states, by undertaking actions specified in the MOU.

In 2018, an *Electric Vehicle Policy Baseline for the Intermountain States* was issued, which included a state profile of Montana outlining related policies and planned allocations from the Volkswagen Settlement's Environmental Mitigation Trust. A *2021 Progress Report* identified Montana actions to undertake activities outlined in the MOU.

How is this plan relevant to carbon emissions reduction and the CRS?

- Providing a reliable network of EV charging infrastructure can help encourage EV usage by reducing range anxiety associated with EV battery capacity and by providing dedicated infrastructure for EV owners who may lack at-home charging or other charging access.
- EV trips do not produce carbon emissions, and use of EVs in place of fuel combustion vehicles is a carbon-reducing strategy.



APPENDIX B

PUBLIC COMMENTS

Public Comments During Review Period

MDT solicited public comments on the draft Montana CRS during a public review period from September 13 through September 27, 2023. The document was posted for review at https://www.mdt.mt.gov/pubinvolve/crs. The table below includes public comments provided by telephone and in writing, along with MDT responses.

No.	Date/ Name	Comment	Response
1	**9/13/2023 Dennis Findorff**	Stop wasting taxpayer resources on "climate change" boondoggles!	*Thank you for your comment.*
2	**9/13/2023 Conrad Stroebe** **(By telephone)**	What will be the carbon impact associated with the Billings Bypass Project? Specifically, will the expansion of freeway lanes and the potential for increased traffic volumes negatively impact carbon emissions? What are the traffic projections associated with the project? Can MDT prohibit single occupant vehicle trips on the new bypass? Would be possible to plant trees along the bypass to reduce carbon and noise impacts?	*Thank you for your comment.* *Additional information and contacts for the Billings Bypass Project is available at: https://www.mdt.mt.gov/pubinvolve/billingsbypass/* *Sections 3.2.2 and 3.2.3 of the Montana CRS outline strategies encouraging low-emission vehicles, ride-sharing, and other modes of travel as alternatives to single-occupant vehicle trips.* *Additionally, Section 3.2.6 of the CRS addresses alternative uses of highway right-of-way, including biologic carbon sequestration.*

No.	Date/ Name	Comment	Response
3	**9/14/2023** **Michele Carey**	This is a comment on the carbon emissions report. The following is what I'd like to see in Montana Ban leaf and snow blowers Have regular passenger train service between all the medium and larger cities of the state. Because of the rural nature of the state, it would be helpful to have car trains, where it is easy and inexpensive to load your car onto the train much like a ferry system works. Amtrak is expensive and difficult to schedule trips on and for someone living in Bozeman, impractically located - surely we could have an easy system to use, like in Germany for example. And have train travel be highly subsidized. Significant state tax incentives for people who have or install solar water/electric/heat pumps/solar chimneys in homes, businesses, and rental properties Have a solar panel rental system for people who live in rental units. Get rid of fracking, any oil and gas exploration or drilling, and coal plants Electric buses, and more of them in all towns of any size - linked to the train schedules. Regular free electric buses to all ski/recreation areas. More bike lanes. Massive tax reduction for purchase of electric cars/vehicles/lawn mowers/weed whackers I like that street lights need to be LED, cities should install shades on them to decrease light pollution though Massive tax reduction on triple glazed windows Increased taxation of the incredibly wealthy, on second /third homes, on tourists All buildings over 2000 square feet should be required to have solar panels on them Solar roadways? Many more fast public electric vehicle charging stations Install many small wind generators along interstates with wildlife crossing corridors/bridges.	*Thank you for your comment.* *The Montana CRS is focused on reducing carbon dioxide emissions associated with on-road transportation sources.* *Suggestions for rail service, electric buses and other vehicles, electric infrastructure upgrades, electric vehicle charging stations, and alternative uses of highway right-of-way are addressed in the CRS as potential strategies to reduce transportation emissions (see Sections 3.2.2, 3.2.3, and 3.2.6).* *Suggestions relating to building design and energy usage, lawn/garden equipment, natural resource exploration and extraction, power plants, and taxation are outside the scope of the CRS.*
4	**9/18/2023** **Katie Harrison**	I would like to voice my request in regards to the Carbon Reduction Strategy to please use the most current scientific information available in regards to reducing carbon emissions while finalizing this strategy. I myself am not an expert on any of the matters discussed within the carbon reduction strategy, but I am a climate activist and have witnessed time and time again OLD, outdated & even biased research being used in order to sway the public or those involved in getting things passed. What is important as I see it is twofold: keeping us and our planet safe from further harm due to excessive, unlawful and unconstitutional carbon emissions, and doing everything we can to keep our everyday costs down while taking advantage of the money that is being made available for our state to clean our air up going forward. Montana has to do its part in protecting the earth and its inhabitants, and I thank you all for helping us to achieve that in this Carbon Reduction Strategy! You are very much appreciated.	*Thank you for your comment.* *Please refer to the References section for publications, studies, and reports consulted in the development of the CRS.*

No.	Date/ Name	Comment	Response
5	**9/20/2023** **John Brian Driscoll**	Please accept the following as my formal comment regarding the draft Montana Carbon Reduction Strategy. My name is John Driscoll, I live at 30 South Davis Street, Helena, MT 59601(Cell: 406/437-1526). I am the Vice President and Treasurer of The Steward (501c3) (See GuideStar) which has been a Montana non-profit since 1998. Of late we have been focused on affordable housing which led to serious interest in Compressed Agricultural Fiber, initially manufacturing (annually) 120,000 3.5" thick 4'x8' building panels, each weighing 160 pounds for the New Carbon Architecture construction materials industry. Eight panels at a minimum sequester 1 ton of carbon dioxide equivalent. Other players in the new market created by the need to respond to climate change by sequestering carbon in our built environment are the woods products industry which has jumped with both feet into what they call "Mass Timber." Bottom line is that the winners in this new market are montana building fiber manufacturers who can gather, process (with hydrogen fuel cells) and deliver to building sites using carbon free class 8 Fuel Cell Electric Vehicles (FCEV) instead of diesel powered. Class 8 trucks. The difference between Compressed agricultural fiber/ mass timber and concrete and steel as building materials is already glaringly obvious using "whole building life cycle analysis). We need green hydrogen electrolyzed from Montana water and highway-related structures built in accordance with "The New Carbon Architecture." All the components of a green hydrogen production, product processing and transportation economy are descending on Montana in simultaneous parallel levels extremely rapidly. PACAR is already taking orders and distributing its first Pederbilt and KW tractors, as are Nikola and Hyundai. The Montana Trucking Association is discussing procurement of the first Hydrogen Mobike Refueling Trailer as already done by the Alberta Truckers Association, electrolyzer, fuel cell and solar tracking companies are surveying possible locations near available industrial water rights (City of Great Falls, Sidney Sugar, Golden Sunlight, and others at Saint Regis, Butte, Dillon South, and Otter Creek on the Wyoming border near I-90. Mitsubishi is angling toward converting water in the Berkeley Pit to green hydrogen at Silver Bow for pipeline shipment to salt caverns in Utah for sequencing of quality-coded shipments into the Los Angeles Basin. In the LA Basin receiving entities are looking at moving away from color-coding hydrogen to quality-coding by carbon content. Unless you	*Thank you for your comment.* *Hydrogen as a fuel source is addressed in Section 3.2.3 under Vehicle Alternatives and Section 3.2.7 under the Construction and Maintenance Equipment Alternatives strategies.*

No.	Date/ Name	Comment	Response
5	**9/20/2023** **John Brian Driscoll** **Continued**	include hydrogen, especially Montana green hydrogen in our Montana Carbon Reduction Strategy, it will be obsolete by the time it leaves the printing office. Since I don't know how serious your office, our present administration and the contractor supporting this project are regarding climate change response, I'll not elaborate further unless you get back to me. I am attaching a couple of analyses that may lend further support to these comments.	
6	**9/20/2023** **Jackson Hurst**	I have reviewed the Draft Montana Carbon Reduction Strategy document and I approve and support the findings in the document.	*Thank you for your comment.*
7	**9/20/2023** **Edie Leech**	Why in the world would Montana want to create a strategic plan for Carbon Reduction Strategy? This is a waste of time and money! Just plant more trees instead of giving any credence to this left wing green new deal climate scam! Montanans are to smart to not see through this [**]!	*Thank you for your comment.* *Under the Infrastructure Investment and Jobs Act (IIJA), each state must develop a statewide Carbon Reduction Strategy (CRS) in consultation with local Metropolitan Planning Organizations (MPOs) and in support of federal goals.* *Planting and maintaining woody vegetation such as trees and shrubs is identified as a potential strategy for Alternative Uses of Highway Right-of-Way.*
8	**9/21/2023** **Darrin Ackerman**	First and foremost Montana should not be considering any new ideas or policy changes from the Biden Crime Family, as you stated you only need act on this to receive their federal bribe money, we don't need it!! Set the precedent and reject this on behalf of all Montanans, we do not want this…. Period	*Thank you for your comment.* *Please see response to Comment #6.*

***Note: MDT restricts offensive language in published comments. Original comments are kept on file by MDT.*

No.	Date/ Name	Comment	Response
9	**9/21/2023** **Heidi Barr**	Regarding the draft carbon reduction project. My primary highway concern? Trash. This has become a significant problem in Montana. Regarding carbon reduction- While I do believe there had been some warming in recent decades, we've entered a period of global cooling. Mankind's contribution to climate, aside from pollution (not carbon) is negligible. Please study actual science rather than science with a specific agenda. Atmospheric warming began to decrease in 1999- Dr. Bob Carter, climatologist, Cook University. (Snow was supposed to disappear by 2014 according to Al Gore, remember.) Montana has had two cold summers in a row. Climate is affected by many things, in particular solar activity and volcanic activity here on earth with resulting ash and atmospheric water vapor. If Montana wants to do one thing it's this- keep the roadsides clean. I oppose any futile attempt at carbon reduction. In fact, it carbon is essential to life on earth. Study history please.	*Thank you for your comment.* *Trash and pollution are not primary focus areas addressed in the CRS, apart from references to potential air quality effects from carbon reduction strategies.* *Please see response to Comment #3 regarding references consulted for development of the CRS.*
10	**9/21/2023** **Jim Bigley**	Montana Carbon Reduction Strategy: So, has Montana bought into the climate change/ WEF Reset and the end of the fossil fuel industry?	*Thank you for your comment.* *The CRS identifies potential strategies that could be implemented to reduce transportation emissions.*
11	**9/21/2023** **Matt Blank**	The carbon reduction strategy is a complete and total waste of time. Most of global warming is natural cycles that the world goes through and the government has randomly decided they want to blame people, and gullible people fall in line, so that they can take away our rights when it comes to things like choosing vehicles, which can basically trap us, especially in cold weather, choosing what kind of household appliances we use and what sources of power we use a society, with incredibly unreliable renewable being at the forefront. I know MDT is by far the worst state agency, but it would be great if this giant waste of money didn't continue and you did something like actually maintaining roads and not randomly closing roads that have zero reason to be closed.	*Thank you for your comment.*

No.	Date/ Name	Comment	Response
12	**9/21/2023** **Joseph Buczek**	This comment is on the Montana CRS study. There is no "settled science" on the need for carbon reduction. So primarily, the goal of this program is questionable. CO2 is not a pollutant but, rather, an important photosynthesis food for plants that not only fuel agriculture but produce life giving Oxygen for the planet. Constructing a plan to reduce carbon is really questionable and should, at the very least, be publicly debated by scientists who can adequately represent differing points of view on the question. This has not been done and taking action to reduce carbon without understanding the ultimate effect of doing so is, summarily, "ready, fire, aim". That said, there is a single recommendation I believe would be highly beneficial to Montanans that would also reduce fuel consumption and carbon emissions: the creation of passenger rail service between Billings and Bozeman, perhaps extending to Missoula, as well. I wonder if the CRS study examined the traffic between these population hubs and the effect on carbon reduction of having rail service as an option? I did not see such an option examined in the public document.	*Thank you for your comment.* *Please see response to Comment #3 regarding references consulted for development of the CRS.* *Rail service is addressed in Section 3.2.2 under the Public Transportation strategy.*
13	**9/21/2023** **Tim Butler**	CRS. Why are we going along with this global warming tripe. Your CRS looks to me to be an a government invasion into things you should let the private market handle itself. When you start talking about electrification of fleets in a place like Montana, it shows that you have tunnel vision and facts be dammed. We drive too far and live in too cold a climate for electric vehicles to be a feasible alternative at this point. The goals, although well meaning, are only going to be forced upon the population through mandate and higher taxes. Leave us alone to live our lives and stop sitting around thinking about ways to spend our money.	*Thank you for your comment.* *Implementation considerations outlined in the CRS reflect Montana's unique context and variety of conditions across the state, including geography, population, weather patterns, vehicle mix, and other transportation system and land use characteristics.*
14	**9/21/2023** **Bonnie Jo Eldredge**	In connection with this project, people should be able to learn how much their vehicles emit. An occasional drive-up emissions test area could be helpful with correction suggestions/remedies from professionals.	*Thank you for your comment.* *The EPA and other agencies have published greenhouse gas calculators to help the public understand the impact of their energy use.* *https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator*
15	**9/21/2023** **Tim Field**	I am all for reducing carbon emissions by car pooling, smarter use of equipment and machinery. I don't believe switching to electric vehicles will benefit the environment. In fact, I believe electric vehicles cause more harm than combustion engines. I am therefore against implementing or using electrics vehicles by MDT.	*Thank you for your comment.* *The CRS did not consider the full suite of life-cycle emissions and impacts associated with electric vehicles. This could be considered in a future update to the CRS, depending on available data and modeling tools.*

No.	Date/ Name	Comment	Response
16	**9/21/2023** **Joe Grana**	I DO NOT support any type of CO2 emissions reduction plan. Period. Stop with the communist propaganda.	*Thank you for your comment.*
17	**9/21/2023** **James Groff**	This "carbon reduction" nonsense is an utter waste of time and money. It's nothing but another means to control and further restrict the populace over petty bs. Look outside, we live in one of the most beautiful states in the union and are people are failing daily because of every reason under the sun OTHER than too much carbon. Keep this BS out of Montana!!!	*Thank you for your comment.*
18	**9/21/2023** **Not Provided**	For anything but a daily publication this notice is pretty much worthless. Are you really wanting to inform the public?	*Thank you for your comment. MDT posted the draft CRS online at https://www.mdt.mt.gov/pubinvolve/crs/ and provided public notice in newspaper advertisements, press releases, and social media announcements. Alternative accessible formats are available by contacting the MDT Office of Civil Rights.*
19	**9/21/2023** **Sean McGrew**	The Carbon Reduction Strategy is an enormous boondoggle that will waste taxpayer dollars, and damage Montana's economy and the liberties of its citizens, while not accomplishing a single measurable improvement. The term "climate change" has gone from something that is an observable phenomenon, and has been purposefully changed to an unfalsifiable catch-all term designed to eliminate discussion and debate in order to further a progressive agenda. It's one thing to point to the Great Lakes and say, "Oh, well there once were glaciers there, and then the climate, without any input from humans, changed for the warmer, and the glaciers receded, leaving these huge holes that filled with melting glacial water, forming the Lakes." It's entirely another thing to say, "Oh, mankind's use of fossil fuels is causing the climate to change. Natural cyclic change is totally a non-factor, and it's only carbon dioxide from fossil fuels that is the primary cause. Let's ignore water vapor and pretend that the carbon from human sources behaves totally differently than carbon from natural sources. Also, our hypothesis is unfalsifiable, and we will use all data, including seemingly contradictory data, to "prove" it, and then we will assassinate the character of anyone--including scientists--who say that this is unscientific by calling them 'climate deniers' and getting them censored and punished in their careers. We will only support research that seems to support our preconceived conclusions so that we will further a future built on our ideas about progressivism." Any program that sees human beings as a problem to be solved, rather than stewards of God's creation is going to fail because ideas have consequences and bad ideas have victims. In the biblical account of reality, we exist to glorify and love God and	*Thank you for your comment.*

No.	Date/ Name	Comment	Response
19	**9/21/2023** **Sean McGrew** **Continued**	enjoy Him forever. He created humans with a telos, and part of ours is that we get to steward His creation, caring for the earth, forming and filling it with more humans. We are given dominion over the animals and are to use the resources of the planet in creative ways, providing human flourishing and mitigating the effects of the Fall of mankind into sin. The extinction of humans due to the use of fossil fuels is not part of God's metanarrative. It simply can't happen. The new environmental religion sees humans as the problem, the use of fossil fuels as the original sin, and demands penance and sacrifices of our automobiles and autonomy on the alter of climate change. This carbon reduction strategy is nothing but the catechism of this new religion and our tax dollars should be shut off from the program, the people involved should all be fired and made to go get productive work, the offices razed, and the ground beneath them salted.	
20	**9/21/2023** **Daniel Phariss**	Carbon reduction? [**] is wrong with the MDT. Carbon is not the problem. The problem is [**] that people have been fed. And apparently the MDT has bought into it. There is no “science” that proves “carbon reduction” does [**]. NUMEROUS PhDs and Nobel Laureates have pointed out the NUMEROUS flaws in this. In fact its IMPOSSIBLE to model the climate since its TOO COMPLEX. If you spend MY money on this you need to be removed from you “job”.	*Thank you for your comment.* *Please see response to Comment #3 regarding references consulted for development of the CRS.*
21	**9/21/2023** **Rita**	This carbon reduction act is a lot of hot air. You have not updated the electric grid to sustain your ideal. You are dictating to people what they should do just like China. Speaking of you don’t see other major countries reducing their carbon so get off the bone omit train before the USA goes bankrupt	*Thank you for your comment.* *The CRS is focused on current transportation emissions in Montana and potential strategies to reduce emissions. Consideration of the electric grid is outside the scope of the document.*
22	**9/21/2023** **Greg Wirth**	Plan should more actively support walking and biking. MDT needs to employ context sensitive designs to avoid building ridiculously wide roads that are very carbon intensive to construct, significantly reduce greenspace with impervious areas and discourage non-motorized use. MDT should support modern and effective urban transportation for more efficient land use and avoid disrupting communities.	*Thank you for your comment.* *The CRS addresses biking and walking in Section 3.2.2 under the Active Transportation and Micromobility strategy. Land Use Development Patterns are addressed in Section 3.2.1. MDT employs context sensitive design approaches throughout its programs.*

***Note: MDT restricts offensive language in published comments. Original comments are kept on file by MDT.*

No.	Date/ Name	Comment	Response
23	**9/22/2023** **Kyle**	The Montana Carbon Reduction Strategy is a very blatant pull to take away rights of people who wish to travel. The US courts have validated the freedom of movement many times, and a quick online search can verify this from many sources. Any legislation that attempts to benefit a single mode of transportation over another or restrict, tax, or otherwise hinder any mode transportation is unconstitutional.	*Thank you for your comment.* *MDT supports all modes of travel and all users on Montana's public roadways.*
24	**9/22/2023** **Bradley Williams**	The climate hoax pretends to control the uncontrollable for simple greed and power. Sure would like to follow the money to identify who paid off who to facilitate this scam…	*Thank you for your comment.* *Please see response to Comment #7 regarding the federal requirement for CRS development.* *Funding for development of the Montana CRS was provided by federal planning funds.*
25	**9/22/2023** **Nan Wise**	Regarding your carbon reduction strategy, why don't you plant more trees? What better way to reduce C02 which will enhance oxygen levels for healthy living. Also stop letting them spray our sky with chemicals.	*Thank you for your comment.* *Please see response to Comment #6 regarding planting and maintaining woody vegetation such as trees and shrubs. Please see response to Comment #8 regarding pollution.*
26	**9/22/2023** **Michael Johnson**	The document references Public Transportation in several places. I question the reduction of emissions using public transportation in a State the size of Montana with the low density of population. Public transportation must be considerate of the population density and context of the state, I wonder if you can identify the carbon emissions per passenger mile traveled in a normal city bus and compare that the carbon emissions of a passenger car with more than 1 passenger? Locally in Billings it is very rare to see one of the City busses with more than 2 passengers and it is common to watch them driving around empty. It seems to me that much more emission friendly alternatives are possible. In addition to the empty diesel bus driving around belching black smoke you need to consider the infrastructure necessary to get the bus system into operation! MDT has built several bus facilities around the state, using concrete (huge emitter of CO2) and scarce building materials like wood. The bus itself causes long lines of congestion because they move slowly and stop frequently (to check for passengers). There are many ways to handle the transportation of people that are far less impactive than public transportation. Please examine the actual emission of pollutants based upon actual movement of people. thank you	*Thank you for your comment.* *Public transportation can be an effective strategy to reduce carbon emissions if multiple travelers are aggregated into a single bus, thereby offsetting single occupant vehicle trips. Implementation considerations, including relative emissions per person-mile, ideas for increasing ridership, and frequency considerations, are detailed under the Public Transportation strategy. Additionally, the Vehicle Alternatives strategy notes that transit operators can purchase electric/alternative fuel/fuel-efficient vehicles for their fleets to reduce emissions.*

No.	Date/ Name	Comment	Response
27	**9/22/2023** **Kevin Rechkoff**	Thank you for completing and the draft Carbon Reduction Strategy. As Montana grows, improving non-motorized transportation options is critical to having vibrant, connected, and safe communities. Increasing walkable and bike friendly routes only aids in implementing the CRS. Please look for more opportunities to incorporate non-motorized options into MDT projects.	*Thank you for your comment.* *Please see response to Comment #21 regarding discussion of biking and walking in the CRS.*
28	**9/22/2023** **Nicholas Fitzmaurice, on behalf of MEIC**	On behalf of the Montana Environmental Information Center (MEIC) and our members from across Montana we wish to submit the following comments on the draft Montana Carbon Reduction Strategy (CRS). **I. The draft CRS should be revised to include:** **A. Analysis of carbon reduction pathways.** **B. Commitments to pursue specific projects that have been outlined.** **C. Explicit carbon reduction goals with a plan to measure interim progress.** The draft CRS establishes a transportation emissions baseline, outlining a number of possible projects and actions to reduce these emissions that could be pursued by Montana Department of Transportation (MDT), Metropolitan Planning Organizations (MPOs), local governments, other programs, private employers, private businesses, and individuals. However, the draft CRS establishes no carbon reduction goals or commitments to pursue specific projects. Furthermore, carbon reduction outcomes from implementing the outlined projects are not analyzed for empirical emissions reduction against the established baseline. The draft CRS is effectively a superficial carbon audit of the transportation system in Montana, providing negligible direction for the MDT to pursue carbon reduction pathways. Carbon Reduction Program (CRP) Implementation Guidance notes that states are encouraged to incorporate program evaluation including associated data collection activities from the outset of their program design and implementation to meaningfully document and measure their progress toward meeting carbon reduction goals. The draft CRS put forth by the MDT does not analyze the specific carbon reduction potential of outlined projects, lacking in meaningful measurement metrics towards unspecified carbon reduction goals. **II. The draft CRS should be revised to include analysis for current and future emissions associated with a growing EV fleet, and a plan for addressing them.**	*Thank you for your comment.* *Currently, federal law does not require the identification of specific carbon reduction targets or commitments. These components would be addressed by MDT if required in the future.* *The Montana CRS fulfills current federal requirements and supports the implementation of CRP funding allocated to Montana.* *Future emissions levels associated with strategy implementation and a full analysis of life-cycle emissions associated with electricity generation were not included in the Montana CRS. These could be considered in a future update to the CRS, depending on available data and modeling tools.* *Please see response to Comment #2 regarding discussion of passenger rail service.* *Discussion of high-density mixed-use developments that support biking, walking, and transit are discussed under Land Use Development Patterns in Section 3.2.1.* *Thank you for comment regarding Figure 2.9. The legend has been corrected.*

No.	Date/ Name	Comment	Response
28	**9/22/2023** **Nicholas Fitzmaurice, on behalf of MEIC** **Continued**	Notably, the draft CRS highlights that direct tailpipe emissions from on-road sources account for the majority of the 8 million annual tons of CO2 emissions from transportation in the state. The draft CRS explains that these emissions can be partially mitigated through "Vehicle Alternatives" (i.e. electric vehicles), but the emissions associated with electricity generated to power those vehicles is only mentioned in passing. The draft CRS does not include current calculations for transportation emissions associated with this electricity generation, nor are future emissions projected to reflect growing EV fleets. The draft CRS also does not include a plan on how MDT and other stakeholders intend to work with utility partners to reduce these emissions. **III. The draft CRS should be revised to include deeper consideration of passenger rail expansion in Montana and its potential to reduce transportation emissions.** The draft CRS gives "Public Transportation and Passenger Rail" projects a "low" maximum potential effectiveness rating. However, limited consideration is provided towards supporting intra-urban rail expansion with partners such as Amtrak (currently pursuing a 15-year "Amtrak Connects US" expansion utilizing funding in the Infrastructure Investment and Jobs Act) and the Big Sky Passenger Rail Authority (BSPRA). The current Amtrak expansion plan does not aim to improve access in Montana (there is currently one northern route through the state), but the MDT could work with Amtrak and BSPRA to include an expansion of passenger rail access along the I-90 corridor, where connection is notably lacking. Expanding passenger rail access would reduce highway maintenance costs, highway congestion, and carbon emissions from transportation. Under this federal legislation, the MDT has the opportunity to plant seeds today for a more connected passenger rail future in Montana. **IV. The draft CRS should be revised to include increased emphasis on containing suburban sprawl.** "Active Transportation and Micromobility" projects are given a "low-medium" maximum potential effectiveness rating. The draft CRS should have more emphasis on containing suburban sprawl throughout Montana as a strategy for reducing transportation related emissions in Montana's urban and surrounding suburban environments. Revision should consider projects that move communities away from a car dependent culture, and encourage greater walk and bikeability within urban core areas. Additionally, the concept of simply moving more cars quickly through an area should be refocused with greater emphasis on public	

No.	Date/ Name	Comment	Response
28	**9/22/2023** **Nicholas Fitzmaurice, on behalf of MEIC** **Continued**	transportation to get people to urban areas and then safe options for moving people within those corridors. Specifically, options should be developed and pursued for alternative transportation options between adjacent communities or developments, such as bike paths along transportation corridors. **V. The key in Figure 2.9 "Highway Travel and Fuel Consumption" (page 19) is backwards.** The labels for "Highway vehicle-miles traveled (millions)" and "Highway use of gasoline (thousand gallons)" are flipped from the in-text description of the figure. **Conclusion** By incorporating these revisions, the MDT has the opportunity to get the CRS right the first time, fully taking advantage of the benefits available in the federal Infrastructure Investment and Jobs Act and avoiding challenges posed by future federal and regional carbon reduction mandates. Without explicit goal-setting and analysis of carbon reduction pathways, the CRS will not prove effective in achieving carbon reduction for Montana's transportation system.	
29	**9/26/2023** **Claire Reichert Baiz**	Developing a state CRS is a requirement under the Infrastructure Act's Carbon Reduction Program. We have a moral obligation and legal precedent to reduce carbon emissions from transportation sources. We need specific goals and strategies for the MDT to receive an estimated $68.1 million in funding apportioned to Montana over the next five years. While the draft CRS establishes the current transportation emissions in Montana at 8 million tons of CO2 per year, MDT commits to no specific emissions reduction goals. The draft CRS that was discussed appears to only vaguely outline potential projects for reducing transportation emissions. Does it contains any analysis for the emission reduction potential of projects? Please develop an explicit plan for reducing transportation emissions, or the available funds will go to waste. Please see to it that the voices of Montanans are heard, plans are in place, and funding is wisely used to mitigate transportation emissions for "this and future generations." We need you to tell MDT to commit to an explicit carbon reduction goal and make a sound plan for achieving it so that your federal dollars will be used effectively toward reducing transportation emissions in the state.	*Thank you for your comment.* *Please see response to Comment #27 regarding future carbon reduction targets and commitments.*

No.	Date/ Name	Comment	Response
30	**9/26/2023** **Linda Beischel**	I see that the Montana Department of Transportation (MDT) recently released its draft Carbon Reduction Strategy (CRS) for public review and comment. I also learned that developing a state CRS is a requirement under the Carbon Reduction Program (part of the Infrastructure Investment and Jobs Act) in order to access federal funding for projects that will reduce carbon emissions from transportation sources. **This plan is essential for the MDT to receive an estimated $68.1 million in funding apportioned to Montana over the next five years. As a Montana taxpayer concerned about carbon pollution and the climate crisis, I want to see Montanans access our full share of Federal tax dollars to help achieve carbon reduction goals.** **I was dismayed, however to learn that while** the MDT draft CRS establishes the current transportation emissions in Montana at 8 million tons of CO2 per year, **MDT commits to no specific emissions reduction goals**. Additionally, the draft CRS vaguely outlines potential projects for reducing transportation emissions, but contains no analysis for the emission reduction potential of those projects. **This is not acceptable – MDT must develop an explicit plan for reducing transportation emissions, or the available FEDERAL funds will go to waste.** **I urge MDT to commit to an explicit carbon reduction goal** and make a sound plan for achieving it so that our federal dollars will be used effectively toward reducing transportation emissions in the state. That should be well within MDT's expertise under appropriate leadership and cooperation with appropriate Montana advocacy groups!	*Thank you for your comment.* *At this time, the $68.1 million in CRP funding anticipated to be allocated to Montana over the next five years is not contingent upon identification of specific targets or commitments.* *Please see response to Comment #27 regarding future carbon reduction targets and commitments.*
31	**9/26/2023** **Jecyn Bremer**	Please do not let MDT let an estimated $68.1 million in funding over five years disappear by failing to prepare an explicit plan for reducing transportation emissions. Vaguely described potential projects are insufficient. MDT must commit to an explicit carbon reduction objective and a feasible plan for achieving that so that Montanans can benefit from this allocation of federal funds.	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.*

No.	Date/ Name	Comment	Response
32	**9/26/2023** **Rebecca Canright**	I am a young person who cares greatly about protecting our environment! Thanks for all that you do safeguard our ecosystems. Specifically, I would like to express support for a strong emissions reduction plan in our beautiful state. Surely we can all work together to ensure that we protect our beautiful clean air, clean water, and magnificent ecosystems for generations to come. I really appreciate your time and consideration of this important matter. **This carbon reduction plan is essential for the MDT to receive an estimated $68.1 million in funding apportioned to Montana over the next five years.** Together we can reduce emissions and I hope you understand the importance of this goal.	*Thank you for your comment.* *As outlined in Appendix A of the CRS, one of MDT's goal areas is responsible stewardship of the built and natural environment. In support of this goal, MDT strives to understand environmental constraints and opportunities, coordinate and consult with partner agencies, and meet regulatory requirements. The Montana CRS directly supports this goal.*
33	**9/26/2023** **Michele Dieterich**	Thanks for taking a stab at a plan to reduce emissions in Montana. It is so necessary for Montana to move towards renewables and to reduce emissions. It is astounding that the current transportation emissions in Montana is 8 million tons of CO2 per year. It seems there would be many ways to reduce this figure. But it seems the draft strategy does not create specific emissions reduction goals. A strategy should have goals or it is not worth the paper on which it is printed. The strategy does include some projects that could reduce emissions, but it does not looks at how much these projects would reduce emissions. Analyzing these projects and targeting those that will use the funds most efficiently to reduce emissions is necessary and should be a part of this strategy. The strategy should set specific goals and outline projects that would reach these goals and when we might reach those goals if the projects were implemented. Please create a strategy that includes clear goals and clear pathways to reach them including timelines. Please use federal funding wisely to reduce emissions in Montana.	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.* *All strategies are intended to address the primary CRS purpose of reducing transportation carbon emissions, and the maximum potential effectiveness of each strategy is defined. The exact carbon reduction potential of an individual project could vary greatly depending on the size and scope of the project.*
34	**9/26/2023** **John E Dunkum**	MDT's draft carbon strategy is a start, but needs to include specific emissions reduction goals. Please commit to specific emissions reduction goals, and how to get there so that the federal dollars at stake do not go to waste. Thank you	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.*

No.	Date/ Name	Comment	Response
35	**9/26/2023** **Bob Filipovich**	Earning $68.1 million dollars from the federal government is good, and reducing the carbon pollution resulting from combustion of transportation fossil fuels is even better. The CRS needs a measurable carbon reduction goal and a plan to accomplish that goal. Here are some ways I support to reduce the global heating that results from burning liquid fossil fuels: Incentivize public transportation: buses, rail, car pool parking, and sidewalks & bike lanes. Coordinate and time traffic lights to keep vehicles moving within the speed limit. Increase penalties for speeding -- in towns and highways. Post & enforce limits. Lower the highway speed limit by 5 - 10 percent based on honest MPG ratings of vehicles less than 15 years old. Support EVs and related technologies: residential & commercial solar PV, charging stations, and potential-to-kinetic clean energy. Disallow engine idling in many specific circumstances and temperatures including railroad locomotives. Enforce exiting local ordinances and state laws. Establish a cash-for-clunkers program that works for lower income Montanans. Increase vehicle registration & licensing fees for 2 axle private or business vehicles that have the lowest MPG. Raise taxes and royalties on producers of crude oil, refineries, and vehicles that transport these fuels to retailers. Raise the MT gasoline and diesel fuels tax. Create PSAs to encourage these suggestions. Remember, the objective is to reduce carbon emissions and global heating. Don't spend $68 million to make it more convenient to drive a Hummer all over to get the best price on a box of toothpicks.	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.* *Many of the suggestions you note are addressed in the CRS, including support for active transportation, public transportation, and shared rides (Section 3.2.2), optimized traffic operations (Section 3.2.5), electric and other vehicle alternatives (Sections 3.2.3 and 3.2.7), charging infrastructure (Sections 3.2.3 and 3.2.6), reduced truck idling (Section 3.2.4), and education campaigns (Sections 3.2.2 and 3.2.3).* *The CRS is focused on identifying strategies for reducing on-road transportation emissions. Suggestions relating to building design, petroleum product manufacturing, and taxation are outside the scope of the CRS. However, the CRS recognizes that achieving meaningful reductions in carbon emissions will require a multifaceted approach with cooperation from multiple partners.*

No.	Date/ Name	Comment	Response
36	**9/26/2023** **Bonnie Hickey**	Bridger Bowl Ski Area would like MDT's full participation in the Carbon Reduction Program under the IIJA by completing a fully developed Carbon Reduction Strategy with specific goals, significant potential projects and complete analysis reflecting the ghg reduction potential of those projects. This is important for MDT to access the federal funding that can help Montana accomplish those reduction projects. It seems there should be quite a few stakeholders who would love to help develop ideas for potential projects and plenty of talent to bring in the science to demonstrate the value of those projects. As one of the largest non-profit ski areas in the country and a valuable amenity in SW MT, Bridger Bowl has set our own reduction goals and is consistently working to update strategies for achieving those goals. As one example, on the transit and ghg reduction side, we invest over $180,000 annually to provide otherwise non-existent shuttle service between Bozeman and Bridger Bowl. This shuttle service provided 35,497 rides in just four months, averting 64.8 MTCO2e. Demand greatly outstrips my ability to provide that service! We also have many employees driving Bozeman Pass and Jackson Creek Rd daily from Livingston. Transit from Livingston would be another way to reduce ghg emissions. I would love to find ways that we can use these available federal funds to improve and expand that service as the carrying capacity of that hwy is inadequate on peak weekend days. I believe that Montanans should have access to funds that will help see carbon reduction transit projects to fruition, projects that make living in Montana better and that are better for the planet. Bonnie Hickey, Sustainability Director, Bridger Bowl Ski Area	*Thank you for your comment.* *Please see responses to Comments #27, #29, and #34 regarding future carbon reduction targets/commitments, receipt of CRP funding, and coordination with partners.* *Public transportation projects are eligible for CRP funding under 23 USC 175(c)(1)(B).*
37	**9/26/2023** **Joe Loos**	Re: The Montana Carbon Reduction Strategy to comply with the Federal Infrastructure Investment and Jobs Act. MDT must develop an explicit plan for reducing transportation emissions, or the available funds will go to waste. MDT should commit to an explicit carbon reduction goal and make a sound plan for achieving it so that our federal dollars will be used effectively toward reducing transportation emissions in the state. The currently proposed plan sets no such goals and strategy and therefore is not acceptable.	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.*

No.	Date/ Name	Comment	Response
38	**9/26/2023** **Elizabeth Madden**	Thank you for the chance to review and comment on this draft Carbon Reduction Strategy (CRS) for Montana. Please accept my comments here. In order that we not jeopardize future federal funding for Montana, we need a CRS that outlines specific emission reduction goals. The draft CRS is lacking these, it merely states our current emissions of 8 million tons of CO2 per year. This is NOT adequate or acceptable. Montana needs a plan to reduce our emissions! Please do not jeopardize important (critical) federal funding for MDT. Develop some concrete goals for reduction.	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.*
39	**9/26/2023** **Woody Nedom**	A "plan" as vague and noncommittal as this one is no plan at all. MDT needs to commit to defined goals that are realistic yet ambitious, goals that require effort and creativity to achieve. Carbon reduction has to be achieved; this and future generations of Montanans count on it.	*Thank you for your comment.* *Please see response to Comment #27 regarding future carbon reduction targets and commitments.*
40	**9/26/2023** **William Nelson**	Please commit to commit to a emissions reduction goal in its Carbon Reduction Strategy.	*Thank you for your comment.* *Please see response to Comment #27 regarding future carbon reduction targets and commitments.*
41	**9/26/2023** **David Patenaude**	These comments are for the Montana Carbon Reduction Strategy. MDT must commit to an explicit carbon reduction goal and make a sound plan for achieving it so that my federal dollars will be used effectively toward reducing transportation emissions in the state.	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.*
42	**9/26/2023** **Mark Payne**	You need to commit to an explicit carbon reduction goal and make a sound plan for achieving it so that my federal dollars will be used effectively toward reducing transportation emissions in the state Montana. Your current draft of the Montana Carbon Reduction Strategy does not state a specific number.	*Thank you for your comment.* *Please see response to Comment #27 regarding future carbon reduction targets and commitments.*
43	**9/26/2023** **Helen Pilling**	MDT must develop an explicit plan for reducing transportation emissions, or the available funds will go to waste. While the draft CRS establishes the current transportation emissions in Montana at 8 million tons of CO2 per year, MDT commits to no specific emissions reduction goals. Additionally, the draft CRS vaguely outlines potential projects for reducing transportation emissions, but contains no analysis for the emission reduction potential of those projects. PLEASE MDT, commit to an explicit carbon reduction goal and make a sound plan for achieving it so that your federal dollars will be used effectively toward reducing transportation emissions in the state.	*Thank you for your comment.* *Please see responses to Comments #27, #29, and #32 regarding future carbon reduction targets/commitments, receipt of CRP funding, and carbon reduction potential for projects.*

No.	Date/ Name	Comment	Response
44	**9/26/2023** **Emily Rodway**	Thank you for keeping our roads and bridges safe and open. I'm commenting today to encourage you to write your MT Carbon Reduction Strategy with a commitment to an explicit carbon reduction goal along with a written viable plan for achieving it. Federal dollars are on the line. Please use my tax dollars effectively toward reducing transportation emissions in our state.	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.*
45	**9/26/2023** **Kate Ryan**	What are the MDTs specific carbon emissions reduction goals? I don't see any in the CRS draft?	*Thank you for your comment.* *Please see response to Comment #27 regarding future carbon reduction targets and commitments.*
46	**9/26/2023** **Leslie Stoltz**	Please follow the Montana Constitution, abide by the court ruling in *Held*, and start making legal decisions that protect our right to a clean and healthful environment. **The time is up for DEQ to keep kicking this can down the road on climate change.....please** comply with the Held Decision and consider climate change in ALL permitting decisions as well as for Montana Renewables and the Calumet refinery. It must comply with our constitutional rights and protect our climate from further degradatin.	*Thank you for your comment.* *Suggestions relating to MDEQ permitting decisions are outside the scope of the Montana CRS.*
47	**9/27/2023** **Alexis Adams**	Please commit to an explicit carbon reduction goal and make a sound plan for achieving it. Thank you.	*Thank you for your comment.* *Please see response to Comment #27 regarding future carbon reduction targets and commitments.*
48	**9/27/2023** **Carla Abrams**	Thank you for releasing the Draft Plan for Carbon reduction strategy. This plan must be improved by including specific emissions reduction goals, and specific methods for how these goals will be achieved.	*Thank you for your comment.* *Please see response to Comment #27 regarding future carbon reduction targets and commitments.*
49	**9/27/2023** **Jan Bertelsen-James**	This plan is essential for the MDT to receive an estimated $68.1 million in funding apportioned to Montana over the next five years. While the draft CRS establishes the current transportation emissions in Montana at 8 million tons of CO2 per year, MDT commits to no specific emissions reduction goals. Additionally, the draft CRS vaguely outlines potential projects for reducing transportation emissions, but contains no analysis for the emission reduction potential of those projects. This is not acceptable – MDT must develop an explicit plan for reducing transportation emissions, or the available funds will go to waste. MDT needs to commit to an explicit carbon reduction goal and make a sound plan for achieving it so that my federal dollars will be used effectively toward reducing transportation emissions in the state. Not acceptable as is.	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.*

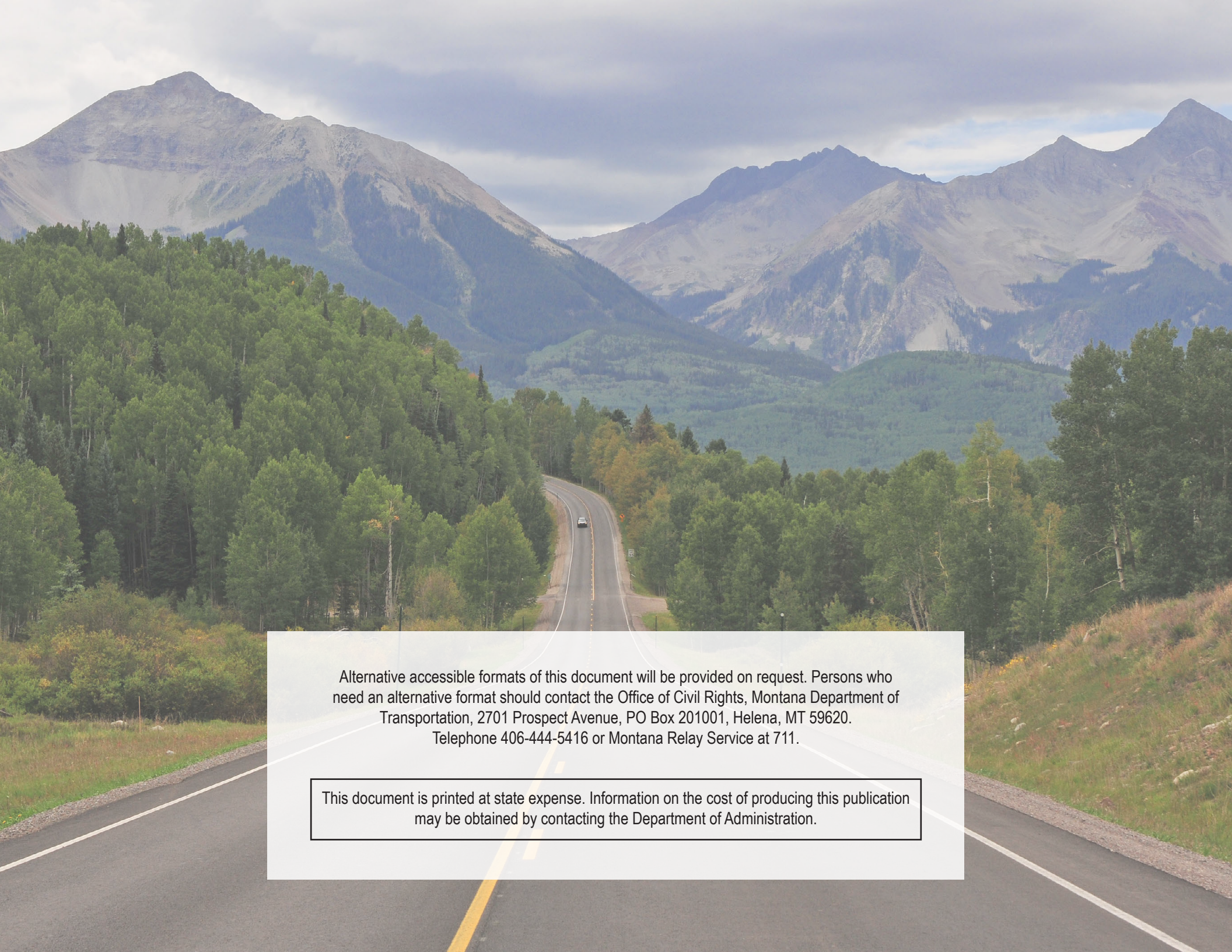
No.	Date/ Name	Comment	Response
50	**9/27/2023** **D.L. Blank**	The Carbon Reduction Strategy needs a specific target - the amount of reduction, date to achieve it, and how we are going to get there. Each potential method needs an assessment of how much it will contribute to the goal. As transportation experts, you know that it is crucial to have a clear destination and good path forward.	*Thank you for your comment.* *Please see responses to Comments #27 and #32 regarding future carbon reduction targets, commitments, and carbon reduction potential for projects.*
51	**9/27/2023** **Jill Davies**	Please commit to an explicit carbon reduction goal and make a sound plan for achieving it so that our federal dollars will be used effectively toward reducing transportation emissions in the state.	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.*
52	**9/27/2023** **Matthew Elsaesser**	Great to see the exploration of highways and related right-of-way for energy and conservation projects. State of Montana policy or law should allow lighting districts as a mechanism to house grid-tied alternative energy. For example, a "solar tree" or wind turbine could be a functional education and production piece at a rest stop or solar panels could be a top intersection or exit lighting. Reducing greenhouse gases should include reused and recycled materials in road and related construction; efforts to help Montana recycling and related value-added industry including recycling options at rest stops; and efforts to expand composting and use of compostable products to limit plastics and waste while providing compost opportunities to keep soil and nutrients in Montana. Community gardens should be established at exits when community partners are available. Construction should include life-cycle analysis in all components to explore green alternatives that may be higher cost upfront but justified with reduction goals and cost savings. For example, the use of recycled tires in the road surface to reduce noise pollution in certain areas and last longer or using recycling glass aggregate to help recycle and lower demand for gravel.	*Thank you for your comment.* *Alternative uses of highway right-of-way including renewable energy generation such as solar arrays and wind turbines are addressed in Section 3.2.6.* *Alternative construction materials including recycled materials and in-place recycling processes are addressed in Section 3.2.7.* *Suggestions relating to recycling options at rest areas, composting and compostable products, and community gardens are outside the scope of the Montana CRS.* *A full analysis of transportation life-cycle emissions was not included in the Montana CRS. This could be considered in a future update to the CRS, depending on available data and modeling tools.* *MDT will consider co-benefits associated with potential strategies when implementing specific projects.*

No.	Date/ Name	Comment	Response
53	**9/27/2023** **Anne Stites Hausrath**	Thank you for the opportunity to comment on the Montana Carbon Reduction Strategy. Work with appropriate agencies to promote high density, mixed use development When constructing or rehabilitating transportation infrastructure in urban areas, give preference and funding for non-motorized transportation. Making walking and bicycling safe, interesting, comfortable and connecting places people want to go reduces carbon and saves money! Do not widen any more roads or intersections! Wider roadways cost more to build and maintain and encourage more driving. Work with electrical companies to encourage greater use of renewables like wind and solar and reduce reliance on fossil fuels.	*Thank you for your comment.* *Discussion of high-density mixed-use developments that support biking, walking, and transit are discussed under Land Use Development Patterns in Section 3.2.1. Additionally, the CRS addresses biking and walking in Section 3.2.2 under the Active Transportation and Micromobility strategy.* *MDT determines the need for roadway widening based on safety, operational, and other context-specific considerations. However, federal guidance indicates CRP funding generally may not be used to add lane capacity for single occupant vehicle use.* *The suggestion relating broadly to renewable energy production is outside the scope of the Montana CRS.*
54	**9/27/2023** **Kathy Kilmer**	The IRA, passed summer of 22, was a game changer for the climate crisis— but only if monies spent do what they were allocated to do: reduce carbon emissions. The MDT plan MUST put carbon reduction first, for the planet and also to adhere to the intent of the legislation. I ask that MDT commits to a real and significant carbon reduction goal and that the plan specifies how the reduction will be achieved. Further, I ask that the plan include periodic assessments of carbon reduction and a commitment to achieving the goals. Thank you for the opportunity to comment.	*Thank you for your comment.* *Please see response to Comment #27 regarding future carbon reduction targets and commitments.* *MDT will update the Montana CRS every four years in compliance with federal requirements.*

No.	Date/ Name	Comment	Response
55	**9/27/2023** **Chelsea Liddell**	I am writing to comment on your draft Carbon Reduction Strategy. In order to be effective, a strategy needs to have a clear plan for carbon reduction. This means that different elements of the strategy need to be clearly outlined, and each should have a timeline, with the carbon reduction amounts associated with each strategy and the year by which those reductions are reached. This should contribute to an explicit overall numerical goal of the amount of carbon to be reduced, which should be included in the plan. Without an explicit carbon reduction goal and a sound plan for achieving it, the strategy is an unacceptable use of taxpayer money and will be ineffective in working toward the energy transition and slowing global warming. Please create an effective plan that Montana can be proud to work toward!	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.*
56	**9/27/2023** **Twila Moon**	I'm a Montana citizen living in Carbon County. I also work full-time as a glaciologist and climate scientist and am deeply aware of the implications of ongoing human-caused climate change and the actions needed to minimize risks and damage into the future. I'm writing to comment on the draft Carbon Reduction Strategy. Currently, the draft provides no commitments regarding specific emissions reduction goals. Commitments are absolutely necessary for Montana to chart a successful path to emission reductions, with clear activities, plans, and associated timelines. The basic and necessary activity of committing to specific emissions reductions along with outlining of associated activities is fundamental to Montana making efficient and effective use of the $68.1 million that is apportioned to Montana. This is important to me as a tax payer, state citizen, and scientist. I look forward to seeing the next CRS iteration including explicit plans, which I hope are supported by the kind of information that forms SMART goals (specific, measurable, achievable, relevant, and time-bound). Thank you for prompt attention to this matter. Montanans deserve these details and collectively we will be well-served by this CRS improvement.	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.* *Please see response to Comment #53 regarding timing of future updates to the Montana CRS.*

No.	Date/ Name	Comment	Response
57	**9/27/2023** **Debo Powers**	I am commenting on the draft Carbon Reduction Strategy. MDT needs to commit to an explicit carbon reduction goal and develop a sound plan to achieve it in order to receive federal dollars (estimated at $68.1 million). It would be a shame if Montana misses out on this funding because of the absence of this requirement in our strategy.	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.*
58	**9/27/2023** **Rachel Rockafellow**	Please commit to your emissions reduction goal in your Carbon Reduction Strategy by making specific reduction targets.	*Thank you for your comment.* *Please see response to Comment #27 regarding future carbon reduction targets and commitments.*
59	**9/27/2023** **Hallie Rugheimer**	Please consider important update re: MT Carbon Reduction Strategy In order to access funding for projects that will reduce carbon emissions from transportation sources. **This plan is essential for the MDT to receive an estimated $68.1 million in funding apportioned to Montana over the next five years. MDT commits to no specific emissions reduction goals**. This is not acceptable – MDT must develop an explicit plan for reducing transportation emissions, or the available funds will go to waste. We need YOU to tell MDT to commit to an explicit carbon reduction goal and make a sound plan for achieving it so that your federal dollars will be used effectively toward reducing transportation emissions in the state. This is important for the state moving forward with CRS. **MDT should commits to be specific emissions reduction goals**. Thanks for reading these important considerations. I represent a voice that has been a resident of Montana for over 50 years. This is something that must be done, now.	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.*
60	**9/27/2023** **Geoff Showers**	I am asking that the MDT commit to an explicit carbon reduction goal and make a sound plan for achieving it so that your federal dollars will be used effectively toward reducing transportation emissions in the state.	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.*

No.	Date/ Name	Comment	Response
61	**9/27/2023** **Gail Souther**	I was deeply concerned to learn that MDT's recently released draft Carbon Reduction Strategy contains only vague emissions reduction goals. Its outline of potential projects for reducing transportation emissions includes no specific analyses of the emissions reduction potential of the projects proposed. Without such specificity, this so-called "plan" merely gives lip service to the goal of emissions reduction. I urge you to take the goal of transportation emissions reduction seriously, and come up with a well researched blueprint for implementing future emissions reductions. Thank you for your consideration of my concerns.	*Thank you for your comment.* *Please see response to Comment #27 regarding future carbon reduction targets and commitments.*
62	**9/27/2023** **Lauren Sullivan**	With regards to the MONTANA CARBON REDUCTION STRATEGY, I would like to see additional details defined for considering train connectivity across the state including the possibility of an energy efficient high speed train option to reduce the carbon footprint. I'd also like to see additional details on single family vehicle alternatives such as the use of bikes, but with a plan to address actual bike lane issues and bike-ability in major cities across the state and addressing bike travel connectivity between towns by potentially creating rails to trails or better bike lanes for rural folks looking to commute in to the urban areas. Thanks for the opportunity to comment.	*Thank you for your comment.* *Rail service is addressed in Section 3.2.2 under the Public Transportation strategy.* *The CRS addresses biking and walking in Section 3.2.2 under the Active Transportation and Micromobility strategy.*
63	**9/27/2023** **Janet H Wallace**	MDT must make a plan to reduce carbon emissions on vehicles, or available funds will go to waste. That is unconscionable. Climate change is real and harmful to the entire world. PLease make a plan to do your part.	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.*
64	**9/27/2023** **Sas Weber**	This comment is in regards to the Montana Carbon Reduction Strategy. I want to see the MDT commit to an explicit carbon reduction goal and make a sound plan for achieving it so that my federal dollars will be used effectively toward reducing transportation emissions in the state. The funds are available for Montana's use if you would make a commitment to our future by reducing emissions. Please act on all of our behalf and make bold reduction goals. Thank you.	*Thank you for your comment.* *Please see responses to Comments #27 and #29 regarding future carbon reduction targets/commitments and receipt of CRP funding.*



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