DEPARTMENT OF TRANSPORTATION

CARBON REDUCTION STRATEGY

2023

NOVEMBER 2023

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EXECUTIVE SUMMARY

WHAT IS THE CARBON REDUCTION STRATEGY?

The Minnesota Carbon Reduction Strategy (CRS) supports Minnesota's greenhouse gas (GHG) reduction goals. The CRS identifies priorities for advancing transportation investments to reduce carbon emissions from:

- **On-road transportation sources,** which include cars, trucks, buses, and other vehicles used by people and for movement of goods on our transportation network.
- **Development and maintenance of the transportation system,** including infrastructure construction, repair, and energy used in transportation facilities and operations.

Development of a CRS is required under the Carbon Reduction Program (CRP), a federal program created by the Infrastructure Investment and Jobs Act (IIJA). The CRP provides Minnesota with approximately $20.9 million annually between federal fiscal year 2022 and 2026 to fund projects that reduce carbon emissions from surface transportation. Program funding is distributed across the state, with a portion to areas specifically based on population.[1]

While the CRS is being developed to meet requirements associated with the CRP, the policies and prioritizations within this document will guide how Minnesota funds a wide array of transportation programs to reduce carbon emissions. The CRS identifies priorities for state, regional and local transportation partners to work together to achieve climate goals through the development of transportation projects and investments. MnDOT and partner agencies will support projects that that reduce carbon emissions and reduce localized air pollution. Other goals include improvin improving transportation safety, system stewardship, critical connections and healthy equitable communities.

In addition, a wide array of other federal, state, and local programs can be used to support carbon reduction. The CRS identifies priority strategies and project types to guide how the Minnesota Department of Transportation (MnDOT) and partner agencies use transportation funds to reduce carbon emissions. The CRS is accompanied by a CRP Toolkit, which will be used by MnDOT, metropolitan planning organizations (MPOs) and Area Transportation Partnerships (ATPs) to prioritize, select and fund projects through the CRP.

[1] Under federal law, within each state, 65% of CRP funds must be allocated to areas of the state in proportion to population size and 35% of CRP funds may be allocated in any area of the state (23 U.S.C. 175(e)).

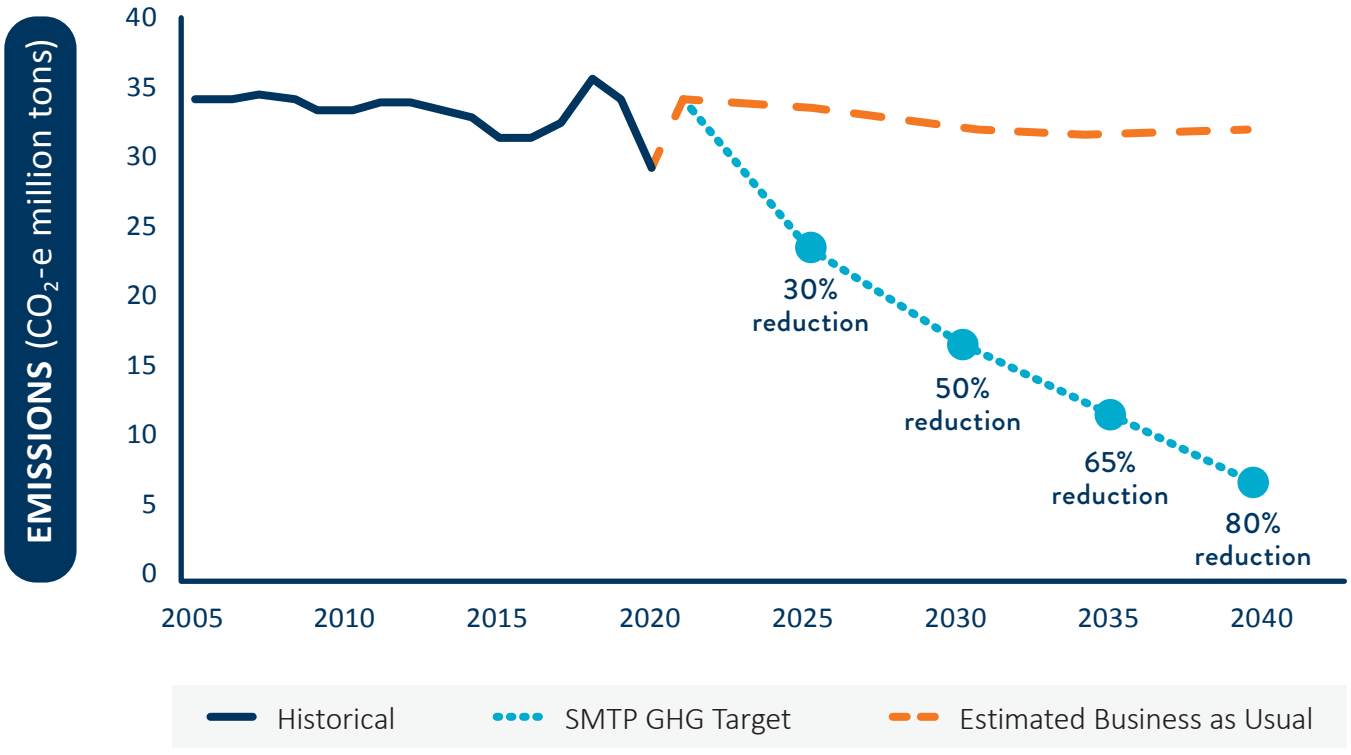
WHAT ARE WE TRYING TO ACHIEVE?

Minnesota is committed to decarbonizing the transportation sector. Minnesota's Next Generation Energy Act (NextGen) requires Minnesota to reduce greenhouse gas (GHG) emissions statewide to net zero by 2050. It also sets interim goals to reduce GHG emissions statewide by at least 15% by 2015, 30% by 2025, and 50% by 2030 from 2005 levels, which are consistent with Minnesota's 2022 Climate Action Framework goals. Consistent with these goals for decarbonization, the Minnesota 2022 Statewide Multimodal Transportation Plan (SMTP) established a target to reduce annual GHG emissions from the transportation sector by 80% from 2005 levels by 2040, along with interim targets.

Achieving these reductions requires significant changes in the historical trajectory of carbon emissions from transportation, as shown in **Figure ES-1**.

Figure ES-1.

Transportation GHG emissions and reduction targets, 2005-2040



WHO IS INVOLVED IN THE STRATEGY?

The CRS was developed in coordination with community and implementation partners, including members of the public, MPOs, ATPs, local governments (e.g., cities, counties), Tribal governments, state agencies and other partners across Minnesota. Implementation of the CRS requires teamwork, coordination and cooperation across all levels of government and the public.

PARTNERS

PUBLIC

Users of the transportation system and community members can provide input on project concepts and help to shape projects funded in support of the CRS. MnDOT is committed to ensuring equitable and on-going engagement of the public in the decisions that come out of implementation of this strategy.

LOCAL AND REGIONAL PARTNERS

Partner transportation agencies include MPOs, ATPs, local governments (e.g., cities, counties), transit agencies and other organizations that play a key role in identifying, proposing, funding or selecting projects.

STATE AGENCIES

MnDOT, the Minnesota Pollution Control Agency (MPCA) and other state agencies all play key roles in developing and implementing the CRS through various funding sources.

TRIBAL GOVERNMENTS

Eleven federally recognized sovereign Tribal Nations have jurisdiction over land and resources in Minnesota. Indian Country includes road, bridges, highways, transit services, sidewalks and more. Tribal partners plan, build and manage key parts of Minnesota's transportation system and tribes are key partners in moving transportation forward.

FEDERAL AGENCIES

The Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) play a key role in funding transportation through distribution of federal formula and discretionary program grants and oversight of programs.

WHAT IS DIRECTING THE MINNESOTA CRS?

The CRS builds on Minnesota state policy and plans for reducing carbon emissions from the transportation sector. It also has been shaped through extensive engagement with the public and transportation partners.

STATEWIDE POLICY AND STUDIES ON EFFECTIVE STRATEGIES

The process of developing the CRS included conducting a review of three Minnesota policy documents, each of which involved technical analyses and public engagement:

- The 2019 Pathways to Decarbonization study (Pathways),
- The 2022 Minnesota Climate Action Framework (Framework) and
- The 2022 Statewide Multimodal Transportation Plan (SMTP).

Carbon reduction strategies and actions contained within each of the policy documents were compiled as an initial base for identifying strategies to be included in the CRS. Further, findings and recommendations from these documents provide insight into the effectiveness of different carbon reduction strategies, as well as issues and approaches that are important in making transportation investments.

Research from Pathways showed that Minnesota can achieve decarbonization goals but there is no single action that alone can achieve the goals. The Framework and SMTP also emphasize the importance of an equitable transportation system that ensures that all Minnesotans can travel safely, conveniently and affordably.

Together Pathways, the Framework, and the SMTP identify key strategies and actions centering around clean transportation (e.g., electric vehicles [EVs] and zero emission vehicles [ZEVs]) and enhancing travel options (e.g., public transportation, walking, bicycling) that seek to achieve an equitable transportation system.

PUBLIC ENGAGEMENT

Engagement gathered input on priorities and issues the public feels are important for prioritizing projects that reduce carbon emissions. Specific efforts were undertaken to engage historically disadvantaged and underrepresented communities, including those identified as Justice40 communities, or historically disadvantaged communities that, for decades, have experienced underinvestment. Public engagement occurred in two phases.

PHASE 1: UNDERSTANDING PRIORITIES (MAY THROUGH JULY 2023)

The following activities were carried out to gather public input on priorities to consider when developing the CRS. More information on each activity and the key takeaways can be found in Chapter 3 of the 2023 Minnesota Carbon Reduction Strategy.

- CRS website
- Public online survey
- "Pop up" events in communities throughout Minnesota
- Virtual community roundtable
- Virtual public forum
- Social media

Phase 1 takeaways

The first phase of engagement identified that Minnesotans are generally very supportive of addressing climate change through reducing carbon emissions in the transportation sector. While there was a diversity of opinions shown through the survey, in-person input and social media, the public generally expressed support in (1) prioritizing shorter travel distances and walkable communities, (2) enhancing public transit, (3) supporting EVs and alternative fuels, (4) low-cost maintenance efforts and (5) ways to reduce time stopped at intersections.

The public also highlighted that top priorities to consider when selecting projects should be to:

- Invest in projects that increase the ability for people to get to destinations without a vehicle.
- Invest in projects that achieve the largest emissions reductions or have the lowest cost and highest benefit.
- Invest in projects that support community development.

This information helped to shape the strategies and project priorities contained in the CRS. See **Appendix B: Engagement summary** for more information on input received throughout the development of the Minnesota CRS.

PHASE 2: GATHERING FEEDBACK (AUGUST THROUGH SEPTEMBER 2023)

The following activities were carried out to gather public feedback on the draft CRS document.

- Booth at the Minnesota State Fair
- Community roundtable
- Live virtual public forum (2)
- Self-paced virtual public forum

Phase 2 takeways

The engagement identified that those who reviewed the draft strategy were generally supportive of the prioritized strategies and expressed interest in ensuring that carbon reduction strategies help historically disadvantaged populations. Individual participants wanted to ensure strategies meet the

needs of people in urban and rural areas and expressed particular support for expanding travel options to reduce driving. Participants also appreciated the collaborative focus of the CRS on working among transportation partners. This information helped to validate and refine strategies and project priorities contained in the Minnesota CRS. See **Appendix B: Engagement summary** for more information on input received throughout the development of the Minnesota CRS.

PARTNER ENGAGEMENT

MnDOT engaged with partners through several advisory groups and external meetings to guide the development of the CRS. Partner engagement was critical to selecting and identifying priority strategies and project types for inclusion in the CRS. The groups included the Carbon Reduction Strategy Project Management Team, the Carbon Reduction Program Subgroup, the Climate and Resilience Workgroup and coordination with regional partners including MPOs and ATPs, Tribal Nations and state agencies (e.g., the Minnesota Pollution Control Agency).

WHAT STRATEGIES WILL GUIDE MNDOT AND PARTNERS TO REDUCE TRANSPORTATION CARBON EMISSIONS?

Building on existing policy documents and strategies, public and partner engagement refined the direction of the Minnesota Carbon Reduction Strategy. The CRS identifies a set of priority categories, key transportation strategies and supportive project types for investment and implementation to reduce carbon emissions from surface transportation in Minnesota.

The CRS is organized into three overarching categories. Each category has subsequent supportive strategies and associated project types.

ELECTRIFICATION

Decarbonization of the transportation fleet is critical to achieve climate goals. Transitioning vehicle fleets (public and private) to EVs is necessary to achieve deep reductions in carbon emissions from surface transportation.

TRAVEL OPTIONS

Increasing the availability and use of alternatives to single occupancy vehicles reduces individuals' motor vehicle emissions. Travel options also support many transportation goals related to access, mobility, safety and equity.

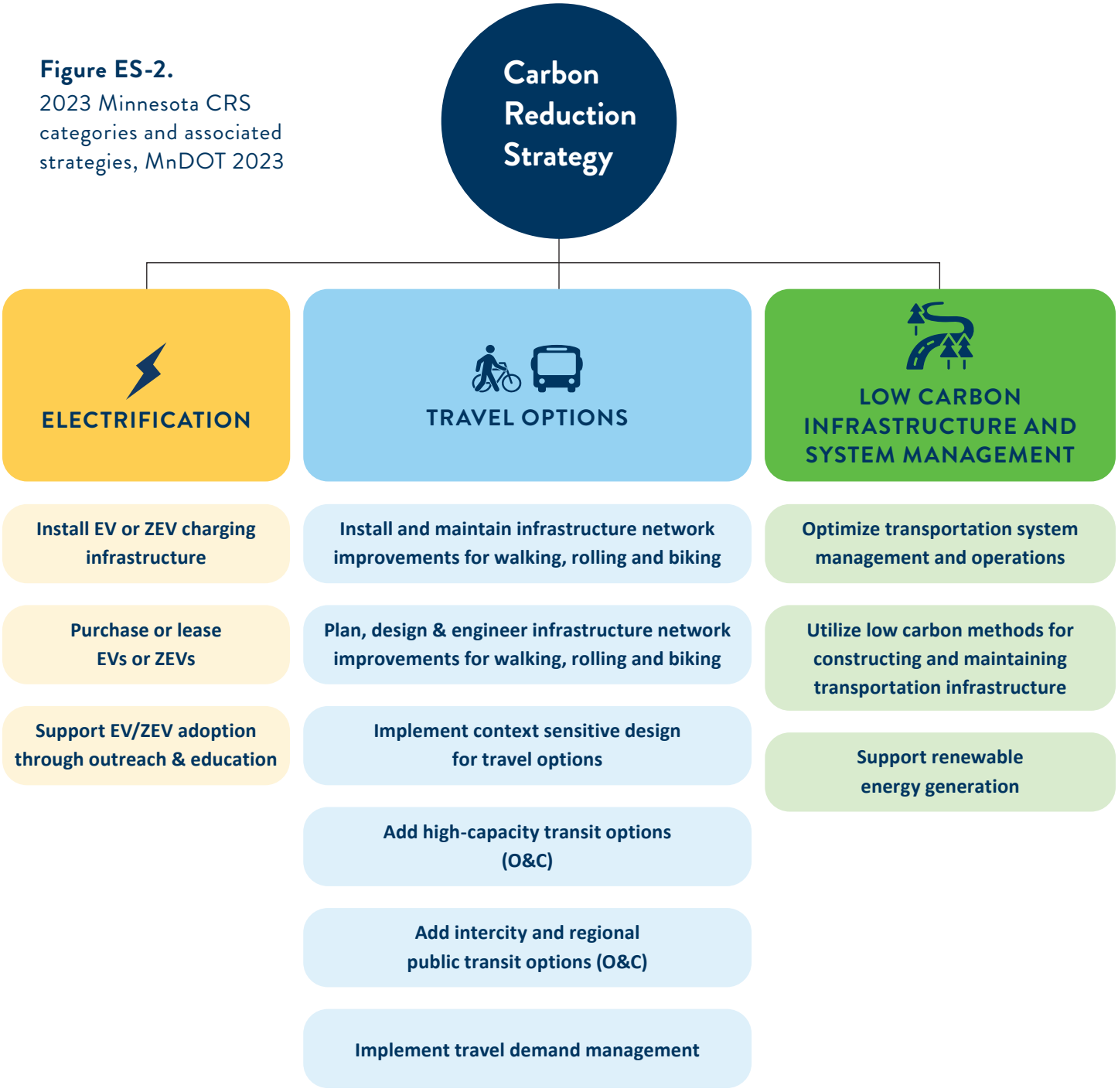
LOW CARBON INFRASTRUCTURE AND SYSTEM MANAGEMENT

Low carbon materials, construction and maintenance practices, natural vegetation and system operations practices help to reduce emissions associated with transportation infrastructure and vehicle operations.

These three categories of strategies directly address SMTP policy objectives and targets, including targets established for increasing ZEVs, reducing vehicle miles traveled (VMT) per capita and supporting system stewardship.

Within each category, strategies and project types were prioritized based on criteria important to Minnesotans, including emissions reduction potential, cost, implementation ease, time to achieve emissions benefits, and potential to support resiliency, safety and equity. The prioritized strategies are highlighted in **Figure ES-2**, and more information on each category, strategy and project types are included in the 2023 Minnesota CRS Chapter 4.

Figure ES-2.
2023 Minnesota CRS categories and associated strategies, MnDOT 2023



ELECTRIFICATION

Minnesota's policy documents and studies including Pathways, the Framework and the SMTP identified electrification as a primary way to reduce carbon emissions from transportation. The electrification category includes efforts to replace conventionally fueled vehicles with vehicles that emit zero tailpipe emissions, including battery electric vehicles and fuel cell vehicles powered by hydrogen. Key strategies include:

- Install EV or ZEV charging infrastructure.
- Purchase or lease EVs or ZEVs.
- Support EV and ZEV adoption through outreach and education.

TRAVEL OPTIONS

Increasing the availability, safety, reliability and convenience of travel options, such as walking, rolling, bicycling or taking transit, can encourage people to shift or swap trips previously taken by car. Having travel options also reduces individual travel costs and supports more equitable access to amenities, since these travel options do not require owning a private vehicle. Options such as telecommuting, taking shorter trips or combining errands to reduce VMT, also support carbon reduction by reducing driving that produces emissions. Key strategies include:

- Install and maintain infrastructure network improvements for walking, rolling and bicycling.
- Plan, design and engineer infrastructure network improvements for walking, rolling and bicycling.
- Implement context sensitive design for travel options.
- Add high-capacity public transit options (operations & capital).
- Add intercity and regional public transit options (operations & capital).
- Implement travel demand management.

LOW CARBON INFRASTRUCTURE AND SYSTEM MANAGEMENT

Transportation infrastructure must be maintained and operated, and when new infrastructure is being constructed (e.g., roads, transit stations, bicycle or pedestrian connections, facilities) transportation agencies can play a role in reducing carbon emissions associated with these activities. Low carbon infrastructure reduces the amount of carbon emissions associated with the construction and maintenance of transportation infrastructure. It also includes efforts to remove carbon from the atmosphere through the use of green infrastructure (e.g., trees, vegetation, carbon sinks). System management addresses how transportation agencies operate the transportation system to optimize system performance and reduce unnecessary idling to reduce motor vehicle emissions. Key strategies include:

- Optimize transportation system management and operations.
- Utilize low carbon methods for constructing and maintaining transportation infrastructure.
- Support renewable energy generation.

HOW WILL MNDOT AND PARTNERS IMPLEMENT THE CRS?

Implementing the CRS will involve partnerships at the state, regional and local levels to advance projects that support reducing carbon emissions from surface transportation in Minnesota. While federal CRP funds provide dedicated funds to program and implement carbon reduction projects, there are many state and federal transportation funding programs administered by MnDOT and partners that can be used to reduce carbon emissions.

Often carbon reducing strategies can be integrated into projects. It is MnDOT and partner organizations' role to work together to prioritize carbon reducing approaches and projects as identified in the CRS. This can be done through investment planning, project scoping, project prioritization and selection processes.

USING FEDERAL AND STATE TRANSPORTATION FUNDS

While the CRP provides an important source of funds dedicated to carbon reduction, MnDOT and Minnesota transportation agencies have access to dozens of other state and federal transportation funding sources. These funds may also be used to support carbon reduction strategies identified in the CRS. Examples of these funding sources are noted under federal funding programs, state funding programs and local funding programs.

Appendix C: Federal and state funding sources identifies federal and state transportation programs that may be possible sources of funds to support the implementation of the 2023 Minnesota Carbon Reduction Strategy by matching program funds to specific project types. More information about possible funding programs can be found in the 2023 Minnesota CRS Chapter 5.

Local governments and the private sector can also play a role in supporting the CRS through programming and funding projects that support the CRS categories and strategies with additional local funds.

INCORPORATING THE CRS INTO STATEWIDE AND REGIONAL INVESTMENT DECISIONS

MnDOT intends to integrate the CRS into federal and state transportation programs that it administers and will explore how the CRS can be advanced through MnDOT's investment planning and programming processes. Moreover, MnDOT is convening a GHG Emissions Impact Mitigation Working Group, which will prepare recommendations for implementing a Transportation GHG Emissions Impact Assessment for capacity expansion projects on state highways. This assessment requires that projects expected to increase GHGs or VMT will need to implement an impact mitigation plan, which may involve funding carbon reduction strategies that are included in this CRS.

At the regional level, MPOs, ATPs and Regional Development Organizations (RDOs) are the primary drivers for planning and programming projects. MnDOT encourages each to incorporate the CRS prioritized strategies and project types within their regional planning and programming processes. This

can be done by incorporating carbon emissions criteria and factors into project scoring, project scoping, priorities in long range planning documents and investment priorities.

CRP TOOLKIT

Based on federal law, CRP program funds are to be distributed as follows:

- 65% of the state's apportioned funds are to be obligated to areas of the state in proportion to their share of the state's population; and
- 35% of the state's apportioned funds may be obligated in any area of the state.

Within Minnesota, this breaks down to approximately 38% of funds dedicated to urbanized areas represented by MPOs, and 27% dedicated to rural areas (areas with population less than 50,000). See **Figure ES-3**.

To support effective and consistent programming of the CRP funds, the CRP Toolkit will be shared with MPOs and ATPs to assist in soliciting, selecting and programming CRP funds. The CRP toolkit is intended to ensure a coordinated effort that maximizes the benefits of the CRP program and reduces the administrative burden of developing a program funding solicitation and selection process. See the Carbon Reduction Program Toolkit section of Chapter 5 for more information.

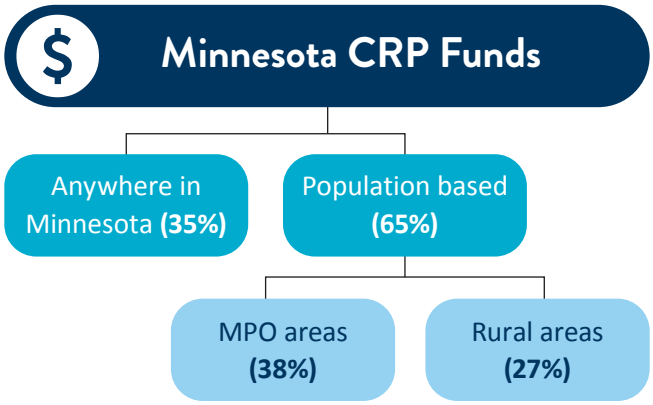


Figure ES-3.
Distribution of CRP Funds in Minnesota

MnDOT's CRP Toolkit supports coordinated project prioritization, which will be used by MnDOT Districts, MPOs and ATPs to prioritize and select projects under the CRP that align with the CRS. The CRP Toolkit includes the following:

- Informational memorandum
- CRP application
- Project carbon emissions estimation methodologies
- Carbon emissions tool (e.g., spreadsheet formatted tool)
- Project evaluation criteria
- Project scoring template

MnDOT will share the CRP Toolkit with MPOs and ATPs to initiate a solicitation for CRP project applications. Applicants will complete an application for each project applying for CRP funding. MPOs and ATPs will rank and select the projects with the most carbon reducing, cost-effective and beneficial projects based on the evaluation criteria to support Minnesota's carbon reduction goals that align with their regional priorities.

MnDOT District staff will use the CRP Toolkit to evaluate projects and calculate the carbon emissions reduction of each project. This is to ensure that each district's selected projects align with the Minnesota CRS and CRP eligibility.

TRACKING PROGRESS

MnDOT will achieve carbon reduction goals by tracking progress on the following targets:

- **GHG Emissions:** Total annual greenhouse gas emissions from the transportation sector.
- **ZEVs Registered in Minnesota:** Percent of all light-duty vehicles registered in Minnesota that are electric or another type of ZEV.

- **ZEVs Sold in Minnesota:** Percent of new light-duty vehicles sold in Minnesota that are electric or another type of ZEV.
- **VMT Per Capita:** Number of miles traveled across Minnesota per capita.

MnDOT will also examine how the CRP funded projects and other CRS prioritized projects are playing a role in achieving these targets. This information will be used when updating the Minnesota CRS to assist in prioritizing project types. Further, this data and information can be used to assess what projects and where projects have been most impactful in achieving carbon emissions reductions.

WHAT IS NEXT FOR THE CARBON REDUCTION STRATEGY?

The 2023 Minnesota CRS is the first for Minnesota and is an important component in the state's commitment to decarbonization. The content contained in this CRS is intended to inform planning and programming activities for MnDOT and other transportation partners throughout Minnesota. Further, it provides the guidance and tools to effectively evaluate projects for distribution of CRP funds.

The CRS will be updated every four years, with the next in 2027. Between now and then, MnDOT and partners will implement the CRS. Through implementation MnDOT and partners will document and learn the effectiveness of the strategy, implementation issues and opportunities and evaluate the CRP toolkit. Based on what is learned, the next CRS should update the GHG inventory and projections, revisit the strategies and project types and explore opportunities to enhance CRS implementation and CRP project selection.

CHAPTER 1

WHAT ARE WE TRYING TO ACHIEVE?

Minnesota is committed to reducing greenhouse gas (GHG) emissions contributing to climate change. Carbon dioxide (CO_2) is the most prevalent GHG emitted from human sources, accounting for about 79% of GHG emissions in the United States, based on global warming potential[2], and emissions of CO_2 are commonly referred to as carbon emissions. This Carbon Reduction Strategy (CRS) focuses on reducing carbon emissions from the transportation sector, specifically from surface transportation sources such as cars, trucks and buses, as well as transportation infrastructure.

MINNESOTA'S COMMITMENT TO CLIMATE ACTION

Climate change is here and now. Damaging storms and floods have increased in frequency, and winters are warming fast, reducing lake ice coverage across the state by 10 to 14 days over the past 50 years. Additionally, summer heat has increased, and July 2023 was the warmest month in documented history of the Earth.[3] Along with increased heat there is the potential for longer dry spells and more frequent extreme weather events. These changes are caused by human activities that release GHGs.

Minnesota has a strong foundation for climate action and has been moving forward on many fronts to set the stage for significant reductions in GHG emissions over the coming years (**Figure 1**). The CRS builds on statewide goals and policy actions, as well as previous analyses, specific to the transportation sector.

Figure 1.
Timeline of Minnesota's Climate Actions

2007 **Next Generation Energy Act** created goal to reduce Minnesota GHG emissions 80% by 2050

2008 Minnesota **Climate Change Advisory group** publishes final report recommending a comprehensive set of state-level climate polocies

2016 **Climate Solutions and Economic Opportunity report** identifies near-term emission reduction opportunities

2019 MnDOT publishes **Pathways to Decarbonizing Transportation in Minnesota**, outlining potential transportation actions to meet GHG goals

2020 **Sustainable Transportation Advisory Committee** established

2021 **Clean Cars Minnesota** rule adopted

2022 Minnesota's **Climate Action Framework** set goal to reduce GHG emissions by 50% by 2030 and achieve net-zero by 2050

Minnesota **Statewide Multimodal Transportation Plan** establishes transportation GHG reduction targets consistent with the Framework (80% reduction by 2040)

2023 **HF 2887** law creates new transportation funding sources for sustainable transportation, rebates and work groups

Next Generation Energy Act adopts goal to reduce GHG emissions by 30% by 2025, 50% by 2030 and net-zero emissions by 2050

Clean Transportation Fuel Standard Working Group and **GHG Emissions Impact Mitigation Working Group** are established and begin work

[2] U.S. Environmental Protection Agency, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021," EPA430-R-23-002, 2023, https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2021.

[3] United Nations, "It's official: July 2023 was the warmest month ever recorded," *UN News*, August 8, 2023, https://news.un.org/en/story/2023/08/1139527.

NEXT GENERATION ENERGY ACT

In 2007, Minnesota passed and signed into law the Next Generation Energy Act (NextGen), focusing on energy conservation, renewable energy, and GHG reduction across all sectors of the economy. When initially passed, NextGen required Minnesota to reduce GHG emissions statewide to 80% below 2005 levels by 2050 and established interim goals. Following development of the statewide Climate Action Framework, NextGen's goals have been updated to be consistent with the Climate Action Framework's goal of net zero emissions (carbon neutral) by 2050 with interim goals to reduce GHG emissions statewide from 2005 levels by at least 15% by 2015, 30% by 2025 and 50% by 2030.

PATHWAYS TO DECARBONIZING TRANSPORTATION IN MINNESOTA

Minnesota DOT (MnDOT) completed the Pathways to Decarbonizing Transportation in Minnesota (Pathways) report in 2019 to identify strategies to significantly reduce carbon emissions in the transportation sector. The development of the report coordinated with state and national experts to create models, assess future GHG emissions scenarios, and engage Minnesotans to understand their thoughts on opportunities and challenges for GHG emissions reductions from transportation. The report modeled a business-as-usual scenario, an "80x50" scenario in which an 80% reduction is achieved by 2050, and a "100x50" scenario in which an 100% reduction is achieved by 2050. The study demonstrated potential pathways to decarbonization, and each scenario showed that a wide array of GHG reduction strategies will be necessary to achieve the stated targets.

SUSTAINABLE TRANSPORTATION ADVISORY COUNCIL (STAC)

In 2020, MnDOT established the Sustainable Transportation Advisory Council to provide recommendations to reduce carbon emissions from transportation, consistent with the goals of NexGen. The STAC supports Minnesota's transition to a low carbon transportation system, focusing on supporting the implementation of new sustainability programs.

CLEAN CARS MINNESOTA

In 2021, Minnesota Pollution Control Agency (MPCA) adopted the Clean Cars Minnesota Rule, which will take effect in 2024 for the 2025 model year. The rules are modeled after California's clean car standards and have been adopted by 13 other states, requiring carmakers to deliver for sale in Minnesota a gradually increasing number of low emissions and zero emissions vehicles (ZEVs).

MINNESOTA'S CLIMATE ACTION FRAMEWORK

To accelerate climate action in Minnesota, the State developed a Climate Action Framework (Framework) in 2022. The Framework guides Minnesota's response to climate change across all sectors of the economy and identifies immediate, near-term actions to reduce climate pollution and prepare Minnesota communities for the impacts of climate change. The Framework describes six goals for Minnesota to address climate change:

- Clean transportation
- Climate-smart natural and working lands
- Resilient communities
- Clean energy and efficient buildings
- Healthy lives and communities
- Clean economy

It also set new goals for Minnesota to reduce GHG emissions from 2005 levels by 50% by 2030 and achieve net-zero emissions by 2050, which have subsequently been adopted as NextGen goals (**Figure 2**).[4]

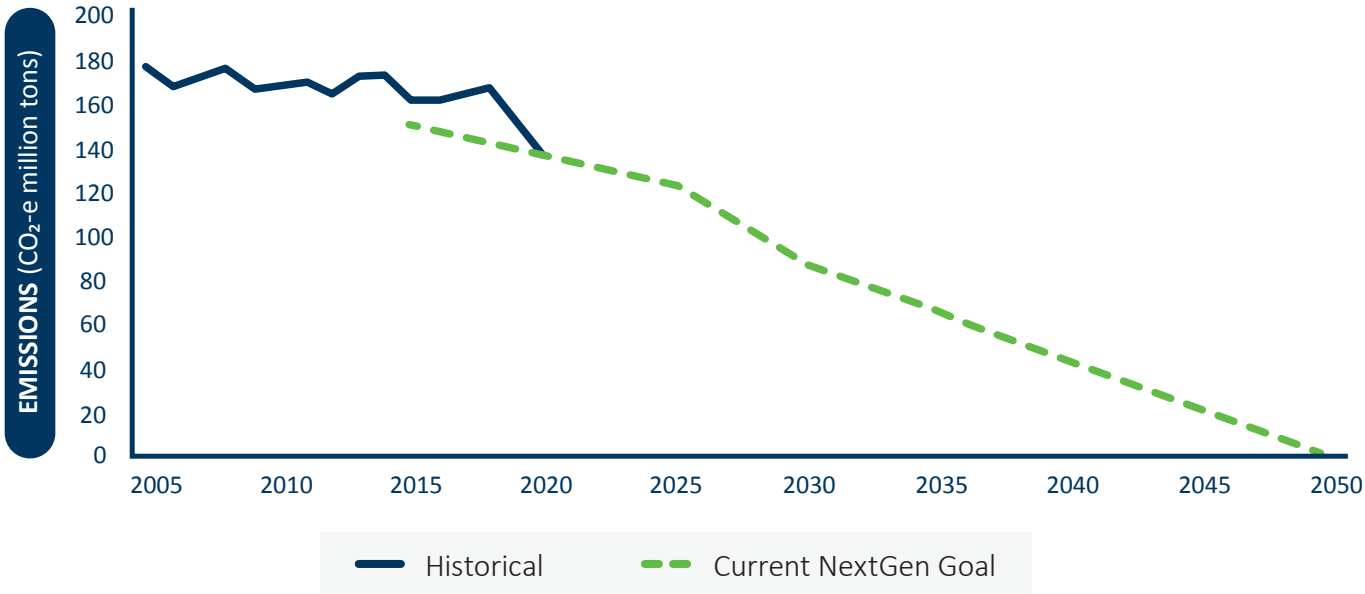
Under the Framework's clean transportation goal, two initiatives were identified: 1) connected communities and 2) clean and efficient vehicles. Connected communities focuses on maintaining and improving multimodal transportation connections to reduce emissions and congestion. Clean and efficient vehicles focus on accelerating the transition to electric vehicles (EVs), alternative fuels and greater fuel efficiency.

The Framework identifies priority actions to support these initiatives which include:

- Increasing funding for non-motorized transportation
- Increasing transit services
- Planning land use and transportation together
- Continuing to explore opportunities for a clean fuels standard
- Expanding regional EV charging
- Developing a Minnesota EV plan

Figure 2.

Minnesota's greenhouse gas emissions (2005-2020) and statewide policy goals, 2023



Source: Historical trend based on data from Minnesota Pollution Control Agency, "Greenhouse gas emissions in Minnesota, 2005-2020." Report to the Legislature (January 2023). Goals reflect a reduction from 2005 levels by at least 15% by 2015, 30% by 2025, 50% by 2030, and net zero by 2050.

[4] United States, Minnesota Legislator, Greenhouse gas emissions-reduction goal, Sec. 61 Minnesota Statutes 2022, section 216H.02, Subdivision 1. Minnesota Session Laws – 2023, Regular Session. https://www.revisor.mn.gov/laws/2023/0/60/laws.12.61.0#laws.12.61.0.

STATEWIDE MULTIMODAL TRANSPORTATION PLAN

The 2022 Statewide Multimodal Transportation Plan (SMTP) is the statewide transportation policy plan, and focuses on six objectives:

- Transportation safety
- System stewardship
- Climate action
- Critical connections
- Healthy equitable communities
- Open decision making

The climate action objective builds off the Framework and includes performance measures and targets, along with strategies and actions. Consistent with the Framework goal for Minnesota to be carbon neutral by 2050, the SMTP establishes a target to reduce annual GHG emissions from the transportation sector by 80% from the 2005 level by 2040. It also includes interim targets to reduce transportation GHG emissions by 30% by 2025, 50% by 2030, and 65% by 2035, from the 2005 level.

The SMTP also includes additional targets that contribute to the reduction of transportation GHG emissions.

- Zero emission vehicles (ZEVs) make up 65% of all light-duty vehicles registered in the state by 2040.
- 100% of all new light-duty vehicles registered in Minnesota are electric or another type of zero emission vehicle by 2035.
- Vehicle miles traveled (VMT) per capita in Minnesota to be reduced by 14% by 2040 compared to the level in 2019 (under the critical connections objective).

TRANSPORTATION SECTOR GHG REDUCTION GOALS IN THE SMTP

From 2005 levels:

- **30%** reduction by 2025
- **50%** reduction by 2030
- **65%** reduction by 2035
- **80%** reduction by 2040

HF 2887

A Minnesota transportation funding bill, known as HF 2887, passed in May 2023, allocates a total of $9 billion to transportation projects and programs, with a focus on investments and policies to support GHG reduction. HF 2887 includes the following relevant components:

- Indexes the gas tax to inflation and increases the sales tax on new vehicles, with 40% of the latter going to transit.
- Creates a new sales tax in the Twin Cities area specifically devoted to transit.
- Creates a statewide e-bike rebate of up to $1,500 for qualified households, in addition to $2,500 rebates for electric vehicles under $55,000.

- Provides investments for a variety of projects including dedicated funds for bus rapid transit, enhanced intercity rail, bicycle and pedestrian networks, safe routes to schools, and funds for the transportation management organizations in the Twin Cities region.
- Requires the development of working group to study and address opportunities for a clean transportation fuel standard that requires the aggregate carbon intensity of transportation fuel supplied within the state to be reduced to 25% below a 2018 baseline by the end of 2030, to 75% below the baseline by 2040 and 100% below the baseline by 2050.
- Requires that prior to inclusion of a highway capacity expansion project in the state transportation improvement program or metropolitan transportation improvement program, an impact assessment study must be conducted to assess whether the project will increase emissions and VMT. If so, the project must either be removed from the program, altered in scope or design or implement mitigation to address these impacts.

WORKING GROUPS

Through HF 2887, the 2023 Minnesota legislature established a Clean Transportation Standard Work Group, which is being jointly convened by the Commissioners of Agriculture, Commerce, Transportation and the MPCA. The working group will make recommendations on fuel pathways and determine impacts on jobs, fuel prices, rural and agricultural economic development to support legislation for the 2024 legislative session to reduce the carbon intensity of fuels. The 2023 legislature also established the Greenhouse Gas Emissions Impact Mitigation Working Group to prepare recommendations for implementing a Transportation GHG Impact Assessment for capacity projects on state highways.

ROLE OF THIS CARBON REDUCTION STRATEGY

The Minnesota CRS supports the achievement of Minnesota's GHG reduction goals. The CRS identifies priorities for advancing transportation investments to reduce carbon emissions from:

- **On-road transportation sources,** which include cars, trucks, buses, and other vehicles used by people and for movement of goods on our transportation network.
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It is important to note that beyond transportation investments, which are the focus of this CRS document, there are regulatory and policy actions that are critical to meeting transportation carbon reduction goals. Examples of these include clean fuels standards, amending state building codes to support accessible EV charging and land use policies (e.g., updates to zoning requirements to promote development around transit, adjustments to parking requirements). These regulatory and policy actions play a key role in decarbonizing transportation when combined with transportation investments.

ROLE OF PARTNERS

The CRS is developed in coordination with partners that include, Metropolitan Planning Organizations (MPOs), Area Transportation Partnerships (ATPs), the public, transportation advocacy groups and other partners across Minnesota. Implementation of the CRS requires teamwork, coordination and cooperation across all levels of government and the public.

PUBLIC

The public plays an important role in implementation. Users of the transportation system and community members can provide input on project concepts and help to shape projects funded in support of the CRS. MnDOT is committed to ensuring equitable and on-going engagement of the public in the decisions that come out of implementation of this strategy. Moreover, the public also plays a key role

[5] Under federal law, within each state, 65% of CRP funds must be allocated to areas of the state in proportion to population size and 35% of CRP funds may be allocated in any area of the state (23 U.S.C. 175(e)).

in implementation through their decisions to use carbon-free or low-carbon travel options, such as EVs, walking, rolling, bicycling and transit, as well as by combining trips to reduce their amount of driving.

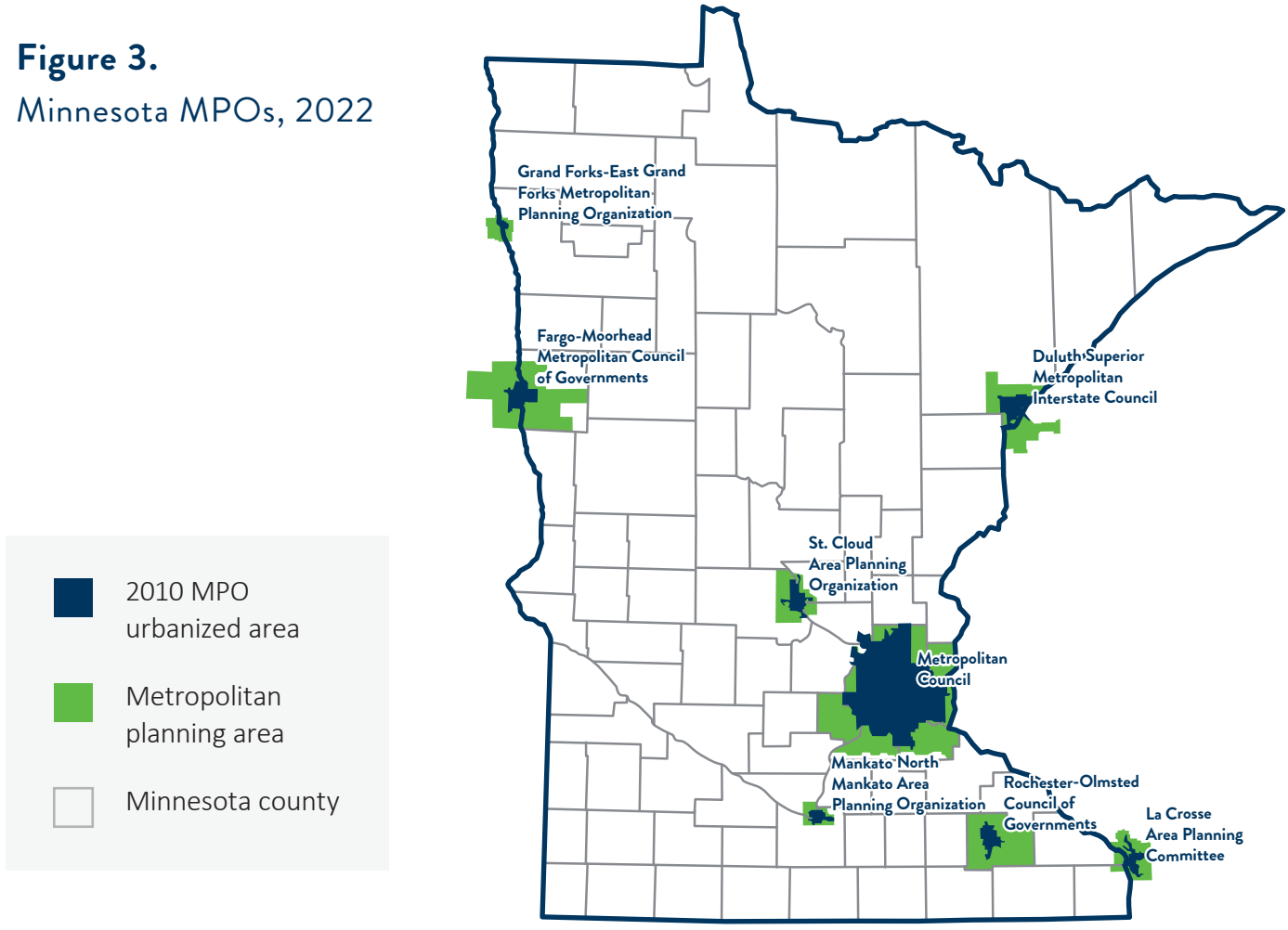
LOCAL AND REGIONAL PARTNERS

Partner transportation agencies include MPOs, ATPs, local governments (e.g., cities, counties), transit agencies and other organizations that play a key role in identifying, proposing, funding or selecting projects.

MPOs

Minnesota has eight MPOs (**Figure 3**). MPOs carry out planning activities for a region of over 50,000 people. With the CRP funds, every MPO is suballocated funds to program projects within their planning area.[6] As part of the CRS, MnDOT has and continues to coordinate with each of the MPOs in Minnesota to carry out a continuing, cooperative and comprehensive performance-based multimodal transportation planning process that is consistent throughout Minnesota.

Figure 3.
Minnesota MPOs, 2022



[6] 'Planning area' is defined by FHWA based upon the population size of the MPO. Transportation Management Areas (TMAs) are MPOs with populations of over 200,000. A TMA planning area is defined as the full metropolitan planning area (MPA). Suballocated TMA CRP funds can only be programmed on projects within a TMA's MPA. Non-TMAs are MPOs with populations of 50,000 to 200,000. A non-TMA's planning area is defined as the MPO's urbanized area. Suballocated non-TMA CRP funds can only be programmed on projects within a non-TMA's urbanized area.

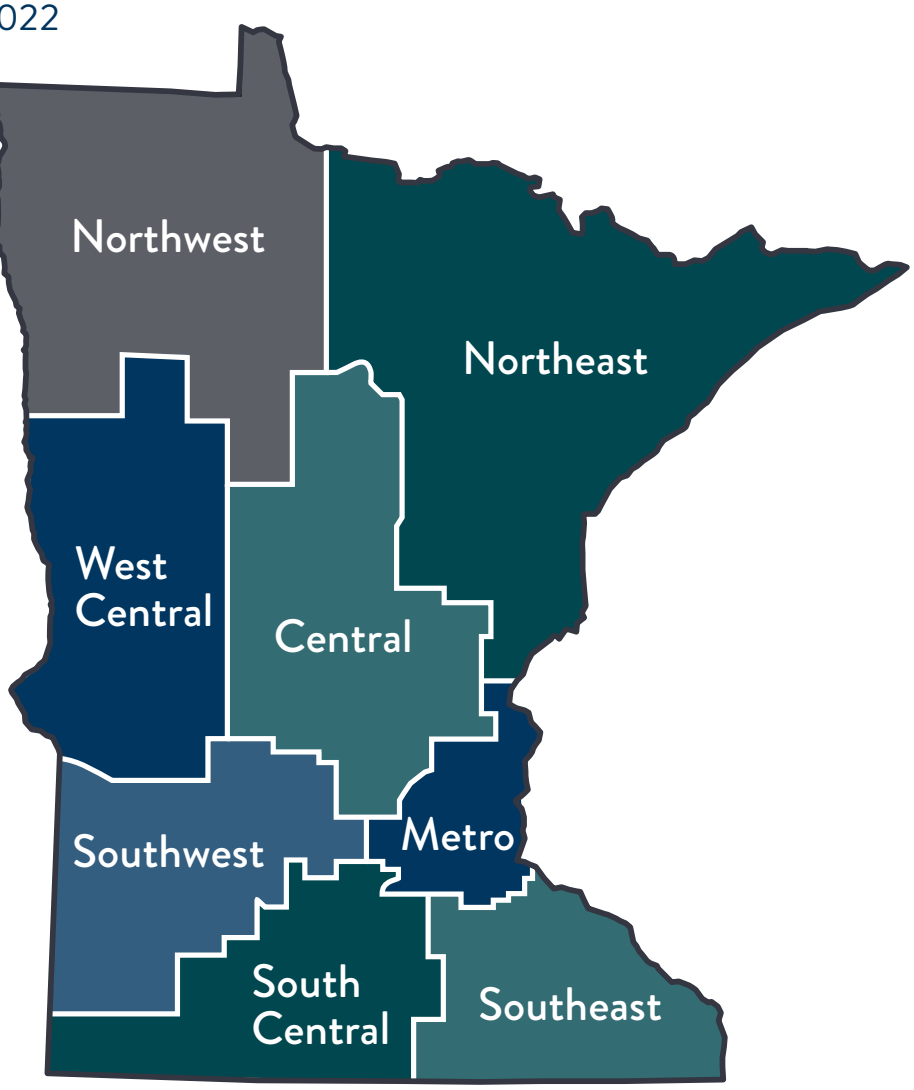
ATPs

An ATP is a group of traditional and non-traditional transportation partners including representatives from MnDOT, MPOs, Regional Development Organizations, counties, cities, tribal governments, special interests and the public that have the responsibility of developing a regional transportation improvement program for their area of the state.

Minnesota established eight ATPs in the early 1990s to emphasize greater public involvement, enhance regional planning and increase the development of the Minnesota State Transportation Improvement Program (STIP). **Figure 4** identifies each of the ATPs. Each ATP is made up of representatives from the cities, counties, MnDOT districts, regional development organizations (RDOs) and MPOs within the ATP boundary. Each ATP selects what and how transportation projects will be funded for their region.

Figure 4.

Minnesota ATPs, 2022



STATE AGENCIES

MnDOT

MnDOT's vision is that Minnesota's multimodal transportation system maximizes the health of people, the environment and our economy.[7] By contributing to climate change, carbon emissions are detrimental to the environment and public health, ultimately creating costs on our economy. Transportation projects that reduce carbon emissions also can improve local air quality, enhance travel options, and strengthen community development, which supports this vision.

MnDOT manages the Minnesota Carbon Reduction Program (CRP) and administers a wide array of state and federal transportation programs, which can be used to implement strategies within this CRS. These efforts support MnDOT's mission to plan, build, operate and maintain a safe, accessible, efficient and reliable multimodal transportation system that connects people to destinations and markets throughout the state, regionally and around the world. MnDOT's activities support the SMTP's objectives of transportation safety, system stewardship, climate action, critical connections, healthy equitable communities and open decision making. As a result, MnDOT has incorporated these objectives into the CRP project selection criteria described further in this document and into the process of developing the priority strategies and project types within the CRS.

MnDOT will guide the overall implementation of the CRS and updates in the future.

Minnesota Pollution Control Agency (MPCA)

The MPCA is responsible for preventing and reducing the pollution of air, land and water and leads Minnesota's efforts on climate change. MPCA has many initiatives focused on reducing transportation carbon emissions, especially by supporting the adoption of EVs. This includes the Clean Cars Minnesota standard, using funds from Minnesota's share of the national Volkswagen settlement to build charging infrastructure across the state and administering the electric school bus grant program. MPCA also plays a key role in tracking progress toward climate goals through development of the biennial Greenhouse Gas Emissions Report that is submitted to the Minnesota Legislature to track the state's contribution to emission. MPCA is a key partner in development of the CRS and will continue to be a coordinating partner in implementation of the CRS.

Other state agencies

Coordinating across state agencies is key to ensure that carbon emission from transportation is reduced. A few state agencies, such as the Minnesota Department of Natural Resources (DNR), play a role in implementing the CRS through the administration of funding programs that support prioritized types of projects in the CRS. For instance, the DNR's parks and trails budget, Regional Trail Grant Program and Local Trail Connection Program fund walking, bicycling and rolling projects in parks which reduces transportation emissions within the parks.

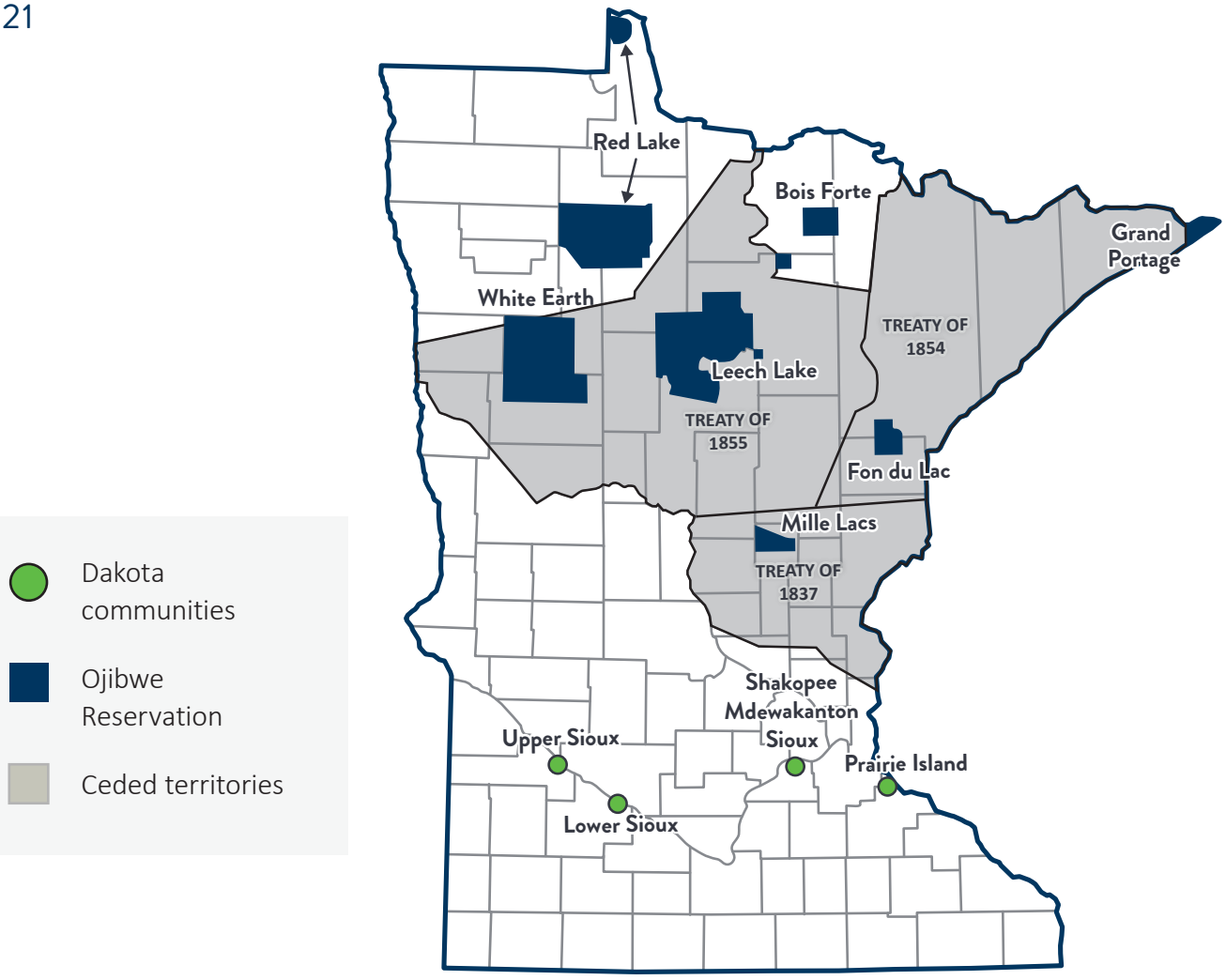
[7] Minnesota Department of Transportation, "MnDOT Vision," Our vision, mission, and core values (2023), https://www.dot.state.mn.us/vision/

TRIBAL GOVERNMENTS

There are the 12 federally recognized sovereign Tribal Nations with jurisdiction over land and resources in Minnesota (**Figure 5**). Indian Country includes road, bridges, highways, transit services, sidewalks and more. Tribal partners plan, build and manage key parts of Minnesota's transportation system and tribes are key partners in moving transportation forward.

Figure 5.

Tribal reservations and communities in Minnesota, 2021



FEDERAL AGENCIES

The Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) play a key role in funding surface transportation through distribution of federal formula and discretionary program grants. FHWA is responsible for dispersing Federal-aid Highway program funds to Minnesota, has provided guidance on priorities for use of Federal-aid Highway formula funds, including the CRP, and plays an oversight role for the Minnesota CRS. FTA is also responsible for federal program funds, which may be used by MnDOT and partners in Minnesota to support implementation of this strategy. Coordination with the Federal Railroad Administration (FRA) is another avenue to continue to explore to support the efforts and projects prioritized in the CRS.

BEYOND TRANSPORTATION INVESTMENTS

Beyond transportation investments as the focus the CRS, state agencies, MPOs, regional development organizations, local agencies, Tribal Nations and others play an important role in the development of policies, regulations, incentives and other efforts that will help move toward decarbonization of the transportation system. The actions of these organizations should be coordinated with the CRS to maximize emissions reduction benefits. For instance, many decisions such as land use, housing, economic development and public health decisions interact closely with the CRS. These decisions are typically outside the scope of MnDOT.

Coordination amongst partners is needed to create synergies that maximize benefits of transportation investments and projects. Currently, MnDOT is coordinating with state agencies (e.g., Minnesota Department of Commerce, MPCA, Minnesota Department of Agriculture, Minnesota Department of Natural Resources) on the implementation of the Minnesota Climate Action Framework and through MnDOT's Electric Vehicle (EV) Subgroup, Climate and Resiliency Workgroup (CRW) and Next Generation Highways Workgroup to maximize the reduction of carbon emissions through the various programs throughout the state.

CHAPTER 2

WHAT IS THE CURRENT STATE OF CARBON EMISSIONS FROM TRANSPORTATION IN MINNESOTA?

The transportation sector is the largest source of carbon emissions in Minnesota, with surface transportation sources, such as cars, trucks and buses making up about 22% of GHG emissions in 2020. Transportation carbon emissions are a result of fossil fuel combustion in vehicles and are influenced by:

- The amount of vehicle miles traveled (VMT),
- Fuel economy, which in turn is affected by the types of vehicles used and how they operate on the transportation system, and
- Fuel type used (such as conventional gasoline or diesel, biofuels or other alternative fuels).

Carbon emissions are also produced from transportation infrastructure construction and maintenance and the generation of electricity used in equipment, facilities and EVs, as well as other upstream emissions from fuel processing. These carbon emissions are not accounted for as transportation emissions in the GHG inventory since they are not emitted directly from vehicles but are important to consider when looking at the overall impact of transportation systems.

Across all sectors of the economy, Minnesota did not meet the NexGen target to reduce GHG emissions statewide to at least 15% below 2005 levels by 2015, and significant actions will be needed to meet future goals.

UNDERSTANDING CARBON EMISSIONS

GHGs trap heat in the atmosphere and warm the Earth. Human activity has dramatically increased the amount of GHGs in the atmosphere. CO_2 is the most abundant GHG with the most significant effect on climate. Other primary GHGs include methane (CH_4), nitrous oxide (N_2O) and hydrofluorocarbons (HFCs). These non-CO_2 gases are emitted in much smaller amounts than CO_2 but are more powerful in trapping heat and stay in the atmosphere for a very long time. As a result, emissions of GHGs are typically reported in CO_2-equivalent using a measure of global warming potential associated with each gas.

GHGs come from a variety of sources including:

- Fossil fuel combustion (used to fuel vehicles and generate electricity), which is the largest sources of CO_2 emissions,
- Animal agriculture, which produces methane emissions, and fertilizers used in agriculture, which create over 50% of N_2O emissions, and
- Refrigerants used in air conditioning in vehicles and buildings, which emit HFCs.

CO_2 makes up about 70% of GHGs emitted in Minnesota, based on CO_2-equivalent. Transportation sources primarily emit CO_2 due to combustion of fossil fuels, with CO_2 contributing over 90% of transportation GHG emissions in Minnesota.[8] Consequently, the CRS focuses on "carbon emissions," which reflect the emissions of CO_2 that make up most of transportation's GHG emissions.[9]

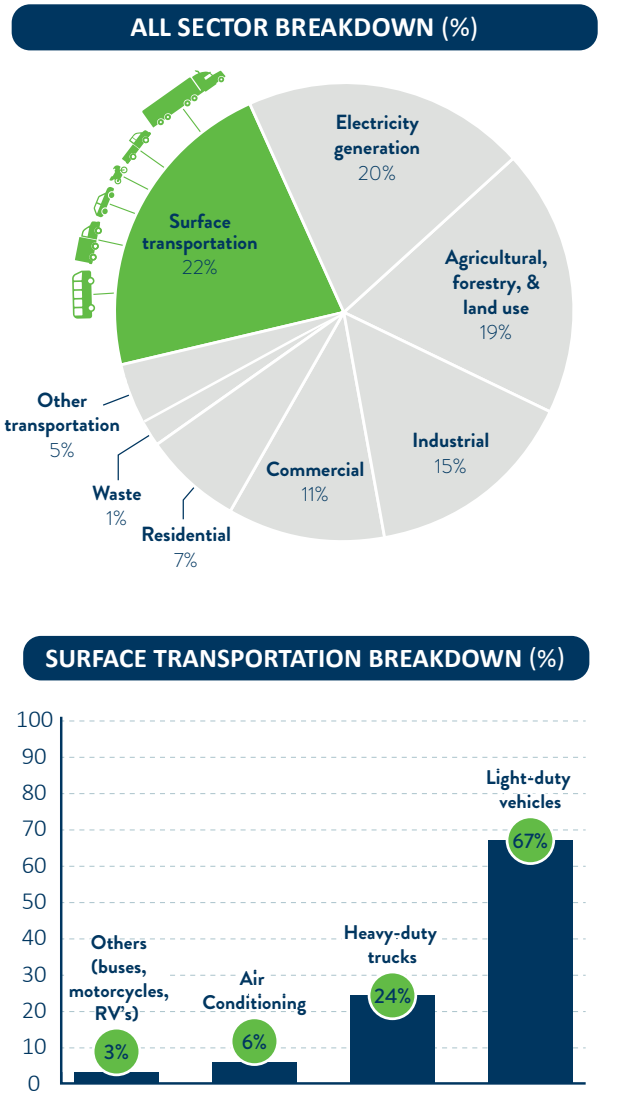
GREENHOUSE GAS EMISSIONS FROM SURFACE TRANSPORTATION

Minnesota's largest contributor of GHG emissions is the transportation sector. Surface transportation, such as cars, trucks, buses, motorcycles, and vehicle air conditioning contributed about 22% of GHG emissions in Minnesota in 2020, with an additional 5% of GHG emissions coming from other transportation sources, such as aviation, rail, marine and pipelines.[10]

The largest sources of GHG emissions from surface transportation are light-duty vehicles making up 67% of surface transportation carbon emission in 2020. Light-duty vehicles include passenger cars and light-duty trucks, such as sport utility vehicles (SUVs), minivans and pickup trucks, which are primarily used as passenger vehicles. Heavy-duty trucks, which are largely used for moving freight, contributed to 24%

Figure 6.

Minnesota's GHG emissions sources, with surface transportation detail, 2020



Source: Developed based on data from Minnesota Pollution Control Agency, "Greenhouse gas emissions in Minnesota, 2005-2020." Report to the Legislature (January 2023).

[8] Minnesota Pollution Control Agency, "Greenhouse gas emissions in Minnesota, 2005-2020." *Report to the Legislature* (January 2023) https://www.pca.state.mn.us/sites/default/files/lraq-2sy23.pdf, with data detail at: https://public.tableau.com/app/profile/mpca.data.services/viz/GHGemissioninventory/GHGsummarystory.

[9] Federal law on the Carbon Reduction Program defines transportation emissions as "carbon dioxide emissions from on-road highway sources" (23 U.S.C. 175(a)(2)), which are referred to as "carbon emissions" in this document. Note that many charts in this document present "GHG emissions," which encompass CO_2 and other GHGs. The transportation sector in the Minnesota GHG inventory includes both surface transportation sources (which include on-road highway sources and vehicle air conditioning sources) and other transportation sources (such as aviation, railroads, marine sources and natural gas transmission pipelines).

[10] Minnesota Department of Transportation, "Minnesota's Climate Action Framework.", (2021). Accessed August 8, 2023. https://climate.state.mn.us/minnesotas-climate-action-framework.

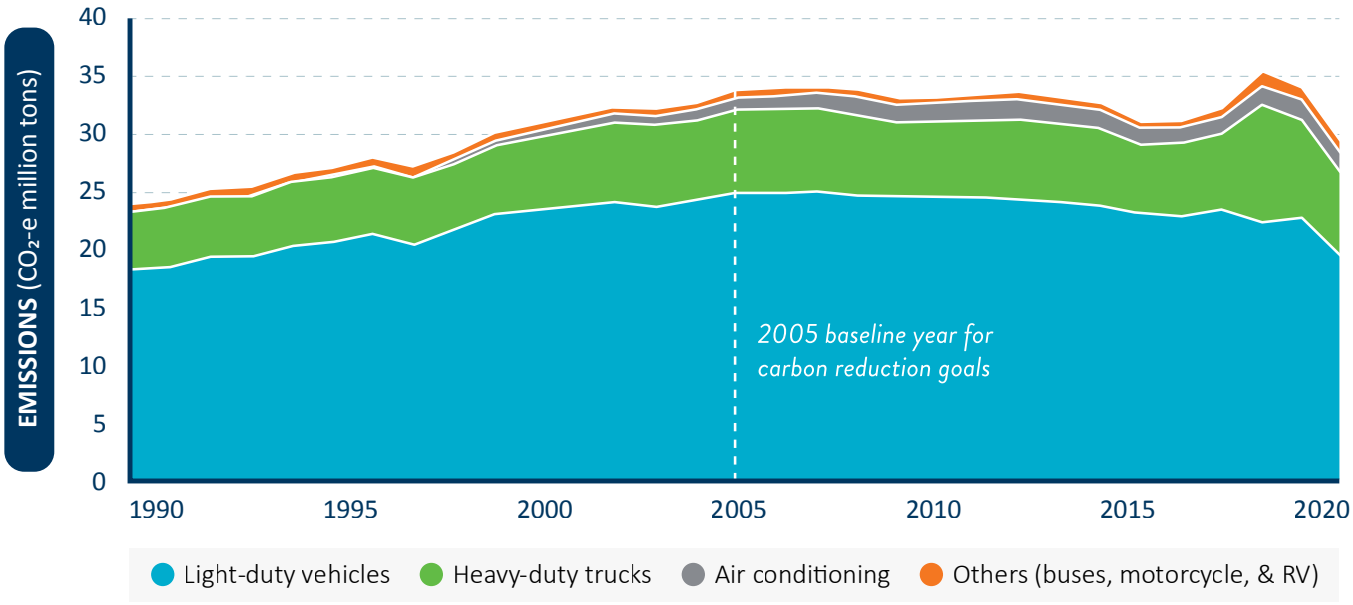
of surface transportation emissions. The remaining 9% of surface transportation emissions in 2020, were contributed by mobile air conditioning,[11] buses, recreational vehicles (RVs) and motorcycles.

EMISSIONS TRENDS

Despite improvements in fuel economy, surface transportation emissions have increased since 1990 (**Figure 7**). Due to a substantial increase in Minnesota's population and VMT, carbon emissions from on-road transportation sources (including light-duty vehicles, heavy-duty trucks, buses, motorcycles and RVs) are estimated to have increased about 36% between 1990 and 2005. More stringent vehicle emissions standards at the federal and state level have since lowered carbon emissions. However, the long-term consumer trend of choosing larger vehicles and increasing VMT has prevented more significant emissions reductions. From 2005 to 2020, carbon emissions from on-road transportation sources decreased by almost 17%.

A notable drop in emissions occurred in 2020 due to the significant reduction in VMT during the COVID-19 pandemic. From 2005 to 2019, carbon emissions from on-road transportation sources decreased by less than 2%. The year 2020 was unusual due to the widespread closure of in-person activity for many businesses and schools. Since then, VMT have been returning to pre-pandemic levels.[12]

Figure 7.
Surface transportation GHG emissions trends, 1990-2020



Source: Developed based on data from Minnesota Pollution Control Agency, "Greenhouse gas emissions in Minnesota, 2005-2020." Report to the Legislature (January 2023).

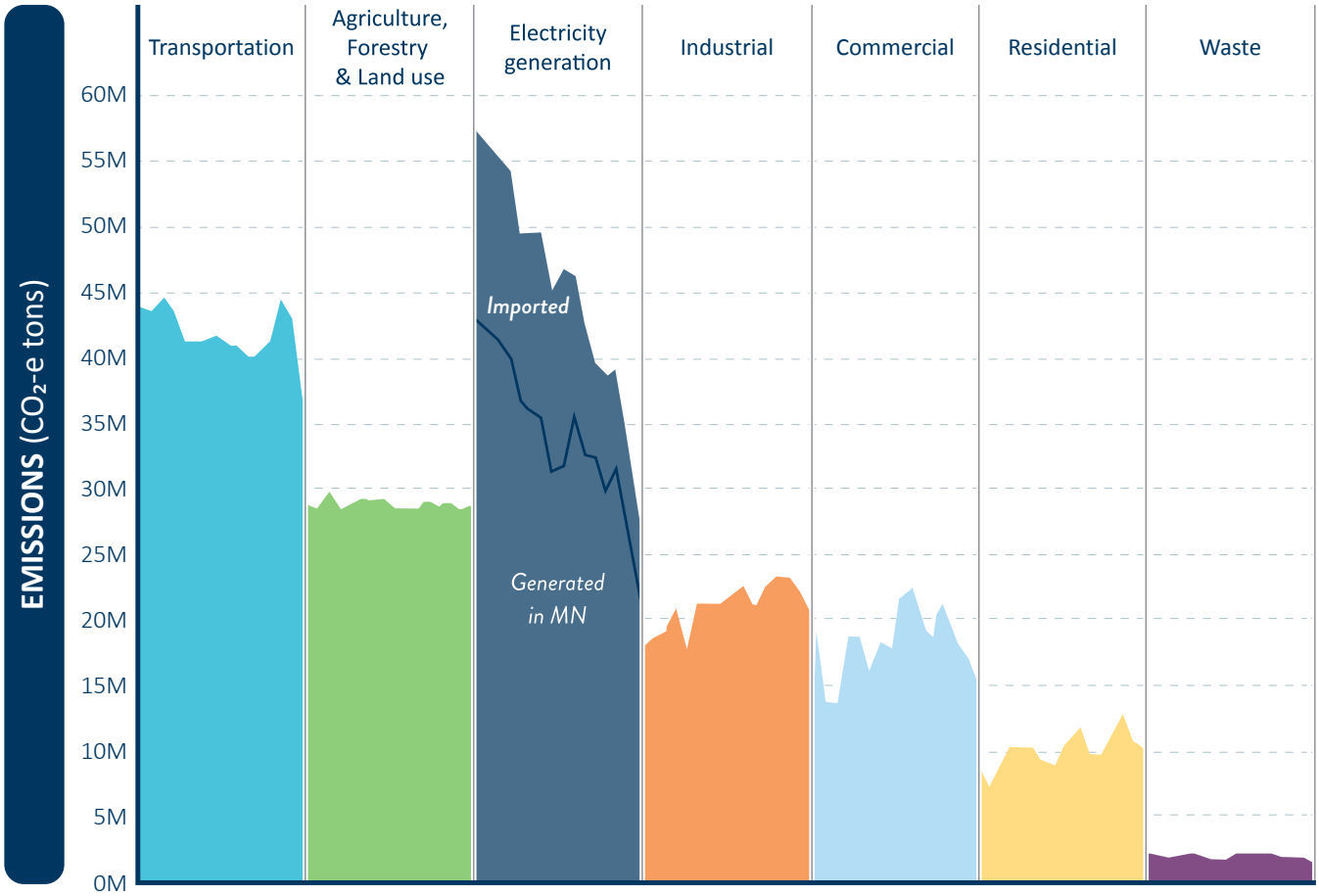
[11] While mobile air conditioning primarily releases HFCs, other surface transportation sources primarily emit CO_2, with much smaller amounts of CH_4 and N_20 released.

[12] Federal Highway Administration, "Highway Statistics 2021," (2022) https://www.fhwa.dot.gov/policyinformation/statistics/2021/.

Across all sectors in Minnesota, the largest reduction in GHG emissions occurred in the electricity generation sector, which declined by 54% between 2005 and 2020. The significant decrease was mainly a result of producing more electricity from renewable sources (e.g., wind and solar) instead of coal. Within the transportation sector (which includes surface transportation sources and other sources, such as aviation and pipelines), GHG emissions over the same period fell 18%, but much of the decrease is attributed to the reduction in vehicle use and aviation during the pandemic. Between 2005 and 2019, GHG emissions from transportation only declined by 1%, as shown in **Figure 8**. Industrial and residential emissions increased between 2005 and 2020, and agriculture, forestry and land use emissions were relatively flat.

Figure 8.

Minnesota's GHG emissions across economic sectors, 2005-2020



	Transportation	Agriculture, Forestry & Land use	Electricity generation	Industrial	Commercial	Residential	Waste
2019	-1%	-2%	-45%	25%	-10%	22%	-15%
2020	-18%	0%	-54%	14%	-22%	14%	-40%

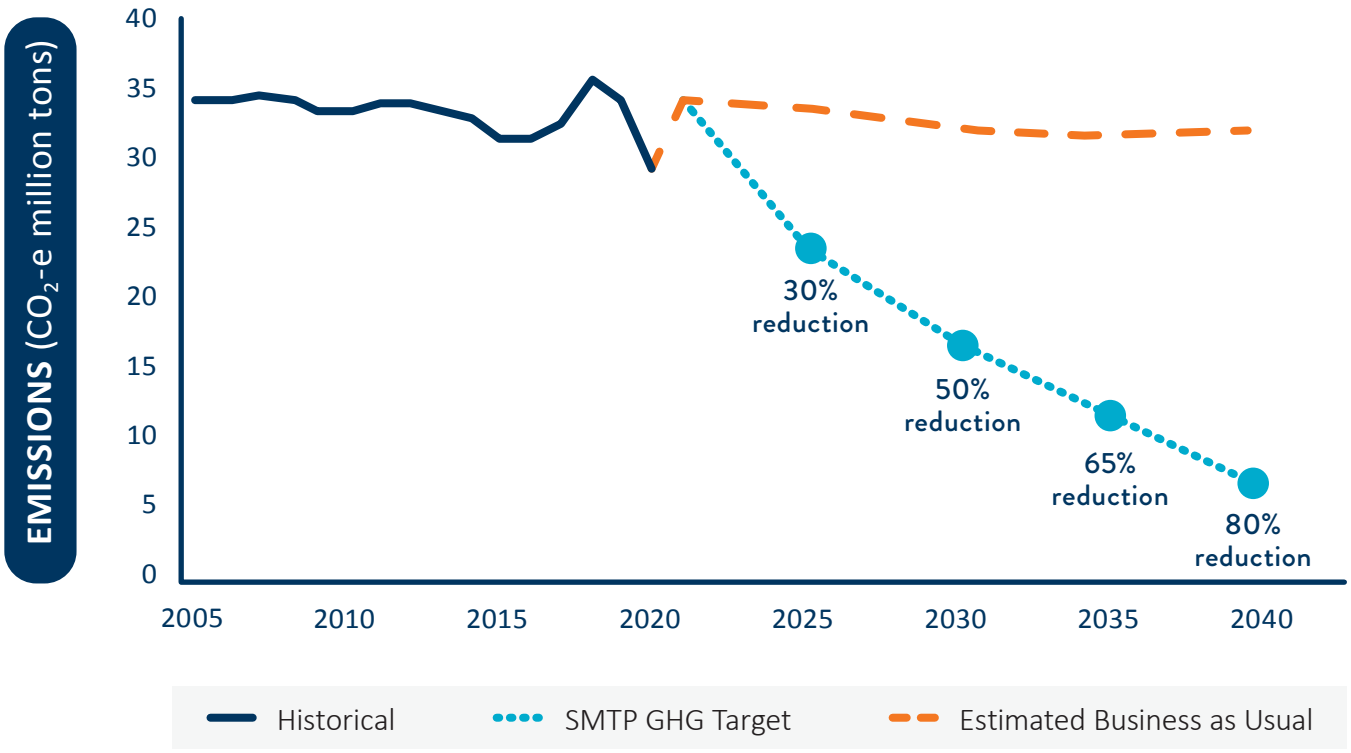
Source: Minnesota Pollution Control Agency, "Greenhouse gas emissions in Minnesota, 2005-2020." Report to the Legislature (January 2023).

CHALLENGES MOVING FORWARD

Achieving the SMTP target of an 80% reduction in transportation GHG emissions from the 2005 level by 2040 requires significant changes in the historic trajectory of carbon emissions from transportation, as shown in **Figure 9**. This figure applies the percent reduction targets for transportation in the SMTP to estimated surface transportation GHG emissions (light-duty vehicles, heavy-duty trucks, buses, motorcycles, RVs and air conditioning).

Figure 9.

Transportation GHG emissions and reduction targets, 2005-2040



Note: Historical trend reflects surface transportation emissions from Minnesota Pollution Control Agency, "Greenhouse gas emissions in Minnesota, 2005-2020." Report to the Legislature (January 2023). Estimated business as usual reflects assumptions for improved fuel economy used in the Pathways study scenarios combined with additional data from 2017-2020, which became available after the 'Pathways' model was developed and using 2019 as a reference point given the uniqueness of 2020. The SMTP GHG target line reflects that percentage GHG reduction targets for 2025, 2030, 2035, and 2040, applied to surface transportation GHG emissions.

A challenge to this aggressive reduction in transportation emissions is that many decisions that affect transportation emissions typically take time to come to realization. For example, purchasing an entire new fleet of vehicles is expensive and the average life of a light-duty vehicle is 12 years. Therefore, an organization or agency is not able to replace all their fleet vehicles at once.[13] Further, land use and development patterns have been shaped over decades through transportation partners and transportation investments typically take years to plan, fund and implement.

One rapid development that was conveyed by the pandemic was that patterns of where people live, work and travel can be dramatically influenced by technology. This was shown through shifts to telework, telehealth and flexible work schedules that occurred rapidly during the pandemic. Unfortunately, the decline in VMT was somewhat short-lived and it remains to be seen how the changes in travel behavior may impact the future of transportation travel patterns.

The positive news is that Pathways showed how it is possible to achieve dramatic reductions in transportation GHG emissions through significant actions across many fronts. The analysis showed possible trajectories to achieve an 80% reduction by 2050 (80x50) and 100% reduction by 2050 (100x50). The goal of achieving an 80% reduction by 2040 requires movement along the 100x50 path. Modeling has shown this pathway is possible through rapid shifts toward EVs, ZEVs and low-carbon fuels. Reducing VMT per capita will also be important to help support the emission reduction goals.

Given the rapid shifts that will be required to meet these goals, action is needed on many fronts, including regulations related to vehicles and fuels, incentives for purchasing EVs and ZEVs, transportation investments to support the transition to EVs and ZEVs and reducing vehicle travel per capita. This CRS identifies priority strategies and project types for transportation investments that will contribute to these goals.

[13] The average age of light-duty vehicles in the U.S. is over 12 years, according to data from S&P Global Mobility. https://www.spglobal.com/mobility/en/research-analysis/average-age-of-vehicles-in-the-us-increases-to-122-years.html

CHAPTER 3

WHAT IS DIRECTING THE MINNESOTA CARBON REDUCTION STRATEGY?

The CRS builds on Minnesota state policy and plans for reducing carbon emissions from the transportation sector. It also has been shaped through extensive engagement with the public and transportation partners.

STATEWIDE POLICY AND STUDIES ON EFFECTIVE STRATEGIES

The process of developing the CRS included conducting a review of three Minnesota key policy documents:

- The 2019 Pathways to Decarbonization study (Pathways),
- The 2022 Minnesota Climate Action Framework (Framework) and
- The 2022 Statewide Multimodal Transportation Plan (SMTP).

Each of these policy documents was developed with detailed technical analyses and public engagement.

Strategies and actions contained within each policy document were identified as an initial base for determining strategies to be included in the CRS. Further, scenarios from each of the policy documents were analyzed to identify critical components of how Minnesota can achieve its transportation carbon reduction goals. Findings and recommendations from these documents reinforce one another and provide insight into how to reduce carbon emissions from transportation.

2019 PATHWAYS TO DECARBONIZING TRANSPORTATION IN MINNESOTA (PATHWAYS)

The purpose of Pathways was to explore opportunities for GHG emission reductions from surface transportation. The three scenarios were modeled:

- A no-action alternative
- 80 x 50 scenario: a pathway to meet the NextGen GHG reduction goal for an 80% reduction below 2005 levels by 2050, assuming that surface transportation would meet the economy wide goal.
- 100 x 50 scenario: a pathway to achieve zero emissions from surface transportation by 2050 (this scenario pathway most closely matches the SMTP goal to reduce transportation GHG emissions by 80% by 2040).

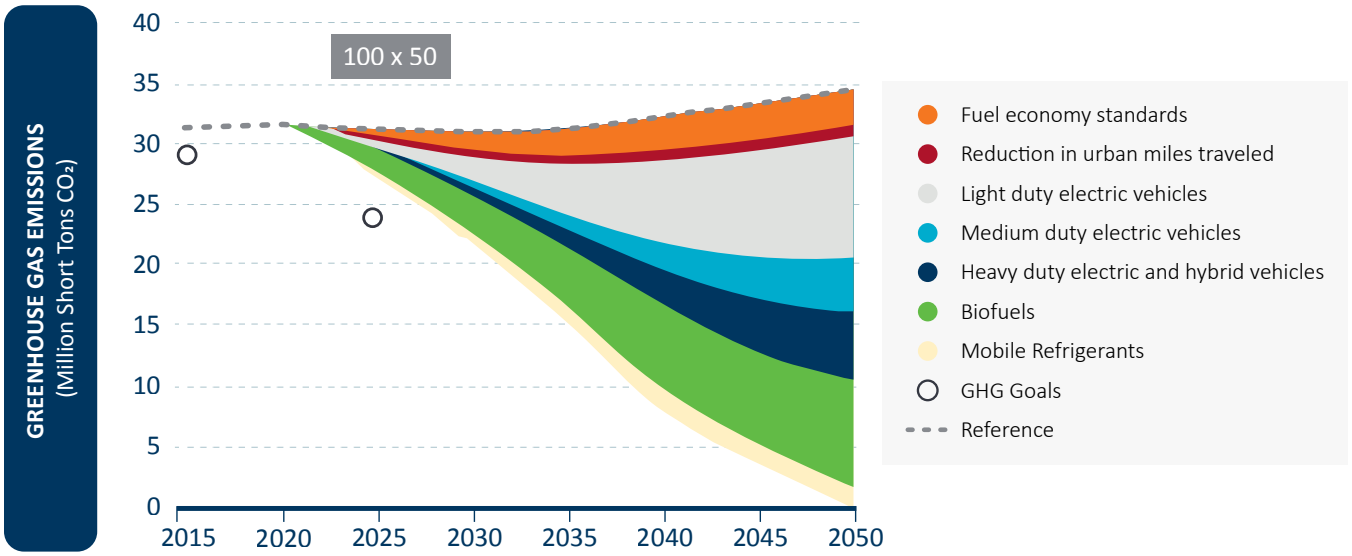
The results of the 100 x 50 scenario are shown in **Figure 10** on the next page. The Pathways models show that Minnesota can achieve these significant GHG reduction goals but 1) immediate action is needed, 2) action is needed across vehicle classes, and 3) there is no "silver bullet" or single action that alone can achieve the goals. In the modeling, the largest

reductions were identified to be achieved by shifting to EVs, hybrid vehicles that are more fuel efficient and using biofuels to reduce the carbon intensity of fuels. Reductions could also be achieved by switching to low global warming potential refrigerants in vehicle air-conditioning and reduced urban VMT.[14] The strategies included in this scenario include:

- EVs make up 60% of light-duty vehicle sales by 2030 and 100% by 2040,
- A 20% blend of biofuels with a 50% reduction in carbon intensity relative to 2016 by 2030, and 100% biofuel blend by 2050 with 100% reduction in carbon intensity,
- 100% low-carbon mobile refrigerants by 2025, and
- Light-duty VMT statewide 5% below the reference case by 2030 and 10% below by 2050.

Figure 10.

Emissions reductions by strategy area in Pathways 100 x 50 scenario, 2019



Source: MnDOT, "Pathways to Decarbonizing Transportation in Minnesota" (August 2019).

[14] MnDOT, "Pathways to Decarbonizing Transportation in Minnesota" (August 2019). https://minnesotago.org/stay-updated/featured-content/pathways-decarbonizing-transportation-report.

Based on the results of the analysis and public input, Pathways listed several recommended actions and next steps:

- Find integrated solutions to decarbonize transportation that go beyond single policies, agencies or efforts and involve regional collaboration and multi-sector collaboration with electricity generation and agriculture and ensure a focus on equity and environmental justice.
- Build an EV market and provide more EV options to reduce barriers to EV adoption, such as through adoption of clean car standards.
- Promote biofuels to reduce GHG emissions and support rural Minnesota through strategies, such as expanding biofuel infrastructure, facilitating higher biofuels blends and renewable diesel and strengthening Minnesota's Petroleum Replacement Goals (Minn. Stat Sec. 239.7911).
- Fund EV infrastructure statewide to support increased adoption of EVs in personal, public and corporate fleets.
- Provide EV incentives, such as point-of-sale rebates, state tax credits and free access to carpool lanes, to increase EV adoption, especially for passenger vehicles.
- Provide more travel options on projects to reduce VMT and provide health, equity and safety benefits that come from more walkable and bikeable communities.

MINNESOTA CLIMATE ACTION FRAMEWORK (FRAMEWORK) (2022)

The Framework sets a vision for how Minnesota will address and prepare for climate change. As a multisector framework, it identifies immediate, near-term actions to achieve the long-term vision of a carbon-neutral, resilient and equitable Minnesota. In the transportation sector, the Framework highlights six priority actions to achieve carbon reduction.

- Increase funding for non-motorized transportation.
- Increase transit services.
- Plan land use and transportation together.
- Continue exploring opportunities for a clean fuels standard.
- Expand regional charging.
- Develop a Minnesota EV Plan.

The Framework further notes that in order to achieve the largest GHG reductions in transportation Minnesota must:

- Transition to cleaner fuels, including electricity and biofuels, through incentives and policies such as a low carbon fuel standard.
- Increase EV adoption by making EVs more affordable, requiring and incentivizing manufacturers to sell EVs in Minnesota and expanding charging infrastructure.
- Increase efficiency of vehicles fueled by traditional fuels, such as gasoline and diesel, so they pollute less.

The Framework also emphasizes an equitable transportation system that ensures that all Minnesotans can travel safely, conveniently and affordably. Climate action must address inequities and redress past harms by prioritizing investments in infrastructure and improved travel options for populations that have historically been underserved. Consequently, transportation initiatives in the Framework focus on key strategies in connected communities and clean and efficient vehicles.

The Climate Action Framework's Clean Transportation goal is to *"Connect and serve all people through a safe, equitable and sustainable transportation system."*

2022 STATEWIDE MULTIMODAL TRANSPORTATION PLAN (SMTP)

As the highest policy plan for transportation in Minnesota, the SMTP provides objectives, performance measures, strategies and actions for Minnesota's transportation system over the next 20 years. The SMTP focuses on six objectives: transportation safety, system stewardship, climate action, critical connections, healthy equitable communities and open decision making. Many strategies and actions identified in the SMTP relate to and have implications for the CRS.

Transportation safety strategies include a focus on ensuring the safety of more vulnerable people, especially those walking, rolling, bicycling and taking transit. These strategies also focus on modifying infrastructure to accommodate all modes of transportation using complete streets, context sensitive and Safe System approaches. These strategies that support safety can also support opportunities to use alternatives to driving and reduce carbon emissions.

The Climate Action objective includes targets for GHG emissions reduction, ZEVs registered in Minnesota and ZEVs sold in Minnesota. It highlights strategies to transition the transportation sector away from dependence on fossil fuels and make transportation and land use decisions that reduce carbon emissions.

The Critical Connections objective includes a VMT per capita reduction target and strategies to provide travel options and encourage modal shifts away from single-occupant vehicles through infrastructure improvements, education, programs and services, among other strategies.

Together Pathways, the Framework, and the SMTP identify key strategies and actions centering around clean transportation (e.g., EVs and ZEVs) and enhancing travel options (e.g., public transportation, walking, bicycling) that seek to achieve an equitable transportation system.

ENGAGEMENT AND COORDINATION

Key to the development and formation of the Minnesota CRS was public and partner engagement.

PUBLIC ENGAGEMENT

Engagement gathered input on priorities and issues the public feels are important for prioritizing projects that support the reduction of carbon emissions. Specific efforts were undertaken to engage historically disadvantaged and underrepresented communities, including those identified as Justice40 communities.

Under Executive Order 140008, the Biden-Harris Administration created the federal Justice40 initiative to confront and address decades of underinvestment in disadvantaged communities. The U.S. Department of Transportation (DOT) has made it a goal that 40% of the benefits from many DOT grants, programs and initiatives, including the CRP, flow to disadvantaged communities.[15]

Public engagement was conducted in two phases (**Figure 11**).

Figure 11.
CRS public engagement phases

[15] U.S. Department of Transportation, "Justice40 at USDOT.". (May 4, 2023) https://www.transportation.gov/equity-Justice40.

PHASE 1: UNDERSTANDING PRIORITIES

The first phase of engagement focused on understanding what priorities are important to the public in order to prioritize strategies to reduce carbon emissions from surface transportation. This phase was conducted from May 1 through July 14, 2023, and involved a wide variety of activities.

Carbon Reduction Strategy website

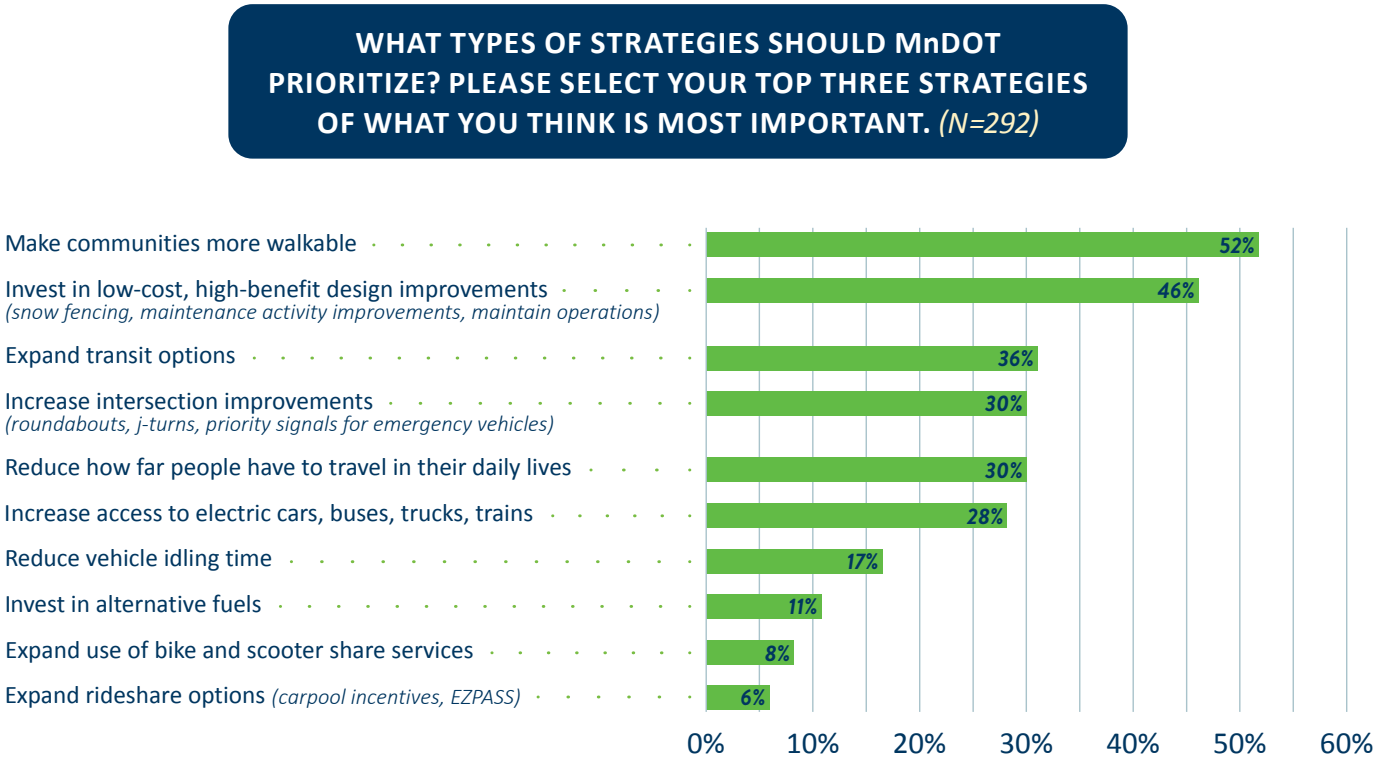
The project website was hosted on MnDOT's Let's Talk Transportation website at https://talk.dot.state.mn.us/carbon-reduction-strategy. The website went live on April 19, 2023, and included information about the CRS, an email list sign-up to stay informed, a public online survey, an online forum and a link to read more information about the Carbon Reduction Program in Minnesota.

Public online survey

A public online survey went live on May 8, 2023, and closed on July 14, 2023. The survey asked about respondents' travel methods, communities, transportation improvements, strategies for reducing carbon emissions, project considerations and demographics. There were 292 responses of which 79% said they usually drive their own vehicle to get around. When asked 'What best describes the kind of community you live in?' 45% of respondents said a 'city', while 21% said 'rural area or countryside'

Figure 12.

Survey results for question about strategies to prioritize



and 19% said a 'suburb'. Responses to questions indicate that the survey respondents were reflective of Minnesotan's primary modes of travel. Responses also indicated that the response rates for rural and suburban households were higher than urban households compared to a recent study.[16]

The survey results showed the highest priority strategies, as identified in **Figure 12** on the previous page, were to make communities more walkable, expand transit options and invest in low-cost high-benefit design improvements.

More detailed information on the survey and respondents can be found in **Appendix B**.

"Pop up" events in communities throughout Minnesota

Project staff visited six community events across the state in Brainerd, two neighborhoods in Minneapolis, North Mankato, Rochester and Saint Paul. These included markets, fairs and festivals. Staff engaged 314 people at these events. A key feature of these pop-up events was a prioritization activity where attendees could hang a decorative leaf on a miniature tree that represented which type of strategy they thought MnDOT should prioritize to reduce carbon emissions. Attendees could vote up to twice.

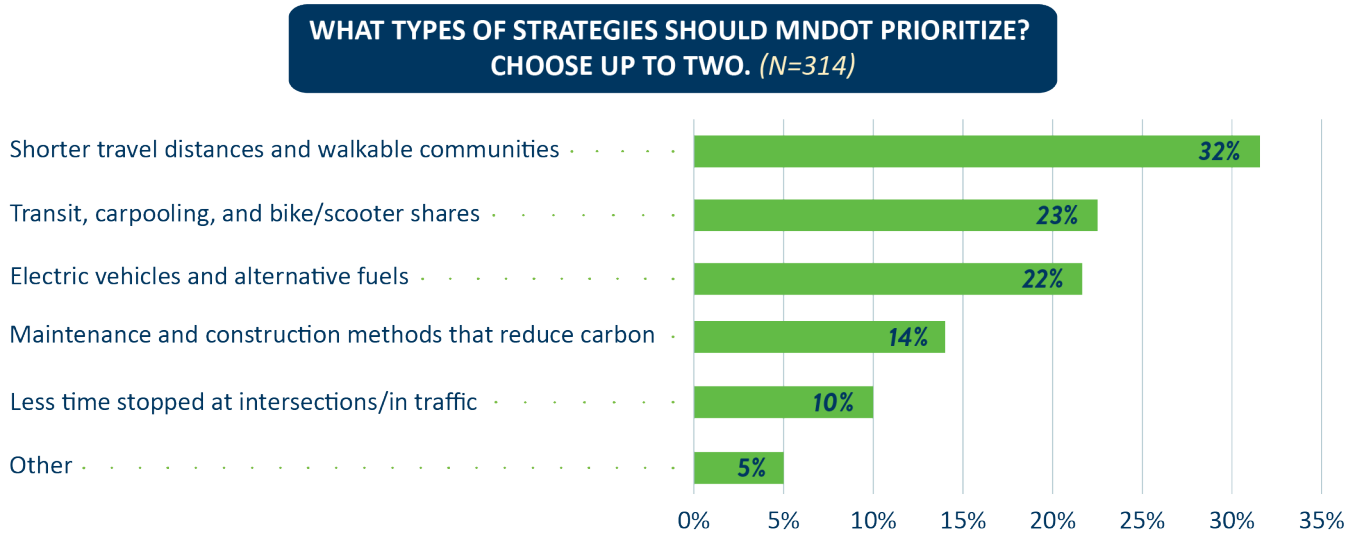
Strategies included:

- Shorter travel distances and walkable communities
- Transit, carpooling and bicycle/scooter shares
- EVs and alternative fuels
- Maintenance an construction methods that reduce carbon
- Less time stopped at intersections/in traffic
- Other

Through the prioritization exercise, the strategy type with the highest number of votes was shorter travel distances and walkable communities with 32% of the votes (see **Figure 13**).

Figure 13.

Results of prioritization activity at pop up events

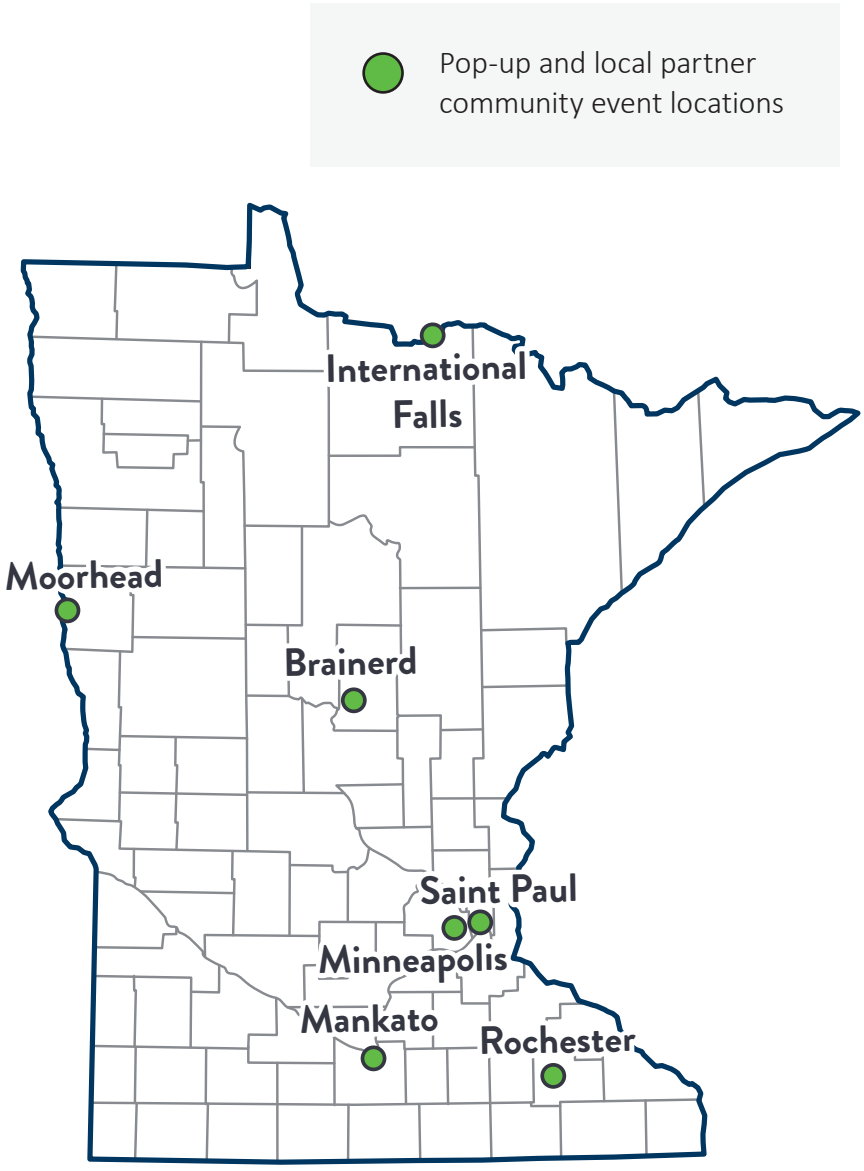


[16] Minnesota State Demographic Center, "Greater Minnesota Refined and Revisited," Department of Administration, (January 2017), https://mn.gov/admin/assets/greater-mn-refined-and-revisited-msdc-jan2017_tcm36-273216.pdf

In addition, local partners also shared information about the CRS at community events in several loations across the state, including at the Minnesota State University Moorhead Earth Day festival, the Pelican Rapids International Friendship Festival and the Saint Paul Choose How You Move Fair, as shown in **Figure 14.**

Figure 14.

Pop up and local partner community event locations, 2023



Virtual community roundtable

On June 30, 2023, the project team hosted a virtual discussion about the CRS. More than 30 organizations were invited to participate. Organizations were identified by MnDOT and transportation partners because of their work serving one or a combination of the following groups: youth, people of color, refugees, people with disabilities and low-income people. The meeting included attending representatives from ARC MN, the Minnesota Department of Education and the Governor's Office. For those organization representatives who could not attend, project information and opportunities for feedback were provided via email.

Participants of the community roundtable expressed interest in ridesharing programs, particularly in rural areas where there are not many travel options, as well as Safe Routes to School initiatives. They also expressed support for roundabouts, bicycle lanes, sidewalks, transit hubs and vanpool programs. They suggested that community colleges and community benefit offices could be possible locations for EV charging stations. Further participants recommended that land use decisions need to support more travel options (e.g., locating schools and childcare centers more centrally in communities).

Virtual public forum

From July 5 through July 14, 2023, a virtual public forum was hosted on the CRS website. A forum invitation was sent to the email list. The forum included an informational video about the purpose of the CRS, provided examples of policies and projects and shared how participants could stay informed and provide feedback. The forum also included a discussion board for questions and comments and additional context for carbon reduction efforts. There were 38 visits to the virtual forum and 3 comments and questions.

Social media

Information on the CRS was advertised through social media ads that targeted Justice40 communities via zip codes and through coordination with partner organizations.

Phase 1 takeaways

The first phase of engagement identified that the Minnesotans are generally very supportive of addressing climate change through reducing carbon emissions in the transportation sector. While there was a diversity of opinions shown through the survey, in-person input and social media, the public generally expressed support in (1) prioritizing shorter travel distances and walkable communities, (2) enhancing public transit, (3) supporting EVs and alternative fuels, (4) low-cost maintenance efforts and (4) ways to reduce time stopped at intersections.

Minnesotans shared their priorities:

"[We need] safer infrastructure for bikers and pedestrians, and more connectivity."

"Improved transit! I live and work in St. Paul. My child goes to school in St. Paul. I should be able to use transit for our daily commute…"

"Promote EV adoption and continue to build out charging infrastructure."

"Increase reliable broadband for teleworking."

"Reduce congestion."

The public also highlighted that top priorities to consider when selecting projects should be to:

- Invest in projects that increase the ability for people to get to destinations without a vehicle.
- Invest in projects that achieve the largest emissions reductions or have the lowest cost and highest benefit.
- Invest in projects that support community development.

This information helped to shape the strategies and project priorities contained in the CRS. See **Appendix B: Engagement summary** for more information on input received throughout the development of the Minnesota CRS.

PHASE 2: GATHERING FEEDBACK

The second phase of engagement focused on reviewing the strategies and project priorities in the draft CRS to gather feedback and adjust project priorities prior to finalizing the document. This phase was conducted from late August through September 2023 and included a booth at the Minnesota State Fair, a second virtual community roundtable, two virtual open houses and a second online virtual forum.

Booth at the Minnesota State Fair

MnDOT co-hosted a booth in the ECO experience at the Minnesota State Fair from August 24 through September 4, 2023 that highlighted the work occurring to reduce carbon emissions in the transportation sector. This included the work on the CRS. Fairgoers could review display boards and scan a QR code to learn more about the work MnDOT is doing to reduce carbon emissions.

Community roundtable

MnDOT hosted a virtual community roundtable on September 14, 2023 to gather feedback from invited community groups, with a focus on organizations serving disadvantaged communities including people of color, immigrants, people with different abilities and people with low incomes, as well as environmental organizations.

Participants in the roundtable noted the importance of collaboration with partners across the state. The discussion brought up the different opportunities for carbon reduction in urban and rural areas, and one participant suggested developing area specific VMT per capita reduction goals within the state. The participants discussed the idea of hierarchy of strategies and one participant suggested prioritizing VMT reduction as a core approach followed by electrification, recognizing that reduced demand also reduces emissions associated with extraction of minerals for EV batteries. Other participants noted the connections between housing and transportation and noted the needs of rural area residents, particularly persons with disabilities. This individual recommended ensuring that all charging stations are accessible, offering assistance for people with disabilities to replace gas-powered vehicles and providing lift-equipped vehicles in rural areas.

Live virtual public forum

MnDOT hosted two identical live virtual public forums. To provide a range of attendance options, the first was hosted from 6 to 7 PM on September 19, 2023 and the second was hosted from 12 to 1 PM on September 21, 2023. These events were advertised to the public and hosted on Zoom to provide an opportunity for the public to hear an update on the drafted CRS document and provide feedback. The events included a brief presentation on the CRS and were used to solicit feedback on the strategy, project priorities and implementation approach. The events together had 11 distinct log ins, some of which included multiple participants in a room together.

Feedback on priorities noted by attendees included reducing barriers to EV adoption based on access to residential charging, land use planning, highway bus rapid transit and electric school buses. Specifically, it was suggested that electric school buses be prioritized with an environmental justice lens in communities that have higher emissions. One participant expressed concern that reducing travel time prioritizes vehicle travel and asked about system improvements for other modes.

Self-paced virtual public forum

Further, MnDOT hosted a self-paced virtual public forum on the CRS website. The self-paced forum allowed people to review the content from the live virtual public forum at their convenience and provide comments. A recorded presentation providing highlights of the CRS and a feedback form for comments were posted to the website. The self-paced virtual public forum was open for comments from September 19, 2023 through September 29, 2023. No comments were received during this time.

Phase 2 takeaways

The engagement identified that those who reviewed the draft strategy were generally supportive of the prioritized strategies and expressed interest in ensuring that carbon reduction strategies help historically disadvantaged populations. Individual participants wanted to ensure strategies meet the needs of people in urban and rural areas and expressed particular support for expanding travel options to reduce driving. Participants also appreciated the collaborative focus of the CRS on working across transportation partners. This information helped to validate and refine strategies and project priorities contained in the Minnesota CRS. See **Appendix B: Engagement summary** for more information on input received throughout the development of the Minnesota CRS.

COORDINATION WITH PARTNERS

MnDOT engaged partners and MnDOT staff through several advisory groups and external meetings to guide the development of the CRS. Coordination with partners was critical to inform the identification and selection of priority strategies and project types, as well as develop the implementation approach for the CRP.

See **Appendix A: Acknowledgements** for members of the many individuals who participated on committees to provide input on the Minnesota CRS.

MnDOT Carbon Reduction Strategy management team (PMT)

Starting in April 2023, the PMT met monthly to provide input, feedback and engagement support through the development of the CRS. The PMT helped prioritize categories, strategies and project types to include in the CRS. Further, the PMT provided guidance on how Minnesota can implement the CRS, which included considering the role of transportation investments and priorities beyond CRP funds.

Members also provided input to shape the public engagement strategy and shared information within their communication networks to spread the word about the CRS development. Membership on the PMT included representatives from MnDOT, MPCA, MPOs, Regional Development Organizations (RDOs) and non-governmental organizations.

Carbon Reduction Program (CRP) subgroup

The CRP Subgroup is a MnDOT workgroup that focuses on reviewing and providing guidance to the Climate and Resilience Workgroup (CRW) on how to program the federal CRP funds. The CRP Subgroup supported the engagement and development of the CRS through review and guidance on policy and programming

direction. Members also shared information within their communication networks to spread the word about the CRS development.

Membership on the CRP Subgroup includes representatives from MnDOT, the Minnesota Department of Employment and Economic Development (DEED), MPOs, RDOs, rural and urban counties and cities, a Tribal government, FHWA, the I-494 Corridor Commission, the University of Minnesota, the private sector and non-profit sector.

Climate and Resilience Workgroup (CRW)

The CRW is a MnDOT workgroup that provides guidance and recommendations on climate and resilient transportation programming in Minnesota. Their focus is to review recommendations from the CRP Subgroup, Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Subgroup and EV Subgroup. The CRW then makes recommendations to the Transportation Programming and Investment Committee (TP&IC).

Members reviewed the CRS engagement approach and were engaged through discussions on the CRS categories, strategies and project type approach. The CRW was asked to provide input and direction on the implementation of the CRS across funding programs beyond the CRP funds. The CRW also provided direction on the CRP distribution formula in Minnesota. Further, members also shared information within their communication networks to spread the word about the CRS development.

Membership on the CRW includes representatives from MnDOT, MPCA, MPOs, rural and urban counties and cities, a Tribal government, FHWA, the University of Minnesota, the private sector and non-profit sector.

Regional partners

Regional partners include MPOs, RDOs and ATPs, which play a lead role in transportation planning and investment decisions.

METROPOLITAN PLANNING ORGANIZATIONS (MPOs)

MPO engagement included meeting and presenting to each Policy Board in the month of June 2023. The engagement surrounded how and what to prioritize for carbon reduction at a high-level and strategy-level. Presentations were conducted virtually to reduce the carbon emissions impact of attending all 8 meetings throughout Minnesota. Further engagement also occurred by presenting to and asking for feedback on the CRP and CRS at the May 2023 MPO Directors Meeting and the August 2023 MPO Summer Workshop.

Additional presentations and conversations with MPO committees occurred as requested.

Each MPO is represented on the CRP Subgroup. There are two representatives for MPOs on the CRS PMT.

REGIONAL DEVELOPMENT ORGANIZATIONS (RDOs)

RDO engagement included meeting and presenting virtually at the May 2023 Quarterly RDO meeting and August 2023 Quarterly RDO meeting. Additional presentations and conversations with RDO committees occurred as requested. The engagement focused on how and what to prioritize for carbon reduction at a high-level and strategy-level. Presentations were conducted virtually to reduce the carbon emissions due to travelling throughout Minnesota.

RDOs are represented on the CRP Subgroup and the CRS PMT.

AREA TRANSPORTATION PARTNERSHIPS (ATPs)

Beginning in November 2022, MnDOT began attending ATP meetings virtually. The purpose of the meetings was to educate local jurisdictions on the CRP funding opportunity and discuss how the ATPs could program fiscal year 2023 and fiscal year 2024 CRP funds. Ongoing coordination with ATPs and local jurisdictions occurred through ATP meetings and individual conversations and emails.

As the CRS kicked off in late March 2023, engagement throughout summer and early fall 2023 focused on strategy-level and project type-level preferences and feedback. ATP members were also asked for input on the CRP funding distribution for fiscal year 2025 and beyond in September 2023. Comments and feedback were considered and incorporated when applicable into the CRS.

ATP members are represented by MnDOT State Aid staff and greater Minnesota county and city representatives on the CRS PMT, CRP Subgroup and CRW.

State agencies

MnDOT engaged with other State agencies through the CRS development, both directly and through the CRS PMT. Specifically, the MPCA provided input and support on the GHG emissions inventory and Minnesota emissions values for different activities. Cross-agency collaboration on GHG emissions reduction is occurring through the Minnesota Office of Enterprise Sustainability and Climate Action Framework workgroups.

Tribal governments

For development of the CRS, MnDOT coordinated with Tribal Nations through government-to-government relations. Tribal Nations were engaged through the Area Transportation Partnership process and through coordination with the Regional Development Organization contacts throughout the state. Per Minn. Statute 10.65, Executive Order 19-24, and MnDOT Tribal Nations Policy, MnDOT must consult and coordinate with Tribal Nations on topics of tribal interest. In accordance with those requirements, MnDOT will pursue coordination efforts, in a timely and meaningful manner, on CRS development and beyond the completion of the 2023 Minnesota CRS, over the next few years in anticipation of the implementation steps and updates to the Minnesota CRS.

CHAPTER 4

WHAT STRATEGIES WILL GUIDE MNDOT AND PARTNERS TO REDUCE TRANSPORTATION CARBON EMISSIONS?

Building on existing policy documents and strategies, public and partner engagement refined the direction of the Minnesota Carbon Reduction Strategy. The CRS identifies a set of priority categories, key transportation strategies and supportive project types for investment and implementation to reduce carbon emissions from surface transportation in Minnesota.

MnDOT, MPOs and local jurisdictions will use the Minnesota CRS as a guide to plan, select, fund and implement projects across state and federal funding sources in Minnesota.

STRATEGIES AND HOW THEY WERE PRIORITIZED

As shown through previous work in Pathways, Minnesota Climate Action Framework and SMTP, significant efforts across many strategy areas are needed to decarbonize transportation. MnDOT and transportation partners in Minnesota play an important role in achieving carbon emissions reduction goals but are only part of the picture. Many strategies that are critical to decarbonizing transportation involve policy and regulatory actions. Examples of these types of strategies include:

- Establishing clean car vehicle standards, such as Clean Cars Minnesota
- Implementing a statewide clean fuel standard or incentives for higher biofuel blends
- Amending state building codes to support accessible EV charging
- Providing point-of-purchase rebates for new and used EVs
- Providing e-bicycles or e-bike rebates and incentives
- Implementing land use policies that encourage compact, infill and transit-oriented development (e.g., zoning, land use, parking policies)

The CRS focuses on strategies and project type investments that can be funded and implemented as of November 2023 by MnDOT and partners through federal transportation funding sources (e.g., Carbon Reduction Program funds, Transportation Alternatives funds, Surface Transportation Block Grants) and state transportation funding sources (e.g., Active Transportation, Safe Routes to School). The Minnesota CRS is one part of Minnesota's commitment and work toward decarbonizing the transportation sector (**Figure 15**).

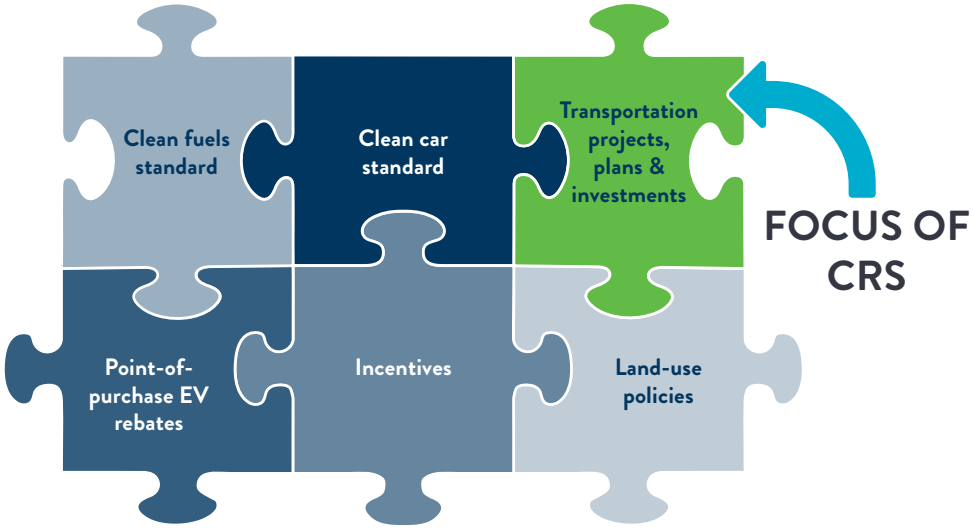


Figure 15.
The strategies and projects in the CRS are one piece of an overarching and comprehensive effort to decarbonize surface transportation, MnDOT 2023

CATEGORIES

The CRS is organized into three overarching categories. Each category has subsequent supportive strategies and associated project types.

ELECTRIFICATION

Decarbonization of the transportation fleet is critical to achieve climate goals. Transitioning vehicle fleets (public and private) to EVs is necessary to achieve deep reductions in carbon emissions from surface transportation.

TRAVEL OPTIONS

Increasing the availability and use of alternatives to single occupancy vehicles reduces individuals' motor vehicle emissions. Travel options also support many transportation goals related to access, mobility, safety and equity.

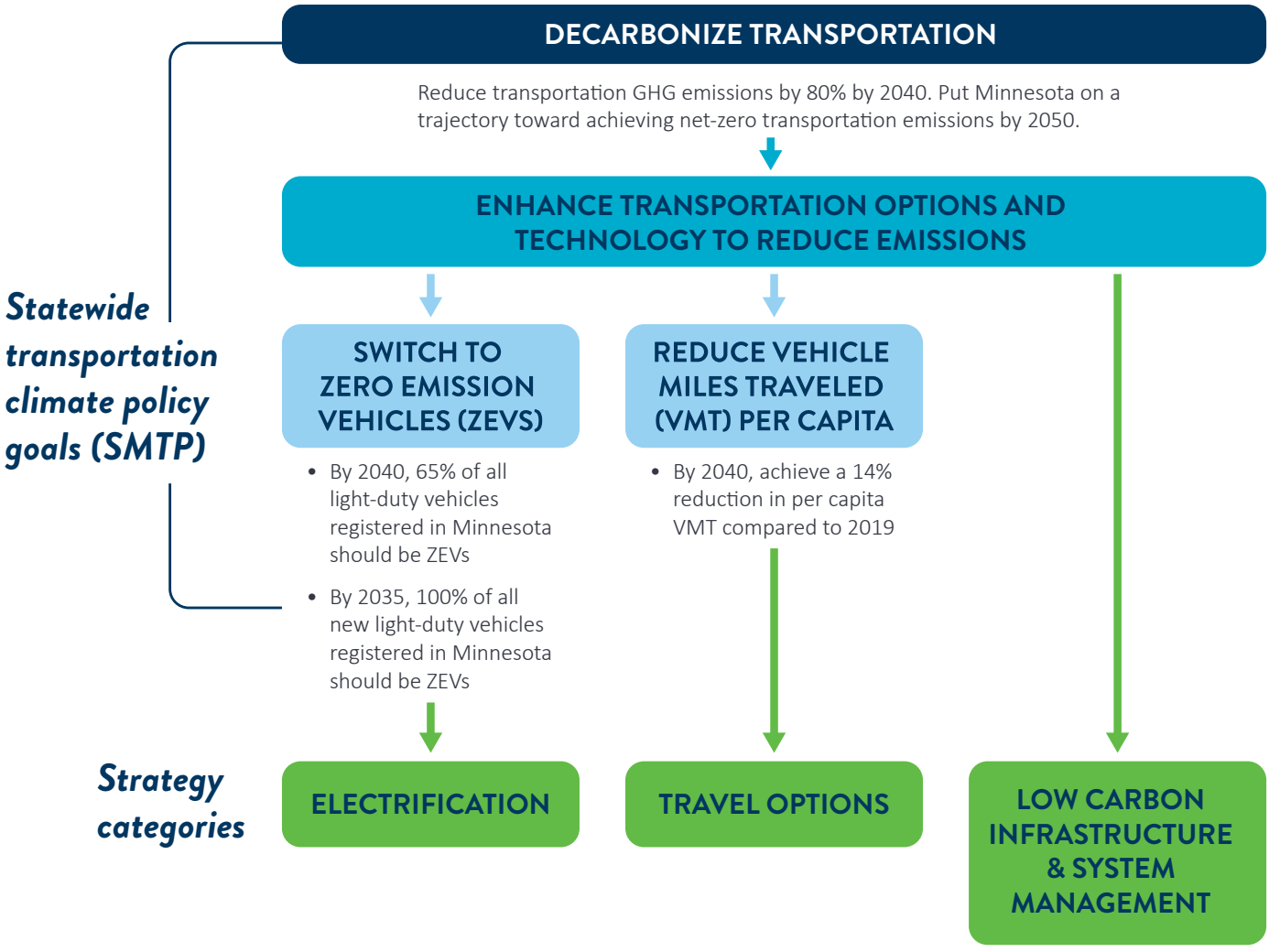
LOW CARBON INFRASTRUCTURE AND SYSTEM MANAGEMENT

Low carbon materials, construction and maintenance practices, natural vegetation and system operations practices help to reduce emissions associated with transportation infrastructure and vehicle operations.

Electrification, Travel Options and Low Carbon Infrastructure and System Management directly support SMTP objectives and targets (**Figure 16**). Electrification supports the policy targets established for increasing ZEVs. Travel Options supports targets established to reduce VMT per capita. Low Carbon Infrastructure and System Management plays a supporting role by addressing carbon emissions from the construction and maintenance of transportation infrastructure and vehicle operations, which relate to system stewardship.

Figure 16.

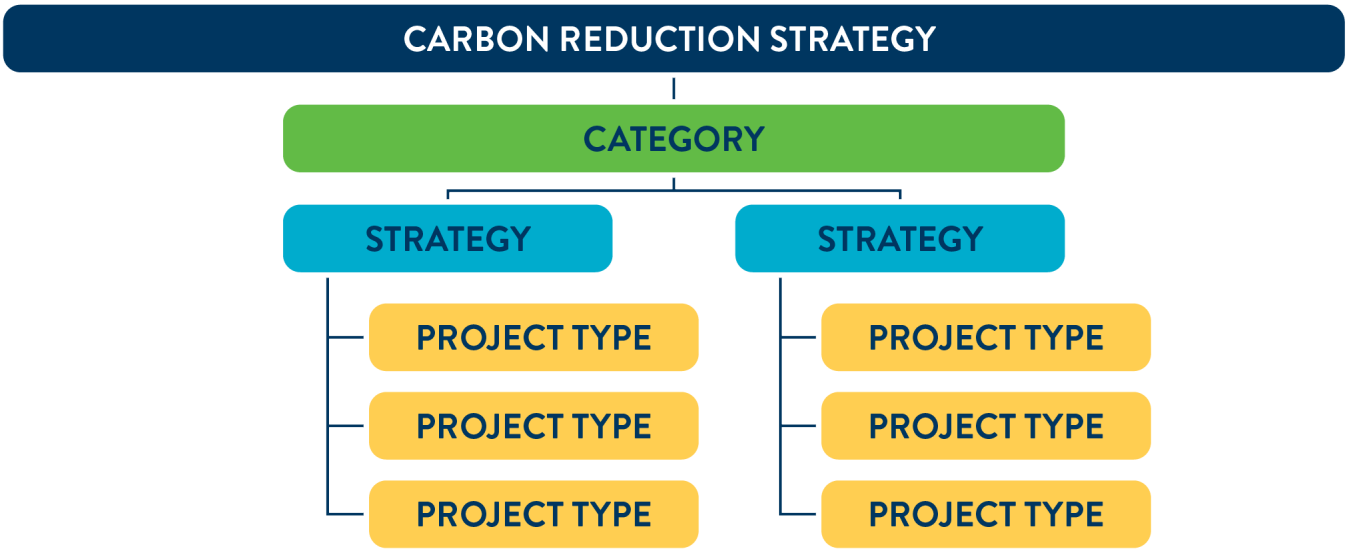
Connection between Minnesota Policy Goals and the Carbon Reduction Strategy



Within each of these categories, the CRS identifies a set of strategies and project types that have been identified as priorities through the CRS development and engagement process (**Figure 17**).

Figure 17.

Correlation between CRS's categories, strategies and project types, MnDOT 2023



CRITERIA USED TO PRIORITIZE PROJECT TYPES

Project types included in the CRS were prioritized based on criteria that are important to Minnesotans (see **Appendix B: Engagement summary** for details on public and partner engagement feedback). **Table 1** shows each of the criteria, along with a description of the criteria and why it was included in the prioritization process. The CRS PMT and other partners were engaged to qualitatively assess different types of projects across these criteria to support identification of high priority project types for funding consideration. These priorities serve as a guide to MnDOT and partners when considering projects.

Table 1.

Criteria used to support identification of high priority project types, 2023

Criteria	Description	Why is it included
EMISSIONS REDUCTION POTENTIAL	How much carbon emissions reduction can generally be achieved for this type of project	Relates to overall goal of CRS and SMTP objectives
COST	How expensive is the type of project generally in terms of requirements for public funds	Limited funding requires consideration of cost
IMPLEMENTATION EASE	How easy or difficult is the project type to implement, from a technical and/or political standpoint	Implementation challenges could delay achievement of emission reductions
TIME	How quickly can the type of project generally be implemented and begin to achieve emissions benefits	Carbon emissions are cumulative and near-term reductions offer benefits
RESILIENCY	To what extent does this type of project enhance transportation system resiliency	SMTP objectives
SAFETY	To what extent does this type of project enhance traveler safety (i.e., reduce fatalities and serious injuries)	SMTP objectives
EQUITY	To what extent does this project type offer the potential to support historically disadvantaged or vulnerable populations	SMTP objectives, Justice40 requirement

Figure 18 illustrates the correlation between the three categories and their subsequent strategies. The following sections in chapter 4 further detail the priority strategies and project types within each category.

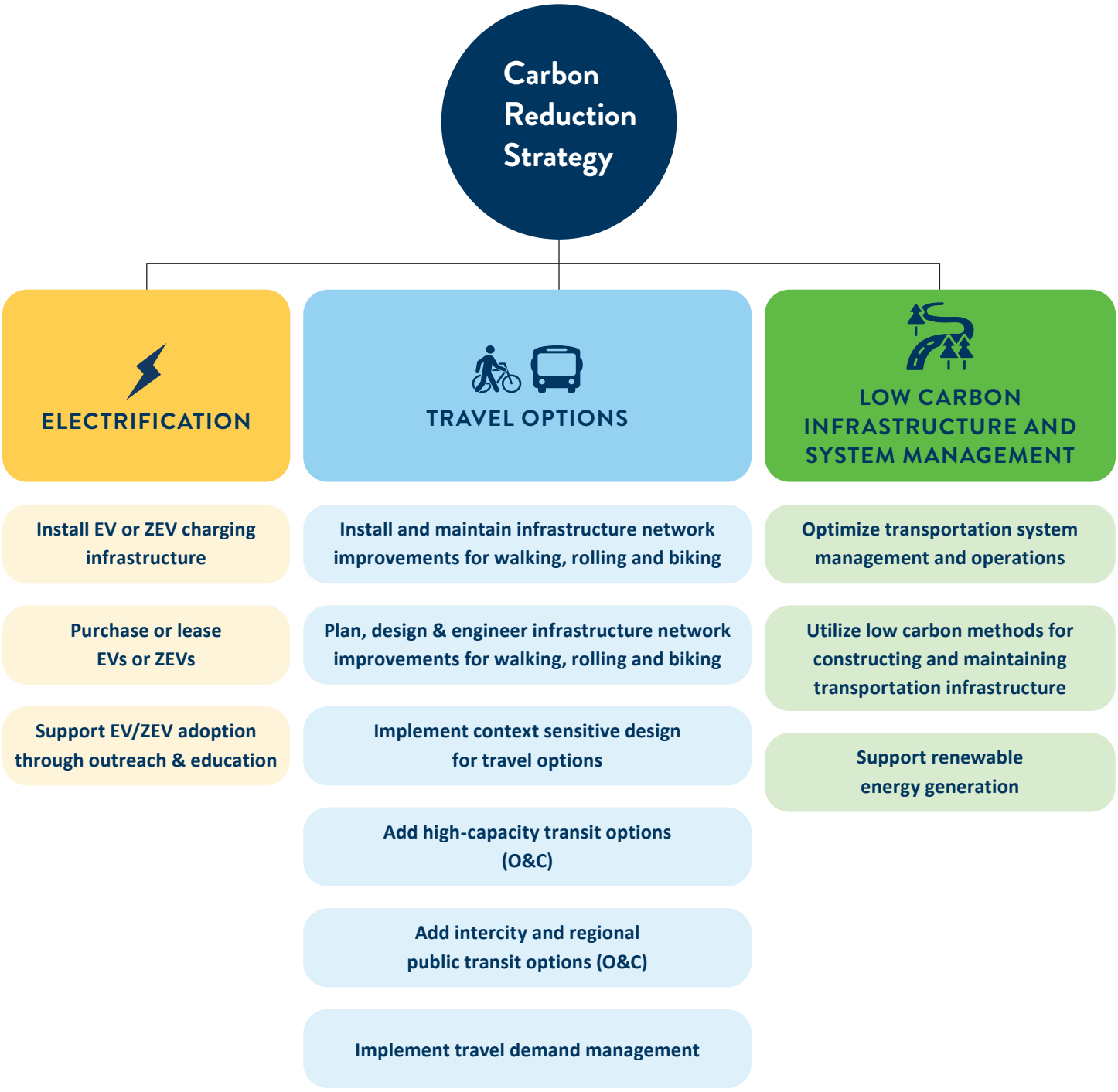


Figure 18.
2023 Minnesota CRS categories and associated strategies, MnDOT 2023

ELECTRIFICATION

Electrification of the transportation system is proven to reduce transportation carbon emissions. Pathways, the Framework and SMTP have identified electrification as a primary way to reduce carbon emissions in Minnesota. For purposes of the CRS, the electrification category includes efforts to replace conventionally fueled (e.g., fossil fuel) vehicles with vehicles that emit zero tailpipe emissions, including battery electric vehicles and fuel cell vehicles powered by hydrogen. Shifts to alternative fuels (e.g., compressed natural gas (CNG), propane, biofuel blends) also can play a role in carbon reduction and the overall transition of vehicle fleets. However, the overarching strategy is to prioritize ZEVs.

Electrification includes three transportation investment strategies:

- Install EV or ZEV charging infrastructure.
- Purchase or lease EVs or ZEVs.
- Support EV and ZEV adoption through outreach and education.

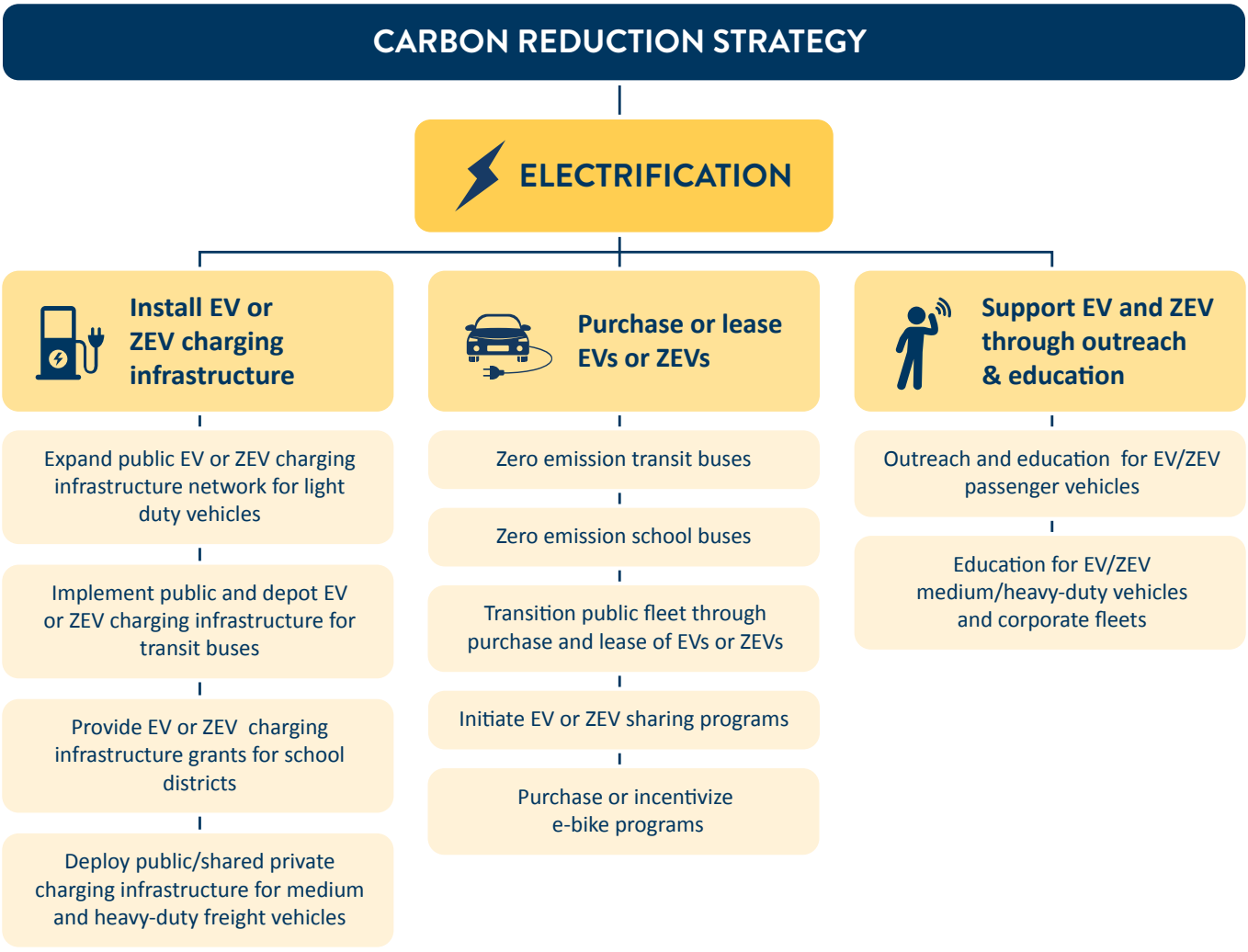


Figure 19.
2023 Minnesota CRS Electrification priority strategies and project types, MnDOT 2023

INSTALL EV OR ZEV CHARGING INFRASTRUCTURE

Installation of EV charging infrastructure promotes the adoption of EVs by addressing range anxiety and providing the necessary convenience for EV owners. Convenience helps facilitate a shift from fossil fuel-based vehicles to EVs and ZEVs. This transition helps reduce carbon emissions as EVs emit no tailpipe pollutants and, when charged with energy from renewable sources, contribute significantly less to overall greenhouse gas emissions.

Four priority project types associated with installation of EV charging infrastructure strategy include:

- Expand public EV or ZEV charging infrastructure network for light duty vehicles.
- Implement public and depot EV or ZEV charging infrastructure for transit buses.
- Provide EV or ZEV charging infrastructure grants for school districts.
- Deploy public or shared private charging infrastructure for medium and heavy-duty freight vehicles.

PURCHASE OR LEASE EVS OR ZEVS

Transportation funds may be used to help agencies purchase or lease EVs or other ZEVs to replace diesel or other fossil-fueled vehicles. With zero tailpipe emissions, the EVs or other ZEVs result in an immediate reduction in carbon emissions when used in place of conventionally fueled vehicles.

Five project types have been identified as priorities under the purchase or lease of EVs or other ZEVs strategy:

- Zero emission transit buses.
- Zero emission school buses.
- Transition public fleet (e.g., vehicles operated by municipalities, such as police vehicles or fleet vehicles) through purchase or lease of EVs or ZEVs.
- Initiate EV or ZEV sharing programs (e.g., making EVs or ZEVs accessible to more people without the commitment of ownership)
- Purchase or incentivize e-bike programs.

SUPPORT EV AND ZEV ADOPTION THROUGH OUTREACH AND EDUCATION

Transportation funds may be used to develop outreach and educational materials that help tell transportation users the benefits of purchasing an EV or ZEV. Educational campaigns are similarly used to encourage transportation users to drive in a safer manner or to use travel options other than driving alone for their work commute.

This strategy includes two primary project types:

- Outreach and education for EV or ZEV passenger vehicles.
- Outreach and education for EV or ZEV medium-duty and heavy-duty vehicles and corporate fleets.

ADDITIONAL STRATEGIES

In addition to these transportation investments, policies that support electrification and shifts to alternative fuels have been identified as important components of an overall statewide strategy to reduce carbon emissions. Some examples include:

- Rulemaking to adopt clean car vehicle standards.
- Amending state building code to support accessible EV charging.
- Making new construction and commercial buildings EV-ready.
- Clean vehicle initiatives, such as:
  - Providing point-of-purchase rebates for new and used EVs.
  - Developing dealer and salesperson recognition and incentive programs.
  - Developing a marketing campaign to improve consumer understanding of EVs.
  - Creating income-based car swap programs to replace oldewr vehicles.

In addition, related actions include consideration of a clean fuels standard to incentivize increased investment in a broad portfolio of cleaner fuels, including advanced biofuels, renewable natural gas and other renewable fuels.

TRAVEL OPTIONS

Increasing the availability, safety, reliability and convenience of travel options, such as walking, rolling, bicycling or taking transit, can encourage people to shift or swap trips previously taken by car. Having travel options also reduces individual travel costs and supports more equitable access to amenities, since these travel options do not require owning a private vehicle. Options such as telecommuting, taking shorter trips or combining errands to reduce VMT can also support carbon reduction by reducing driving that produces emissions. Travel options that increase capacity per vehicle (e.g., transit, rideshare) reduce carbon emissions in relation to the amount of reduced vehicle travel.[17]

Pathways, the Framework and SMTP have identified "mode shift" from driving alone to other travel option as a primary method for reducing emissions in Minnesota. Partner and public engagement strongly supported walking, bicycling and transit options as a category.

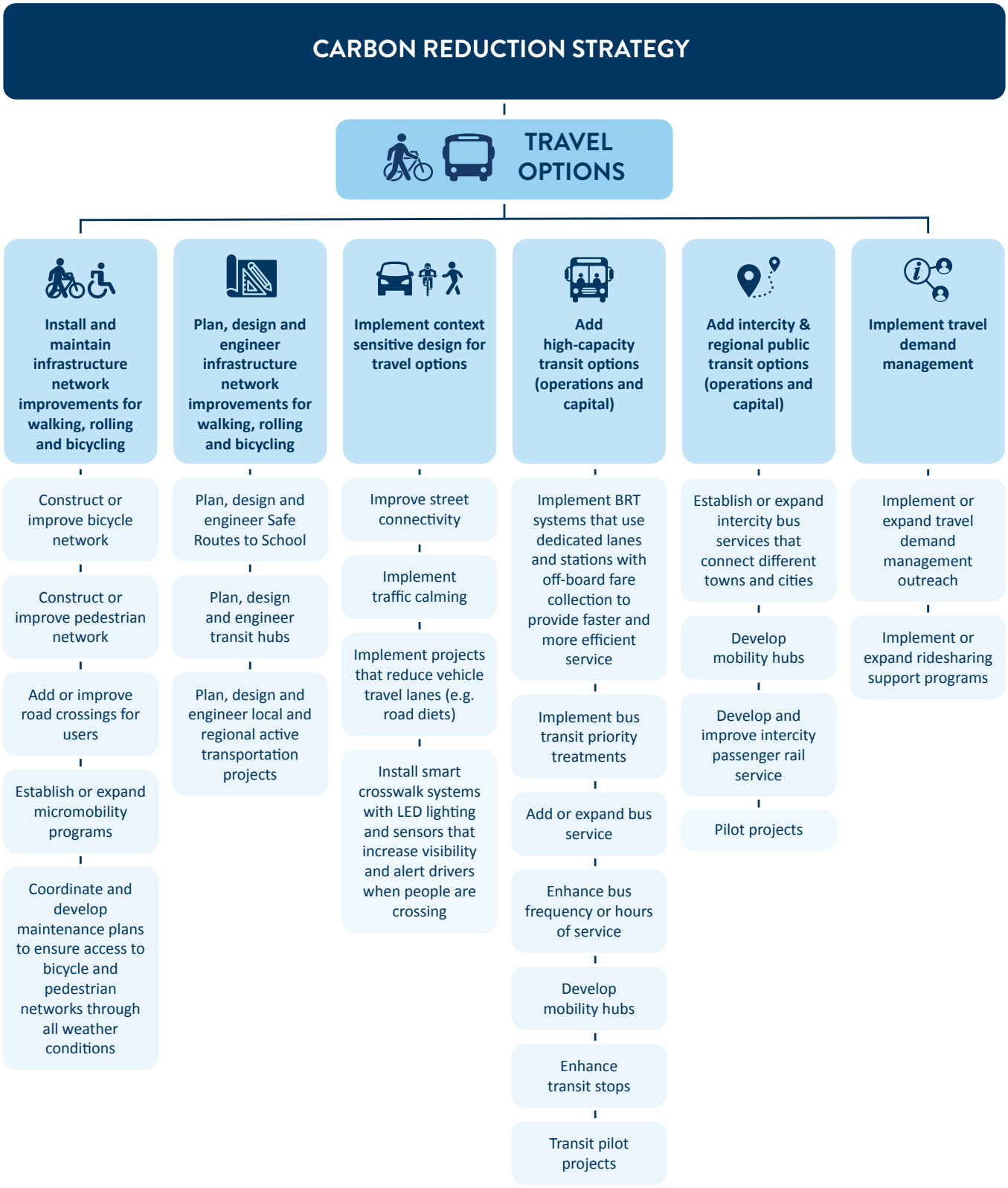
Travel Options identifies six transportation investment strategies:

- Install and maintain infrastructure network improvements for walking, rolling and bicycling.
- Plan, design and engineer infrastructure network improvements for walking, rolling and bicycling.
- Implement context sensitive design for travel options.
- Add high-capacity public transit options (operations & capital).
- Add intercity and regional public transit options (operations & capital).
- Implement travel demand management approaches and infrastructure.

[17] An example is that one person driving alone for 50 miles creates 0.018 metric tons of carbon emissions. If that person drives 2 other people that would normally drive alone for 50 miles, the carpool has reduced about 0.036 metric tons of carbon (0.018 metric tons per trip times two eliminated vehicle trips), compared to if each person drove alone.

Figure 20.

2023 Minnesota CRS Travel Options priority strategies and project types, MnDOT 2023



INSTALL AND MAINTAIN INFRASTRUCTURE NETWORK IMPROVEMENTS FOR WALKING, ROLLING AND BICYCLING

Improving the network for walking, rolling and bicycling involves creating safe, efficient and interconnected routes to meet people's needs. These enhancements encourage active and sustainable mobility, resulting not only in a decrease in carbon emissions but also improving public health, safety and community vitality.

Five project types have been identified under installation of infrastructure network improvements for walking, rolling and bicycling strategy as priorities:

- Construct or improve bicycle network (e.g., add on-street bike lane, add protected bike lanes or separated bikeway, shared use paths, trails).
- Construct or improve pedestrian network (e.g., add sidewalks, expand sidewalks, fill gaps in sidewalk network, shared use paths, trails).
- Add or improve road crossings for users (e.g., add intersection crosswalks, add a pedestrian refuge island).
- Establish or expand micromobility programs (e.g., bicycle sharing stations, scooter sharing program).
- Coordinate and develop maintenance plans to ensure access to bicycle and pedestrian networks through all weather conditions.

PLAN, DESIGN AND ENGINEER INFRASTRUCTURE NETWORK IMPROVEMENTS FOR WALKING, ROLLING AND BICYCLING

Planning for walking, rolling and bicycling infrastructure network improvements involves assessing needs of current facilities, identifying gaps and proposing enhancements to foster a safe, efficient and interconnected mobility network.[18] This planning aims to determine what types of improvements are needed to support active modes of transportation to reduce carbon emissions and support other goals (e.g., improving accessibility, enhancing public health). Designing and engineering for walking, rolling and bicycling infrastructure network improvements involves developing plans into implementable projects.

Three project types have been identified as priorities under this strategy:

- Plan, design and engineer Safe Routes to School (e.g., develop a plan into design- and engineering-level to support non-motorized access to schools).
- Plan, design and engineer transit hubs (e.g., develop a plan into design- and engineering-level to support network improvements to enhance access to transit hubs).
- Plan, design and engineer local and regional active transportation projects (e.g., develop a plan into design- and engineering-level to support local or regional areas for walking, rolling and bicycle improvements and implementation).

[18] Note that planning, designing and engineering do not directly yield emissions reductions until infrastructure network improvements are implemented. Consequently, calculating the emissions reduction benefits would identify anticipated emissions reduction if the network improvements were installed. No separate emissions reduction calculation methodologies would be developed for the planning, designing or engineering activity.

IMPLEMENT CONTEXT SENSITIVE DESIGN FOR TRAVEL OPTIONS

Context sensitive design involves adjusting the design of transportation infrastructure to enhance the safety of people. Designs should reflect and be respectful of the local built, natural and cultural context. Through this process the roadway should reflect the goals of people who live, work and travel in the area. This strategy involves use of complete streets, context sensitive design and Safe System approaches to prioritize the development of travel options that are not only effective in meeting mobility needs and improving safety but also enhance the quality of life.

Four project types have been identified as priorities under the context sensitive design for travel options strategy.

- Improve street connectivity (e.g., increasing vehicle intersection density allowing shorter and more efficient trips between destinations, reducing travel times and congestion).
- Implement traffic calming (e.g., narrower crossings, narrower streets, speed bumps, signage).
- Implement projects that reduce vehicle travel lanes (e.g., road diets).
- Install smart crosswalk systems with LED lighting and sensors that increase visibility and alert drivers when people are crossing.

ADD HIGH-CAPACITY PUBLIC TRANSIT OPTIONS (OPERATIONS & CAPITAL)

Adding high-capacity public transit options involves expanding or implementing transit systems (e.g., buses, trams, trains) that can accommodate a large number of passengers. This enhances the overall transit capacity for local and intra-regional travel. These operations and capital investments provide efficient trips and reduce traffic congestion which also contribute to lower per-capita carbon emissions.

Seven project types have been identified as priorities under the add high-capacity public transit options (operations and capital) strategy.

- Implement Bus Rapid Transit (BRT) systems that use dedicated lanes and stations with off-board fare collection to provide faster and more efficient service.
- Implement bus transit priority treatments (e.g., transit signal priority to reduce travel time and enhance reliability, bus only lane infrastructure improvements).
- Add or expand bus service (e.g., new routes, on-demand service, expanded coverage area).
- Enhance bus frequency or hours of service.
- Develop mobility hubs (e.g., stations that connect high-capacity transit routes, stations that connect to shared mobility and micromobility options, transit stations that include park and ride facilities to encourage commuters to leave vehicles and use transit).
- Enhance transit stops (e.g., add benches, shelters, lighting, heat).
- Transit pilot projects (e.g., on-demand service to test feasibility in an area, re-routing projects).

ADD INTERCITY AND REGIONAL PUBLIC TRANSIT OPTIONS (OPERATIONS & CAPITAL)

Adding intercity and regional public transit options entails introducing or expanding services (e.g., regional trains, buses, shuttles) that connect different cities or regions. These operational and capital investments improve connectivity, reduce reliance on personal vehicles for long-distance travel and contribute to a decrease in carbon emissions. They can also increase the economic resilience of an area by providing travel options that expand workforce and healthcare opportunities.

Four project types have been identified as priorities under the add intercity and regional public transit options (operations and capital) strategy.

- Establish or expand intercity bus services that connect different towns, cities and regions.
- Develop mobility hubs (e.g., stations that connect transit routes to other travel options and between regions considering land use and amenities, stations that include park and ride facilities to encourage commuters to leave vehicles and use transit).
- Develop and improve intercity passenger rail service.
- Pilot projects (e.g., integrated ticketing system that allows passengers to use multiple types of regional and intercity public transit with a single ticket or pass).

IMPLEMENT TRAVEL DEMAND MANAGEMENT

Travel demand management (TDM) is designed to support the use of higher occupancy vehicles and non-driving travel options through policies, communications, education, programming, incentives and pricing models. Whereas other strategies under Travel Options focus on providing services or infrastructure to improve the availability, access and quality of travel options, TDM focuses on information, services, and incentives to support traveler behavior and travel decisions that reduce peak demand of roadway use.

TDM can encompass a wide range of actions that increase vehicle occupancy, reduce VMT by shifting modes or shifting travel times to less congested times (e.g., alleviating congestion). Each of these actions reduce carbon emissions.

Two project types have been identified as priorities under this strategy.

- Implement or expand travel demand management outreach (e.g., employer outreach, public outreach and education).
- Implement or expand ridesharing support programs (e.g., ride matching software and technology, carpooling incentives, guaranteed ride home programs).

ADDITIONAL STRATEGIES

Beyond transportation planning and investments, land use and development play a key role in how, when and why people travel. Transportation agencies like MnDOT do not have a lead role in how land is used and developed but recognize the critical role land use decisions made by local governments have in shaping travel patterns.

Thetemphasizes the importance of integrating transportation and land use decision-making. Examples of land use policies that encourage compact development and support transit, walking, rolling and bicycling include:

- Updates to zoning requirements to promote infill development and increasing density around transit and support walking, rolling and bicycling,
- Requirements for developers to include infrastructure and amenities that support travel options, and
- Urban design standards and adjustments to parking requirements.

Other types of policies such as VMT-based pricing and ordinances for employers to reduce vehicle trips at worksites can also play a role in reducing VMT.

The 2023 Minnesota CRS development process identified several additional Travel Option project types that can reduce carbon emissions. However, they were not identified as priority implementation project types, but may become priorities in the future. More work needs to be done before the CRS is updated to determine the priority of these project types in Minnesota.

- Construct new light rail lines or expand existing ones.
- Develop integrated fare payment systems for various modes of transportation.
- Develop or expand commuter rail services (e.g., to connect suburban areas with city centers).
- Implement dynamic road pricing, where fees vary based on the current level of congestion.
- Coordinate with regional TDM action plans and programs.
- Develop technical assistance programs for TDM implementation.

LOW CARBON INFRASTRUCTURE AND SYSTEM MANAGEMENT

Transportation infrastructure must be maintained and operated, and when new infrastructure is being constructed (e.g., roads, transit stations, bicycle or pedestrian connections, facilities) transportation agencies can play a role in reducing carbon emissions associated with these activities. Low carbon infrastructure reduces the amount of carbon emissions associated with the construction and maintenance of transportation infrastructure. It also includes efforts to remove carbon from the atmosphere through the use of green infrastructure (e.g., trees, vegetation, carbon sinks). System management addresses how transportation agencies operate the transportation system to optimize system performance and reduce unnecessary idling to reduce motor vehicle emissions.

While not emphasized in Pathways, the Framework and SMTP as a key climate change strategy, these strategies support carbon reduction and other statewide transportation objectives related to transportation safety, system stewardship and critical connections. The SMTP includes, for instance, actions under these objectives to:

- Minimize environmental impacts and lower lifecycle costs through the reuse of materials and use of innovative new materials and techniques.

- Review planned maintenance and reconstruction projects to identify cost-effective opportunities to improve safety, manage congestion and improve travel options.
- Promote pollinator habitat, native plantings and trees within transportation right-of-way.
- Integrate green infrastructure practices into transportation projects and facilities.
- Use technology for system optimization for all modes.

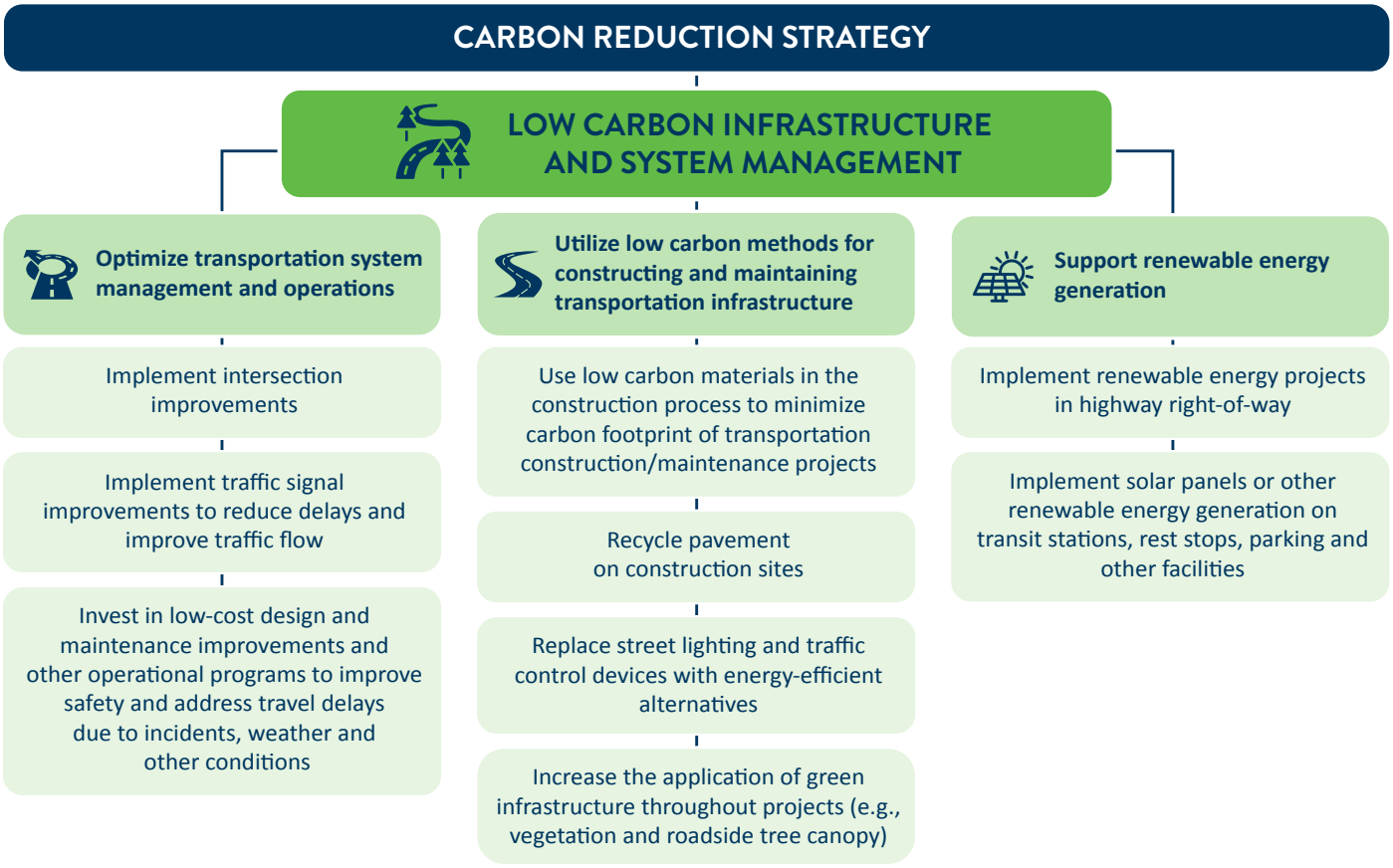
Additionally, partner and public engagement supported this as a category. For instance, in the public survey, "Invest in low-cost, high benefit design improvements (snow fencing, maintenance activity improvements, maintain operations)" and "Increase intersection improvements (roundabouts, j-turns, priority signals for emergency vehicles)" were two of the four strategies rated highest in importance for MnDOT to prioritize. These were rated third and fourth behind strategies related to making communities more walkable and expanding transit options.

Low Carbon Infrastructure and System Management identifies three transportation investment strategies:

- Optimize transportation system management and operations.
- Utilize low carbon methods for constructing and maintaining transportation infrastructure.
- Support renewable energy generation.

Figure 21.

2023 Minnesota CRS Low Carbon Infrastructure and System Management priority strategies and project types, MnDOT 2023



OPTIMIZE TRANSPORTATION SYSTEM MANAGEMENT AND OPERATIONS

This strategy focuses on opportunities to improve transportation system performance by improving travel time reliability, enhancing safety and reducing travel delays. Conventional motor vehicles are less fuel efficient and produce more carbon emissions during stop-and-go traffic compared to smoother traffic flow and when idling (producing emissions without moving). Moreover, heavy-duty trucks contributed nearly one-quarter of the greenhouse gas emissions from motor vehicles in 2020 in Minnesota and improving system operations can help to reduce emissions from these vehicles, which are difficult to address through other strategies.

Three project types have been identified as priorities under the optimize transportation system management and operations strategy.

- Implement intersection improvements (e.g., roundabouts, turn lanes).
- Implement traffic signal improvements to reduce delays and improve traffic flow (e.g., adaptive traffic signal systems that adjust signal timings based on real-time traffic conditions, signal coordination).
- Invest in low-cost design and maintenance improvements and other operational programs to improve safety and address travel delays due to incidents, weather and other conditions (e.g., snow fencing, maintenance activity improvements, enhanced incident management).

While many members of the public who provided input expressed the importance of addressing traffic congestion and reducing unnecessary delay, there were also concerns expressed by some that efforts to enhance traffic flow could work against GHG reduction goals by facilitating more vehicle travel. Transportation agencies should look at the context of specific projects, emphasize context-specific improvements and focus on low-cost solutions that reduce delays due to crashes, weather and poorly timed traffic signals. These strategies will not only reduce GHG emissions but also improve safety.

UTILIZE LOW CARBON METHODS FOR CONSTRUCTING AND MAINTAINING TRANSPORTATION INFRASTRUCTURE

Using more sustainable transportation infrastructure focuses on reducing the lifecycle emissions associated with materials used in construction and maintenance of transportation infrastructure. This strategy also involves reducing carbon emissions associated with energy used by transportation assets (e.g., street lighting, construction equipment). It includes using green infrastructure (e.g., adding roadside tree canopy and shrubs, which are proven to absorb carbon in the air).

Four project types have been identified as priorities under the low-carbon transportation infrastructure and construction strategy.

- Use low carbon materials and recycled materials in the construction process to minimize carbon footprint of transportation construction and maintenance projects (e.g., sustainable asphalt).
- Recycle pavement on construction sites (e.g., maximize the amount of recycled pavement used on a construction site).
- Replace street lighting and traffic control devices with energy-efficient alternatives (e.g., LED lighting).
- Increase the application of green infrastructure throughout projects (e.g., vegetation and roadside tree canopy).

SUPPORT RENEWABLE ENERGY GENERATION

Develop renewable energy sites on lands and facilities operated by transportation agencies. This strategy does not affect emissions from motor vehicles but focuses on generating clean energy that can be used to displace other power sources and provide clean energy to power EV buses, EV charging stations, public sector fleets or transportation facilities (e.g., rest stops, maintenance facilities, truck stations). Renewable energy generation can also support the resilience of the power grid.

Two project types have been identified as priorities under the support renewable energy generation strategy:

- Implement renewable energy projects in highway right-of-way.
- Implement solar panels or other renewable energy generation on transit stations, rest stops, parking lots and other facilities.

ADDITIONAL STRATEGIES

Through the 2023 Minnesota CRS development process strategies were identified that can reduce carbon emissions but were not identified as priority implementation project types for the 2023 CRS. More work and research will need to be done before the CRS is updated to determine the priority of these project types as they relate to carbon emissions reduction in Minnesota.

- Enhance traffic monitoring, management and control along freeways and major roadways (e.g., installing ramp meters at highway on-ramps, active traffic management techniques such as variable speed limits).
- Establish demand-responsive parking pricing program (e.g., adjust meter and garage parking rates based on time of day or real-time occupancy data).
- Implement smart truck parking programs (i.e., providing real-time information on available truck parking spaces, enabling drivers to plan their rest stops efficiently and reducing unnecessary driving and idling).
- Implement collaboration platforms for freight sharing (i.e., developing digital platforms that enable freight carriers to share capacity and consolidate shipments, reducing the number of partially loaded or empty trucks on the road) and to enhance safe and reliable routing.
- Use low carbon construction equipment.

CHAPTER 5

HOW WILL MNDOT AND PARTNERS IMPLEMENT THE CARBON REDUCTION STRATEGY?

Implementing the CRS will involve partnerships at the state, regional and local levels to advance projects that support reducing carbon emissions from surface transportation in Minnesota. While federal CRP funds provide dedicated funds to program and implement carbon reduction projects, there are many state and federal transportation funding programs administered by MnDOT and partners that can be used to reduce carbon emissions.

Often carbon reducing strategies can be integrated into projects. It is MnDOT and partner organizations' role to work together to prioritize carbon reducing approaches and projects as identified in the CRS. This can be done through investment planning, project scoping, project prioritization and selection processes.

TRANSPORTATION PROGRAMS

While the CRP provides an important source of funds dedicated to carbon reduction, MnDOT and Minnesota transportation agencies have access to dozens of other state and federal transportation funding sources. These funds may also be used to support carbon reduction strategies identified in the CRS. Examples of these funding sources are noted under federal funding programs, state funding programs and local funding programs. **Appendix C: Federal and state funding sources** identifies federal and state transportation programs that may be possible sources of funds to support the implementation of the 2023 Minnesota Carbon Reduction Strategy by matching program funds to specific project types. Local governments and the private sector can also play a role in supporting the CRS through programming and funding projects that support the CRS categories and strategies.

FHWA FUNDING PROGRAMS

MnDOT is apportioned FHWA formula funds pursuant the Infrastructure Investment and Jobs Act (IIJA) for fiscal years 2022 through 2026. The programs included under this annually are:

- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement (CMAQ) Program
- National Highway Performance Program (NHPP)
- Surface Transportation Block Grant (STBG) Program
- Highway Safety Improvement Program (HSIP)
- Railway-Highway Crossings Program (RHCP)
- Metropolitan Planning Program (MPP)
- National Highway Freight Program (NHFP)

- Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Formula Program

Many of these FHWA formula programs are able to fund projects that support the strategies and priority project types identified in the CRS. Plus, each of these programs is able to transfer up to 50% of the state's apportionment of the funds to another formula program listed per 23 U.S.C. 126(a). Exceptions to this are the RCHP funds and MPP funds.

Additionally, there are other funds under IIJA from the General Fund for Highway Infrastructure Programs, such as the National Electric Vehicle Infrastructure (NEVI) Formula Program that also support the strategies and project types identified in the CRS.

In addition, there are a wide array of FHWA competitive grant funding programs that can support projects that reduce carbon emissions. Discretionary funding programs require project sponsors to submit grant applications and compete to receive federal funding.

Carbon Reduction Program (CRP)

The CRP provides funds for transportation projects designed to reduce carbon emissions from surface transportation. A wide array of projects is eligible for CRP funding. More information on specific project eligibility can be found on the FHWA CRP Fact Sheet website.

Approximately $20.9 million is apportioned to Minnesota under the CRP funds annually. Of the CRP funds, 65% of funds are to be obligated in areas based on population. The remaining 35% of funds may be obligated in any area of the state. More information on how MnDOT is distributing CRP funds can be found in Chapter 5's Statewide Implementation section.

Congestion Mitigation and Air Quality Improvement (CMAQ) Program

The CMAQ Program provides a funding source for transportation projects and programs to help meet the requirements of the Clean Air Act (CAA) and its amendments. Funding is available to reduce congestion and improve air quality for areas that do not meet the National Ambient Air Quality Standards for ozone, carbon monoxide, or particulate matter (nonattainment areas) and for former nonattainment areas that are now in compliance (maintenance areas).[19] Many types of projects are eligible under CMAQ that support CRS strategies including, but not limited to, electric vehicle charging stations, diesel engine replacements and retrofits, transit improvements, bicycle and pedestrian facilities, transportation demand management programs, shared micromobility projects and traffic flow improvements.

Approximately $35.8 million is apportioned to Minnesota under CMAQ funds annually.

National Highway Performance Program (NHPP)

The NHPP has four primary purposes. First, to provide support for the condition and performance of the National Highway System (NHS). Second, to provide support for the construction of new facilities on the NHS. Third, to ensure that investments of Federal-aid funds in highway construction are directed to support progress toward the achievement of performance targets established in a state's asset management plan for the NHS. Fourth, to provide support for activities to increase the resiliency of the NHS to mitigate the cost of damages from sea level rise, extreme weather events, flooding, wildfires, or other natural disasters.

[19] "Fact Sheets," Congestion Mitigation and Air Quality (CMAQ) Improvement Program, U.S. Department of Transportation Federal Highway Administration, last modified February 8, 2022, https://www.fhwa.dot.gov/bipartisan-infrastructure-law/cmaq.cfm.

Approximately $482.1 million is apportioned to Minnesota under NHPP funds annually.

Although these are not explicitly carbon reduction strategies, many of the eligible projects could incorporate Low Carbon Infrastructure and System Management strategies into the project scoping.

Surface Transportation Block Grant (STBG) Program

The STBG provides flexible funds to best address state and local transportation needs. These funds can be used for a wide variety of project types, including installation of EV charging infrastructure, deployment of intelligent transportation technologies and capital projects for the construction of a bus rapid transit corridor or dedicated bus lanes.

Approximately $234.5 million is apportioned to Minnesota under STBG Program funds annually. Of the STBG funds, 55% of funds are to be obligated in areas based on population. The remaining 45% of funds may be obligated in any area of the state.

TRANSPORTATION ALTERNATIVES SET-ASIDE

A portion of STBG Program funds are set-aside for Transportation Alternatives, including pedestrian and bicycle facilities and safe routes to school projects, among other project types. MnDOT administers a solicitation for local communities and regional agencies to apply for funding. Many of these projects are identified in the CRS as key project types and strategies to implement the CRS.

STATE PLANNING AND RESEARCH (SPR)

Annually 2% of STBG apportionment is to be set aside for SPR.

Highway Safety Improvement Program (HSIP)

The HSIP's purpose to achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned public roads and roads on tribal land. The HSIP requires a data-driven, strategic approach to improving highway safety on all public roads that focuses on performance. A wide variety of safety improvements are eligible, including projects that reduce carbon emissions (e.g., intersection safety improvements that provide safety for all road users including roundabouts, improvements for pedestrian or bicyclist safety, roadway improvements that provide separation between motor vehicles and bicyclists or pedestrians including protected bike lanes, medians and pedestrian crossing islands).

Many of these projects are identified in the CRS as key project types and strategies to implement the CRS and the co-benefit of safety is clear.

Approximately $48.2 million is apportioned to Minnesota under HSIP funds annually.

National Highway Freight Program (NHFP)

The NHFP continues to improve the efficient movement of freight on the National Highway Freight Network (NHFN) and support several goals:

- Investing in infrastructure and operational improvements that strengthen economic competitiveness, reduce congestion, reduce the cost of freight transportation, improve reliability, and increase productivity,
- Improving the safety, security, efficiency, and resiliency of freight transportation in rural and urban areas,
- Improving the state of good repair of the NHFN,

- Using innovation and advanced technology to improve NHFN safety, efficiency, and reliability,
- Improving the efficiency and productivity of the NHFN,
- Improving State flexibility to support multi-State corridor planning and address highway freight connectivity, and
- Reducing the environmental impacts of freight movement on the NHFN.

Approximately $23 million is apportioned to Minnesota under NHFP funds annually.

Although these are not explicitly carbon reduction strategies, many of the eligible projects could incorporate Low Carbon Infrastructure and System Management strategies into the project scoping. Plus, reducing the environmental impacts of freight movement is a key component to consider when reducing carbon emissions from the transportation sector.

Promoting Resilient Operations for Transformative, Efficient and Cost-saving Transportation (PROTECT) Formula Program

The PROTECT Formula funds are intended to help make surface transportation more resilient to natural hazards, including climate change, sea level rise, flooding, extreme weather events, and other natural disasters through support of planning activities, resilience improvements, community resilience and evacuation routes, and at-risk costal infrastructure.

Approximately $23.7 million is apportioned to Minnesota under PROTECT formula funds annually.

Although these are not explicitly carbon reduction strategies, many of the eligible projects could incorporate Low Carbon Infrastructure and System Management strategies into the project scoping.

National Electric Vehicle Infrastructure (NEVI) Program

The NEVI Program funds the deployment of EV charging infrastructure and establishment of an interconnected network to facilitate data collection, access and reliability. MnDOT's NEVI Plan identifies initial investments in fast charging along Minnesota's existing Alternative Fuel Corridors (AFCs) of Interstate 94 and Interstate 35. Future investments will be determined as the program evolves. The focus in Minnesota is on light-duty EV charging needs.

Approximately $68 million is apportioned to Minnesota under NEVI formula funds over fiscal year 2022 through 2026.

The NEVI Program is clearly linked to the CRS Electrification category and subsequent strategies and project types. Continuing to see how NEVI funds can support the CRS after the AFCs are built out is key to the reduction of carbon emissions from the transportation sector.

FTA FUNDING PROGRAMS

Several FTA programs support capital and operating assistance for transit. There are clear ties to the CRS Travel Options strategies and project types within each of these programs. For a complete list of FTA programs that align with the CRS partners are encouraged to coordinate with MnDOT's Office of Transit and Active Transportation (OTAT).

Urbanized Area Formula Grants (5307 program)

The 5307 program makes federal resources available to urbanized areas for transit capital and operating assistance and for transportation related planning in urbanized areas. An urbanized area is a Census-designated area with a population of 50,000 or more as determined by the U.S. Department of Commerce, Bureau of the Census. These are MPO areas.

For urbanized areas with 200,000 in population and over (e.g., Transportation Management Area MPOs), funds are apportioned and flow directly to a designated recipient selected locally to apply for and receive federal funds. For urbanized areas under 200,000 in population (e.g., Non-Transportation Management Area MPOs), the funds are apportioned to Minnesota for distribution.

Formula Grants for Rural Areas (5311 program)

The 5311 program provides capital, planning, and operating assistance to states to support public transportation in rural areas with populations of less than 50,000, where many residents often rely on public transit to reach their destinations. The program also provides funding for state and national training and technical assistance through the Rural Transportation Assistance Program (RTAP).

Bus and Bus Facilities Formula Grants (5339(a) program)

The 5339(a) program provides capital funding to states and transit agencies through a formula to replace, rehabilitate and purchase buses and bus-related equipment and to construct bus-related facilities.

Capital Investment Grants (5309 program)

The 5309 program is a discretionary grant program that funds transit capital investments, including heavy rail, commuter rail, light rail, streetcars and bus rapid transit (BRT).

STATE FUNDING PROGRAMS

In addition to federal funds, Minnesota collects funds for transportation through general revenues (e.g., collected from income taxes and other state taxes), highway users fees (e.g., the motor vehicle fuel tax, motor vehicle sales tax, vehicle registration fees), and other sources, which are used to fund programs for highways, rail and transit. Examples of state programs that can be used to support carbon reduction strategies include:

Active Transportation (AT) Program

MnDOT's AT program provides grants and technical assistance to cities, counties, townships and non-profit organizations to support walking, biking and rolling. The AT Infrastructure Program supports construction of projects, and separate funding is available for planning assistance. The AT program provides up to 100% funding on infrastructure grants, planning assistance and demonstration project technical assistance. Each section of the AT program aligns with the projects listed in Travel Options.

Greater Minnesota Transit Grants

MnDOT is responsible for administering state and federal transit assistance funds for Greater Minnesota. The Greater Minnesota Transit Plan provides policy guidance for transit systems and is undergoing an update estimated to be completed in spring 2025. The CRS guidance will be incorporated into the Greater Minnesota Transit Plan and assist in guiding the funding for transit grants that combine federal and state funds to improve and support public transit systems within Minnesota. Transit systems include buses, vans and shared transportation vehicles. These programs include, but are not limited to:

- **Minnesota Intercity Bus Program** – Provides funding to support intercity bus transportation service to non-urbanized communities.

- **Public Transit Facilities and Public Transit Large Capital Grants** – Supports public transit facilities and non-vehicle capital needs.
- **Public Transit New Service Grants** – Provides funds for new services under Minnesota Statutes, section 174.24.
- **Public Transit Operating Grants** – Provides financial assistance to rural, small urban, and tribal transit programs.
- **Public Transit Vehicle Replacement Grants** – Supports replacement of public transit vehicles.
- **Transit Technology Grants** – These grants provide financial assistance for hard and software improvements that support rural and small urban area transit operations.

Metropolitan Area Transit Funding Distribution

Metropolitan Council administers these funds to support transit in the Minneapolis-St. Paul region.

MnDOT State Highway Operations and Maintenance

State funds are used to support MnDOT's operations and maintenance budget, which can be used to support CRS priority projects such as low-cost design and maintenance improvements and other operational programs (e.g., snow fencing, maintenance activity improvements, enhanced incident management).

Minnesota General Funds Supporting Electric Vehicle Infrastructure

The 2023 Minnesota Legislature appropriated $13.6 million from the general fund for matching federal aid, related state investments and staff costs for the electric vehicle infrastructure program under Minnesota Statutes, section 174.47. Of this appropriation, $13,600,000 in fiscal year 2024 is onetime and is available until June 30, 2027. These funds are being used to match NEVI Formula Funds and increase availability and reliability of the electric vehicle infrastructure network throughout Minnesota. The funds will assist in the implementation of the projects under Electrification.

Safe Routes to School (SRTS) Program

The Minnesota SRTS program includes a SRTS Infrastructure Program, which provides funds to communities to construct infrastructure that improves access and safety on prioritized routes to and at schools. Minnesota also offers planning assistance grants and SRTS Boost grants to fund non-infrastructure strategies to support current SRTS plans or programs. All of these SRTS funding opportunities align with the intentions of the CRS by encouraging walking, bicycling and rolling.

Additional State Funding Opportunities

State funds provided to the Minnesota Department of Natural Resources, Greater Minnesota Regional Parks and Trails Commission and the Metropolitan Council also support funding for parks and trails, which may support walking, bicycling and rolling investments that are part of the CRS.

Further funding opportunities can be found listed in the appendices.

LOCAL FUNDING

Local governments also provide substantial funding for transportation investments, including local funding for bicycle and pedestrian capital investments and maintenance of facilities, roadway operations, transit capital and transit operations. These investments can also support the CRS and reduce transportation carbon emissions.

STATEWIDE IMPLEMENTATION

Statewide implementation of the CRS will occur through administration of various federal, state and local funding programs. The CRP is just one of the many avenues to implement projects to reduce carbon emissions.

INCORPORATION OF THE CRS INTO STATEWIDE PROGRAMS

Recognizing the broad scope of carbon reduction opportunities, MnDOT intends to integrate the CRS into federal and state transportation programs that it administers. This requires coordination across MnDOT offices and with transportation partners throughout Minnesota. MnDOT's Office of Sustainability and Public Health (OSPH) will lead the coordination effort with the MnDOT Office of Transportation System Management (OTSM), the MnDOT Office of Transit and Active Transportation (OTAT), MnDOT State Aid and MnDOT Operations Division to explore how the CRS can be advanced throughout MnDOT's investment planning and programming processes.

OSPH leads, coordinates and manages the Carbon Reduction Program (CRP) and CRS. Additionally, OSPH manages the transportation programs, policy and implementation related to electric vehicle infrastructure, resiliency, public health, complete streets, efforts to reduce vehicle miles travelled, strategic partnerships and clean fuel standards throughout Minnesota. Each of these areas play a key role and connection to the categories in the CRS.

OTSM focuses on addressing investment planning, programming and performance management. Their role is to manage the many federal and state programs that are administered by MnDOT and ensure compliance and incorporation with the State Transportation Improvement Program (STIP).

OTAT administers several transit and active transportation programs that directly address the CRS Travel Options strategies and projects. Their relationships with transit and active transportation partners is key to ensure the CRS is implemented to its fullest.

State Aid staff are the primary liaisons to the local jurisdictions at a central office and district office level. These staff know what projects and challenges are coming up for local jurisdictions and can coordinate the importance of incorporating the CRS implementation methodology into project development and scoping.

MnDOT District staff are key to understanding construction and programming on a regional level. Their expertise in the current challenges and opportunities arising across Minnesota are integral to the success of reducing carbon emissions statewide. District staff along with others in MnDOT's Operations Division are integral to the implementation of a successful and encompassing carbon reduction strategy.

Moreover, in response to 2023 state legislation, MnDOT is convening a GHG Emissions Impact Mitigation Working Group. By February 2024, this group will prepare recommendations for implementing a Transportation GHG Emissions Impact Assessment for capacity expansion projects on state highways prior to inclusion in the STIP or a metropolitan Transportation Improvement Program (TIP). This assessment requires that projects expected to increase GHGs or VMT will need to implement an impact mitigation plan, which may involve funding carbon reduction strategies that are included in this CRS. More on this will develop over the months following the adoption of the CRS.

STATE CARBON REDUCTION PROGRAM (CRP) IMPLEMENTATION

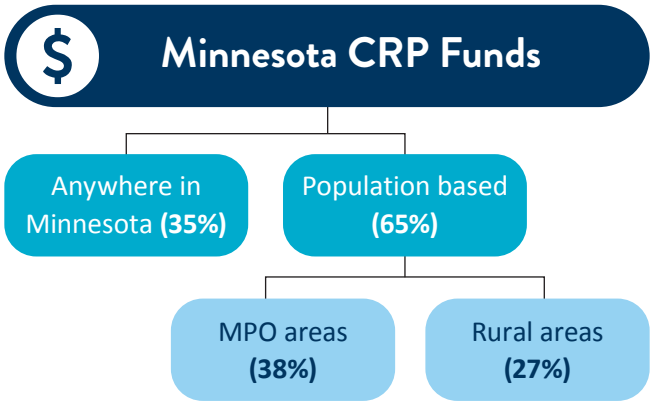
Based on federal law that established the CRP, funds are to be distributed so that:

- 65% of the state's apportioned funds are to be obligated to areas of the state in proportion to their share of the state's population, and
- 35% of the state's apportioned funds may be obligated in any area of the state.

Within Minnesota, this breaks down to approximately 38% of funds dedicated to urbanized areas represented by MPOs, and 27% dedicated to rural areas (areas with population less than 50,000). See **Figure 22**.

To support effective and consistent programming of the CRP funds, the CRP Toolkit will be shared with MPOs and ATPs to assist in soliciting, selecting and programming CRP funds. The CRP toolkit is intended to ensure a coordinated effort that maximizes the benefits of the CRP program and reduces the administrative burden of developing a program funding solicitation and selection process. See the Carbon Reduction Program Toolkit section for more information.

Figure 22.
Distribution of CRP Funds in Minnesota



REGIONAL IMPLEMENTATION

Implementation of the Minnesota CRS depends not only on what projects are programmed and implemented by MnDOT but on what projects are programmed and implemented at the regional and local levels.

INCORPORATION OF THE CRS INTO REGIONAL PROGRAMS AND FUNDING

At the regional level, MPOs, RDOs and ATPs are the primary drivers for planning and programming projects. MPOs and RDOs develop long range planning documents to identify regional priorities for projects and funding. ATPs coordinate and program transportation funding for their regions. Depending on the funding program, the program guidance is developed and refined centrally (e.g., MnDOT Central Office) or regionally (e.g., MnDOT Districts, ATPs, MPOs).

MnDOT encourages MPOs, RDOs and ATPs to incorporate the CRS prioritized strategies and project types within their regional planning and programming processes. This can be done by incorporating carbon emissions criteria and factors into project scoring, project scoping, priorities in long range planning documents and investment priorities.

REGIONAL CARBON REDUCTION PROGRAM (CRP) IMPLEMENTATION

For fiscal years 2025, 2026 and 2027, Minnesota has decided to program CRP funds at a regional level. This means that MPOs, ATPs and MnDOT Districts have the primary responsibility of soliciting, selecting and programming projects with CRP funds to be implemented in those years. For fiscal year 2028

and beyond, MnDOT will review and adjust the distribution and programming process in alignment with the update of the Minnesota Carbon Reduction Strategy and based on lessons learned.

As MPOs are suballocated specific amounts of CRP funds per legislation and based on population, MPOs will solicit, select and program projects with the CRP funds dedicated to their areas based on guidance from the CRP Toolkit. The CRP Toolkit is intended to ensure consistent project selection criteria and implementation of CRP funding to achieve the purpose of the CRP funds and 2023 Minnesota CRS.

For the rural portion of the CRP funds, ATPs will be targeted funds based on their portion of the state's rural population. ATPs will solicit, select and program projects based on guidance from the CRP Toolkit. Again, the CRP Toolkit is intended to ensure consistent project selection criteria and implementation of CRP funding to achieve the purpose of the CRP funds and 2023 Minnesota CRS. Further, the CRP Toolkit should reduce the administrative burden of developing a project solicitation and selection process for the local agencies.

The statewide funds (e.g., the 35% of CRP funds) will be distributed to the MnDOT Districts for project selection and programming within the MnDOT district boundaries. MnDOT District staff will coordinate the carbon reduction needs and priorities of their district to ensure the CRP funds are programmed to projects that are in alignment with the 2023 Minnesota CRS and CRP fund eligibility. District staff must select and program projects based on guidance from the CRP Toolkit.

Each MPO, ATP and MnDOT District will have the flexibility to prioritize projects that align with their regional priorities while maintaining consistency with the CRS and the CRP priorities.

More information about the Carbon Reduction Program in Minnesota can be found on the MnDOT website.

CARBON REDUCTION PROGRAM (CRP) TOOLKIT

MnDOT's CRP Toolkit supports coordinated project prioritization, which will be used by MnDOT and partners to prioritize and select projects under the CRP that align with the CRS.

In developing the toolkit, MnDOT conducted a review of best practices associated with project prioritization approaches for similar types of programs, including experiences with the CMAQ program and climate initiatives implemented across the country. Best practices include:

- Establishing clear criteria for scoring projects that incorporate goals that are important for the program.
- Categorizing projects to enable comparisons among similar types of projects.
- Establishing an application process that is easy to use and complete. A complex application can be a barrier for local governments and other project sponsors to apply for funding and increases the administrative burden.
- Incorporating carbon emissions evaluation procedures into the program and application helps assess whether projects will achieve the goals or expectations of the CRS.

The CRP toolkit includes the following components.

- Informational memorandum
- CRP application
- Project carbon emissions estimation methodologies
- Carbon emissions tool (e.g., spreadsheet formatted tool)
- Project evaluation criteria
- Project scoring template

INFORMATIONAL MEMORANDUM

The informational memorandum provides background information on the CRP, goals of the program and information on how to fill out the application. It also contains information on how a region can adjust the scoring criteria to align with their regional priorities and still maintain consistency with the CRS and CRP.

Further, the memorandum gives examples of how projects may be scored and guidance on how to interpret and measure the scoring criteria. A frequently-asked-questions (FAQs) section also addresses common issues that ATPs or MPOs may encounter while scoring projects.

Finally, a project development timeline provides guidance on project readiness to ensure CRP funds will be authorized in the year in which an entity applies for the funds.

CRP APPLICATION

The toolkit includes an application template that can be used by agencies to apply for CRP funds. MnDOT recognizes the importance of ensuring that the application process is not burdensome and therefore developed a template that aims to limit the time and effort associated with preparing an application. The application still ensures that there is adequate information necessary to evaluate projects for their potential to advance the goals of the CRP and CRS. The application template requests basic information on the proposed project, including:

- Applicant name and contact information.
- Applicant sponsor, if applicable.
- A description of the project, including location and purpose.
- Fiscal year project is intended to be authorized.
- CRP funds requested.
- Total federal and non-federal funds associated with the project.
- Project type dropdown, which uses a checklist with the project types listed in this CRS and cross reference to project types that are eligible for CRP funding.
- Carbon emissions reduced by the project.
- Comment box.

PROJECT CARBON EMISSIONS ESTIMATION METHODOLOGIES

To maximize the benefit of CRP funds, a key factor for prioritizing projects is the estimated carbon emissions reduction benefits of proposed projects.

MnDOT developed a series of project-level carbon emission methodologies (see Appendix D: Carbon Emissions Calculation Methodologies). These methodologies provide simple processes for estimating the carbon reduction benefits of different types of projects, accounting for the various ways projects reduce emissions (e.g., eliminating tailpipe emissions associated with vehicle travel, reducing the amount of vehicle travel, increasing the efficiency of travel). These methods have been developed to:

- Allow applicants to enter basic information about the project (e.g., number of buses replaced, level of increase in transit service).
- Use estimation factors drawn from national research to estimate changes in travel activity or other parameters commonly associated with the type of project.
- Apply Minnesota-specific emissions factors to calculate estimated carbon emissions reduction.
- Allow the user to modify the default values if project-specific information is available to better estimate impacts.

It is important to note that for simplicity, these emission reduction calculation methods:

- Only account for tailpipe emissions from motor vehicles (not full life-cycle emissions), with the exception of low-carbon transportation infrastructure and construction projects and renewable energy generation projects, which calculate the net savings in life-cycle emissions.
- Are used to estimate annual emission reductions for a specific design year (e.g., 2025).
- Account for CO_2 equivalent emissions, accounting for the reduced emissions of CO_2, methane, and nitrous oxide from motor vehicles.

CARBON EMISSIONS TOOL

MnDOT has developed a carbon emissions tool to help applicants calculate carbon emissions and project cost-effectiveness. The carbon emissions tool is a spreadsheet instrument that automates the calculation of emissions benefits based on inputs from the user. The spreadsheet uses the methodologies that have been developed and incorporates additional calculations to allow for comparisons across projects. Specifically, the tool expands upon the methodologies by accounting for the anticipated duration of benefits and accounts for the costs of the project.

The tool includes factors that account for how long project benefits are anticipated to accrue. For instance, infrastructure projects (e.g., a bicycle trail, bus rapid transit project) are generally assumed to be long-lasting and have emissions benefits that occur over a 20-year period. In contrast, a bus replacement assumes a shorter project life of a 6-10 year period. The spreadsheet includes defaults to address the anticipated duration of project benefits for different project types and allows the user to adjust these defaults. As appropriate, the emissions calculation methodology then applies emissions factors for future years (which are anticipated to decline over time) to calculate cumulative emissions reductions.

The tool also includes a place to input information on the requested CRP funding for the project to calculate cost-effectiveness at reducing carbon emissions (based on cumulative emissions benefits divided by cost). This results in an estimated cost per unit of carbon emissions reduced, which is used in the prioritization of projects.

The Greenhouse Gas Emissions Impact Mitigation Working Group will use the project-level carbon emission methodologies in their work over the next few years to ensure consistency between the CRS and the legislative work.

CRP PROJECT EVALUATION CRITERIA

The CRP Toolkit includes a set of project evaluation criteria and scoring methodology to support project prioritization. In addition to carbon reduction, policy goals and public input pointed to the importance of considering other factors when prioritizing projects for CRP funding. Specifically, partner agencies noted that the CRP can support SMTP objectives related to critical connections, healthy equitable communities and transportation safety. They also emphasized having criteria and approaches to evaluation projects that are not too complex or burdensome. **Table 2** shows criteria that are included in the CRP toolkit.

Table 2.

Project evaluation criteria for CRP funds

Criteria	How projects will be analyzed	Why is it included
ESTIMATED COST-EFFECTIVENESS OF CARBON EMISSIONS REDUCTION	Using CRP carbon emissions benefit estimation tool, accounting for estimated cumulative emissions reductions and cost information provided by project sponsors.	Primary goal of the CRS, cost effectiveness at emissions reduction was identified as key priority among the public and partners
EQUITY	Based on the extent to which the project benefits Justice40 communities and/or other vulnerable communities. A scoring methodology will assign points based on whether the project serves Justice40 communities and whether it benefits other vulnerable users.	SMTP objective, support for Justice40 goal
SAFETY BENEFITS	Based on the extent to which the project has the potential to reduce crashes, especially among vulnerable populations. A scoring methodology will assign points based on whether the project has the potential to reduce crashes and whether the project serves an existing high crash rate area, particularly for vulnerable road users. This can build upon MnDOT's Vulnerable Road User Assessment work.	SMTP objective, support for Justice40 goal
TRANSPORTATION ACCESS	Based on the extent to which the project is anticipated to increase multimodal travel options, particularly by those without access to a motor vehicle. A scoring methodology will assign points based on whether the project improves non-motorized access.	SMTP objective, support for Justice40 goal
HEALTH BENEFITS	Based on the extent to which the project is anticipated to support public health, such as by reducing localized air pollution in areas with high levels of asthma and by supporting physical activity. A scoring methodology will assign points based on whether the project improves air quality or increases physical activity.	SMTP objective, support for Justice40 goal

CRP PROJECT SCORING TEMPLATE

The scoring template applies weights to each of the project evaluation criteria in order to calculate an overall score for each project. Emissions reduction cost-effectiveness will always be the most significant factor. MPOs and ATPs responsible for CRP project solicitation, selection and programming may adjust the weighting of each factor or incorporate additional evaluation criteria to reflect their regional goals as long as the intent of the scoring remains consistent with the overarching goals of the CRS and CRP.

A project scoring template document is included in the CRP toolkit with a guidance document on how to adjust the template to meet the needs of each region, while maintaining consistency with the intent of the CRS and CRP.

USING THE CRP TOOLKIT

MnDOT will share the CRP Toolkit with MPOs and ATPs to initiate a solicitation for CRP project applications. Applicants will complete an application for each project applying for CRP funding. MPOs and ATPs will rank and select the projects with the most carbon reducing, cost-effective and beneficial projects based on the evaluation criteria to support Minnesota's carbon reduction goals that align with their regional priorities.

MnDOT District staff will use the CRP Toolkit to evaluate projects and calculate the carbon emissions reduction of each project. This is to ensure that each district's selected projects align with the Minnesota CRS and CRP eligibility.

TRACKING PROGRESS

The SMTP defines the following performance measures and targets, which relate directly to this CRS:

- **Greenhouse Gas Emissions:** Total annual greenhouse gas emissions from the transportation sector (percentages shown in parenthesis reflect percent reduction from 2005) with the following targets:
  - 29.5 million metric tons CO_2e (30%) by 2025
  - 20.1 million metric tons CO_2e (50%) by 2030
  - 14.1 million metric tons CO_2e (65%) by 2035
  - 8.0 million metric tons CO_2e (80%) by 2040
- **Zero Emission Vehicles (ZEV) Registered in Minnesota:** Percent of all light-duty vehicles registered in Minnesota that are electric or another type of ZEV with the following targets:
  - 5% by 2025
  - 20% by 2030
  - 45% by 2035
  - 65% by 2040
- **Zero Emission Vehicles (ZEV) Sold in Minnesota:** Percent of new light-duty vehicles sold in Minnesota that are electric or another type of ZEV with the following targets:
  - 60% by 2030
  - 100% by 2035
  - 100% by 2040

- **Vehicle Miles Traveled Per Capita:** Number of miles traveled across Minnesota per capita (percentages shown in parentheses are the percent reduction from 2019) with the following targets:
  - 10,263 (-4%) by 2025
  - 9,835 (-8%) by 2030
  - 9,515 (-11%) by 2035
  - 9,195 (-14%) by 2040

In order to understand if Minnesota is achieving these goals and how effective each of the goals are at reducing carbon emissions, MnDOT will track progress toward these targets at a statewide level. MnDOT will also examine how the CRP funded projects and other CRS prioritized projects are playing a role in achieving these targets. This information will be used when updating the Minnesota CRS to assist in prioritizing project types. Further, this data and information can be used to assess what projects and where projects have been most impactful in achieving carbon emissions reductions.

CHAPTER 6

WHAT IS NEXT FOR THE CARBON REDUCTION STRATEGY?

The 2023 Minnesota Carbon Reduction Strategy (CRS) is the first CRS for Minnesota and is an important component in the state's commitment to decarbonization. The content contained in this CRS is intended to inform planning and programming activities for MnDOT and other transportation partners throughout Minnesota. Further, it provides the guidance and tools to effectively evaluate projects for distribution of CRP funds. However, the CRS is not a static document.

The CRS is federally required to be updated every 4 years.[20] With that update, and before the update, there are key questions to ask and that MnDOT must consider in order to build upon and strengthen this document.

WHEN WILL THE CRS BE UPDATED?

The CRS is required to be updated every four years. The next CRS is due to FHWA by November 15, 2027, pending any changes in legislation and direction from FHWA. Between the adoption of the 2023 Minnesota CRS and then, MnDOT and partners will implement the CRS. Through implementation MnDOT and partners will document and learn the effectiveness of the strategy, implementation issues and opportunities and evaluate the CRP toolkit.

Additionally, the update of the CRS is anticipated to occur concurrently with the next update to the SMTP and following the updates of many of Minnesota's modal plans. The CRS update will incorporate any changes in statewide transportation policy goals and objectives.

WHO SHOULD BE INVOLVED IN THE UPDATE?

MnDOT will lead the update with coordination and cooperation from MPOs, ATPs, local transportation partners, state agencies and Tribal Nations in Minnesota. As with the development of this initial document, MnDOT will convene a Project Management Team (PMT) to provide feedback and engagement support, coordinate with partners and develop a robust public engagement process, including Justice40 communities and others as federally required and is common practice at MnDOT. Best practices on public and partner engagement will be considered. The MnDOT Plan Development Guidelines should be followed and reviewed a year or more prior to the CRS update deadline to ensure all requirements and expectations of a statewide plan are being met.

[20] 23 U.S.C. 175(d)(3) and (4).

During the next update additional engagement with Tribal Nations should occur earlier and more often to build the relationships with Tribal Nations. Further, internal MnDOT engagement should occur earlier and more frequently with MnDOT Operations Division, MnDOT Maintenance staff, MnROADs and State Aid to ensure coordinated and consistent approaches are being considered in the development and update of the CRS. This is in addition to engagement and coordination with MnDOT Sustainability, Planning and Program Management Division offices.

Continued engagement with Minnesota state agencies (e.g., MPCA, Department of Administration, Department of National Resources) must occur between and during the update of the Minnesota CRS.

WHAT SHOULD BE REVISITED?

Based on what is learned over the coming years, the CRS should update the GHG inventory and projections, strategies and project types, CRS implementation and CRP project selection.

GHG INVENTORY AND PROJECTIONS

Additional data will be available to help shed light on transportation carbon emission trends post the COVID-19 pandemic. In addition, emissions forecasts can account for the latest vehicle emissions standards and models. This will require coordination with MnDOT internal staff and MPCA.

STRATEGIES AND PROJECT TYPES

MnDOT and partners will revisit the prioritized strategies and project types included in the 2023 CRS. The overarching categories, strategies and project types should be reviewed based on effectiveness, public and partner engagement, experience with transportation funding programs and implementation of the transportation GHG Emissions Impact Assessment for Capacity Expansion projects.

Some of the project types that were not prioritized in the 2023 Minnesota CRS and identified as additional strategies in chapter 4 should be reviewed for their potential, applicability and new data during the update. Other project types and strategies may be added or removed depending on public and partner input or emerging information and changing technology (e.g., advanced broadband installation to support reduction of trips, integrated fair systems).

CRS IMPLEMENTATION AND CRP PROJECT SELECTION

MnDOT and partners will need to examine what has been successful and what could be improved in relation to CRS implementation. This will include ways to further integrate carbon reduction priorities throughout state, regional and local transportation investment decision-making, project scoping, project programming and selection processes.

Further, an evaluation and review of the CRP project selection and programming process must occur to ensure its meeting the purpose of reducing carbon emissions from the transportation sector. This will include a review and assessment of the CRP distribution formula, which must include engagement with local jurisdictions, MPOs, RDOs, MnDOT District staff and MnDOT State Aid.

QUESTIONS TO ASK

There are several questions to ask as Minnesota moves through implementation of the CRS and then prepares for the next CRS update. The answers to these questions will help to inform future directions for the CRS.

WHAT HAS CHANGED IN THE TRANSPORTATION SECTOR?

It will be important to consider changes in state policies, as reflected in the updated modal plans and SMTP and any new legislation related to carbon emissions and GHG emissions.

Changes in federal transportation and environmental policy and programs will have to be considered and reviewed as well.

WHAT HAS MINNESOTA PROGRAMMED CRP FUNDS ON SO FAR?

It will be valuable to conduct a review and assessment of funding by project type and across jurisdictions to understand where funds have been programmed and what were the estimated emissions benefits.

This should be a continuous effort from the adoption of the CRS in 2023, with analysis beginning no less than a year prior to the CRS update due date.

HOW EFFECTIVE HAVE THE CRP FUNDED PROJECTS BEEN AT REDUCING CARBON EMISSIONS?

Beyond understanding where funds have been programmed, it will be valuable to explore how effective the funded projects have been at reducing emissions as well as generating co-benefits. This type of analysis requires further work to establish methods to track key metrics associated with implemented projects (e.g., transit ridership increases, use of bicycle and pedestrian facilities, travel delay reduction) and establishing methods to analyze the effectiveness of projects (e.g., surveys or other data collection to understand to what extent the projects changed travel behavior or vehicle purchase decisions).

This should be a continuous effort from the adoption of the CRS in 2023, with analysis beginning no less than a year prior to the CRS update due date.

HOW HAS THE CRS BEEN INTEGRATED ACROSS TRANSPORTATION INVESTMENTS?

In addition to providing guidance for the use of CRP funds, the CRS is designed to support incorporation of carbon reduction considerations across a variety of transportation funding programs. It will be important to assess how MnDOT and other transportation partners' investments are addressing carbon reduction and supporting the CRS goals.

This should be a continuous effort from the adoption of the CRS in 2023, with discussion beginning no less than two years prior to the CRS update due date.

HOW CAN IMPLEMENTATION OF THE CRS BE MADE MORE EFFECTIVE?

Finally, drawing on lessons learned since the adoption of the 2023 Minnesota CRS and experience with the CRP funding and implementation, MnDOT and partners must explore ways to make the CRS implementation more effective. Actions may include adjustments to the CRP project solicitation process and CRP toolkit, adjustments to other planning and programming processes, or other ways to incorporate the CRS into planning and investment decision-making processes at MnDOT, other state agencies and local partners.

APPENDIX A
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APPENDIX B

ENGAGEMENT SUMMARY

INTRODUCTION

There were two phases of public engagement for the 2023 Minnesota Carbon Reduction Strategy (CRS). Phase one occurred from May to July 2023 with an estimated 650 people engaged. This phase focused on understanding what the public and partners believe are the most important considerations for prioritizing carbon reduction strategies. Engagement tactics during this phase included an online survey, a virtual public forum, a virtual community roundtable and nine in-person community events. Communication methods included a website, an informational project handout and social media advertisements focused on Justice40 communities.

Upon completion of draft strategy and project type priorities, public engagement phase two occurred from August to September 2023. This phase of engagement focused on gathering feedback on the draft strategies and project type priorities, as well as ideas to support implementation of the CRS. Engagement tactics in this phase included a booth at the Minnesota State Fair, a virtual community partner meeting, two live virtual public forums and an online virtual forum, which included narrated presentations posted to the project website and an opportunity to provide feedback. Social media advertisements promoted engagement opportunities to Justice 40 communities.

COMMUNICATIONS

WEBSITE

The project website is https://talk.dot.state.mn.us/carbon-reduction-strategy. The website went live on April 19, 2023. The website includes information about the CRS, an email list sign-up and a link to read more information about the federal Carbon Reduction Program. During phase one, the website also hosted an online survey. Updates to the website were made for phase two of engagement, including inclusion of project videos, a virtual forum space to provide live comments and promotions for the virtual forum events.

SOCIAL MEDIA

Paid social media advertisements ran on Facebook and Instagram in 16 Justice40 zip codes (**Table B-1**). During phase one, advertisements ran from June 8 through June 22, 2023. The advertisements received a total of 610 link clicks and reached over 39,000 users.

Table B-1.
Justice40 zip codes

Zip code	Area
55037	Hinkley
55806	Duluth
56634	Clearbrook
56667	Red Lake
56671	Red Lake
56589	White Earth
56729	Halma
56560	Moorhead
56378	Sauk Center
56187	Worthington
55939	Harmony
55107	West St Paul
55411	North Minneapolis
55421	Fridley/Columbia Heights
55106	East St Paul
55336	Glencoe

An organic post went out on June 2, 2023, on MnDOT's Facebook and Twitter pages. The organic post was included in a set of engagement-in-a-box materials for local partners to reshare with their networks. The paid advertisement and organic post encouraged online participation.

During phase two, advertisements ran from September 5 to 21, 2023 in Justice40 communities. The advertisements received a total of 501 link clicks and reached over 18,000 users.

See Exhibit A for images of the social media posts.

HANDOUT

A project handout was created with information about the CRS, the online survey and email list sign-up. The handout was translated to Somali and Spanish. Printed handouts were distributed at events and a digital version was included in the engagement-in-a-box materials for local partners to provide to their communities.

See Exhibit B for an image of the handout.

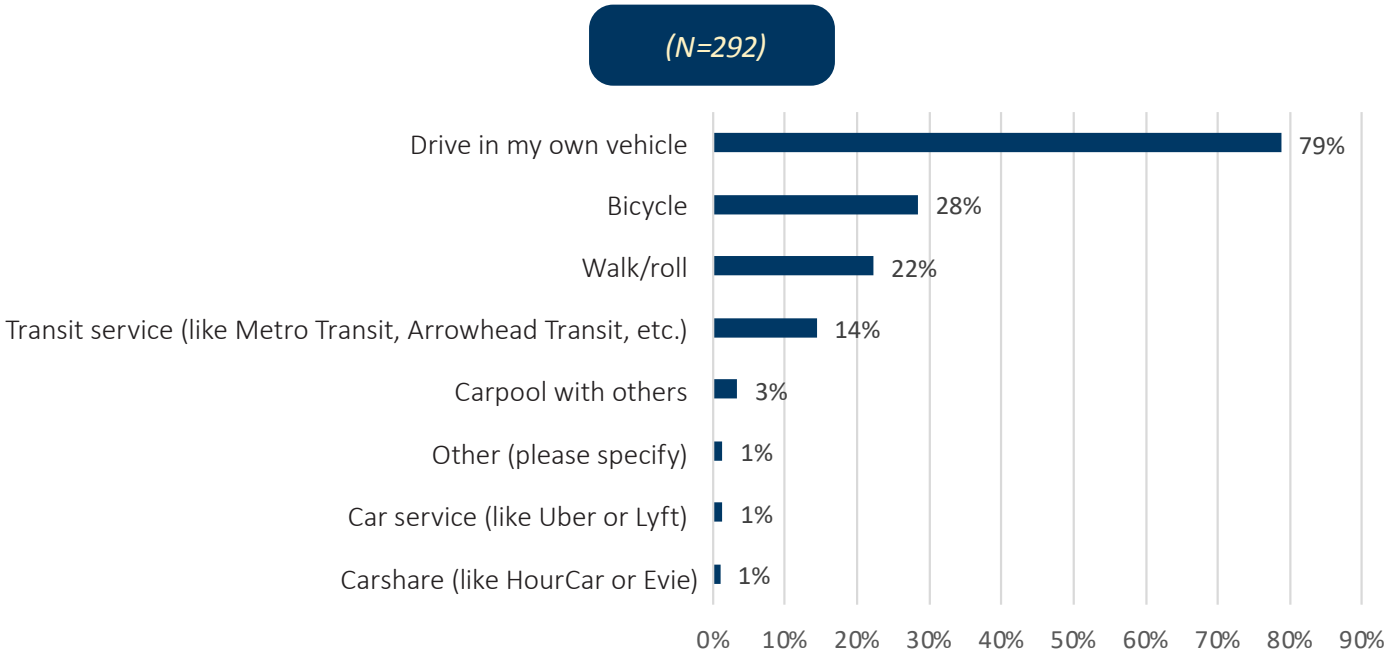
VIRTUAL ENGAGEMENT

ONLINE SURVEY

An online survey went live on May 8, 2023, and closed on July 14, 2023. The survey asked about respondents' travel methods, communities, transportation improvements, strategies for reducing carbon emissions, project considerations and demographics. There were 292 responses.

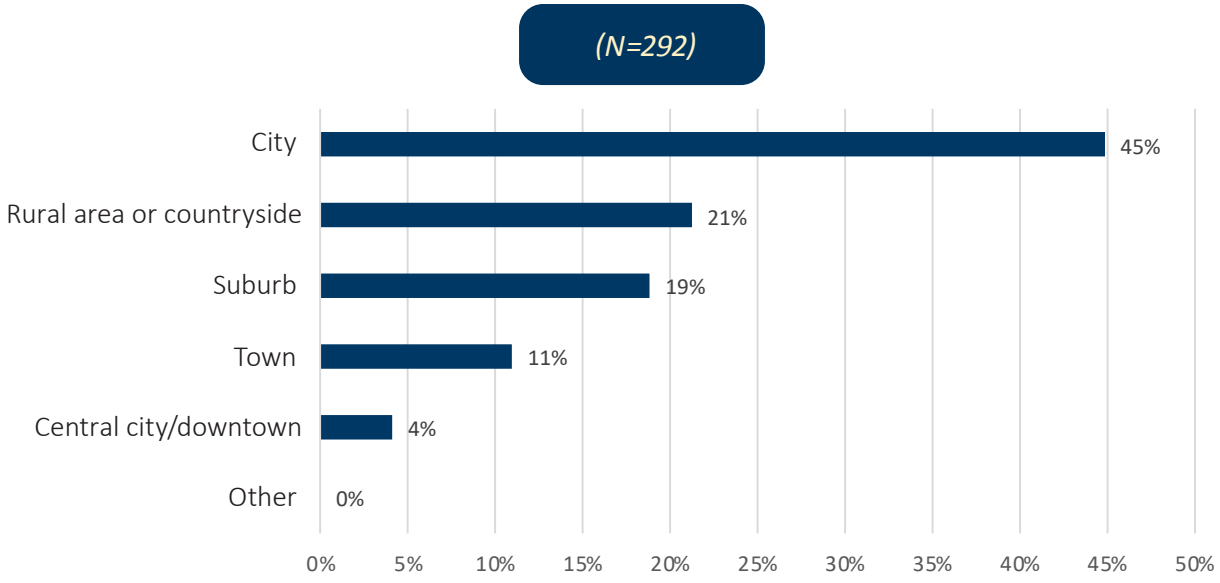
Seventy-nine percent of respondents said they usually drive their own vehicle to get around. About a quarter of respondents said they walk/roll and about another quarter said they bicycle. Respondents could choose up to two travel methods (**Figure B-1**).

Figure B-1.
Survey results for "How do you usually get around? Select up to two options."



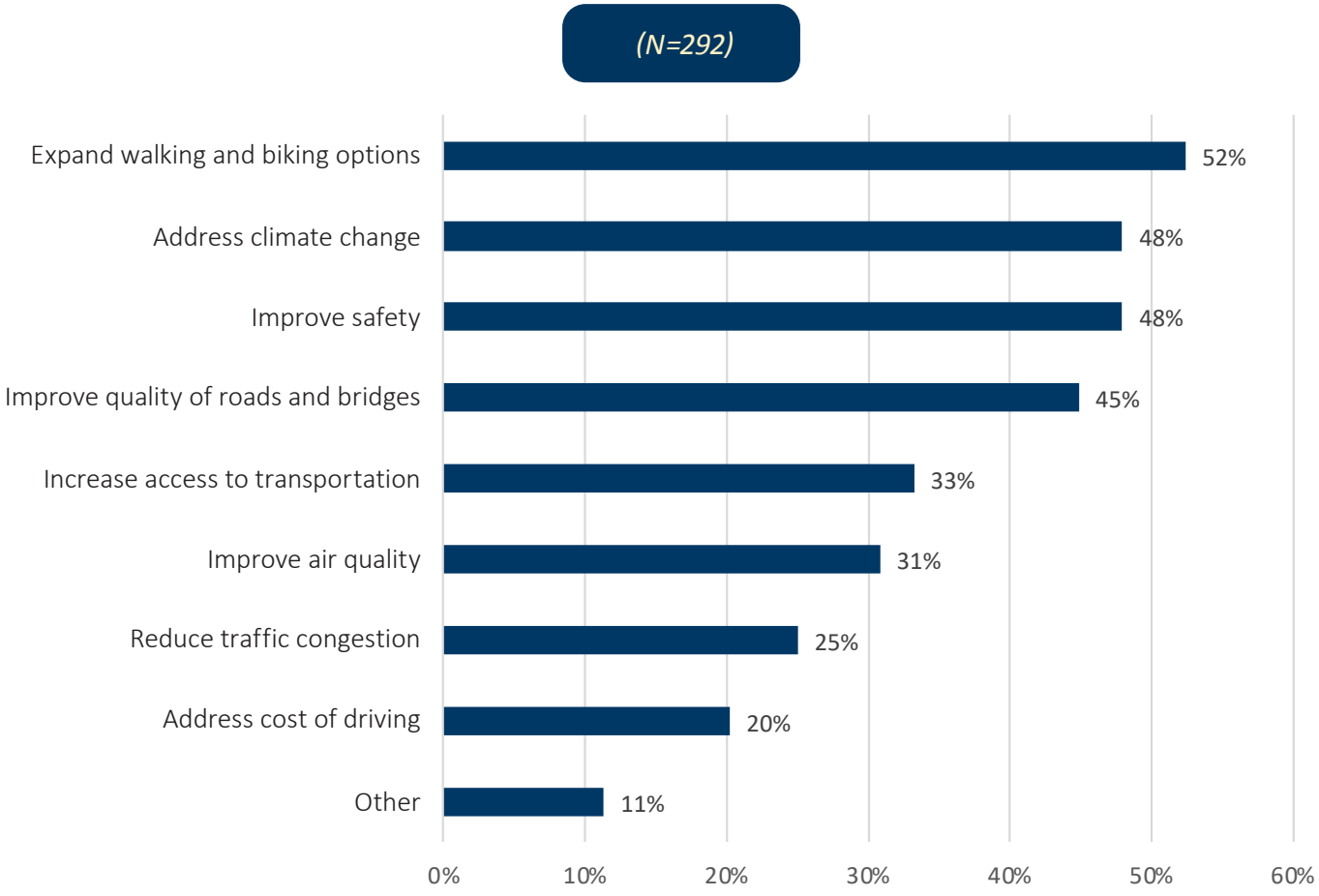
Respondents described the kind of community that they live in. No description of each type was provided to respondents, instead this was based on personal definitions of these community types. Most respondents said they live in a city (45%). Twenty-one percent said their community is rural and 19% said their community is a suburb. Eleven percent of respondents said they live in a town and 4% said they live downtown (**Figure B-2**).

Figure B-2.
Survey results for "What best describes the kind of community you live in?"



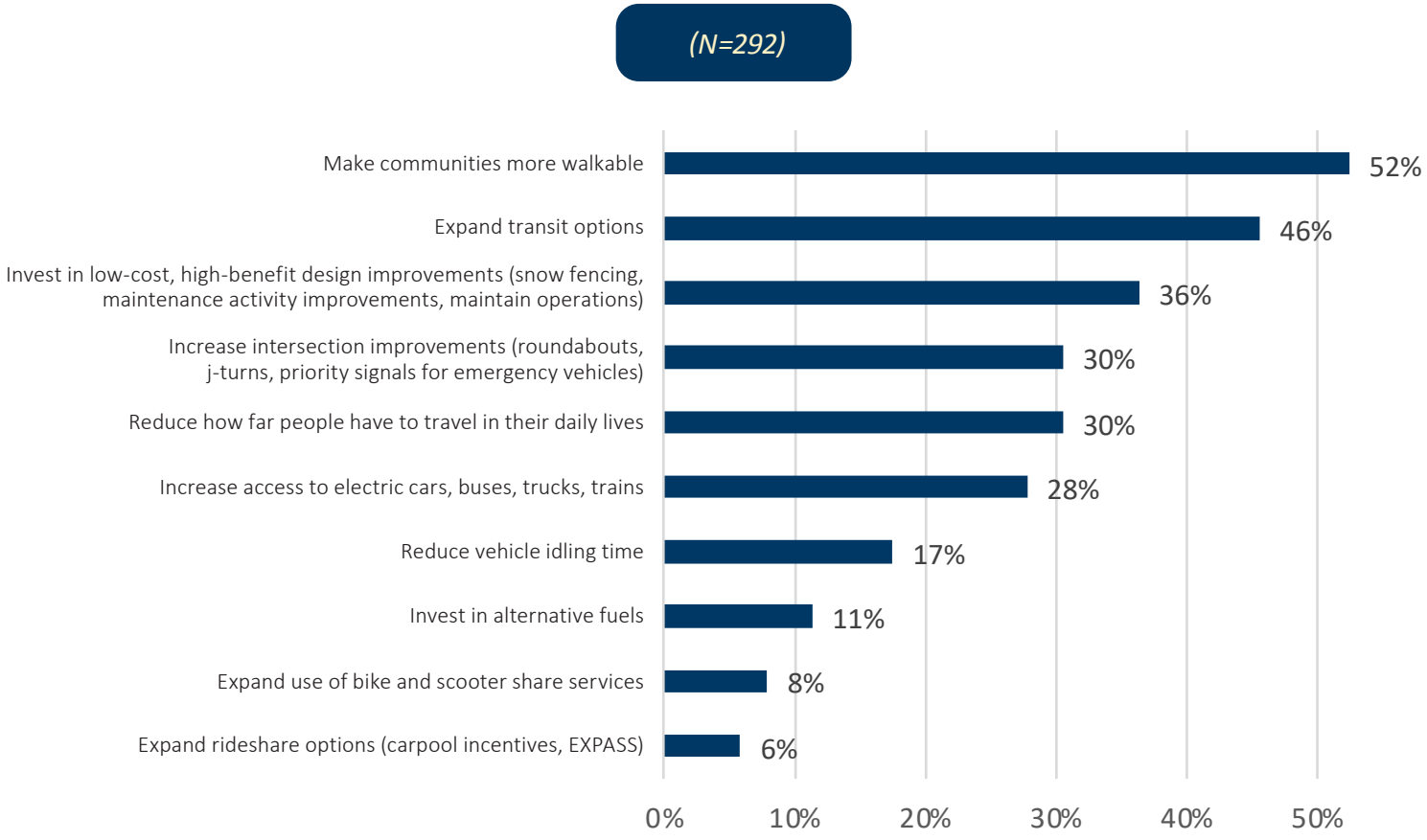
When asked what kinds of improvements to the state's transportation system would be most helpful to them, the top answer was expanded walking and biking options (52%). Improving safety and addressing climate change were each chosen by 48% of respondents. The fourth most common answer was to improve the quality of roads and bridges (45%). Respondents could choose up to four types of improvements (**Figure B-3**).

Figure B-3.
Survey results for "What kinds of improvements to Minnesota's transportation system would help you the most? Choose up to four."



When asked what strategies MnDOT should prioritize to reduce carbon emissions, 52% of respondents said to make communities more walkable. Forty-six percent of respondents said expand transit options, and 36% said invest in low-cost, high-benefit design improvements. Respondents could choose up to three strategy types (**Figure B-4**).

Figure B-4.
Survey results for "What types of strategies should MnDOT prioritize? Please select your top three strategies of what you think is most important."



Respondents also ranked what issues MnDOT should consider when selecting projects. The highest rated answers were to invest in projects that increase the ability to get to destinations without a vehicle, invest in projects that achieve the largest emissions reductions and prioritize projects with the lowest cost and highest benefit (**Figure B-5**).

Figure B-5.
Survey results for "What issues should we consider when selecting projects? Rank the options below from most important (1) to least important (7)."

What issues should we consider when selecting projects? Rank the options below from most important (1) to least important (7)	Average rank
Invest in projects that increase the ability for people to get to destinations without a vehicle.	3.2
Invest in projects that achieve the largest emissions reductions.	3.45
Prioritize projects that have the lowest cost and highest benefit.	3.51
Invest in projects that support community development.	3.53
Invest in projects that support disadvantaged and historically underrepresented communities.	3.78
Invest in projects that save me time.	4.75
Other	5.77

Respondents came from 144 zip codes across the state. See Exhibit C for a map of survey respondent zip codes. Almost half of respondents said their household income was under $100,000. Forty-five percent of respondents were between the ages of 25 and 44, and 38% were between 45 and 64. Half of the respondents identified as male, while 38% identified as female. Seventy-seven percent of respondents said they have a college degree, post-graduate work or advanced degree. Most respondents were white (82%), 1.4% identified as American Indian or Alaska Native, 1.4% identified as Asian, 0.7% identified as Black or African American, and 1.8% identified as some other race or more than one race. The vast majority of respondents primarily speak English at home. Ten percent said they have a long-lasting or chronic condition.

VIRTUAL PUBLIC FORUM

During phase one of engagement, a virtual public forum was hosted on the CRS website from July 5 through July 14, 2023. A forum invitation was sent to the CRS email list. The forum included an informational video about the purpose of the CRS, provided examples of policies and projects and shared how participants could stay informed and provide feedback. The forum also included a discussion board for questions and comments and additional context for carbon reduction efforts. There were 38 visits to the virtual forum.

During phase two of engagement, two live virtual public forums were held. The first was on September 19, 2023, from 6 to 7 p.m. The second was on September 21, 2023, from noon to 1 p.m. The first virtual public forum included one virtual attendee log in and there were no questions. The second virtual public forum included 10 distinct virtual attendee log ins. Some of the accounts that logged in included multiple participants in a room together. See Exhibit D for a detailed summary of the discussion.

In addition, a virtual public forum was hosted on the CRS website from September 19 through September 29, 2023. The public forum included two informational videos about the draft CRS: one providing an overview of the draft CRS including, which received 13 views, and a second providing a more detailed presentation on strategy and project priorities, which received 6 views. The forum also included a discussion board for comments.

VIRTUAL COMMUNITY PARTNER MEETINGS

Both phases of engagement included virtual community partner meetings. Community partner organizations from around the state were invited to participate. The partners were identified in collaboration with MnDOT because their work served one or a combination of the following groups: youth, people of color, immigrants and refugees, people with different abilities and people with low incomes.

During phase one of engagement, the project team hosted a virtual community partner meeting on June 30, 2023. More than 30 organizations were invited to participate. The meeting included attending representatives from The Arc Minnesota, the Minnesota Department of Education, and the Governor's Office. For those organization representatives who could not attend, project information and opportunities for feedback were provided via email.

During phase two of engagement, a virtual community partner meeting was held on September 14, 2023. Meeting attendees included project staff as well as representatives from The Arc Minnesota, the Coalition for Clean Transportation at The Alliance, Fresh Energy, Health Professionals for a Healthy Climate, the Minnesota Housing Partnership, Our Streets MN, the Resource Center for Independent Living, the Sierra Club and the Sustainable Transportation Advisory Council. For those organization representatives who could not attend, project information and opportunities for feedback were provided via email.

See Exhibit E for detailed summaries of the discussions.

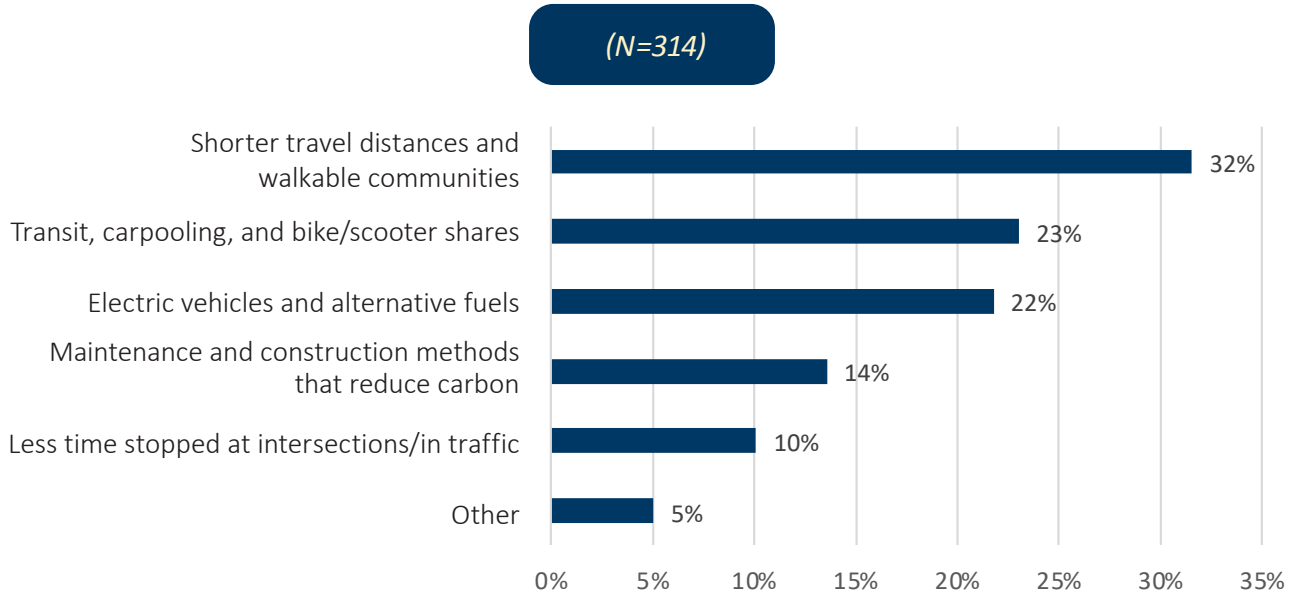
IN-PERSON POP-UP EVENTS

In phase one of engagement, project staff visited six community events across the state, such as markets, fairs and festivals. Three hundred fourteen people were engaged at these events. At each event, staff hosted a table with information about the CRS and conducted engaging activities to encourage attendee participation. A key feature of these pop-up events was a prioritization activity, where attendees could

hang a decorative leaf on a miniature tree that represented which type of strategy they thought MnDOT should prioritize to reduce carbon emissions. Attendees could vote up to twice with 333 total votes cast. Attendees could also share how they usually travel and their demographic information (zip code, age and race/ethnicity).

The strategy type with the highest number of votes was 'shorter travel distances and walkable communities' (32%). Twenty-three percent of participants voted for 'transit, carpooling, and bike/scooter shares', followed closely by 'electric vehicles and alternative fuels' (22%) (**Figure B-6**).

Figure B-6.
Pop-up event results for question, "What types of strategies should MnDOT prioritize? Choose up to two."



See Exhibit F for details on the number of people engaged and the prioritization and demographics data that was collected at each event.

Photo B-1.
Brainerd Tour of Lakes event

BRAINERD TOUR OF LAKES SOCIAL RIDE

On June 3, 2023, project staff hosted a table at Brainerd's annual Tour of Lakes social ride. Portions of the Brainerd area are identified as a Justice40 community.

Project staff engaged with 50 people and collected 57 votes in the prioritization activity. The strategy type with the most votes was 'shorter travel distances and walkable communities' (13), followed closely by 'transit, carpooling, and bike/scooter shares' (12) and 'less time stopped at intersections/in traffic' (11). Some people also prioritized 'electric vehicles and alternative fuels' (9) and 'maintenance and construction methods that reduce carbon' (8). Four people indicated that MnDOT should prioritize other options like LED lights and driver education about pedestrian safety.

The most common method of travel for participants was driving by themselves (13), followed by biking (6), walking or rolling (5), using the bus or train (1) and carpooling (1). Most people said they lived in a zip code that was not in the event area (12), followed by 55401 (5), 56472 (1), and 56468 (1). None of the respondents chose to indicate their race or ethnicity. Most people were between the ages of 55-64 (7), followed by 65-74 (6), 75+ (2), 25-34 (2), under 18 (1) and 35-44 (1).

Photo B-2.
Minneapolis Open Streets (East Lake) event

MINNEAPOLIS OPEN STREETS (EAST LAKE)

On June 10, 2023, project staff hosted a table at Minneapolis' annual Open Streets (East Lake) festival. The East Lake area is identified as a Justice40 community.

Staff spoke with 77 people at the event and collected 70 votes in the prioritization activity. The strategy type with the most votes was 'shorter travel distances and walkable communities' (26), followed by 'transit, carpooling, and bike/scooter shares' (19). Some people prioritized 'electric vehicles and alternative fuels' (8), followed closely by 'maintenance and construction methods that reduce carbon' (7) and

'less time stopped at intersections/in traffic' (6). Four people indicated that they preferred other options that reduce carbon including native plantings and landscaping and maintenance of existing highways instead of expansion. Overall, people were most supportive of multimodal forms of transportation and walkable communities. One person shared that "prioritizing biking and walking should be the standard instead of having to apply for extra funding."

The most common method of travel for participants was biking (16), followed by driving by themselves (14), using the bus or train (9), walking or rolling (7) and carpooling (3). Most people indicated they lived in a zip code outside of the immediate event area (22), followed by 55408 (9), 55406 (7), 55407 (5), 55404 (2), and 55409 (2). The most represented race/ethnicity was white (31), followed by Black or African American (5), Hispanic or Latino (4), Alaskan Native or American Indian (2) and more than one race (1). Most people who responded were between the ages of 25-34 (21), followed by 35-44 (13), 45-54 (5), 18-24 (4), 65-74 (3), under 18 (2) and 55-64 (2).

Photo B-3.
St. Paul Eco Fair event

SAINT PAUL ECO FAIR

On June 17, 2023, project staff hosted a table at the Eco Fair in Como Park, Saint Paul. Staff spoke with 42 people and collected 54 votes in the prioritization activity. The strategy with the most votes was 'shorter travel distances and walkable communities' (17), followed by 'electric vehicles and alternative fuels' (13). 'Construction methods that reduce carbon' strategy received 12 votes. Some people prioritized the 'transit, carpooling, and bike/scooter shares' (5), while others prioritized 'less time stopped at intersections/in traffic' (3). Four people indicated that there were other options that MnDOT should investigate. One person said they would like to see funding for education on how to drive more efficiently.

The most common method of travel for participants was driving by themselves (8), followed by carpooling (3), using the bus or train (3), biking (3) or another method (2). Most people lived in a zip code that was not immediately near the event location (7), followed by 55104 (2), 55108 (2), 55102 (1), 55103 (1) and 55117 (1). The most represented race/ethnicity was white (14), followed by Asian (1), Black or African American (1), more than one race (1) and other (1). The ages of participants varied with most people in the 18-24 age group (6), followed by 45-54 (4), 25-34 (3), 55-64 (2), 65-74 (2), 35-44 (1) and 75+ (1).

Photo B-4.
Rochester Farmers Market event

ROCHESTER FARMERS MARKET

On June 17, 2023, project staff hosted a table at the Rochester Farmers Market. Portions of the Rochester area are identified as Justice40 communities. Staff spoke with 80 people and collected 85 votes in the prioritization activity. The strategy type with the most votes was 'electric vehicles and alternative fuels' (24), closely followed by 'shorter travel distances and walkable communities' (23). People also prioritized 'transit, carpooling, and bike/scooter shares' (17) and 'maintenance and construction methods that reduce carbon' (11). Some people indicated that they prioritized 'less time stopped at intersections/ in traffic' (6), and four people said they would like to see other strategies prioritized.

Overall, there was a strong general interest in making Rochester more multimodal and transit friendly. One person who prioritized walkable communities shared that they wanted to see "safer infrastructure for bikers and pedestrians, and more connectivity." Another participant said, "I am a transportation widow and I think our future should not be car-centric!" People were also interested in electric vehicles and the opportunity to implement them into public transportation. One participant who identified as a MnDOT employee said, "more efficient traffic operations are an important way to reduce carbon," and six people noted they like roundabouts.

The most common method of travel for participants was driving by themselves (12), followed by biking (6), walking or rolling (5), carpooling (4), and using transit (1). People lived in a variety of nearby zip codes with 55902 being most common (6), followed by 55906 (5), 55904 (4), 55901 (4) and 55976 (3). The most represented race/ethnicity was white (11), followed by Asian (6) and other (2). The most common age range was 25-34 (9), followed by under 18 (7), 35-44 (2), 45-54 (2), 55-64 (2), 65-74 (2) and 75+ (1).

Photo B-5.
North Mankato Farmers Market event

NORTH MANKATO FARMERS MARKET

On July 10, 2023, project staff hosted a table at North Mankato Farmers Market. Portions of the Mankato area have been identified as a Justice40

community. Staff spoke with 21 people and collected 20 votes in the prioritization activity. The strategy type with the most votes was 'transit, carpooling, and bike/scooter shares' (8), followed by 'shorter travel distances and walkable communities' (5). One person was interested in pedestrian-friendly options but stated it is "hard to walk and cross big roads in our community." Some people also prioritized 'less time stopped at intersections/in traffic' (3) and 'electric vehicles and alternative fuels' (3). There were mixed feelings about electric vehicles; some people felt they are too expensive, and others questioned whether they perform well in the winter. One person said maintenance and construction methods that reduce carbon should be prioritized. Participants at this event did not share their travel habits or demographic information.

Photo B-6.
Nokomis Farmers Market event

NOKOMIS FARMERS MARKET (MINNEAPOLIS)

On July 12, 2023, project staff hosted a table at the Nokomis Farmers Market in Minneapolis. Staff spoke with 44 people and collected 47 votes in the prioritization activity. The strategy type with the most votes was 'shorter travel distances and walkable communities' (16), followed by 'electric vehicles and alternative fuels' (12) and 'transit, carpooling, and bike/scooter shares' (12). Four people chose 'maintenance and construction methods that reduce carbon', and three chose 'less time stopped at intersections/in traffic'.

Staff had multiple in-depth conversations about the strategies presented. Participants had mixed feelings about electric vehicles and alternative fuels. Some wanted to see more infrastructure for electric vehicles, while others wanted affordable options for purchasing an electric vehicle. One person stated, "the impact of electric vehicles and alternative fuels goes deep; prioritizing them can reduce our dependence on coal and mining." Others felt that electric vehicles would cause a future environmental problem due to the production process and disposal of batteries. One person said they did not support funding electric vehicle infrastructure because "not everyone can afford an electric vehicle, and the batteries are problematic." Others said funding should go towards transit, and one person said, "I love transit but want to make sure it is equitable and accessible for everyone."

The most common method of travel for participants was driving by themselves (13), followed by walking or rolling (7), riding a bike (5), carpooling (3) and using transit (2). Most people indicated they lived in the same Minneapolis zip code as the farmers market, 55417 (15). Participants also lived in 55407 (4), 55406 (4), 55419 (2) and other zip codes that were not listed (3). The most represented race/ethnicity was white (19), followed by Hispanic or Latino (1), Asian (1) and other (2). The most common age ranges were under 18 and 35-44 (6 each), followed by 45-54 (5), 25-34 and 65-74 (4 each), 55-64 (3) and over 75 (1).

IN-PERSON LOCAL PARTNER EVENTS

Local partners engaged with the public and distributed informational handouts at four community events across the state.

MINNESOTA STATE UNIVERSITY MOORHEAD EARTH DAY

On April 20, 2023, a local partner attended the Minnesota State University Moorhead (MSUM) Earth Day Event. They distributed 50 handouts and had several brief conversations with university students. PartnerSHIP 4 Health organized the event. There was an uptick in website visits in the five days after this event. Portions of the Moorhead area are identified as a Justice40 community.

SAINT PAUL 'CHOOSE HOW YOU MOVE' FAIR

On June 17, 2023, local MnDOT staff distributed the project handout at the Choose How You Move Frogtown Fair. Move Minnesota and Frogtown Green organized this event. The event's purpose was to inform the public about how changing their transportation choices can lead to cleaner air in our communities. The Frogtown area is identified as a Justice40 community.

PELICAN RAPIDS INTERNATIONAL FRIENDSHIP FESTIVAL

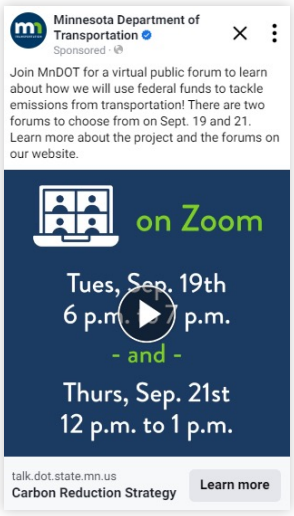
On June 24, 2023, a local partner attended the International Friendship Festival in Pelican Rapids. They distributed project handouts and had a number of brief conversations with attendees. The Pelican Rapids area is identified as a Justice40 community.

BOOTH AT THE MINNESOTA STATE FAIR

MnDOT co-hosted a booth at the Eco Experience exhibit at the Minnesota State Fair from August 24 through September 4, 2023. They highlighted the work occurring to reduce carbon emissions in the transportation sector, including the CRS. Fairgoers could review display boards and scan a QR code to learn more about the work MnDOT is doing to reduce carbon emissions and the CRS.

EXHIBITS

EXHIBIT A: SOCIAL MEDIA



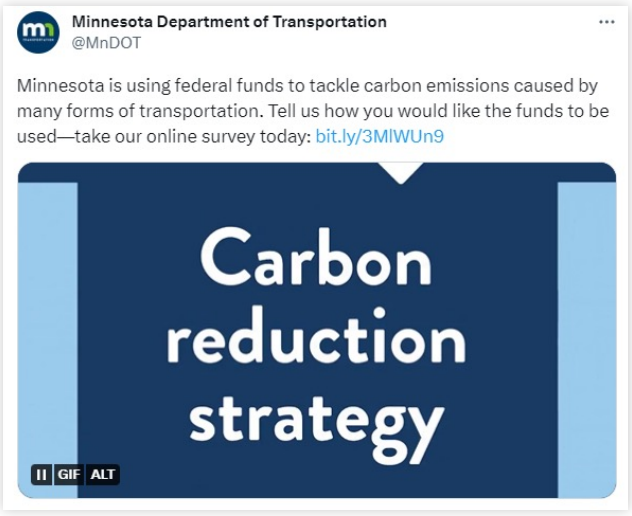
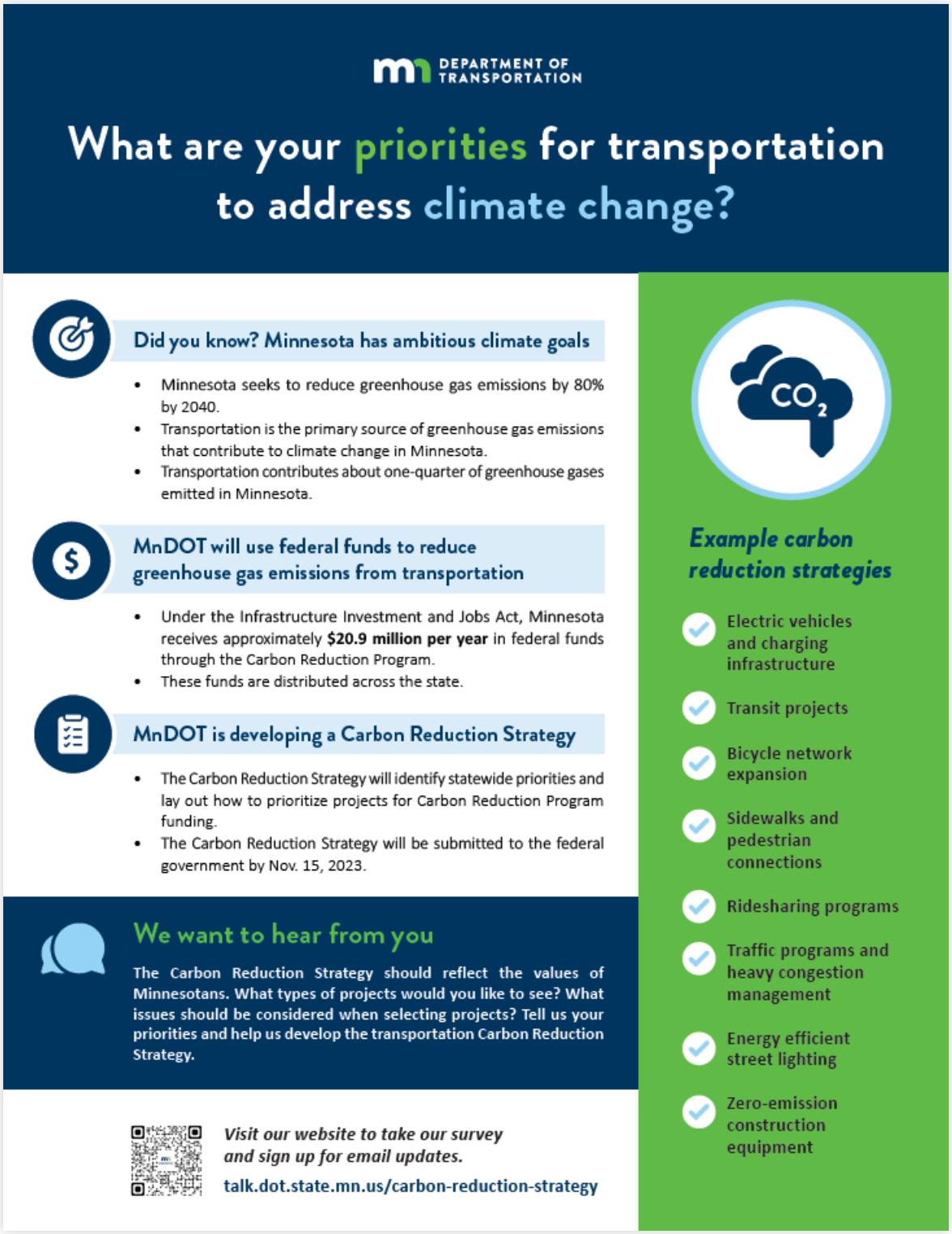


EXHIBIT B: PROJECT HANDOUT



DEPARTMENT OF TRANSPORTATION

What are your priorities for transportation to address climate change?

Did you know? Minnesota has ambitious climate goals

- Minnesota seeks to reduce greenhouse gas emissions by 80% by 2040.
- Transportation is the primary source of greenhouse gas emissions that contribute to climate change in Minnesota.
- Transportation contributes about one-quarter of greenhouse gases emitted in Minnesota.

MnDOT will use federal funds to reduce greenhouse gas emissions from transportation

- Under the Infrastructure Investment and Jobs Act, Minnesota receives approximately **$20.9 million per year** in federal funds through the Carbon Reduction Program.
- These funds are distributed across the state.

MnDOT is developing a Carbon Reduction Strategy

- The Carbon Reduction Strategy will identify statewide priorities and lay out how to prioritize projects for Carbon Reduction Program funding.
- The Carbon Reduction Strategy will be submitted to the federal government by Nov. 15, 2023.

We want to hear from you

The Carbon Reduction Strategy should reflect the values of Minnesotans. What types of projects would you like to see? What issues should be considered when selecting projects? Tell us your priorities and help us develop the transportation Carbon Reduction Strategy.

Visit our website to take our survey and sign up for email updates.

talk.dot.state.mn.us/carbon-reduction-strategy

Example carbon reduction strategies

- Electric vehicles and charging infrastructure
- Transit projects
- Bicycle network expansion
- Sidewalks and pedestrian connections
- Ridesharing programs
- Traffic programs and heavy congestion management
- Energy efficient street lighting
- Zero-emission construction equipment

EXHIBIT C: SURVEY RESPONDENT ZIP CODE MAP

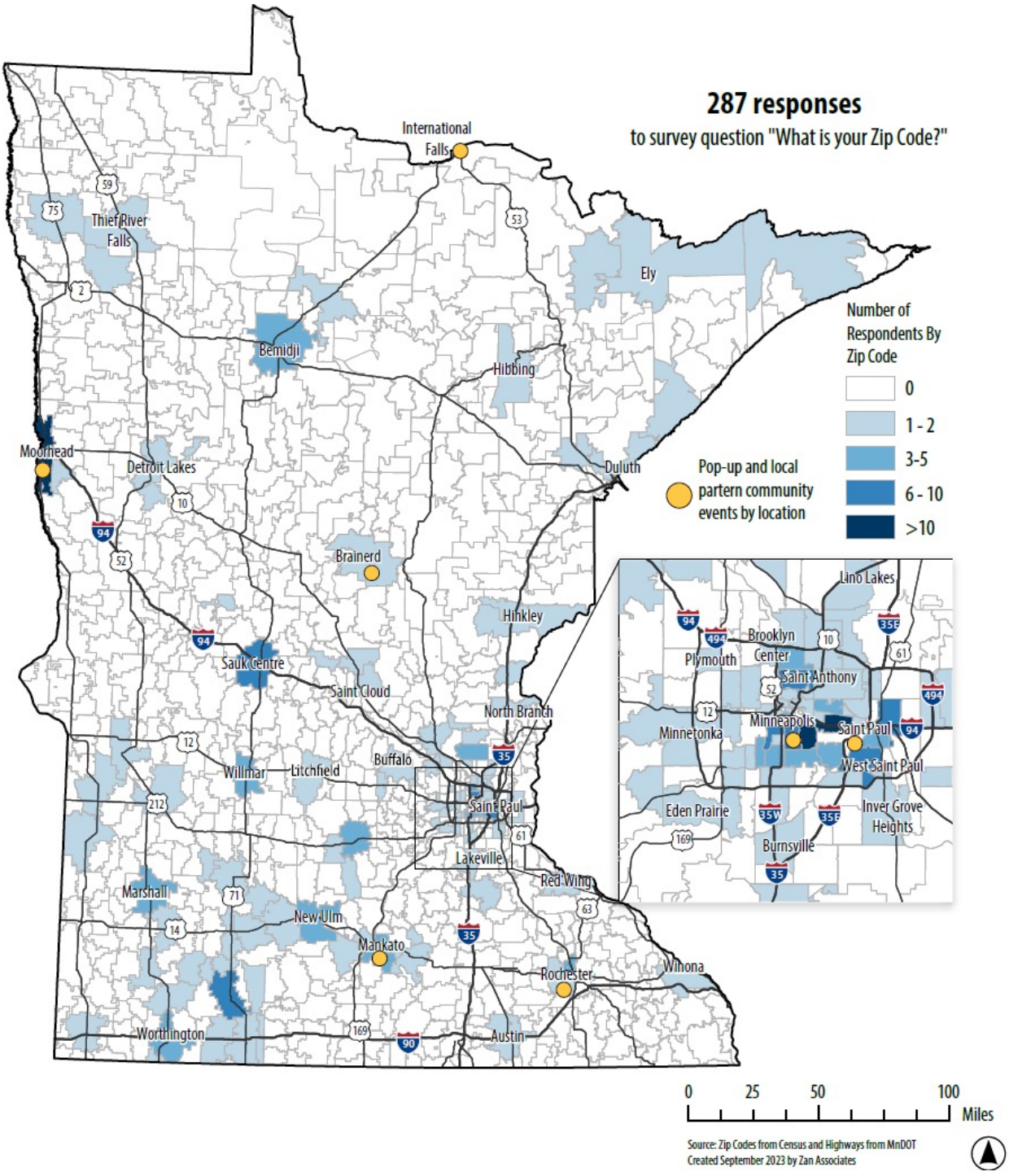


EXHIBIT D: VIRTUAL PUBLIC FORUM DISCUSSION SUMMARY

Topic	Comment
Feedback on priorities	One participant noted that a main barrier to consumers adopting electric vehicles is not having charging stations at their home residence. The participant also noted that land use planning is an important part of travel demand management and should be considered in carbon reduction strategies. Lastly, the same participant stated that the focus on reducing travel time prioritizes vehicle travel and asked about system improvements for other modes of travel. Another participant noted that highway bus rapid transit and electric school buses should be prioritized. Specifically, it was suggested that electric school buses should be prioritized with an environmental justice lens in communities that have higher emissions.
Other questions and comments	A participant with experience managing CRP fund distribution asked if tools and guidance would be provided as part of the document and appreciated that it would.

EXHIBIT E: VIRTUAL COMMUNITY PARTNER MEETINGS DISCUSSION SUMMARY

PHASE 1

Discussion Question	Comment
What policies or projects resonate with your organization and the people you serve?	Interest in rideshare programs that pair those who drive with those who don't. Especially in rural areas where there aren't many modal options. Some businesses want transportation for their workers, which could be more broadly used.
How do the people you serve get around?	It depends on where they live. It could be a smaller bus if available, but if someone is in a rural area without many options, they're limited as to what jobs they can have/get to. Also, services like Dial-a-Ride have very limited hours. Transportation use and needs vary across the state. • For example, in a rural area, if there is no transit, they may have medical transportation benefits available, but that doesn't include everyone. Many people are limited in where they can go, and where they can work, which is a huge lost opportunity. • The north shore needs reliable transportation. Some must travel far for medical services including birthing. Childcare openings are left open simply because caregivers are unable to get there. One factor is having multiple stops (errands, childcare, work, etc.). Personal vehicles can be cost-prohibitive; both the up-front purchase cost and the cost of maintenance.

How do you see the community working towards [strategy]? What types of projects would support your community towards [strategy]?

Strategy	Comment
Electrification	Possible locations for charging stations that serve children and young families could be community colleges and benefits offices.
Travel choices	Bicycle lanes could be helpful; major roads aren't currently safe for bikes. More sidewalks would make travel feel safer for children. Have heard a desire from rural communities for dial-a-ride, which can be crucial for young people to get to work. Vanpools could be great too. • Should have the flexibility to have more than one destination. • This service would be great for medical appointments in rural areas. Ensuring enough people know about the service to use it is crucial. • Service should include considerations like car seats and seatbelt shorteners for children.
System management	Pedestrians in the winter • Curb cuts help those with mobility issues and caregivers with strollers. • Curb cuts sometimes get blocked by snowplow piles, which can be a big challenge for mobility. The St. Cloud transit hub has great accessibility features; would be nice to have that kind of facility throughout the state.

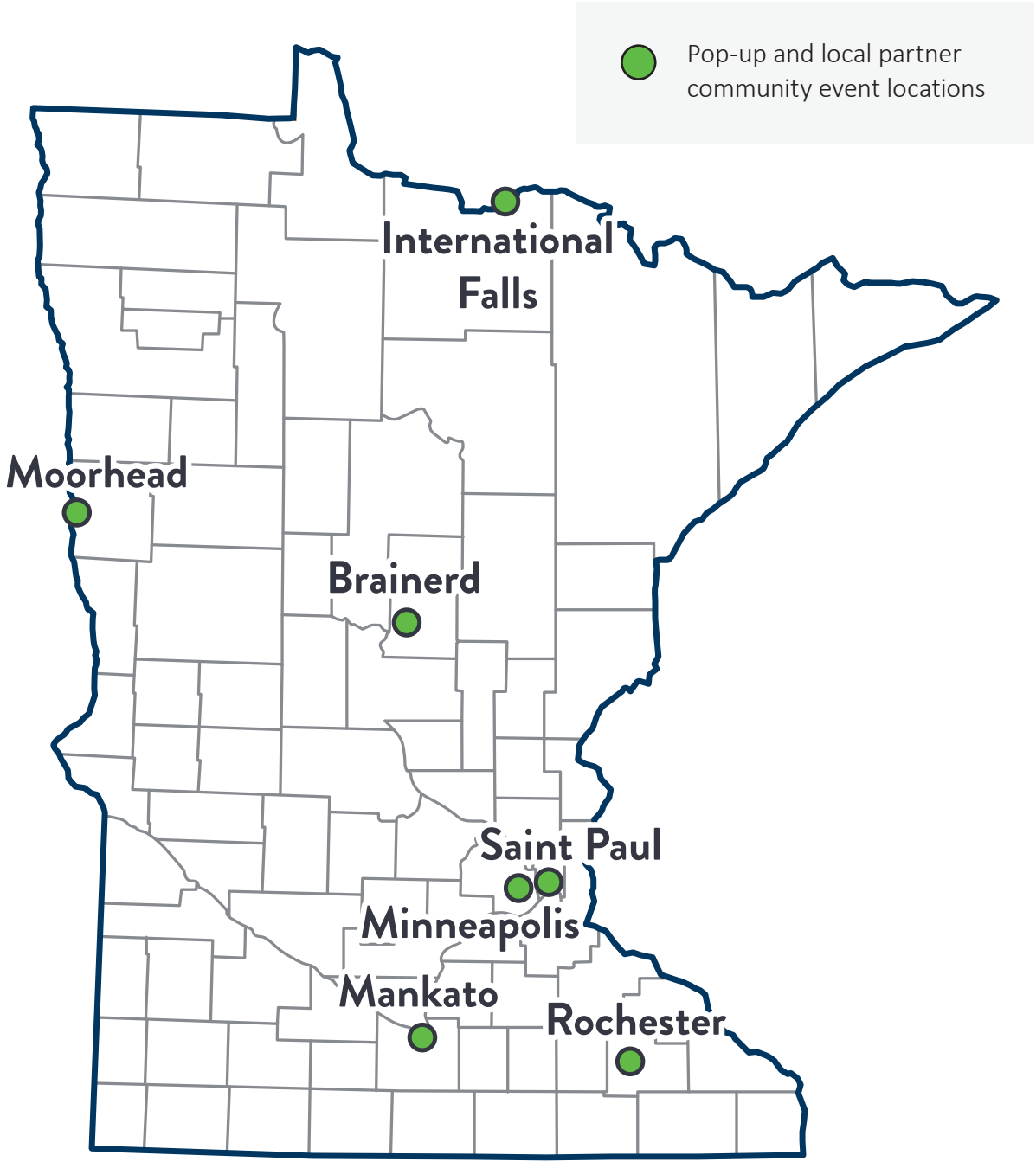
PHASE 2

Topic	Comment
Geographically specific goals	Multiple participants noted that they appreciated the acknowledgement that different areas of the state should have different goals. One suggestion that was given and supported by other participants was area-specific VMT goals. A participant also noted the need to recognize common goals across the state and that the urban/rural narrative is an impediment. The participant also noted that the focus should be on urban areas when it comes to travel choices.
Priority strategies and project types	A participant noted that the categorization of strategies and project types is important, as well as prioritization based on level of impact. Specifically, the individual recommended creating an impact hierarchy of reducing miles traveled, electrification, and decarbonization, similar to the idea of reduce, reuse, and then recycle. The participant also said travel choices should be a subset of the VMT reduction goal, and that land use reforms should be considered as land use heavily relates to transportation. The importance of having a Minnesota-wide plan that's implementable across agencies was also emphasized. Another participant noted that alongside increasing travel choices, it is important to specifically emphasize the importance of reducing driving. The participant suggested that it's important to note that VMT reduction has a lot of value beyond the reduction in tailpipe emissions. This includes reduced demand on battery materials, which are carbon intensive to extract and are mostly located on wild and indigenous lands in the global south. Another participant noted there are also significant health benefits from increasing active transportation options.

Topic	Comment
Other statewide plans	A participant asked about how the Carbon Reduction Strategy (CRS) relates to other statewide plans. A project team member explained that plans like the Climate Action Framework and Statewide Multimodal Transportation Plan were reviewed during the creation of the CRS, and that the CRS supports those efforts and focuses on implementation of transportation investments that support carbon reduction.
Other questions and comments	A participant noted curiosity as to how the CRS can help with needs for non-car driving residents of rural areas. Another participant noted that the connection between housing and transportation is important. After the meeting, a participant submitted comments about how persons with disabilities who utilize subsistence transportation are historically and continually out of reach, especially in rural areas. The individual noted this is mostly due to cost or lack of adaptive equipment. The participant also noted that even counties with buses have limited schedules and destinations, the lack of snow removal and sidewalk infrastructure makes walking or rolling difficult, and the cost of accessible vans (especially electric vehicles and their charging stations), are significant barriers. This participant shared recommendations, including: • Make sure all charging stations are accessible. • Raise awareness for lift-equipped vehicles, including hybrids, and provide such vehicles to rural residents. • Offer low-interest loans or other assistance for people with disabilities to replace gas-powered vehicles.

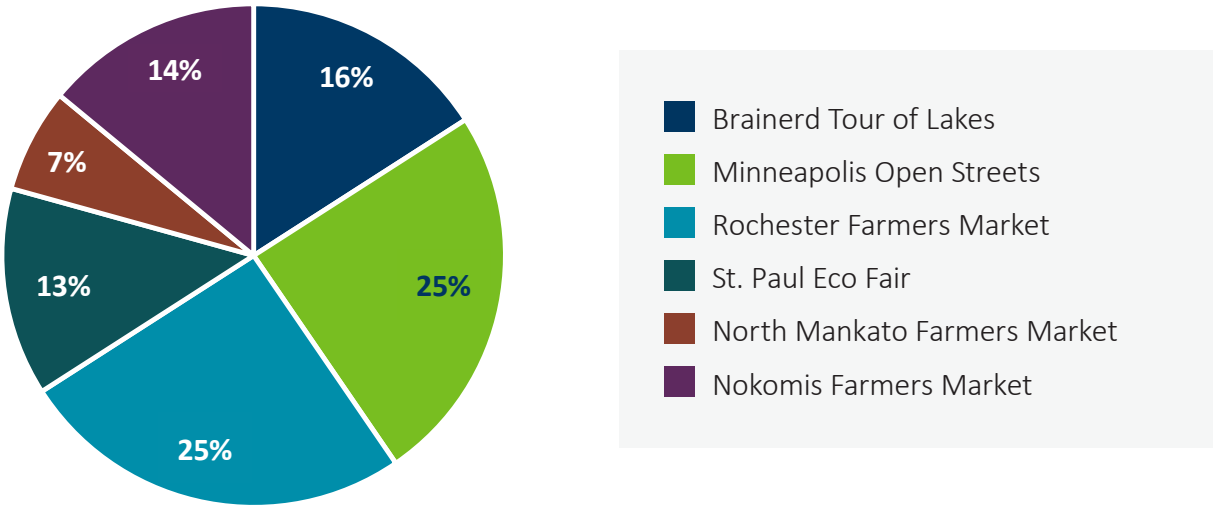
EXHIBIT F: ENGAGEMENT EVENT DATA

Pop-up and local partner community event locations

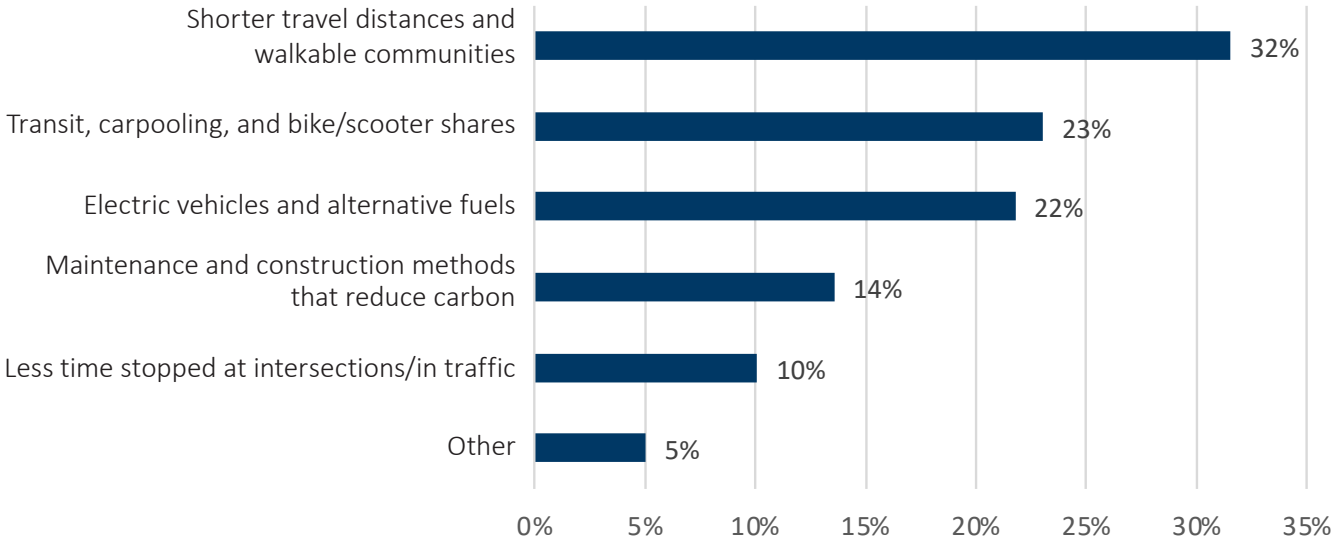


Pop-up event data

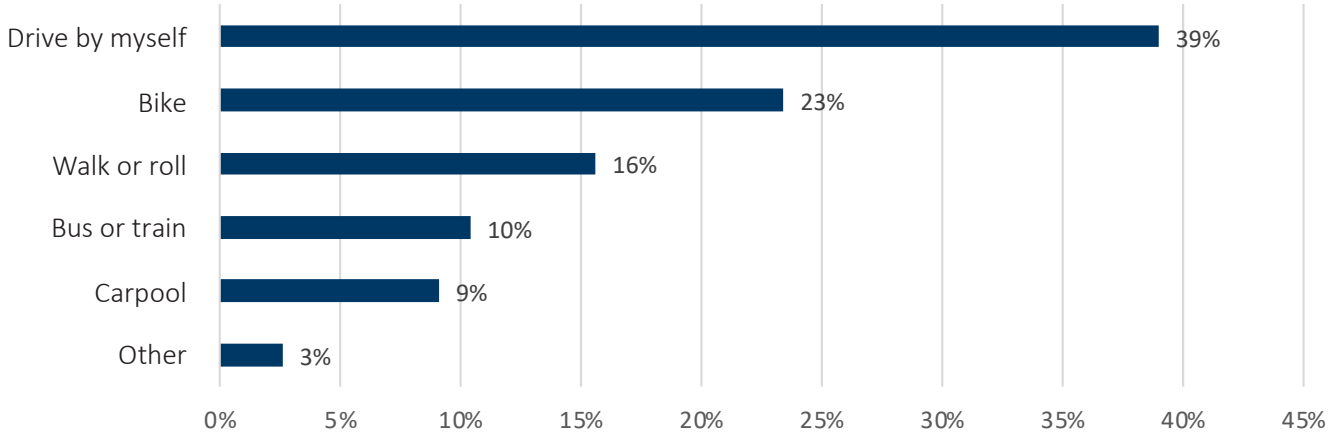
PEOPLE ENGAGED BY EVENT
(N=314)



WHAT TYPES OF STRATEGIES SHOULD MnDOT PRIORITIZE? CHOOSE UP TO TWO.
(N=314)

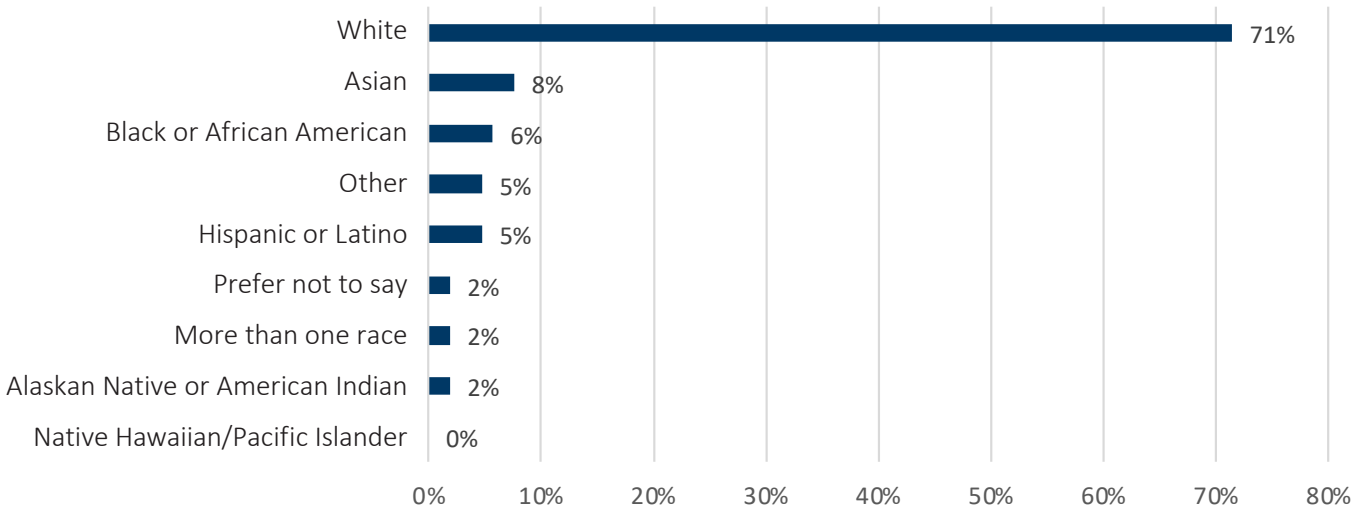


HOW DO YOU USUALLY GET AROUND?
(N=154)

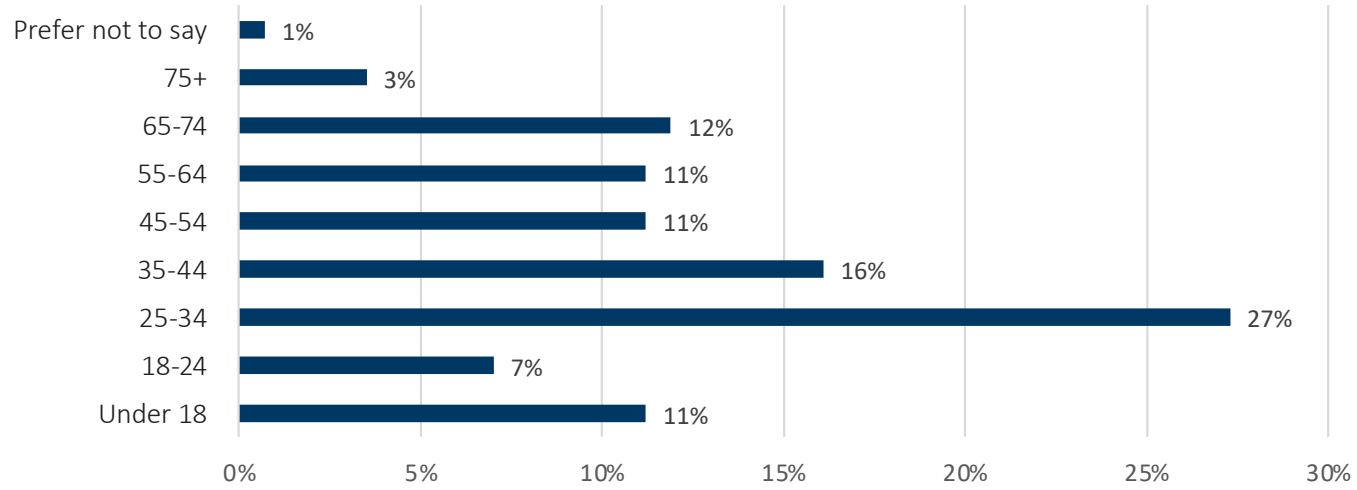


Zip code *(N = 132)*		
55417	11%	Minneapolis
55408	7%	Minneapolis
55406	5%	Minneapolis
55902	5%	Rochester
56401	4%	Brainerd
55407	4%	Minneapolis
55906	4%	Rochester
55901	3%	Rochester
55904	3%	Minneapolis
55407	3%	Minneapolis
55406	2%	Stewartville/High Forest/Pleasant Grove
55104	2%	St. Paul
55108	2%	St. Paul
55404	2%	Minneapolis
55409	2%	Minneapolis
55419	2%	Minneapolis
55117	1%	St. Paul
55103	1%	St. Paul
55102	1%	St. Paul
56472	1%	Pequot Lakes/Breezy Point
56468	1%	Nisswa
Other	35%	-

RACE/ETHNICITY
(N=105)



AGE
(N=143)



APPENDIX C

FEDERAL AND STATE FUNDING SOURCES

Appendix C identifies potential federal and state funding sources that may support priority project types identified in the CRS. The information found in this appendix should be considered a useful starting point for potential funding opportunities that encourage carbon reduction from the transportation system. It is not intended to imply or obligate that specific projects are eligible or required to be funded by the programs that are listed under them.

Potential funding programs for each project type were identified based on a review of the general scope of each program; however, each funding program has detailed eligibility requirements, which may include characteristics or requirements that may not be met by individual projects. All project sponsors should consult with program guidance, MnDOT, FHWA, and FTA, as applicable, for specific determinations of eligibility for each funding program.

Appendix C should be read using the following format.

CATGEORY

STRATEGY

Project type

- Potential federal and state funding programs that may fund the above project type.
- Potential federal and state funding programs that may fund the above project type.*

An asterisk (*) is listed for programs where eligibility is unclear and may require further exploration and coordination with the managing state or federal agency.

ELECTRIFICATION

INSTALL EV OR ZEV CHARGING INFRASTRUCTURE

Expand public EV or ZEV charging infrastructure network for light duty vehicle

- Carbon Reduction Program (CRP)
- Charging and Fueling Infrastructure Grants (Corridor Program)
- Charging and Fueling Infrastructure Grants (Community Program)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- FTA 5307 Program – Urbanized Area Formula Grants*
- FTA 5309 Program – Capital Investment Grants*
- FTA 5311 Program – Formula Grants for Rural Areas*
- FTA 5311 Program – Public Transportation on Indian Reservations*
- FTA 5312 Program - Research, Development, Demonstration, and Deployment Projects*
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- National Electric Vehicle Infrastructure (NEVI) Formula Program
- Surface Transportation Block Grant (STBG) Program
- Minnesota General Funds Supporting Electric Vehicle Infrastructure

Implement public and depot EV or ZEV charging infrastructure for transit buses

- Carbon Reduction Program (CRP)
- Charging and Fueling Infrastructure Grants (Corridor Program)
- Charging and Fueling Infrastructure Grants (Community Program)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- FTA 5307 Program – Urbanized Area Formula Grants
- FTA 5309 Program – Capital Investment Grants
- FTA 5311 Program – Formula Grants for Rural Areas
- FTA 5311 Program – Public Transportation on Indian Reservations
- FTA 5339(a) Program - Bus and Bus Facilities Formula Grants
- FTA 5339(c) Program – Low or No Emission (Bus) Grants
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- National Electric Vehicle Infrastructure (NEVI) Formula Program*
- Surface Transportation Block Grant (STBG) Program
- Minnesota General Funds Supporting Electric Vehicle Infrastructure

Provide EV or ZEV charging infrastructure grants for school districts

- Carbon Reduction Program (CRP)
- Charging and Fueling Infrastructure Grants (Corridor Program)*
- Charging and Fueling Infrastructure Grants (Community Program)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- National Electric Vehicle Infrastructure (NEVI) Formula Program
- Surface Transportation Block Grant (STBG) Program
- Minnesota General Funds Supporting Electric Vehicle Infrastructure

Deploy public/shared private charging infrastructure for medium and heavy-duty freight vehicles

- Carbon Reduction Program (CRP)
- Charging and Fueling Infrastructure Grants (Corridor Program)*
- Charging and Fueling Infrastructure Grants (Community Program)*
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- National Electric Vehicle Infrastructure (NEVI) Formula Program
- Nationally Significant Freight and Highway Projects (INFRA)
- Surface Transportation Block Grant (STBG) Program
- Minnesota General Funds Supporting Electric Vehicle Infrastructure

PURCHASE OR LEASE EVs OR ZEVs

Zero emission school buses

- Carbon Reduction Program (CRP)
- Clean School Bus Program
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Surface Transportation Block Grant (STBG) Program

Zero emission transit buses

- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- FTA 5307 Program – Urbanized Area Formula Grants
- FTA 5309 Program – Capital Investment Grants
- FTA 5311 Program – Formula Grants for Rural Areas
- FTA 5311 Program – Public Transportation on Indian Reservations
- FTA 5339(a) Program - Bus and Bus Facilities Formula Grants
- FTA 5339(c) Program – Low or No Emission (Bus) Grants
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Surface Transportation Block Grant (STBG) Program

- Greater Minnesota Transit Grants - Public Transit Vehicle Replacement Grant
- Metropolitan Area Transit Funding Distribution

Transition public fleet through purchase and lease of EVs or ZEVs

- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Surface Transportation Block Grant (STBG) Program
- Greater Minnesota Transit Grants - Public Transit Operating Grants
- Greater Minnesota Transit Grants - Public Transit Vehicle Replacement Grant

Purchase or incentivize e-bike programs

- Carbon Reduction Program (CRP)*
- Surface Transportation Block Grant (STBG) Program*
- Transportation Alternatives set-aside (of STBG)*

Initiate ZEV or EV sharing programs

- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- FTA 5312 Program – Research, Development, Demonstration, and Deployment Projects*
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Surface Transportation Block Grant (STBG) Program

SUPPORT EV AND ZEV ADOPTION THROUGH OUTREACH AND EDUCATION

Outreach and education for EV and ZEV passenger vehicles

- Carbon Reduction Program (CRP)*
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)*
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Surface Transportation Block Grant (STBG) Program

Outreach and education for EV and ZEV medium/heavy-duty vehicles and corporate fleets

- Carbon Reduction Program (CRP)*
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)*
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Nationally Significant Freight and Highway Projects (INFRA)
- Surface Transportation Block Grant (STBG) Program

TRAVEL OPTIONS

INSTALL AND MAINTAIN INFRASTRUCTURE NETWORK IMPROVEMENTS FOR WALKING, ROLLING AND BICYCLING

Construct or improve bicycle network

- Active Transportation Infrastructure Investment Program
- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- FTA 5307 Program – Urbanized Area Formula Grants*
- FTA 5309 Program – Capital Investment Grants*
- FTA 5311 Program – Formula Grants for Rural Areas*
  - Limited to Connection to Transit Routes
- FTA 5311 Program – Public Transportation on Indian Reservations*
  - Limited to Connection to Transit Routes
- Highway Safety Improvement Program
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Reconnecting Communities Pilot Program
- Rural Surface Transportation Grant Program
- Safe Streets and Roads for All
- Surface Transportation Block Grant (STBG) Program
- Transportation Alternatives set-aside (of STBG)
- Active Transportation Program (AT)
- Safe Routes to School (SRTS) Program
- State Road Construction

Construct or improve pedestrian network

- Active Transportation Infrastructure Investment Program
- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- FTA 5307 Program – Urbanized Area Formula Grants*
- FTA 5309 Program – Capital Investment Grants*
- FTA 5311 Program – Formula Grants for Rural Areas*
  - Limited to Connection to Transit Routes
- FTA 5311 Program – Public Transportation on Indian Reservations*
  - Limited to Connection to Transit Routes
- Highway Safety Improvement Program
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Reconnecting Communities Pilot Program
- Rural Surface Transportation Grant Program
- Safe Streets and Roads for All
- Surface Transportation Block Grant (STBG) Program
- Transportation Alternatives set-aside (of STBG)
- Active Transportation Program (AT)
- Safe Routes to School (SRTS) Program
- State Road Construction

Add or improve road crossings for users

- Active Transportation Infrastructure Investment Program
- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Highway Safety Improvement Program
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Reconnecting Communities Pilot Program
- Rural Surface Transportation Grant Program
- Safe Streets and Roads for All
- Surface Transportation Block Grant (STBG) Program
- Transportation Alternatives set-aside (of STBG)
- Active Transportation Program (AT)
- Safe Routes to School (SRTS) Program
- State Road Construction

Establish or expand micromobility programs

- Active Transportation Infrastructure Investment Program
- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Congestion Relief Program
- FTA 5312 Program – Research, Development, Demonstration, and Deployment Projects*
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Reconnecting Communities Pilot Program
- Surface Transportation Block Grant (STBG) Program
- Active Transportation Program (AT)
- Safe Routes to School (SRTS) Program
- State Road Construction

Coordinate and develop maintenance plans to ensure access to bicycle and pedestrian networks through all weather conditions

- Carbon Reduction Program (CRP)*
- Safe Streets and Roads for All*
- Active Transportation Program (AT)*
- Safe Routes to School (SRTS) Program*

PLAN, DESIGN AND ENGINEER INFRASTRUCTURE NETWORK IMPROVEMENTS FOR WALKING, ROLLING AND BICYCLING

Plan, design and engineer Safe Routes to School

- Active Transportation Infrastructure Investment Program
- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Highway Safety Improvement Program
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Reconnecting Communities Pilot Program
- Rural Surface Transportation Grant Program
- Safe Streets and Roads for All

- Surface Transportation Block Grant (STBG) Program
- Transportation Alternatives set-aside (of STBG)
- Active Transportation Program (AT)
- Safe Routes to School (SRTS) Program
- State Road Construction

Plan, design and engineer transit hubs

- Active Transportation Infrastructure Investment Program
- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- FTA 5303 Program – Pilot Program for Transit Oriented Development
- FTA 5307 Program – Urbanized Area Formula Grants
- FTA 5309 Program – Capital Investment Grants
- FTA 5311 Program – Formula Grants for Rural Areas
- FTA 5311 Program – Public Transportation on Indian Reservations
- FTA 5339(a) Program – Bus and Bus Facilities Formula Grants
- FTA 5339(c) Program – Low or No Emission (Bus) Grants*
  - Limited to EV Infrastructure
- Highway Safety Improvement Program
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- National Infrastructure Project Assistance (Megaprojects)
- Rural Surface Transportation Grant Program
- Surface Transportation Block Grant (STBG) Program
- Transportation Alternatives set-aside (of STBG)

Plan, design and engineer local and regional active transportation projects

- Active Transportation Infrastructure Investment Program
- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Highway Safety Improvement Program
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Reconnecting Communities Pilot Program
- Rural Surface Transportation Grant Program
- Safe Streets and Roads for All
- Surface Transportation Block Grant (STBG) Program
- Transportation Alternatives set-aside (of STBG)
- Active Transportation Program (AT)

IMPLEMENT CONTEXT SENSITIVE DESIGN FOR TRAVEL OPTIONS

Improve street connectivity

- Active Transportation Infrastructure Investment Program
- Carbon Reduction Program (CRP)*
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Highway Safety Improvement Program
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Reconnecting Communities Pilot Program
- Rural Surface Transportation Grant Program

- Safe Streets and Roads for All
- Surface Transportation Block Grant (STBG) Program
- Active Transportation Program (AT)
- Safe Routes to School (SRTS) Program

Implement traffic calming

- Active Transportation Infrastructure Investment Program
- Carbon Reduction Program (CRP)*
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Highway Safety Improvement Program
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Reconnecting Communities Pilot Program
- Rural Surface Transportation Grant Program
- Safe Streets and Roads for All
- Surface Transportation Block Grant (STBG) Program
- Transportation Alternatives set-aside (of STBG)
- Active Transportation Program (AT)
- Safe Routes to School (SRTS) Program
- State Road Construction

Implement projects that reduce vehicle travel lanes (e.g., road diets)

- Active Transportation Infrastructure Investment Program
- Carbon Reduction Program (CRP)*
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Highway Safety Improvement Program
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Reconnecting Communities Pilot Program
- Rural Surface Transportation Grant Program
- Safe Streets and Roads for All
- Surface Transportation Block Grant (STBG) Program
- Transportation Alternatives set-aside (of STBG)
- Active Transportation Program (AT)
- Safe Routes to School (SRTS) Program
- State Road Construction

Install smart crosswalk systems with LED lighting and sensors that increase visibility and alert drivers when people are crossing

- Active Transportation Infrastructure Investment Program
- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Highway Safety Improvement Program
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Reconnecting Communities Pilot Program
- Rural Surface Transportation Grant Program
- Safe Streets and Roads for All
- Surface Transportation Block Grant (STBG) Program
- Active Transportation Program (AT)
- Safe Routes to School (SRTS) Program
- State Road Construction

ADD HIGH-CAPACITY PUBLIC TRANSIT OPTIONS (OPERATIONS AND CAPITAL)

Implement BRT systems that use dedicated lanes and stations with off-board fare collection to provide faster and more efficient service

- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Congestion Relief Program
- FTA 5303 Program – Pilot Program for Transit Oriented Development*
- FTA 5307 Program – Urbanized Area Formula Grants
- FTA 5309 Program – Capital Investment Grants
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Nationally Significant Freight and Highway Projects (INFRA)
- Reconnecting Communities Pilot Program
- Rural Surface Transportation Grant Program
- Surface Transportation Block Grant (STBG) Program
- Metropolitan Area Transit Funding Distribution
- MnDOT State Highway Operations and Maintenance

Implement bus transit priority treatments

- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Congestion Relief Program
- FTA 5307 Program – Urbanized Area Formula Grants
- FTA 5309 Program – Capital Investment Grants
- FTA 5311 Program – Formula Grants for Rural Areas
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Nationally Significant Freight and Highway Projects (INFRA)
- Reconnecting Communities Pilot Program
- Rural Surface Transportation Grant Program
- Surface Transportation Block Grant (STBG) Program
- Greater Minnesota Transit Grants - Public Transit Technology Grant
- Metropolitan Area Transit Funding Distribution
- MnDOT State Highway Operations and Maintenance

Add or expand bus service

- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Congestion Relief Program
- FTA 5307 Program – Urbanized Area Formula Grants
- FTA 5309 Program – Capital Investment Grants
- FTA 5311 Program – Formula Grants for Rural Areas
- FTA 5311 Program – Public Transportation on Indian Reservations
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Nationally Significant Freight and Highway Projects (INFRA)

- Reconnecting Communities Pilot Program
- Rural Surface Transportation Grant Program
- Surface Transportation Block Grant (STBG) Program
- Greater Minnesota Transit Grants - Public Transit New Service Grants
- Greater Minnesota Transit Grants - Public Transit Operating Grants
- Metropolitan Area Transit Funding Distribution

Enhance bus frequency of hours of service

- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- FTA 5307 Program – Urbanized Area Formula Grants
- FTA 5309 Program – Capital Investment Grants
- FTA 5311 Program – Formula Grants for Rural Areas
- FTA 5311 Program – Public Transportation on Indian Reservations
- FTA 5312 Program – Research, Development, Demonstration, and Deployment Projects*
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Nationally Significant Freight and Highway Projects (INFRA)
- Reconnecting Communities Pilot Program
- Rural Surface Transportation Grant Program
- Surface Transportation Block Grant (STBG) Program
- Greater Minnesota Transit Grants - Public Transit New Service Grants
- Greater Minnesota Transit Grants - Public Transit Operating Grants
- Metropolitan Area Transit Funding Distribution

Develop mobility hubs (e.g., stations that connect high-capacity transit routes, stations that connect to shared mobility and micromobility options, transit stations that include park and ride facilities to encourage commuters to leave vehicles and use transit)

- Active Transportation Infrastructure Investment Program
- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Congestion Relief Program
- FTA 5303 Program – Pilot Program for Transit Oriented Development
- FTA 5307 Program – Urbanized Area Formula Grants
- FTA 5309 Program – Capital Investment Grants
- FTA 5311 Program – Formula Grants for Rural Areas
- FTA 5311 Program – Public Transportation on Indian Reservations
- FTA 5312 Program – Research, Development, Demonstration, and Deployment Projects*
- FTA 5339(a) Program – Bus and Bus Facilities Formula Grants
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- National Infrastructure Project Assistance (Megaprojects)
- Nationally Significant Freight and Highway Projects (INFRA)
- Reconnecting Communities Pilot Program
- Rural Surface Transportation Grant Program
- Surface Transportation Block Grant (STBG) Program
- Metropolitan Area Transit Funding Distribution

Enhance transit stops (e.g., add benches, sheltersm lighting, heat)

- Carbon Reduction Program (CRP)*
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- FTA 5303 Program – Pilot Program for Transit Oriented Development
- FTA 5307 Program – Urbanized Area Formula Grants
- FTA 5309 Program – Capital Investment Grants
- FTA 5311 Program – Formula Grants for Rural Areas
- FTA 5311 Program – Public Transportation on Indian Reservations
- FTA 5312 Program – Research, Development, Demonstration, and Deployment Projects*
- FTA 5339(a) Program – Bus and Bus Facilities Formula Grants
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Nationally Significant Freight and Highway Projects (INFRA)
- Rural Surface Transportation Grant Program
- Surface Transportation Block Grant (STBG) Program
- Metropolitan Area Transit Funding Distribution

Transit pilot projects (e.g., on demand service to test feasibility in an area, re-routing projects)

- Advanced Transportation Technologies and Innovative Mobility Deployment (ATTIMD) Program
- Carbon Reduction Program
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Congestion Relief Program
- Federal-State Partnership for Intercity Passenger Rail Grants
- FTA 5303 Program – Pilot Program for Transit Oriented Development
- FTA 5307 Program – Urbanized Area Formula Grants
- FTA 5309 Program – Capital Investment Grants
- FTA 5311 Program – Formula Grants for Rural Areas
- FTA 5311 Program – Public Transportation on Indian Reservations
- FTA 5312 Program – Research, Development, Demonstration, and Deployment Projects
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Nationally Significant Freight and Highway Projects (INFRA)
- Rural Surface Transportation Grant Program
- Surface Transportation Block Grant (STBG) Program
- Greater Minnesota Transit Grants - Public Transit Operating Grants
- Metropolitan Area Transit Funding Distribution

ADD INTERCITY AND REGIONAL PUBLIC TRANSIT OPTIONS (OPERATIONS AND CAPITAL)

Establish or expand intercity bus services that connect different towns, cities and regions

- Amtrak National Network Grants
- Carbon Reduction Program

- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Federal-State Partnership for Intercity Passenger Rail Grants
- FTA 5307 Program – Urbanized Area Formula Grants
- FTA 5309 Program – Capital Investment Grants
- FTA 5311 Program – Formula Grants for Rural Areas
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- National Infrastructure Project Assistance (Megaprojects)
- Nationally Significant Freight and Highway Projects (INFRA)
- Rural Surface Transportation Grant Program
- Surface Transportation Block Grant (STBG) Program
- Greater Minnesota Transit Grants – Minnesota Intercity Bus Program
- Greater Minnesota Transit Grants - Public Transit New Service Grants
- Greater Minnesota Transit Grants - Public Transit Operating Grants
- Metropolitan Area Transit Funding Distribution

Develop mobility hubs

- Carbon Reduction Program
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Federal-State Partnership for Intercity Passenger Rail Grants
- FTA 5339(a) Program – Bus and Bus Facilities Formula Grants
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Nationally Significant Freight and Highway Projects (INFRA)
- Rural Surface Transportation Grant Program
- Surface Transportation Block Grant (STBG) Program

Develop and improve intercity passenger rail service

- Amtrak National Network Grants
- Carbon Reduction Program*
- Federal-State Partnership for Intercity Passenger Rail Grants
- FTA 5309 Program – Capital Investment Grants
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- National Infrastructure Project Assistance (Megaprojects)
- Nationally Significant Freight and Highway Projects (INFRA)
- Restoration and Enhancement Grant Program
- Rural Surface Transportation Grant Program
- Surface Transportation Block Grant (STBG) Program

Pilot projects

- Active Transportation Infrastructure Investment Program
- Advanced Transportation Technologies and Innovative Mobility Deployment (ATTIMD) Program
- Carbon Reduction Program
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- FTA 5307 Program – Urbanized Area Formula Grants
- FTA 5309 Program – Capital Investment Grants

- FTA 5311 Program – Formula Grants for Rural Areas
- FTA 5311 Program – Public Transportation on Indian Reservations
- FTA 5312 Program – Research, Development, Demonstration, and Deployment Projects
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Rural Surface Transportation Grant Program
- Surface Transportation Block Grant (STBG) Program
- Active Transportation Program (AT)
- Greater Minnesota Transit Grants - Public Transit Operating Grants

IMPLEMENT TRAVEL DEMAND MANAGEMENT

Implement or expand travel demand management outreach

- Active Transportation Infrastructure Investment Program
- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Congestion Relief Program
- Federal-State Partnership for Intercity Passenger Rail Grants
- FTA 5312 Program – Research, Development, Demonstration, and Deployment Projects*
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Surface Transportation Block Grant (STBG) Program

Implement or expand ridesharing support program

- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Congestion Relief Program
- FTA 5312 Program – Research, Development, Demonstration, and Deployment Projects*
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Nationally Significant Freight and Highway Projects (INFRA)
- Rural Surface Transportation Grant Program
- Surface Transportation Block Grant (STBG) Program

LOW CARBON INFRASTRUCTURE AND SYSTEM MANAGEMENT

OPTIMIZE TRANSPORTATION SYSTEM MANAGEMENT AND OPERATIONS

Implement intersection improvements

- Active Transportation Infrastructure Investment Program
- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Highway Safety Improvement Program
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants

- Reconnecting Communities Pilot Program
- Rural Surface Transportation Grant Program
- Safe Street and Roads for All
- Surface Transportation Block Grant (STBG) Program
- Active Transportation Program (AT)

Implement traffic signal improvements to reduce delays and improve traffic flow

- Advanced Transportation Technologies and Innovative Mobility Deployment (ATTIMD) Program*
- Carbon Reduction Program (CRP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Congestion Relief Program
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Nationally Significant Freight and Highway Projects (INFRA)
- Rural Surface Transportation Grant Program
- Safe Street and Roads for All
- Surface Transportation Block Grant (STBG) Program

Invest in low-cost design and maintenance improvements and other operational programs to improve safety and address travel delays due to incidents, weather and other conditions

- Carbon Reduction Program (CRP)*
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Highway Safety Improvement Program
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Nationally Significant Freight and Highway Projects (INFRA)
- Rural Surface Transportation Grant Program
- Surface Transportation Block Grant (STBG) Program
- MnDOT State Highway Operations and Maintenance

UTILIZE LOW CARBON TRANSPORTATION METHODS FOR CONSTRUCTING AND MAINTAINING TRANSPORTATION INFRASTRUCTURE

Use low carbon materials in the construction process to minimize carbon footprint of transportation construction/maintenance projects

- Carbon Reduction Program (CRP)*
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Surface Transportation Block Grant (STBG) Program

Recycle pavement on construction sites

- Carbon Reduction Program (CRP)*
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Surface Transportation Block Grant (STBG) Program

Replace street lighting and traffic control devices with energy-efficient alternatives

- Carbon Reduction Program (CRP)
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Surface Transportation Block Grant (STBG) Program

Increase the application of green infrastructure throughout projects (e.g., vegetation and roadside tree canopy)

- Active Transportation Infrastructure Investment Program*
- FTA 5303 Program – Pilot Program for Transit Oriented Development*
- FTA 5309 Program – Capital Investment Grants*
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants*
- Reconnecting Communities Pilot Program*
- Safe Streets and Roads for All*
- Surface Transportation Block Grant (STBG) Program*
- Transportation Alternatives Set-Aside (of STBG)
- State Road Construction*

SUPPORT RENEWABLE ENERGY GENERATION

Implement renewable energy projects in highway right-of-way

- Carbon Reduction Program (CRP)*
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Surface Transportation Block Grant (STBG) Program

Implement solar panels or other renewable energy generation on transit stations, rest stops, parking and other facilities

- Carbon Reduction Program (CRP)*
- FTA 5339(a) Program – Bus and Bus Facilities Formula Grants
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Local and Regional Project Assistance Grants
- Surface Transportation Block Grant (STBG) Program

APPENDIX D

CARBON REDUCTION STRATEGY: QUANTIFICATION OF GHG EMISSION REDUCTIONS PROJECTS

The purpose of Task 3.2 is to develop methodologies for quantifying the carbon emission reductions associated with different project types that may be funded under the Carbon Reduction Strategy. The development of these quantification methodologies is being coordinated with other carbon[1] reduction methodology development work being conducted by the Metropolitan Council (Met Council).

Most of the quantification methodologies are designed to provide estimated annual carbon emission reductions, in metric ton CO_2-equivalent per year (CO_2e MT/year), associated with proposed projects[2]. These estimates will be used to support project-level prioritization and scoring. Having standardized calculation methods enables comparisons of projects being considered for funding. These methods rely upon formulas that utilize average emissions factors, assumptions about the estimated effects of strategies on transportation activity (e.g., vehicle miles traveled) based on literature and project-specific information. In addition to project-level information that will be used in each of the calculations, project sponsors may substitute local-specific information with default assumptions, if available.

CARBON EMISSION REDUCTION PARAMETERS

The proposed emission reduction calculation methods have been developed with the following considerations for the draft methodologies:

ACCOUNT FOR ONLY TAILPIPE EMISSIONS REDUCTIONS FROM MOTOR VEHICLES

A more robust analysis would account not only for tailpipe emissions but also well-to-tank (WTT) upstream emissions for both electric vehicles (EVs)[3] and internal combustion engine vehicles (ICEVs)[4].

[1] Includes greenhouse gases (GHG) CO_2-equivalent emissions (or CO_2e, including CO_2, CH_4, N_2O) from combustion processes.

[2] As discussed later in this document, carbon emission reductions from construction projects are provided as the lifecycle emissions of the entire project instead of annual emission reductions.

[3] Emissions associated with electricity generation and transmission. Note that the power sector is aiming to reduce GHG intensity of the grid and close coordination with utility partners will be crucial to minimize the GHG impact of increasing electricity demand.

[4] Emissions associated with refining, processing, distribution, and transport of gasoline and diesel fuels.

Since upstream emissions are not included in the Minnesota transportation sector's greenhouse gas (GHG) inventory, including them adds complexity to the analysis and can lead to potential confusion when reporting the emissions reductions of projects. Construction cost was also not included for these projects. Therefore, the analysis on motor vehicle projects focuses on tailpipe emissions for simplicity. However, it is worth noting that this analysis indeed accounts for lifecycle emissions from infrastructure construction projects and upstream emissions from renewable energy generation projects.

DESIGNED TO ESTIMATE ANNUAL EMISSIONS REDUCTIONS FOR A SPECIFIC YEAR (SUCH AS 2025) TO PROVIDE A POINT OF COMPARISON ACROSS PROJECTS

It is important to note that many capital projects (e.g., bus replacements, bicycle infrastructure, transit infrastructure) will have on-going benefits over many years and the duration of benefits for projects will differ among different types of capital projects vs. operating (e.g., rideshare programs). The most robust analysis approach would account for cumulative emissions reductions across the project life in relation to cost to calculate emissions reduction cost-effectiveness, which could be incorporated into project scoring and project prioritization. This approach, however, depends largely on the execution date of different projects since emissions rates for motor vehicles change over time and requires a year-by-year analysis and summation. Note that the impacts for mode choice strategies like bicycling will often be larger in the near-term (e.g., 2025) than farther out into the future (e.g., 2050) when vehicles are cleaner and vehicle miles reduced will displace less emissions. Most project-level methods for programs like the Congestion Mitigation and Air Quality Improvement (CMAQ) program focus on an analysis year for comparison due to this simplicity. While this document focuses on annual emission reduction of any given year, the project scoring criteria and the Emission Calculator Tool will consider cumulative emission reductions of project lifetime. One exception to this approach is that for construction projects, this analysis accounts for lifecycle emissions of the entire project.

EMISSIONS FACTORS

Emissions factors used in the methodology calculations account for carbon dioxide equivalent (CO2e) emissions from all primary GHGs. This is for consistency with the 2019 Pathways to Decarbonizing Transportation in Minnesota work and inventory.

PROJECT-LEVEL GHG EMISSION REDUCTIONS QUANTIFICATION

ID	Project title
E1	Expand public EV charging infrastructure network for light duty vehicles
E2	Deploy charging infrastructure for medium- and heavy-duty freight vehicles
E3	Purchase or lease battery electric transit buses
E4	Purchase or lease battery electric school buses
E5	Transition public fleet through purchase & lease of ZEVs
E6	Initiate ZEV or EV sharing programs
T1	Construct or improve bicycle network
T2	Construct or improve pedestrian network
T3	Establish or expand micromobility programs
T4	Improve street connectivity
T5	Implement Bus Rapid Transit (BRT) systems with dedicated lanes and stations
T6	Implement bus transit priority treatments
T7	Add or expand bus service
T8	Enhance bus frequency or hours of service
T9	Establish or expand intercity bus service
T10	Develop or improve intercity passenger rail service
T11	Construct, expand, or enhance park and ride facilities
T12	Construct roundabout to improve traffic flow
T13	Construct left turn lane to improve traffic flow
LC1	Use low carbon materials in road construction & maintenance
LC2	Recycle pavement on construction sites
LC3	Replace street lighting and traffic control devices with LEDs
RE1	Implement renewable energy projects in highway right-of-way
RE2	Install solar panels on transit stations, rest stops, parking, and other facilities

PROJECT TYPE E1 – EXPAND PUBLIC EV CHARGING INFRASTRUCTURE NETWORK FOR LIGHT DUTY VEHICLES

Project description

This type of project involves the installation of public electric vehicle charging stations (EVCS), including both level 2 (L2) and direct-current fast chargers (DCFC) for light duty vehicles (LDVs). This method considers the potential alleviation of EV range anxiety due to expanded EVSE deployment, which leads to an increase in local EV adoption and reduction of vehicle miles travelled (VMT) from gasoline LDVs. Parking at the chargers must also be limited to EVs to ensure high EVCS utilization rates.

Quantification methodology

The carbon reduction is calculated by estimating the total displaced VMT from gasoline LDVs to EVs, using total electricity or energy consumed by EVCS.

$$\Delta Carbon = \sum N_i P_i U_i H_i \div \eta_{EV,LDV} \times EF_{LDV}$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
N_i	Number of chargers of a certain power level	Project specific	Project-specific measurement needed
P_i	Charger power level	L2: kW – 22 kW; DCFC: 50 kW – 350 kW	Project-specific measurement needed
U_i	Average charger utilization rate	L2: 10% DCFC: 5%	Estimated using current national average [1] [2]; can be replaced with project-specific input using total time a charger is actively used divided by the evaluation period[5]
H_i	Total annual hours in use	8,760 hour/year	Assuming charge in use 24/7
$\eta_{EV,LDV}$	Average EV energy efficiency	0.294 kWh/mile	Average EV efficiency published by the Argonne National Laboratory in 2022 [3]; to be updated with future EV model characteristics
EF_{LDV}	Regional LDV fleet average GHG emission factor	$4.022 \times 10^{-4} CO_2e$ MT/mile	Estimated using statewide VMT [4] and GHG emission inventory [5]; to be updated for analysis year

[5] For example, if a charger is actively used 2 hours in a day, the daily utilization rate would be (2 h)/(24 h)=8.3%.

Project quantification example

For a public EVCS site with ten 50 kW DCFC stations, the annual carbon reduction would be:

$$10 \times 50\ \text{kW} \times \frac{8760\ \text{hour}}{\text{year}} \times 5\% \div \frac{0.294\ \text{kWh}}{\text{mile}} \times \frac{4.022 \times 10^{-4} \text{CO}_2\text{e MT}}{\text{mile}} = \mathbf{299.6} \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

PROJECT TYPE E2 – DEPLOY CHARGING INFRASTRUCTURE FOR MEDIUM- AND HEAVY-DUTY FREIGHT VEHICLES

Project description

This type of project involves the installation of public and depot EVCS for medium- and heavy-duty (MD/HD) vehicles. While most of public EVSC for MD/HD vehicles will require with fast charging capabilities and high power output (350 kW and above) due to their duty cycles, L2 chargers can still be used in depot charging for short-haul MD/HD vehicles when they park at dwelling sites overnight.

Quantification methodology

The carbon reduction is calculated by estimating the total displaced VMT from diesel MD/HD to EVs, using total electricity or energy consumed by EVCS.

$$\Delta Carbon = \sum N_i P_i U_i H_i \div \eta_{EV,MDHD} \times EF_{MDHD}$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
N_i	Number of chargers of a certain power level	Project specific	Project-specific measurement needed
P_i	Charger power level	L2: kW – 22 kW; DCFC: 50 kW – 350 kW	Project-specific measurement needed; for future public MD/HD EVCS sites, megawatt charging system may also be considered [6]
U_i	Average charger utilization rate	20%	Expected optimal utilization [7]; can be replaced with project-specific input using total time a charger is actively used divided by the evaluation period
H_i	Total annual hours in use	8,760 hour/year	Assuming charge in use 24/7
$\eta_{EV,MDHD}$	Average EV energy efficiency	0.5–3.33 kWh/mile	Based on currently available EV models[6] and efficiency varies with vehicle application and weight class; to be updated with future EV model characteristics
EF_{MDHD}	Regional MD/HD fleet average GHG emission factor	2.809 x 10^{-3} $C0_2e$ MT/mile	Estimated using statewide VMT [4] and GHG emission inventory [5]; to be updated for analysis year

[6] Information available through ICF Proprietary Fleet Assessment Model, v2.6

Project quantification example

For a public EVSC site that has 20 DCFC 350 kW charger, assuming most vehicles visiting the site are heavy-duty tractors with an average energy efficiency of 2 kWh/mile, the annual carbon reduction would be:

$$20 \times 350\ \text{kW} \times \frac{8760\ \text{hour}}{\text{year}} \times 20\% \div 2\ \text{kWh/mile} \times 2.809 \times 10^{-3}\ \frac{\text{CO}_2\text{eMT}}{\text{mile}} = \mathbf{17224.8}\ \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

PROJECT TYPE E3 – PURCHASE OR LEASE BATTERY ELECTRIC TRANSIT BUSES

Project description

This type of project involves purchasing or leasing battery electric buses (BEB) to replace conventional diesel-powered buses.

Quantification methodology

The carbon reduction is calculated by estimating the eliminated diesel bus emissions due to the replacement of diesel buses with BEBs.

$$\Delta Carbon = Day_{Bus} \times VMT_{Bus,Daily} \times N_{BEB} \times EF_{Bus,Diesel}$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
Day_{Bus}	Annual transit service days	Project specific	Project-specific measurement needed; could be derived from transit operation schedule of a given agency
$VMT_{Bus,Daily}$	Daily average transit VMT per vehicle	Project specific	Project-specific measurement needed; account for bus miles traveled, not passenger miles
N_{BEB}	Number of buses being converted to BEBs	Project specific	Project-specific measurement needed
$EF_{Bus,Diesel}$	Transit average GHG emission factor	1.62 x $10^{-3}CO_2e$ MT/mile	Based on the most recent national average emission factor in 2022 [8]; may vary by diesel bus model and regional operation; to be updated for analysis year

Project quantification example

For a project to replace 10 diesel buses with BEBs, assuming the transit service has a daily accrual of 100 miles on weekdays and that weekend service is half of weekdays[7]. The annual carbon reduction would be:

$$\frac{312\ \text{day}}{\text{year}} \times \frac{100\ \text{mile}}{\text{bus day}} \times 10\ \text{bus} \times \left(\frac{1.62 \times 10^{-3} CO_2e\ \text{MT}}{\text{mile}}\right) = \mathbf{505.44}\ \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

[7] An estimate of essentially 312 days of full service per year, considering five full days per week + two half days per week, or 6 days per week x 52 weeks per year = 312 days.

PROJECT TYPE E4 – PURCHASE OR LEASE BATTERY ELECTRIC SCHOOL BUSES

Project description

This type of project involves purchasing or leasing battery electric buses (BEB) to replace conventional diesel-powered school buses.

Quantification methodology

The carbon reduction is calculated by estimating the eliminated diesel bus emissions due to the replacement of diesel school buses with BEBs.

$$\Delta Carbon = Day_{Bus} \times VMT_{Bus,Daily} \times N_{BEB} \times EF_{Bus,Diesel}$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
Day_{Bus}	Annual school service days	165 day/year	Current minimum instruction days as required in Minnesota [9]; may vary by school district
$VMT_{Bus,Daily}$	Daily average school bus VMT per vehicle	Project specific	Project-specific measurement needed; account for bus miles traveled, not passenger miles
N_{BEB}	Number of buses being converted to BEBs	Project specific	Project-specific measurement needed
$EF_{Bus,Diesel}$	School district average GHG emission factor	1.475 x $10^{-3}CO_2e$ MT/mile	Based on the Federal Transit Administration estimate [8]; may vary by diesel bus model and regional operation; to be updated for analysis year

Project quantification example

For a project to replace 10 diesel buses with BEBs, assuming the transit service has a daily accrual of 100 miles on weekdays and that weekend service is half of weekdays[7]. The annual carbon reduction would be:

$$\frac{165\ \text{day}}{\text{year}} \times \frac{30\ \text{mile}}{\text{bus day}} \times 5\ \text{bus} \times \left(\frac{1.475 \times 10^{-3}\ CO_2e\ \text{MT}}{\text{mile}}\right) = \mathbf{36.5}\ \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

PROJECT TYPE E5 – TRANSITION PUBLIC FLEET THROUGH PURCHASE & LEASE OF ZEVS

Project description

This type of project involves purchasing or leasing zero emissions vehicles (ZEVs) to replace gasoline, compressed natural gas (CNG), and diesel-powered vehicles in a public fleet. This includes light duty cars and pickups as well as MD/HD vehicles such as fire engines, refuse trucks, and bucket trucks.

Quantification methodology

Emission reduction from public fleets will depend on the original vehicle weight class, application, model, age, and activity that is being replaced. The carbon reduction is calculated by estimating the eliminated vehicle emissions due to fuel savings from purchasing or leasing ZEVs.

$$\Delta Carbon = \sum Day_{Public} \times VMT_{Public,Daily} \times N_{Public} \times EF_{Public,Fuel}$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
Day_{Public}	Annual days in use	250	Typical working days in a year[8]
$VMT_{Public,Daily}$	Daily average VMT per public vehicle	Project specific	Project-specific measurement needed
N_{Public}	Number of public vehicles of the same type being replaced	Project specific	Project-specific measurement needed
EF_{Fuel}	Average fuel based GHG emission factors	Gasoline: $8.887 \times 10^{-3} CO_2e$ MT/Gal; Diesel: $1.018 \times 10^{-3} CO_2e$ MT/Gal	Gasoline and diesel factors are based on U.S. EPA published values [10]; these factors can be applied to CNG if fuel consumption is reported in gasoline gallon equivalent (GGE) or in diesel gallon equivalent (DGE); to be updated for analysis year
η_{Public}	Average fuel economy of public fleets	Gasoline light truck: 13 MPGGE; CNG refuse truck: 1.5 MPDGE	Available via the Argonne National Laboratory Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) Tool [11] in mile per GGE (MPGGE) or mile per DGE (MPDGE); to be updated for analysis year

[8] 5 days/week × 52 week/year – 10 holidays = 250 days.

Project quantification example

A public works department is replacing one gasoline-powered pickup truck and one CNG refuse truck with electric-powered models that both drive 100 miles a day. The annual carbon reduction would be:

$$\frac{250\ \text{Day}}{\text{Year}} \times \frac{100\ \text{mile}}{\text{Day}} \times 1 \div \frac{13\ \text{mile}}{\text{GGE}} \times \frac{8.887 \times 10^{-3}\ \text{CO}_2\text{e MT}}{\text{GGE}} + \frac{250\ \text{Day}}{\text{Year}} \times \frac{100\ \text{mile}}{\text{Day}} \times 1 \div \frac{1.5\ \text{mile}}{\text{DGE}} \times \frac{1.018 \times 10^{-2}\ \text{CO}_2\text{e MT}}{\text{DGE}} = \mathbf{186.8\ CO_2e\ MT/year}$$

PROJECT TYPE E6 – INITIATE ZEV OR EV SHARING PROGRAMS

Project description

This type of project involves implementation of an electric carshare program. These kinds of projects can lead to reduced carbon emissions by lowering vehicle ownership and shifting drivers from ICE to vehicles. This concept draws from research on the free-floating carshare approach and should be cautiously extrapolated to different business frameworks.

Quantification methodology

The carbon reduction is calculated by estimating the amount of non-electric VMT reduction resulting from implementation of the EV carsharing program, building upon the emission reduction methodology for EV sharing program by the California Air Pollution Control Officers Association (CAPCOA) Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity [12].

$$\Delta Carbon = N_{Cars} \times VMT_{Carshare} \times EF_{LDV}$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
$VMT_{Carshare}$	Daily VMT reduction from single occupancy vehicles (SOVs)	144 mile/day per carshare EV	Based on the St. Paul Evie Carshare program estimate [13]; this accounts for VMT avoided from users who chose to sell their cars or not buy due to the availability of a carshare program; could be modified with project-specific input
N_{Cars}	Number of electric cars deployed in the program	Project specific	Project-specific measurement needed
EF_{LDV}	Regional LDV fleet average GHG emission factor	4.022 x 10^{-4} CO_2e MT/mile	Estimated using statewide VMT [4] and GHG emission inventory [5]; to be updated for analysis year

Project quantification example

A city is procuring 50 EVs to start a car sharing program to provide affordable access to cars. The annual carbon reduction would be:

$$50\ car \times \frac{144\ miles}{car\ day} \times \frac{4.022 \times 10^{-4} CO_2 eMT}{mile} \times \frac{365\ days}{year} = \mathbf{1057.0\ \frac{CO_2 e\ MT}{year}}$$

PROJECT TYPE T1 – CONSTRUCT OR IMPROVE BICYCLE NETWORK

Project description

Adding bicycle facilities aims to improve bicycling conditions, displace vehicle travel (by encouraging bicycling instead of driving), and consequently reduce carbon emissions. Bicycle facilities may include off-road bicycle paths (shared use paths), on-road bicycle lanes (side paths or bicycling lanes), or protected bicycle lanes/ cycle tracks.

Quantification methodology

The emission reduction from new bicycle facilities is estimated by calculating the estimated VMT reduced from displaced vehicle activities, building on the emissions reductions equation developed by the California Air Resources Board (CARB) Strategic Growth Council Affordable Housing and Sustainable Communities Program [14]:

$$\Delta Carbon = Day_{Facility} \times AADT \times (AT_{Adj} + CR) \times GFA_{Facility} \times CL \times EF_{LDV}$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
$Day_{Facility}$	Annual days in use of facility	214 day	Bicycle facilities are in regular use in Minnesota from April to October every year [15]; can be updated using project-specific measurement
AADT	Average annual daily traffic on road parallel to facility	Project specific	Project-specific measurement needed
AT_{Adj}	Adjustment factor for active transportation	0.0010 – 0.0207	Based on the existing AADT of the facility, length of the proposed bicycle facility, and area population [14]
CR	Credit for key destinations near facility	0 – 0.003	Based on the number of key destinations or attractions within 0.5 mile of the facility [14]
$GFA_{Facility}$	Growth factor adjustment for facility type	0.46 – 1.54	Based on types of bicycle facilities: off-road, on-road, protected [14]
CL	Average length of vehicle trip replaced by bicycle	2.01 mile	Based on national average [16]; could be replaced by regional specific input
EF_{LDV}	Regional LDV fleet average GHG emission factor	$4.022 \times 10^{-4} CO_2e$ MT/mile	Estimated using statewide VMT [4] and GHG emission inventory [5]; to be updated for analysis year

Project quantification example

For a five-mile-long protected bicycle lane in a populated urban area where average daily traffic is 20,000 per day on the road parallel to the facility. These values are used to look up the three unitless factors needed for this calculation. The annual carbon reduction would be:

$$\frac{214\ \text{day}}{\text{year}} \times \frac{20{,}000}{\text{day}} \times (0.0027 + 0.003) \times 1.54 \times 2.01\ \text{mile} \times \frac{4.022 \times 10^{-4}\ \text{CO}_2\text{e MT}}{\text{mile}} = \mathbf{30.4}\ \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

PROJECT TYPE T2 – CONSTRUCT OR IMPROVE PEDESTRIAN NETWORK

Project description

Adding pedestrian facilities improves the area's walkability, reducing vehicle travel through modal shifts, therefore, reducing overall transportation-related carbon emissions. Pedestrian infrastructure includes sidewalks and curb ramps, shared use paths, crosswalks, and treatment facilities for crossing streets like signals and signs.

Quantification methodology

The emission reduction from new pedestrian facilities is estimated by calculating the estimated vehicle miles traveled (VMT) reduced from displaced vehicle activities, modified from the CAPCOA Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity [8].

$$\Delta Carbon = \left(1 - \frac{SL_{New}}{SL_{Exist}}\right) \times EI_{VMT} \times VMT_{Comm} \times EF_{LDV}$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
SL_{New}	Sidewalk length in study area (constructed/ improved)	Project specific	Project-specific measurement needed
SL_{Exist}	Existing sidewalk length in study area	Project specific	Project-specific measurement needed
EI_{VMT}	Elasticity of household VMT with respect to ratio of sidewalk-to-streets	-0.05	Unit VMT reduction factor based on existing studies [17] [18]
VMT_{Comm}	Non-winter annual VMT of the project area or community	Project specific	Project-specific measurement needed; pedestrian facilities are in regular use in Minnesota from March to October every year [15]
EF_{LDV}	Regional LDV fleet average GHG emission factor	$4.022 \times 10^{-4} CO_2e$ MT/mile	Estimated using statewide VMT [4] and GHG emission inventory [5]; to be updated for analysis year

Project quantification example

If the existing length of sidewalk is 9 miles and the sidewalk length after construction or improvement increases to 10 miles at a community with an annual (non-winter months) VMT of 10 million miles. The annual carbon reduction would be:

$$\left(1 - \frac{10 \text{ miles}}{9 \text{ miles}}\right) \times (-0.05) \times 10 \times 10^6 \frac{\text{mile}}{\text{year}} \times \frac{4.022 \times 10^{-4} \text{ CO}_2\text{e MT}}{\text{mile}} = \mathbf{22.3} \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

PROJECT TYPE T3 – ESTABLISH OR EXPAND MICROMOBILITY PROGRAMS

Project description

Micromobility initiatives offer a variety of travel choices, including e-scooters, e-bicycles, and traditional pedal bicycles. These travel choices generally have no emissions, reducing the carbon emissions due to modal shift. Micromobility could also integrate with transit by providing options for the first- and last-mile of the trips, making transit systems more convenient, reliable, and efficient. This methodology evaluates the emission reduction of establishing or expanding micromobility programs from LDV VMT displacement, while does not consider any impact on existing transit activities.

Quantification methodology

The emission reduction from establishing or expanding micromobility programs is estimated by calculating displaced vehicle activities, using information based on peer-reviewed research that assesses environmental benefits from shared micromobility systems in Minnesota [19].

$$\Delta Carbon = T_M \times D \times CL \times EF_{LDV}$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
T_M	Increase in annual micromobility trips after program expansion	Project Specific	Project-specific measurement needed
D	Vehicle trip distance substitute factor	Docked bicycle: 0.538 – 0.585; Dockless bicycle: 0.573 – 0.62; Dockless scooter: 0.511 – 0.546	Percent of micromobility trip distance that is used to substitute vehicle trips in Minnesota [19]
CL	Average length of vehicle trip replaced by micromobility	1.3 - 1.5 mile	Depends on the micromobility mode [20]; could be replaced by regional-specific input
EF_{LDV}	Regional LDV fleet average GHG emission factor	4.022 x 10^{-4} CO_2e MT/mile	Estimated using statewide VMT [4] and GHG emission inventory [5]; to be updated for analysis year

Project quantification example

For 0.5 million annual shared e-scooter trips with a vehicle trip distance substitute factor of 0.53, the annual carbon reduction would be:

$$\frac{500000}{\text{year}} \times 0.53 \times 1.3 \text{ mile} \times \frac{4.022 \times 10^{-4} \text{ CO}_2\text{e MT}}{\text{mile}} = \mathbf{138.6} \ \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

PROJECT TYPE T4 – IMPROVE STREET CONNECTIVITY

Project description

Improving street connectivity can reduce the trip distance between a pair of origin and destination and thus lower carbon emissions. Various route options could provide choices for multiple road users to make a choice considering perceived safety, speed, comfort and other factors. Increasing route redundancy could support climate resiliency, allowing efficient travel during evacuations and extreme weather events. While improved street connectivity is likely to reduce average vehicle speed, such impact is not considered here due to the lack of quantification methodology [21, 22].

Quantification methodology

The emissions reduction is estimated using the increased vehicle intersection density measure, which is a proxy for street connectivity. The following equation is adapted from the CAPCOA Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity [12] and the CARB Strategic Growth Council Affordable Housing and Sustainable Communities Program [14].

$$\Delta Carbon = \frac{ID_{Avg} - ID_{Site}}{ID_{Avg}} \times El_{ID} \times VMT_{Comm} \times EF_{LDV}$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
ID_{Site}	Intersection density at the project site	Project Specific	Project-specific measurement needed, in intersections per square mile (sq mile)
ID_{Avg}	Average intersection density of the project area or community	76.5 intersection/ sq mile	Average urban intersection density in Minneapolis [23]; could be replaced by regional-specific input
El_{ID}	Elasticity of VMT with respect to intersection density	-0.14	Unit VMT reduction as reported in Stevens 2016 [24]
VMT_{Comm}	VMT of the project area	Project specific	Project-specific measurement needed
EF_{LDV}	Regional LDV fleet average GHG emission factor	$4.022 \times 10^{-4} CO_2e$ MT/mile	Estimated using statewide VMT [4] and GHG emission inventory [5]; to be updated for analysis year

Project quantification example

If the intersection density increases from 76.5 intersections per sq mile to 80 intersections per sq mile in an urban community in Minneapolis with 10 million miles per ye¬ar annual VMT. The annual carbon reduction would be:

$$\frac{76.5\,\frac{\text{intersections}}{\text{sq mile}} - 80\,\frac{\text{intersection}}{\text{sq mile}}}{76.5\,\frac{\text{intersection}}{\text{sq mile}}} \times (-0.14) \times 10 \times 10^{6}\,\frac{\text{mile}}{\text{year}} \times \frac{4.022 \times 10^{-4}\,\text{CO}_2\text{e MT}}{\text{mile}} = \mathbf{25.8}\,\frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

PROJECT TYPE T5 – IMPLEMENT BRT SYSTEMS WITH DEDICATED LANES AND STATIONS

Project description

The dedicated lanes and stations for Bus Rapid Transit (BRT) systems could reduce the travel time of the trip, leading to an increase in transit mode share in the community. This mode shift reduces the overall VMT and the associated carbon emissions. Compared to the traditional bus, BRT with dedicated lanes and stations adds more efficiency with additional services such as a limited number of stops, intelligent transportation technology (e.g., transit signal priority), advanced technology vehicles, efficient fare payment and branding of the system. Note that the change in bus emissions due to improved operation and logistics is not considered and the methodology assumes increased ridership does not increase bus VMT.

Quantification methodology

The emissions reduction due to the implementation of BRT systems with dedicated lanes and stations is estimated using the following equation, building upon the BRT carbon reduction methodology developed by the CARB Strategic Growth Council Affordable Housing and Sustainable Communities Program [14] in the first part of the equation. The second part accounts for the difference in emissions due to an increase in the BRT bus travel speed.

$$\Delta Carbon = IR_{L\&S} \times R_{Con} \times A \times CL \times EF_{LDV} - \Delta EF \times VMT_{Con}$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated

<table>
<tr><th>ID</th><th>Variable</th><th>Value</th><th>Notes</th></tr>
<tr><td rowspan="11">$IR_{L\&S}$</td><td rowspan="11">Increase in ridership for BRT dedicated lanes and stations</td><td rowspan="11">Calculated using maximum BRT ridership improvement and scoring of various project components; can be replaced with project-specific input.</td><td>The ridership increase can be calculated using the following equation [25]:

$IR_{L\&S} = 25\% \times \sum Score\%$

Where 25% is reported as the upper limit for ridership improvement from a full-featured BRT service compared to conventional bus [25]; similar value has been reported by Metro Transit BRT service (32%) and other services [26] [27].

$\sum$Score can be calculated by adding the scoring values from the following table. One component can be selected from the dedicated lane improvement type, whereas multiple components can be selected from the station improvement type.</td></tr>
<tr><td>
<table>
<tr><th>Improvement Type</th><th>Component</th><th>Score%</th></tr>
<tr><td rowspan="5">Dedicated lane</td><td>Running Ways</td><td>20</td></tr>
<tr><td>Grade-separated busways (special right-of-way)</td><td>20</td></tr>
<tr><td>At-grade busway</td><td>15</td></tr>
<tr><td>Median arterial busway</td><td>10</td></tr>
<tr><td>All-day bus lane (specially delineated)</td><td>5</td></tr>
<tr><td rowspan="7">Station (multiple options can be selected)</td><td>Dedicated stations</td><td>15</td></tr>
<tr><td>Uniquely designed shelters</td><td>2</td></tr>
<tr><td>Illumination</td><td>2</td></tr>
<tr><td>Telephones/ security phones</td><td>3</td></tr>
<tr><td>Climate-controlled waiting area</td><td>3</td></tr>
<tr><td>Passenger amenities</td><td>3</td></tr>
<tr><td>Passenger service</td><td>2</td></tr>
</table>
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</table>

ID	Variable	Value	Notes
R_{Con}	Average annual ridership in current bus services	Project Specific	Project-specific measurement needed
A	Adjustment factor for transit dependency	0.62	Ratio of transit riders who own a vehicle as reported by the 2018 Metro Transit Customer Experience & Satisfaction Survey [28]; could be replaced by regional-specific input
CL	Average length of vehicle trip replaced by BRT	4.61 miles	Default value as reported by CARB [14]; could be replaced by regional-specific input
EF_{LDV}	Regional LDV fleet average GHG emission factor	4.022 x 10^{-4} CO_2e MT/mile	Estimated using statewide VMT [4] and GHG emission inventory [5]; to be updated for analysis year
ΔEF	Difference in emissions factor between current and improved service	-8.43×10^{-5} CO_2e MT/mile Calculated using emission speed correction factor from EMFAC [29]	Bus lanes typically increase travel speed by 1.5 to 2 mile per hour (mph) [25]; average travel speed of the Metro Transit is 13.4 mph [30]; the improved speed after treatment is assumed to be 15 mph[9]; could be replaced by project-specific input
VMT_{Con}	Average annual VMT of current bus service	Project Specific	Project-specific measurement needed

Project quantification example

If a transit agency is implementing a BRT system with grade-separated busway, dedicated stations, and climate-controlled waiting area, the increase in ridership would be as follows:

$$\mathrm{IR}_{\mathrm{L\&S}} = 25\% \times (20 + 15 + 3)\% = 0.095$$

Assuming the current bus service travels 200,000 miles every year and has 1 million annual ridership, the annual carbon reduction after the BRT improvement would be:

$$0.095 \times \frac{1000000\ \text{ridership}}{\text{year}} \times 0.62 \times 4.61\ \text{mile} \times \frac{4.022 \times 10^{-4}\mathrm{CO_2e\ MT}}{\text{mile}} - \frac{-8.43 \times 10^{-5}\mathrm{CO_2e\ MT}}{\text{mile}} \times 200{,}000\ \text{mile} = \mathbf{126.1}\ \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

[9] The change in speed can results in a 5% reduction in carbon emissions.

PROJECT TYPE T6 – IMPLEMENT BUS TRANSIT PRIORITY TREATMENTS

Project description

The bus transit priority treatments reduce the travel times and reliability of transit systems by implementing a combination of roadway infrastructure and traffic signal improvements. These improvements increase the transit mode share, resulting in carbon emissions reduction. Note that the change in bus emissions due to improved operation and logistics is not considered and the methodology assumes increased ridership does not increase bus VMT.

Quantification methodology

The emissions reduction due to the bus transit priority treatments is estimated using the following equation, which is adapted from the new or expanded BRT GHG reduction methodology developed by the CARB Strategic Growth Council Affordable Housing and Sustainable Communities Program [14] in the first part of the equation. The second part accounts for the difference in emissions due to an increase in the BRT bus travel speed.

$$\Delta Carbon = IR_{PT} \times R_{Con} \times A \times CL \times EF_{LDV} - \Delta EF \times VMT_{Con}$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
IR_{PT}	Increase in annual ridership after implementing priority treatments	32%	Reported increase in ridership by Metro Transit BRT service [26]; could be replaced by project-specific input
R_{Con}	Average annual ridership in conventional bus services	Project Specific	Project-specific measurement needed
A	Adjustment factor for transit dependency	0.62	Ratio of transit riders who own a vehicle as reported by the 2018 Metro Transit Customer Experience & Satisfaction Survey [28]; could be replaced by regional-specific input
CL	Average length of vehicle trip replaced by BRT	4.61 miles	Default value as reported by CARB [14]; could be replaced by regional-specific input
EF_{LDV}	Regional LDV fleet average GHG emission factor	$4.022 \times 10^{-4} CO_2e$ MT/mile	Estimated using statewide VMT [4] and GHG emission inventory [5]; to be updated for analysis year

ID	Variable	Value	Notes
ΔEF	Difference in emissions factor between current and improved service	-1.34 x 10^{-4} CO_2e MT/mile Calculated using emission speed correction factor from EMFAC [29]	BRT service can improve the bus speed by 20% in Minnesota [31]; average travel speed of the Metro Transit is 13.4 mph [30]; the average travel speed of after priority treatment would be 16 mph[10]; could be replaced by project-specific input
VMT_{Con}	Average annual VMT of current bus service	Project Specific	Project-specific measurement needed

Project quantification example

If a transit agency is implementing bus priority treatment to a conventional bus service that travels 200,000 miles a year and has 0.5 million annual ridership, the annual carbon reduction would be:

$$32\% \times \frac{500000 \text{ ridership}}{\text{year}} \times 0.62 \times 4.61 \text{ mile} \times \frac{4.022 \times 10^{-4} CO_2e \text{ MT}}{\text{mile}} - \frac{-1.34 \times 10^{-4} CO_2e \text{ MT}}{\text{mile}} \times 200{,}000 \text{ mile} = \mathbf{210.7} \frac{\mathbf{CO_2e \text{ MT}}}{\mathbf{year}}$$

[10] 20% change in speed can results in an 8% reduction in carbon emissions.

PROJECT TYPE T7 – ADD OR EXPAND BUS SERVICE

Project description

Adding or expanding bus service in a region improves the transit coverage area, providing transit service to more people. This increases the transit mode share, reducing the overall carbon emissions. Note that any expansion of bus services that use conventional buses would need to account for the increased bus emissions.

Quantification methodology

The emissions reduction due to the addition or expansion of bus service is estimated using the following equation, building upon the quantification methodology developed by the CARB Strategic Growth Council Affordable Housing and Sustainable Communities Program [14] in the first part of the equation. The second term accounts for the increase in emissions due to the addition or expansion of the bus service.

$$\Delta Carbon = PR_{Exp} \times (Elasticity_{Exp} \times R_{Con} \times A \times CL \times EF_{LDV} - VMT_{Con} \times EF_{Bus,Diesel})$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
PR_{Exp}	Percent increase in bus coverage	Project Specific	Project-specific measurement needed
$Elasticity_{Exp}$	Elasticity of ridership due to bus coverage expansion	0.45	Default value based on 215 Metropolitan Statistical Areas (MSAs) [32]; could be replaced by project-specific input
R_{Con}	Average annual ridership in current transit services	27 million	The Metro Transit annual ridership is reported for fixed-route bus service in 2022 [33]; non-metro area ridership in 2022 is reported as 7.1 million; could be replaced by project-specific input
A	Adjustment factor for transit dependency	0.62	Ratio of transit riders who own a vehicle as reported by the 2018 Metro Transit Customer Experience & Satisfaction Survey [28]; could be replaced by regional-specific input
CL	Average length of vehicle trip replaced by bus service	3.29 miles	Default value as reported by CARB [14]; could be replaced by regional-specific input
EF_{LDV}	Regional LDV fleet average GHG emission factor	$4.022 \times 10^{-4} CO_2e$ MT/mile	Estimated using statewide VMT [4] and GHG emission inventory [5]; to be updated for analysis year
$EF_{Bus,Diesel}$	Transit average GHG emission factor	$1.62 \times 10^{-3} CO_2e$ MT/mile	Based on the most recent national average emission factor in 2022 [8]; may vary by diesel bus model and regional operation; to be updated for analysis year
VMT_{Con}	Average annual VMT of transit services	23.5 million miles	The Metro Transit actual vehicles miles reported in National Transit Database (NTD, 2021) [33]; could be replaced by project-specific input

Project quantification example

If transit service in the metropolitan area is expanded by 2% with BEBs, the annual carbon reduction would be:

$$2\% \times 0.45 \times \frac{27 \times 10^{6} \text{ ridership}}{\text{year}} \times 0.62 \times 3.29 \text{ mile} \times \frac{4.022 \times 10^{-4} \text{CO}_2\text{e MT}}{\text{mile}} = \mathbf{199.4} \ \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

PROJECT TYPE T8 – ENHANCE BUS FREQUENCY OR HOURS OF SERVICE

Project description

The increase in bus frequency reduces wait time for transit users and makes using buses more convenient. Adding early morning or late-night hours service provides transit options to alternative-shift workers and helps riders who may be concerned about being stranded if they miss the last bus. Such additional services encourage transit use, reducing the overall VMT and carbon emissions. Note that any expansion of bus services that use conventional buses would need to account for the increased bus emissions.

Quantification methodology

The emissions reduction due to the improving bus frequency and hours of service is estimated using the following equation, which is adapted from the quantification methodology developed by the CARB Strategic Growth Council Affordable Housing and Sustainable Communities Program [14] in the first part of the equation. The second term accounts for the increase in emissions due to the improvement in the bus frequency or hour of service.

$$\Delta Carbon = PR_{F\&S} \times (Elasticity_{F\&S} \times R_{Con} \times A \times CL \times EF_{LDV} - VMT_{Con} \times EF_{Bus,Diesel})$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
$PR_{F\&S}$	Percent increase in frequency or hour of service	Project Specific	Project-specific measurement needed
$Elasticity_{F\&S}$	Ridership elasticity to frequency by service hour	Value from look-up table	Elasticity value for Minneapolis [34]:

Time Period	Elasticity
Weekday AM Peak (6-9 am)	0.77
Weekday Midday (9 am to 4 pm)	0.73
Weekday PM Peak (4-7 pm)	0.83
Weekday Night (7 pm – 6 am)	0.78
Weekend Day (6 am – 7 pm)	0.71
Weekend Night (7 pm – 6 am)	0.92

R_{Con}	Average annual ridership in current transit services	Project Specific	Project-specific measurement needed; corresponds to various time period
A	Adjustment factor for transit dependency	0.62	Ratio of transit riders who own a vehicle as reported by the 2018 Metro Transit Customer Experience & Satisfaction Survey [28]; could be replaced by regional-specific input

ID	Variable	Value	Notes
CL	Average length of vehicle trip replaced by bus service	3.29 miles	Default value as reported by CARB [14]; could be replaced by regional-specific input
EF_{LDV}	Regional LDV fleet average GHG emission factor	4.022 x $10^{-4}C0_2e$ MT/mile	Estimated using statewide VMT [4] and GHG emission inventory [5]; to be updated for analysis year
$EF_{Bus,Diesel}$	Transit average GHG emission factor	1.62 x $10^{-3}C0_2e$ MT/mile	Based on the most recent national average emission factor in 2022 [8]; may vary by diesel bus model and regional operation; to be updated for analysis year
VMT_{Con}	Average annual VMT of transit services	Project Specific	Project-specific measurement needed; corresponds to various time period

Project quantification example

If the bus service frequency on weekday AM peak (6 am to 9 am) is increased by 10% in the metropolitan area using BEBs, assuming AM peak accounts for ¼ of the total transit riders, the annual carbon reduction would be:

$$5\% \times 0.77 \times \frac{27 \times 10^6 \text{ ridership}}{\text{year}} \times \frac{1}{4} \times 0.62 \times 3.29 \text{ mile} \times \frac{4.022 \times 10^{-4} CO_2e \text{ MT}}{\text{mile}} = \mathbf{213.2} \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

PROJECT TYPE T9 – ESTABLISH OR EXPAND INTERCITY BUS SERVICES

Project description

Building or expanding intercity bus services allows passengers to use transit to travel between cities rather than using personal LDVs. This reduces the VMT and the associated carbon emissions. Note that any expansion of intercity bus services that use conventional buses would need to account for the increased bus emissions.

Quantification methodology

The emissions reduction due to the establishing or expanding intercity bus service is estimated using the following equation, building upon the quantification methodology developed by the CARB Strategic Growth Council Affordable Housing and Sustainable Communities Program [14] in the first term of the equation. The second term of the equation accounts for the increase in emissions due to establishing or expanding of the intercity bus service.

$$\Delta Carbon = R_{Con} \times A \times CL \times EF_{LDV} - \Delta VMT \times EF_{IB}$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
R_{Con}	Increase in annual ridership after establishing or expanding intercity bus service	Project Specific	Project-specific measurement needed; given ridership of intercity bus varies greatly by locations and routes, there is no generic elasticity model that can be used to estimate increase in ridership based on service expansion scale
A	Adjustment factor for transit dependency	0.93	Ratio of intercity bus riders who own a vehicle as reported by the 2022 Minnesota Intercity Bus Study Update [35]; could be replaced by regional-specific input
CL	Average length of vehicle trip replaced by intercity bus	23.15 miles	Default value as reported by CARB [14]; could be replaced by regional-specific input
EF_{LDV}	Regional LDV fleet average GHG emission factor	$4.022 \times 10^{-4} CO_2e$ MT/mile	Estimated using statewide VMT [4] and GHG emission inventory [5]; to be updated for analysis year
EF_{IB}	Average GHG emission factor for intercity buses	$1.62 \times 10^{-3} CO_2e$ MT/mile	Based on the most recent national average emission factor in 2022 [8]; may vary by fuel type, model, and regional operation; to be updated for analysis year
ΔVMT	Increase in vehicle miles from the new or expanded service	Project Specific	Project-specific measurement needed

Project quantification example

One of the potential route expansions as proposed by the 2022 Minnesota Intercity Bus Study Update, Thief River Falls - Red Lake Falls – Crookston, has reported an estimated annual ridership of 550. The one-way trip for this route is only 44 miles, which is well within the range of commercially available all-electric coach buses[11]. Assuming the entire service will be conducted by BEBs, the annual carbon reduction would be:

$$\frac{550\ \text{ridership}}{\text{year}} \times 0.93 \times 23.15\ \text{mile} \times \frac{4.022 \times 10^{-4} \text{CO}_2\text{e MT}}{\text{mile}} = \mathbf{4.8}\ \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

[11] A typical coach bus has an average all-electric range of 150 miles, based on manufacturer data.

PROJECT TYPE T10 – DEVELOP OR IMPROVE INTERCITY PASSENGER RAIL SERVICE

Project description

Developing or improving intercity passenger rail services provides efficient and comfortable intercity travel options. This reduces the intercity travel VMT and associated carbon emissions. Note that any expansion of non-zero-emission intercity rail services would need to account for the increased rail emissions.

Quantification methodology

The emissions reduction due to the development or improvement of intercity passenger rail service is estimated using the following equation, which is adapted from the quantification methodology developed by the CARB Strategic Growth Council Affordable Housing and Sustainable Communities Program [14] in the first term of the equation. The second term of the equation accounts for the increase in emissions due to establishing or expanding of the intercity passenger rail service.

$$\Delta Carbon = (PR_{IR} \times R_{Con} \times A \times CL \times EF_{LDV}) - (\Delta RailMT \times EF_{IR})$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
PR_{IR}	Percent increase in intercity passenger rail service	Project Specific	Project-specific measurement needed; given ridership of intercity rail varies greatly by locations and routes, there is no generic elasticity model that can be used to estimate increase in ridership based on service expansion scale
R_{Con}	Average annual ridership in current intercity passenger rail services	Empire Builder: 172,550 TCMC: 96,900	Projected annual ridership of the Empire Builder serving Minnesota Market in 2025 and the Twin Cities - Milwaukee - Chicago Intercity Passenger Rail Project (TCMC) in Minnesota for opening year of service in 2024 are provided by MnDOT [36]; could be replaced by project-specific input
A	Adjustment factor for transit dependency	0.867	Default value representing the portion of transit riders who reduce a vehicle trip as reported by CARB [14]; could be replaced by regional-specific input
CL	Average length of vehicle trip replaced by rail service	25.63 miles	Default value as reported by CARB [14]; could be replaced by regional-specific input
EF_{LDV}	Regional LDV fleet average GHG emission factor	4.022 x 10^{-4} CO_2e MT/mile	Estimated using statewide VMT [4] and GHG emission inventory [5]; to be updated for analysis year

ID	Variable	Value	Notes
EF_{IR}	Average GHG emission factor for intercity rail	2.8 x $10^{-2}CO_2e$ MT/mile	Based on the most recent national average emission factor in 2022 [8]; may vary by fuel type, model, and regional operation; to be updated for analysis year
ΔRailMT	Increase in rail vehicle miles from the new or expanded service	Project Specific	Project-specific measurement needed

Project quantification example

For a 10% increase in TCMC intercity passenger rail ridership from improved service and management (without any increase in railVMT), the annual carbon reduction would be:

$$10\% \times \frac{96{,}900}{\text{year}} \times 0.867 \times 25.63 \text{ mile} \times \frac{4.022 \times 10^{-4} CO_2e \text{ MT}}{\text{mile}} = \mathbf{86.6} \frac{\mathbf{CO_2e \text{ MT}}}{\mathbf{year}}$$

PROJECT TYPE T11 – CONSTRUCT, EXPAND, OR ENHANCE PARK AND RIDE FACILITIES

Project description

Park and ride facilities near transit or high-occupancy vehicle lanes encourage people to use transit or car- and van-pooling for daily commute. Such facilities reduce the overall VMT from single-occupancy vehicles and associated carbon emissions in areas with high travel demands and congestion. Note that this methodology assumes no transit service is added or expanded, and no induced VMT.

Quantification methodology

The emissions reduction due to the construction, expansion, or improvement of park and ride infrastructure is estimated using the following equation, which is dependent on the number of available parking spaces, facility utilization, and commuter miles saved:

$$\Delta Carbon = P_{Total} \times Day_F \times U \times CL \times EF_{LDV}$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
DAY_F	Annual days in use of a park and ride facility	250	Typical working days in a year
P_{Total}	Total new parking space of a park and ride facility	Project Specific	Project-specific measurement needed
U	Facility utilization rate	56.8%[12]	Average utilization rate from active park and ride facilities in the Twin Cities in 2019 [37]; could be replaced by regional-specific input
CL	Average daily commuter trip length (to and from work)	17.4 mile	State average daily commute trip length in Minnesota [38]; could be replaced by regional-specific input
EF_{LDV}	Regional LDV fleet average GHG emission factor	4.022 x 10^{-4} CO_2e MT/mile	Estimated using statewide VMT [4] and GHG emission inventory [5]; to be updated for analysis year

[12] Data available for 2020 as well. However, due to COVID-19, the facility utilization rate has dropped significantly to 3.13%.

Project quantification example

For a new park and ride facility with 100 parking spaces, assuming the facility is actively used on working days and has a similar utilization rate as in 2019, the annual carbon reduction would be:

$$\frac{250\ \text{day}}{\text{year}} \times 100 \times 56.8\% \times \frac{17.4\ \text{mile}}{\text{day}} \times \frac{4.022 \times 10^{-4} \text{CO}_2\text{e MT}}{\text{mile}} = \mathbf{99.4}\ \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

PROJECT TYPE T12 – CONSTRUCT ROUNDABOUT TO IMPROVE TRAFFIC FLOW

Project description

Adding a roundabout to an existing 4-way signalized intersection can lead to significant reductions in travel delays by drivers. This reduction in delays has a direct impact on the emissions from drivers who use that intersection. Note that the methodology only accounts for emissions post construction, while construction related emissions can be calculated using the Minnesota Infrastructure Carbon Estimator (MICE) tool [39].

Quantification methodology

The emission reduction for this project starts by calculating the travel delay associated with a specific intersection. The delay reduction from a proposed roundabout project is then determined by the difference between the projected new delay and the current delay. Finally, the emission savings are determined by multiplying the average idling emissions rate with the duration of the driving time reduced. The methodology is developed using the Federal Highway Administration (FHWA) Congestion Mitigation and Air Quality (CMAQ) Emissions Calculator Toolkit [40].

$$\Delta Carbon = \sum_{i} AADT_i \times EF_{idle,LDV} \times (D_{0i} - D_{1i})$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
D_{0i}	Existing intersection travel delay per car	Project Specific	Units of seconds per passenger car. See FHWA CMAQ Emissions Calculator Toolkit for calculation details [40]
D_{1i}	Intersection delay after improvement per car	Calculated	Calculated using formulas from the Highway Capacity Manual, based on peak hour volume, truck percentage, number of lanes per approach, number of left and right turns, number of lanes in roundabout and number of approach directions. See FHWA CMAQ Emissions Calculator Toolkit for calculation details [40]
AADT	Average annual daily traffic volume for each approach direction	Project Specific	Project-specific measurement needed
$EF_{idle,LDV}$	Regional LDV fleet average GHG idling emission factor	$5.88 \times 10^{-7} CO_2e$ MT/s	From Argonne National Lab study of a sedan [41]. CMAQ tool uses a state-specific value from MOVES 3

Project quantification example

A city is changing one of its intersections in a business district with 4 approach directions each with an AADT of 2000, a peak hour volume of 200 veh/hr, and an estimated delay per vehicle of 40 s with one lane. These values help determine the delay improvement calculated with the FHWA tool. The annual carbon reduction would be:

$$\sum_4 \left(2000 \frac{\text{car}}{\text{day}} \times \left(\frac{40\text{s}}{\text{car}} - \frac{10\text{s}}{\text{car}}\right) \times \frac{5.88 \times 10^{-7} \text{CO}_2\text{e MT}}{\text{s}}\right) \times 365 \frac{\text{day}}{\text{year}} = \mathbf{51.5} \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

PROJECT TYPE T13 – CONSTRUCT LEFT TURN LANE TO IMPROVE TRAFFIC FLOW

Project description

Adding two-way left turn lanes to an existing un-divided roadway can lead to significant reductions in travel delays by drivers. This reduction in delays has a direct impact on the carbon emissions from drivers who use that intersection from decreased idle time.

Quantification methodology

The emission reduction for this project involves calculating the travel delay caused by drivers waiting to turn left in an undivided roadway. Then, the delay reduction resulting from a given left turn project is simply the difference between the projected new delay and the existing delay. Finally, the emissions savings are quantified by multiplying the average emissions rate by the amount of driving time reduction. This doesn't account for any potentially induced demand as a result of these projects. The methodology is developed using the FHWA CMAQ Emissions Calculator Toolkit [40].

$$\Delta Carbon = \sum_{2} AADT_i \times EF_{idle,LDV} \times (D_{0i} - D_{1i})$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
D_{0i}	Existing intersection travel delay per car	Project Specific	Units of seconds per passenger car. See FHWA CMAQ Emissions Calculator Toolkit for calculation details [40]
D_{1i}	Intersection delay after improvement per car	Calculated	Calculated using formulas from the Highway Capacity Manual, based on peak hour volume, truck percentage, number of lanes per approach, number of left and right turns, number of lanes in roundabout and number of approach directions. See FHWA CMAQ Emissions Calculator Toolkit for calculation details [40]
AADT	Average annual daily traffic volume for each approach direction	Project Specific	Project-specific measurement needed
$EF_{idle,LDV}$	Regional LDV fleet average GHG idling emission factor	$5.88 \times 10^{-7} CO_2e$ MT/s	Sedan idling emission factor reported by the Argonne National Lab [41]; CMAQ tool uses a state-specific value from MOVES 3

Project quantification example

A city is adding a two-way left turn lane on a major arterial with an AADT of 4000 in each direction, a peak hour volume of 600 veh/hr, 5% left turn rate, 5% right turn rate, 45 mph speed limit, 4 total lanes and 10 stops on either side of the road for a one-mile section. This is used by the FHWA tool to calculate both the D0i and the D1i. The annual carbon reduction would be:

$$\sum_{2}\left(4000\,\frac{\text{cars}}{\text{day}}\times(0.8\,\text{s}-0\,\text{s})\times\frac{5.88\times10^{-7}\,\text{CO}_2\text{e MT}}{\text{s}}\times 365\,\frac{\text{day}}{\text{year}}\right)=\mathbf{1.35}\,\frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

PROJECT TYPE T14 – SYNCHRONIZE TRAFFIC SIGNALS TO REDUCE DELAY TIME

Project description

Traffic signals programmed individually for daily cycles tend to experience more traffic than those synchronized as part of a system. Signal synchronization projects result in quicker travel times across a city. Additionally, reduced total travel time equates to lower systemwide emissions.

Quantification methodology

The emission reduction for this project involves first calculating the travel delay associated with the corridor which is being synchronized. Then, the delay reduction resulting from the synchronization project is simply the difference between the projected new delay after synchronization and the existing delay. Finally, the carbon emissions savings are quantified by multiplying the average emissions rate by the amount of driving time reduction. The methodology is developed using the FHWA CMAQ Emissions Calculator Toolkit [40].

$$\Delta Carbon = \sum_{i} AADT_i \times EF_{idle,LDV} \times (D_{0i} - D_{1i})$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
D_{0i}	Existing intersection travel delay per car	Project Specific	Units of seconds per passenger car. See FHWA CMAQ Emissions Calculator Toolkit for calculation details [40]
D_{1i}	Intersection delay after improvement per car	Calculated	Calculated using formulas from the Highway Capacity Manual, based on peak hour volume, truck percentage, number of lanes per approach, number of left and right turns, number of lanes in roundabout and number of approach directions. See FHWA CMAQ Emissions Calculator Toolkit for calculation details [40]
AADT	Average annual daily traffic volume for each approach direction	Project Specific	Project-specific measurement needed
$EF_{idle,LDV}$	Regional LDV fleet average GHG idling emission factor	$5.88 \times 10^{-7} CO_2e$ MT/s	Sedan idling emission factor reported by the Argonne National Lab [41]; CMAQ tool uses a state-specific value from MOVES 3

Project quantification example

A city is synchronizing 10 of its intersections on a 3-mile stretch of arterial with a bidirectional AADT of 6000, speed limit of 40 mph, a peak hour volume of 550 veh/hr, and an estimated corridor travel time of 8 minutes. These are used to calculate D0i and D1i using the CMAQ tool. The annual carbon reduction would be:

$$\frac{6000\ \text{car}}{\text{day}} \times \frac{10\ \text{s}}{\text{car}} \times \frac{5.88 \times 10^{-7} \text{CO}_2\text{e MT}}{\text{s}} \times 365 \frac{\text{days}}{\text{year}} = \mathbf{12.9}\ \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

PROJECT TYPE LC1 – USE LOW CARBON MATERIALS IN ROAD CONSTRUCTION & MAINTENANCE

Project description

By using low carbon pavement materials, the lifecycle carbon intensity of a roadway construction or maintenance project can be significantly reduced compared with using virgin material. Unlike the mobile source projects, the methodology calculates full lifecycle emissions instead of annual emissions. This does not consider a change in lifespan from using these materials due to limited data for some materials. The difference in emissions from various maintenance cycles can be quantified using MICE separately [42] [43].

Quantification methodology

The reduction in carbon emissions is estimated using the MICE tool by comparing the lifecycle carbon emissions of traditional roadway materials to those of low-carbon materials. The low-carbon materials that can be modeled include warm mix asphalt, recycled asphalt as a substitute for asphalt aggregate, recycled asphalt as a replacement for asphalt bitumen, industrial by-products as a substitute for Portland cement, and recycled concrete aggregate in place of base stone.

$$\Delta Carbon = GHG_0 \times R_{LC} \times P$$

ID	Variable	Value	Notes		
ΔCarbon	Lifecyle carbon emissions reduction	N/A	Calculated		
GHG_0	Lifecycle carbon emissions from the traditional materials used to build or maintain a roadway	Calculated with MICE	Calculated using the MICE tool [39]		
R_{LC}	Reduction in GHG from the low carbon material pathway	Included in MICE; varies with the material [39]	**Material**	**Replacing**	**R_{LC}**
			Recycled asphalt	Virgin asphalt aggregate	12%
			Recycled asphalt	Virgin asphalt bitumen	68%
			Industrial byproducts	Portland Cement	59%
			Recycled concrete aggregate	Base stone	58%
			Warm-mix asphalt	Hot-mix asphalt	37%

ID	Variable	Value	Notes
P	Proportion of the virgin material replaced with the low carbon material	Project Specific	Project-specific measurement needed; current standard practice in Minnesota is 20 – 30%

Project quantification example

A major highway resurfacing project is using industrial byproducts as a 20% substitute for Portland cement over the course of a 100 lane-miles of urban highway. Using the MICE tool, this gives us the initial lifecycle emissions from the roadway materials. The total carbon reduction would be:

$$2312\ CO_2e\ MT \times 0.59 \times 20\% = \mathbf{272.8\ CO_2e\ MT}$$

PROJECT TYPE LC2 – RECYCLE PAVEMENT ON CONSTRUCTION SITES

Project description

By recycling pavement on a construction site, a project can eliminate the need for new material to be produced, thus eliminating the lifecycle carbon emissions of that new material replaced.

Quantification methodology

The reduction in carbon emissions is estimated using the MICE tool by comparing the lifecycle carbon emissions from the traditional roadway materials to that of the recycled material. The recycling techniques which can be modeled with the tool include cold in-place recycling and full-depth reclamation.

$$\Delta Carbon = GHG_0 \times R_{LC} \times P$$

ID	Variable	Value		Notes
ΔCarbon	Lifecycle carbon emissions reduction	N/A		Calculated
GHG_0	Lifecycle carbon emissions from the traditional materials used to build or maintain a roadway	Calculated with MICE		Calculated using the MICE tool [39]
R_{LC}	Reduction in GHG from the recycled roadway material	**Recycling type**	**Reduction**	Reduction depends on the process used; included in MICE; varies with the material [39]
		Cold in-place	37%	
		Full depth reclamation	68%	
P	Proportion of the roadway length to which the recycling process is being applied	Project Specific		Project-specific measurement needed

Project quantification example

A rural highway maintenance project is using cold in-place recycling for 30% of the length over the course of a 70 lane-miles of the rural highway. The total carbon reduction would be:

$$1016\ CO_2e\ MT \times 0.37 \times 30\% = \mathbf{112.8\ CO_2e\ MT}$$

PROJECT TYPE LC3 – REPLACE STREET LIGHTING AND TRAFFIC CONTROL DEVICES WITH LEDS

Project description

This project type includes replacing existing street lighting or traffic lights with higher efficiency LED lighting.

Quantification methodology

The emissions benefits for these projects are calculated as the difference in electricity use from the use phase of the streetlights between LEDs and the HPS alternative.

$$\Delta Carbon = N_{lights} \times CI_{elec} \times Hour_{Op} \times Day_{Op} \times (L_{Exist} - LED_{Power})$$

ID	Variable	Value	Notes		
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated		
CI_{elec}	Average carbon intensity of local electricity generation	3.91 x 10^{-7} CO_2e MT/Wh	State average for Minnesota in 2021 [44]; could be replaced by regional-specific input		
N_{lights}	Number of lamps being replaced	Project Specific	Project-specific measurement needed		
$Hour_{Op}$	Average hours of operation per day	12 hour/day	Value follows baseline from FHWA INVEST tool for street lighting [45]. Use 8 hours for traffic lights		
Day_{Op}	Days of operation per year	365 day/year	Year-round operation; for projects with seasonal differences, can be replaced with project-specific number		
L_{Exist}	Power consumption of existing lights (use high-pressure sodium, or HPS, for streetlights)	Depends on lumens needed, in W	**Lumens**	**HPS Power (W)**	**LED Power (W)**
			4000-5000	100	40
			7000-8800	150	82
			8500-11500	200	100
			11500-16000	240	125
LED_{Power}	Power consumption of LED lights	Depends on lumens needed, in W	18000-28000	400	242
			28800-42000	400	308
			46500-52800	750	402
			52500-58300	1000	474
			Traffic	100W for incandescent	10

Project quantification example

A city is replacing 150 streetlights that have 10000 lumens with LED lights. The annual carbon reduction would be:

$$150 \text{ lights} \times 3.91 \times 10^{-7} \frac{\text{MT CO}_2}{\text{Wh}} \times 12 \frac{\text{h}}{\text{day}} \times 365 \frac{\text{day}}{\text{year}} \times (200 \text{ W} - 100 \text{ W}) = \mathbf{25.7} \frac{\mathbf{CO_2eMT}}{\mathbf{year}}$$

PROJECT TYPE RE1 – IMPLEMENT RENEWABLE ENERGY PROJECTS IN HIGHWAY RIGHT-OF-WAY

Project description

This project involves installing new renewable electricity generation assets in the right-of-way for highway transportation projects.

Quantification methodology

To quantify the emissions benefits from installing new generation, it is assumed that new generation is a direct replacement for the average electricity produced by the existing grid. A differing capacity factor is used for each type of generation to accurately calculate the energy replaced. Emissions factors used in the following table consider lifecycle carbon emissions.

$$\Delta Carbon = P \times (EF_{grid} - EF_{new}) \times C \times H$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
P	Rated generating power added (MW)	Project Specific	Project-specific measurement needed
EF_{grid}	Emissions factor of local power grid	0.391 CO_2e MT/MWh	State average for Minnesota in 2021 [44]; could be replaced by utility-specific input [46]
EF_{new}	Emissions factor of renewable generation added	See table. [47]	Values from a 2021 NREL report [47]
H	Number of hours per year	8760 hr/year	Year-round operation; can be replaced with project-specific value
C	Capacity factor – ratio of actual amount generated to possible amount generated	Solar: 24.8%, Wind: 36.1%	Values based on the Energy Information Administration; varies with energy types [48]

Generation Type	EF (MT/MWh)
Photovoltaic	0.043
Wind	0.013
Geothermal	0.037
Hydropower	0.021
Ocean	0.008
Biomass	0.052
Concentrated Solar	0.028

Project quantification example

A highway project is installing 2 megawatts of landfill gas turbines in a right of way where the emission factor of the landfill gas is 0.052 MT/MWh with a capacity factor of 61.7%. The annual carbon reduction would be:

$$2\ \text{MW} \times \left(0.391\ \frac{\text{CO}_2\text{e MT}}{\text{MWh}} - \ 0.052\ \frac{\text{CO}_2\text{e MT}}{\text{MWh}}\right) \times 8760\ \frac{\text{hr}}{\text{year}} \times \ 61.7\% \ = \ \mathbf{3664.5}\ \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

PROJECT TYPE RE2 – INSTALL SOLAR PANELS ON TRANSIT STATIONS, REST STOPS, PARKING AND OTHER FACILITIES

Project description

This project involves installing solar panels in spaces controlled by transportation agencies as a means of producing low-cost and low carbon electricity for those spaces and the surrounding grid.

Quantification methodology

To quantify the emissions benefits from installing new solar panels, it is assumed that the solar power will replace the average electricity produced by the existing grid. This is a reasonable assumption because typically solar has the lowest marginal cost and fossil fuels have much higher marginal costs of production.

$$\Delta Carbon = I \times \eta \times A \times EF_{grid} \times C \times U$$

ID	Variable	Value	Notes
ΔCarbon	Annual carbon emissions reduction	N/A	Calculated
I	Average solar irradiance	0.004 MWh/m^2-day	From the National Solar Radiation Database for Minnesota [49]; could be replaced by project-specific input
η	Efficiency of the solar panels	25%	Observed efficiency of current photovoltaic systems [50]; could be replaced by project-specific input
A	Area of the project	Project Specific, in m^2	Project-specific measurement needed
EF	Emissions factor of local power grid	0.391 CO_2e MT/MWh	State average for Minnesota in 2021 [44]; could be replaced by regional-specific input
C	Coverage	Project Specific	Percent of the project area covered with panels; Project-specific measurement needed
U	Number of days per year	365 day/year	Year-round operation; can be replaced with project-specific value

Project quantification example

A new transit station is installing solar panels over a new surface parking lot with 1,000 spaces and 29,000 square meters of area with 80% coverage. The annual carbon reduction would be:

$$\frac{0.004\ \text{MWh}}{\text{m}^2\text{day}} \times 25\% \times 29000\ \text{m}^2 \times 0.391 \frac{\text{CO}_2\text{e MT}}{\text{MWh}} \times 365 \frac{\text{day}}{\text{year}} \times 80\% = \mathbf{3311.0}\ \frac{\mathbf{CO_2e\ MT}}{\mathbf{year}}$$

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APPENDIX E

SUMMARY OF CRS CATEGORIES, STRATEGIES AND PROJECT TYPES

Categories	Strategies	Project types
Electrification	Install EV or ZEV charging infrastructure	• Expand public EV charging infrastructure network for light duty vehicles • Implement public and depot EV charging infrastructure for transit buses • Provide EV charging infrastructure grants for school districts • Deploy public/shared private charging infrastructure for medium and heavy-duty freight vehicles
	Purchase/lease EVs or other ZEVs	• Zero emission transit buses • Zero emission school buses • Purchase or incentivize e-bike programs • Transition public fleet (e.g., vehicles operated by municipalities, such as police vehicles or fleet vehicles) through purchase and lease of ZEVs or EVs • Initiate ZEV or EV sharing programs (e.g., making ZEVs or EVs accessible to more people without the commitment of ownership)
	Support EV/ZEV adoption through outreach and education	• Outreach and education for EV or ZEV passenger vehicles. • Outreach and education for EV or ZEV medium-duty and heavy-duty vehicles and corporate fleets

Categories	Strategies	Project types
Travel options	Install and maintain infrastructure network improvements for walking, rolling and bicycling	• Construct or improve bicycle network (e.g., add on-street bike lane, add protected bike lane/separated bikeway, shared use paths, trails) • Construct or improve pedestrian network (e.g., add sidewalks, expand sidewalks, fill gaps in sidewalk network, shared use paths, trails) • Add or improve road crossings for users (e.g., add intersection crosswalks, add pedestrian refuge island) • Establish or expand micromobility programs (e.g., bicyclesharing stations, scooter sharing program) • Coordinate and develop maintenance plans to ensure access to bicycle and pedestrian networks through all weather conditions
	Plan, design and engineer infrastructure network improvements for walking, rolling and bicycling	• Plan, design and engineer Safe Routes to School (e.g.,develop a plan into design- and engineering-level to support non-motorized access to schools) • Plan, design and engineer transit hubs (e.g., develop a plan into design- and engineering-level to support network improvements to enhance access to transit hubs) • Plan, design and engineer local and regional active transportation projects (e.g., develop a plan into design- and engineering-level to support local or regional areas for walking, rolling and bicycle improvements and implementation)
	Implement context sensitive design for travel options	• Improve street connectivity (e.g., increasing vehicle intersection density allowing shorter and more efficient trips between destinations, reducing travel times and congestion) • Implement traffic calming (e.g., lower speed limits, narrower streets, speed bumps, signage) • Implement projects that reduce vehicle travel lanes (e.g., road diets) • Install smart crosswalk systems with LED lighting and sensors that increase visibility and alert drivers when people are crossing

Categories	Strategies	Project types
Travel options	Add high-capacity public transit options (operations & capital)	• Implement Bus Rapid Transit (BRT) systems that use dedicated lanes and stations with off-board fare collection to provide faster and more efficient service • Implement bus transit priority treatments (e.g., transit signal priority to reduce travel time and enhance reliability, infrastructure improvements such as bus only lanes during certain hours) • Add or expand bus service (e.g., new routes, on-demand service, expanded coverage area) • Enhance bus frequency or hours of service • Develop mobility hubs (e.g., stations that connect many high-capacity transit routes, along with shared mobility and micromobility options, transit stations that include park and ride facilities to encourage commuters to leave vehicles and use transit). • Enhance transit stops (e.g., add benches, shelters, lighting, heat) • Transit pilot projects (e.g., on-demand service to test feasibility in an area, re-routing projects).
	Add intercity and regional public transit options (operations & capital)	• Establish or expand intercity bus services that connect different towns and cities • Develop mobility hubs (e.g., stations that connect transit routes to other travel options and between regions considering land use and amenities, stations that include E-3 Minnesota Carbon Reduction Strategy park and ride facilities to encourage commuters to leave vehicles and use transit) • Develop and improve intercity passenger rail service • Pilot projects (e.g., integrated ticketing system that allows passengers to use multiple types of regional and intercity public transit with a single ticket or pass
	Implement travel demand management	• Implement or expand travel demand management outreach (e.g., employer outreach, public outreach and education) • Implement or expand ridesharing support programs (e.g., ride matching software and technology, carpooling incentives, guaranteed ride home programs)

Categories	Strategies	Project types
Low carbon infrastructure and system management	Optimize transportation system management and operations	• Implement intersection improvements (e.g., roundabouts, turn lanes) • Invest in low-cost design and maintenance improvements and other operational programs to improve safety and address travel delays due to incidents, weather and other conditions (e.g., snow fencing, maintenance activity improvements, enhanced incident management) • Implement traffic signal improvements to reduce delays and improve traffic flow (e.g., adaptive traffic signal systems that adjust signal timings based on real-time traffic conditions, signal coordination)
	Utilize low carbon methods for constructing and maintaining transportation infrastructure	• Use low carbon materials and recycled materials in the construction process to minimize carbon footprint of transportation construction/maintenance projects (e.g., sustainable asphalt) • Recycle pavement on construction sites (e.g., maximize the amount of recycled pavement used on a construction site) • Replace street lighting and traffic control devices with energy-efficient alternatives (e.g., LED lighting) • Increase the application of green infrastructure throughout projects (e.g., vegetation and roadside tree canopy)
	Support renewable energy generation	• Implement renewable energy projects in highway right-ofway • Implement solar panels or other renewable energy generation on transit stations, rest stops, parking and other facilities

APPENDIX F

CARBON REDUCTION PROGRAM PROJECTS

Appendix F includes a list of projects funded with Carbon Reduction Program (CRP) Formula Funding for fiscal year 2023 and fiscal year 2024. These projects were programmed only using the guidance from FHWA and what is found in 23 CFR 175 as of July 1, 2023. What is programmed in fiscal year 2023 and fiscal year 2024 are not reflective of what may or may not be programmed in future years. The intent of these two years was to not allow funds to lapse and, to the best of Minnesota jurisdictions' abilities, program and fund projects that fulfilled the intent of the CRP.

Fiscal year 2025 through 2027 will use guidance from the 2023 Minnesota CRS to select, program and fund projects with CRP Formula funding. These projects will align with the prioritized categories, strategies and project types as illustrated in the 2023 Minnesota CRS.

Projects are organized by fiscal year and State Project Number (SP#), project description, CRP funds, project total cost.

For the most current CRP funded projects see the Minnesota State Transportation Improvement Program (STIP).

FISCAL YEAR 2023 CRP PROJECTS

- 156-111-007 **CRP**CITY OF RED WING: ROADWAY RECONSTRUCTION, ADA, SIDEWALK, STORM SEWER - PHASE 1 FROM 540 FEET EAST OF CENTENNIAL STREET TO WILKINSON STREET, RED WING
  - CRP funds: $487,376
  - Total cost: $584,851
- 085-621-015 **CRP**CITY OF WINONA: CSAH 21 FROM TH 43 TO 3.5 MILES NW, 2 MILES SOUTH FROM CITY OF WINONA, RECONSTRUCTION
  - CRP funds: $582,624
  - Total cost: $699,149
- 119-080-012 **CRP**CITY OF EAST GRAND FORKS: PURCHASE AND INSTALLATION OF 11 PREEMPTION EMITTERS ON FIRE TRUCKS
  - CRP funds: $4,980
  - Total cost: $6,225
- 236-080-004 **CRP**CITY OF LA CRESCENT: LEASE 1 ELECTRIC VEHICLE TO REPLACE POLICE CRUISER
  - CRP funds: $12,000
  - Total cost: $15,000
- 137-080-004 **CRP**CITY OF MANKATO: ELECTRIC VEHICLE LEASE FOR MINNESOTA STATE UNIVERSITY, MANKATO
  - CRP funds: $82,276
  - Total cost: $102,845

- TRF-0034-23M **CRP**FTA5307: CITY OF MOORHEAD: TRANSIT HUB IMPROVEMENTS-DILWORTH WALMART (ASSOCIATED WITH TRF-0034-23K)
  - CRP funds: $67,200
  - Total cost: $84,000
- 144-030-006 **CRP**CITY OF MOORHEAD: PURCHASE SOFTWARE FOR ADVANCED TRAFFIC MANAGEMENT SOFTWARE (ATMS) AND ASSOCIATED HARDWARE
  - CRP funds: $50,000
  - Total cost: $62,500
- TRF-0047-23I **CRP**CITY OF ROCHESTER: MICRO-TRANSIT PILOT PROJECT - OPERATIONS, 2 ELECTRIC VEHICLES, CHARGERS
  - CRP funds: $310,000
  - Total cost: $387,500

FISCAL YEAR 2024 CRP PROJECTS

- 3805-106 **CRP**MN 61, SAFETY IMPROVEMENTS AT SILVER CLIFF, BR#38005 & LAFAYETTE BR#38003 TUNNELS.TUNNEL LIGHTING REVISIONS INSTALL LED LIGHTING
  - CRP funds: $850,000
  - Total cost: $5,799,970
- 058-591-001 **CRP**PINE COUNTY: CONSTRUCT TRAIL BETWEEN PINE CITY HIGH SCHOOL AND ROCK CREEK CITY CENTER ALONG COUNTY ROAD 61
  - CRP funds: $860,000
  - Total cost: $2,000,000
- 068-090-008 **CRP**CITY OF ROSEAU: ENGINEERING COSTS FOR SP 068-090-007, ROSEAU RIVER TRAIL - PHASE IV (CAPPED $253,000)
  - CRP funds: $253,000
  - Total cost: $316,250
- 071-596-010 **CRP**CONSTRUCT NEW TRAIL ALONG E 2ND ST FROM 5TH AVE N OT LIONS PARK IN CITY OF ZIMMERMANN
  - CRP funds: $411,380
  - Total cost: $514,225
- 222-105-003 **AC**CRP**SCHOOL BOULEVARD, FROM MN 25 TO COUNTRY AVE, RECONSTRUCT & CONSTRUCT ROUNDABOUTS IN THE CITY OF MONTICELLO (PAYBACK IN 2027)
  - CRP funds: $485,000
  - Total cost: $607,000
- 227-020-013 **CRP**WRIGHT CSAH 35, FROM JAMISON AVE TO CR 119 (4TH ST NE), CONSTRUCT MULTIUSE TRAIL
  - CRP funds: $230,000
  - Total cost: $287,500
- 117-080-006 **CRP**CITY OF DETROIT LAKES: DESIGN AND CONSTRUCTION OF TRAILHEAD PARKING FOR HEARTLAND TRAIL AND 2 PUBLIC EV CHARGING STATIONS
  - CRP funds: $398,000
  - Total cost: $498,000
- 056-596-005 **CRP**OTTER TAIL COUNTY: LEASE OF 2 ELECTRIC VEHICLES AND PURCHASE AND INSTALLATION OF 2 ELECTRIC VEHICLE CHARGING STATIONS
  - CRP funds: $166,400
  - Total cost: $208,000

- 006-596-001 **CRP**BIG STONE COUNTY: LEASE 1 ELECTRIC PICK-UP TRUCK VEHICLE
  - CRP funds: $40,000
  - Total cost: $50,000
- 8804-CRP-24 **CRP**WHITE EARTH PUBLIC TRANSIT: PURCHASE OF 2 PROPANE BUSES
  - CRP funds: $337,238
  - Total cost: $421,548
- 079-607-026 **CRP**2-FOOT SHOULDER, 4-INCH CENTERLINE, 6-INCH GIWR, SHOULDER RUMBLES ON CSAH-7 FROM TH 60 TO 0.1MILE SOUTH OF CSAH 16
  - CRP funds: $815,000
  - Total cost: $1,018,750
- 125-090-007 **CRP**CONSTRUCT CANNON RIVER TRAIL
  - CRP funds: $275,000
  - Total cost: $350,000
- 088-596-001 **CRP**DISTRICTWIDE, LEASE ELECTRIC TRUCK FOR EACH COUNTY IN THE DISTRICT
  - CRP funds: $841,174
  - Total cost: $1,137,500
- 165-080-003 **CRP**PURCHASE AND INSTALL EIGHT ELECTRIC VECHICLE CHARGING STATIONS IN VARIOUS LOCATIONS
  - CRP funds: $68,826
  - Total cost: $86,032
- 064-596-001 **CRP**INSTALL 2 ELECTRIC VEHICLE CHARGERS IN THE CITY OF REDWOOD FALLS
  - CRP funds: $325,680
  - Total cost: $400,000
- 8828-250crp **CRP**DISTRICT WIDE BLOWING SNOW CONTROL
  - CRP funds: $404,320
  - Total cost: $1,336,586
- 220-090-004 **CRP**CITY OF SARTELL: BIKEWAY ENGINEERING, SARTELL BRIDGE TO BENTON DRIVE
  - CRP funds: $179,800
  - Total cost: $224,800
- 162-080-009 **CRP**CITY OF ST. CLOUD: INSTALL ELECTRIC VEHICLE CHARGING STATIONS AT 5 LOCATIONS THROUGHOUT THE CITY OF ST CLOUD
  - CRP funds: $200,000
  - Total cost: $250,000
- 119-090-007 **CRP**CITY OF EAST GRAND FORKS: INSTALL SIDEWALK ALONG 5TH AVE NW FROM 4TH ST NW TO THE BUS SHELTER NORTH OF 4TH ST NW AND INSTALL TRAIL ALONG 4TH ST NW FROM 5TH AVE NW TO EXISTING TRAIL WEST OF THE FLOODWALL
  - CRP funds: $40,000
  - Total cost: $109,129
- 236-080-004 **CRP**CITY OF LA CRESCENT: LEASE 1 ELECTRIC VEHICLE TO REPLACE POLICE CRUISER
  - CRP funds: $12,000
  - Total cost: $15,000
- 137-030-004 **CRP**MANKATO LED

  LIGHTING UPGRADE
  - CRP funds: $144,000
  - Total cost: $180,000

- TRS-0047-24B **CRP**CITY OF ROCHESTER:

  MICRO-TRANSIT PILOT PROJECT – OPERATIONS

  - CRP funds: $155,000
  - Total cost: $405,000

- 159-090-024 **CRP**CITY OF ROCHESTER: WILLOW CREEK TRAIL FEASIBILITY STUDY
  - CRP funds: $155,000
  - Total cost: $193,750

- 069-609-050CRP **CRP**ST LOUIS COUNTY: CSAH9 (WOODLAND AVE) RESURFACE FROM CSAH 37 (SNIVELY RD) TO ANOKA ST. MILL AND OVERLAY, SIDEWALK IMPROVEMENTS, STORM SEWER AND CURB AND GUTTER REPLACEMENT. (AC PROJECT PAYBACK 2025)
  - CRP funds: $360,000
  - Total cost: $450,000

- 144-080-011 REPLACEMENT OF HPS LIGHT HEADS WITH LED LIGHT HEADS ON VARIOUS LOCATIONS IN MOORHEAD
  - CRP funds: $78,800
  - Total cost: $98,500

- 098-080-054 CONSTRUCT RAPID-FLASHING BEACON AT CSAH 9 (40TH ST. N.) AND 4TH AVE. NW IN DILWORTH
  - CRP funds: $44,000
  - Total cost: $60,000

- 8816-3427 **CRP**STATEWIDE PEDESTRIAN BRIDGE WORK
  - CRP funds: $12,000,000
  - Total cost: $15,000,000