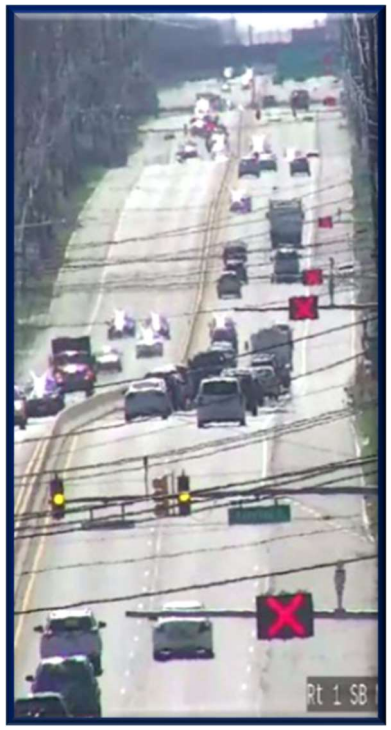
New Jersey

Carbon Reduction Strategy

New Jersey Department of Transportation

November 2023



Route 1

Atlantic City

NJDOT Headquarters

Route 46

New Jersey Department of Transportation's Carbon Reduction Strategy

Executive Summary

New Jersey Department of Transportation (NJDOT) prepared this Carbon Reduction Strategy (CRS) as directed by the Carbon Reduction Program (CRP) that was established under the Infrastructure Investment and Jobs Act (IIJA), also known as the Bipartisan Infrastructure Law (BIL).

This document serves as a guide and blueprint for NJDOT to reduce carbon emissions and work with partner agencies and stakeholders. This document is an initial step in identifying transportation project types that will achieve reductions in carbon emissions from the transportation sector. As per the federal legislation, New Jersey's CRS will be updated every four years.

Strategy Development

An initial phase of the CRS development process involved reviewing existing documents concerning carbon emissions and greenhouse gases (GHG) in New Jersey. These documents also provided initial insights into projects and programs already undertaken by various state, regional, and private entities.

Development of the CRS was largely based on FHWA regulations in addition to NJDOT subject matter experts and collaboration from the Carbon Reduction Strategy Working Group. This Working Group was convened specifically for this study and mainly consisted of representatives from NJDOT, the state's three metropolitan planning organizations (MPOs), and a few other statewide, regional, and federal agencies, including New Jersey Transit (NJ TRANSIT), the Port Authority of New York and New Jersey (PANYNJ), and the Federal Highway Administration (FHWA).

Strategy to Reduce Carbon Emissions

The CRS is focused on reduction of carbon dioxide (CO_2) emissions from the transportation sector, which accounts for 41% of New Jersey's total CO_2 emissions. Climate change caused by carbon emissions and other GHGs impact human health, the environment, and the economy.

The Carbon Reduction Strategy includes five categories of transportation project types that can be implemented by NJDOT and partner agencies and have the potential to achieve reductions in CO_2 emissions.

Carbon Reduction Strategy

1. **Promote electric and zero-emission vehicles**
2. **Increase use of mass transit and active modes**
3. **Support efficient roadway operations**
4. **Incorporate efficient construction and maintenance**
5. **Enable innovative solutions**

Strategy Implementation

Recommendations highlight opportunities to incorporate carbon reduction into NJDOT's many existing processes, including those relating to funding and project development. One recommendation is to maintain the Carbon Reduction Working Group established for this study. A second recommendation is that the Strategy function as a resource for NJDOT, metropolitan planning organizations, counties, planning organizations, counties, and municipalities.

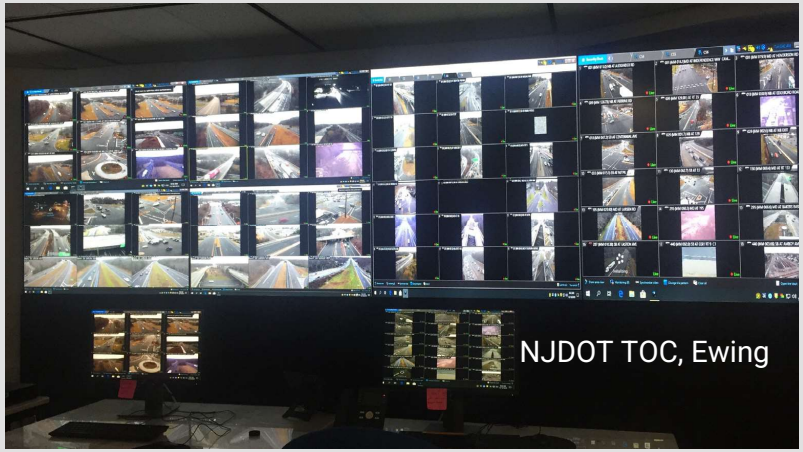
Introduction

The IIJA, also known as the BIL, was enacted on November 15, 2021. This act authorizes and re-authorizes substantial funding for surface transportation, aviation, energy, water and wastewater systems, cybersecurity, and broadband. Section 11403 of the IIJA establishes the CRP. The CRP is a new formula program to reduce transportation sector carbon emissions. Nationally, $6.4B will be allocated to this program with approximately $154M for New Jersey over the 5-year period between FY 2023 and FY 2027.

CRP funds may be obligated for projects supporting the reduction of carbon emissions from the transportation sector, including projects promoting alternative fuels, providing alternatives to driving alone, and reducing carbon emissions through roadway operations or construction methods. Many transportation projects are eligible, provided they can demonstrate a reduction in transportation carbon emissions. The full list of eligible project types is included in Appendix A. CRP funding can be used in combination with funding from other sources.

The program requires each state to consult with other state agencies and MPOs to prepare a CRS. The CRS must be submitted to the Federal Highway Administration (FHWA) by November 15, 2023, and updated every four years thereafter. The CRS is meant to identify carbon reduction strategies unique to each state and is not limited to the use of CRP funds.

The NJDOT CRS summarizes existing programs within the state to reduce carbon emissions from the transportation sector and identifies project types with the greatest potential for reducing carbon emissions. NJDOT and other planning agencies can use the CRS as a guide for considering carbon emissions reductions during project planning processes.



NJDOT's Bureau of Mobility and Systems Engineering manage real-time traffic flow on state highways by monitoring and modifying signal timing at its three Transportation Operations Centers. This reduces congestion and provides traveler information to avoid delays from unplanned road closures.

Purpose

The NJDOT CRS serves as a blueprint for the agency to reduce carbon emissions and work with partner agencies and stakeholders. This document is an initial step to identifying transportation project types that will achieve reductions in carbon emissions from the transportation sector. Reducing carbon emissions will reduce the impacts of climate change and its potential impacts to New Jersey's economy and the health of New Jersey's residents.

The United States Department of Transportation's (USDOT) Fiscal Year 2022-2026 Strategic Plan establishes the USDOT's strategic goals and objectives. These goals are also supported by this CRS.

Safety – Make our transportation system safer for all people.

Many of the project types in NJDOT's CRS improve safety, including encouraging walking and biking, use of public transportation, and improving roadway efficiency.

Economic Strength and Global Competitiveness – Grow an inclusive and sustainable economy.

The recommendations outlined in this strategy include cost-effective measures to reduce carbon emissions, a core element of a more sustainable economy.

Equity – Reduce inequities across our transportation systems and the communities they affect.

Historically underserved communities have been disproportionately affected by carbon emissions while tending to rely on more environmentally-friendly transportation modes, such as transit, walking and biking. Implementing the CRS will improve access for historically underserved communities, including ALICE (Asset Limited, Income Constrained, Employed) and reduce carbon emissions in these communities.

Climate and Sustainability – Tackle the climate crisis by ensuring that transportation is central to the solution.

The primary goal of the CRS is to reduce carbon emissions from the transportation sector. All recommendations and tactics included in this Strategy support this goal of supporting the climate and sustainability.

Transformation – Invest in purpose-driven research and innovation to meet the challenges of the present and modernize a transportation system of the future that serves everyone today and, in the decades to come.

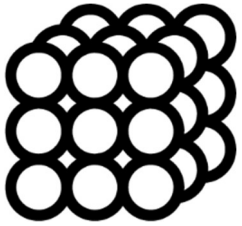
The continued consideration of carbon reduction advanced by this CRS supports further utilization and understanding of transformational techniques yet to come, including technical advances.

Organizational Excellence – Advance the Department's mission by establishing policies, processes, and an inclusive and innovative culture.

This CRS utilizes the vast array of existing processes established by NJDOT to efficiently, effectively, and comprehensively address transportation sector carbon emissions.

Context

The following characteristics help make New Jersey unique and were considered in the development of this CRS.



New Jersey is the most densely populated state in the country – New Jersey has 1,263 people per square mile, more than any other state. Based on the 2020 U.S. Census, six of the nation's ten most densely populated municipalities are in New Jersey. This high population density is precipitated in part by New Jersey's proximity to the major cities of New York and Philadelphia as well as the early development of its own cities. This high population density developed in tandem with the state's public transportation network. The presence and use of these have provided a lower baseline level of carbon emissions than a purely autocentric state.

New Jersey is a major freight hub with easy access to the New York City and Philadelphia metropolitan areas – New Jersey's freight infrastructure plays an essential role in the regional economy. Freight-dependent industries account for approximately 32% of the state's gross domestic product and employ almost two million people, representing 45% of the total employed workforce. The Port of New York and Jersey is the busiest East Coast port in the United States, handling more than $211 billion of the nearly $1.8 trillion of the nation's international freight. Additionally, Newark Liberty International Airport ranks twelfth nationally by landed weight of all-cargo operations. According to USDOT's Freight Analysis Framework version 5.3, 68% of domestic state-to-state freight tonnage in New Jersey is moved by truck, with an additional 18% by pipeline, and 6% by rail. The importance of freight in New Jersy is recognized by New Jersey's 2023 Statewide Freight Plan, which also discusses means of reducing freight-related carbon emissions and strengthening the transportation sector's resiliency. Freight in New Jersey leads to increased emissions due to the need for diesel-fueled vehicles to not only service the state but also the larger region. Switching to electric-powered trucks provides an opportunity to reduce carbon emissions.

New Jersey is vulnerable to climate change –New Jersey's economy and environmental assets are vulnerable to climate change. The state's vibrant agricultural sector suffers from extreme heat. The millions of people living near or visiting the Shore routinely face severe storms. DOT faces maintenance and rebuilding costs due to severe weather, adding to the 1.5 billion dollars it annually takes to plan, construct, operate, and maintain NJDOT roadways and bridges[1]. New Jersey is also home to a substantial number of overburdened communities. Based on the New Jersey Department of Environmental Protection's (NJDEP) definition of overburdened communities, nearly one third of the state's census block groups meet the criteria based on the presence of racial and ethnic minorities, 22% meet the threshold for low-income populations, and two percent meet the threshold for limited-English proficiency. These communities are concentrated in the state's urban areas near industrial clusters that face more pollution.

Carbon Emissions in New Jersey

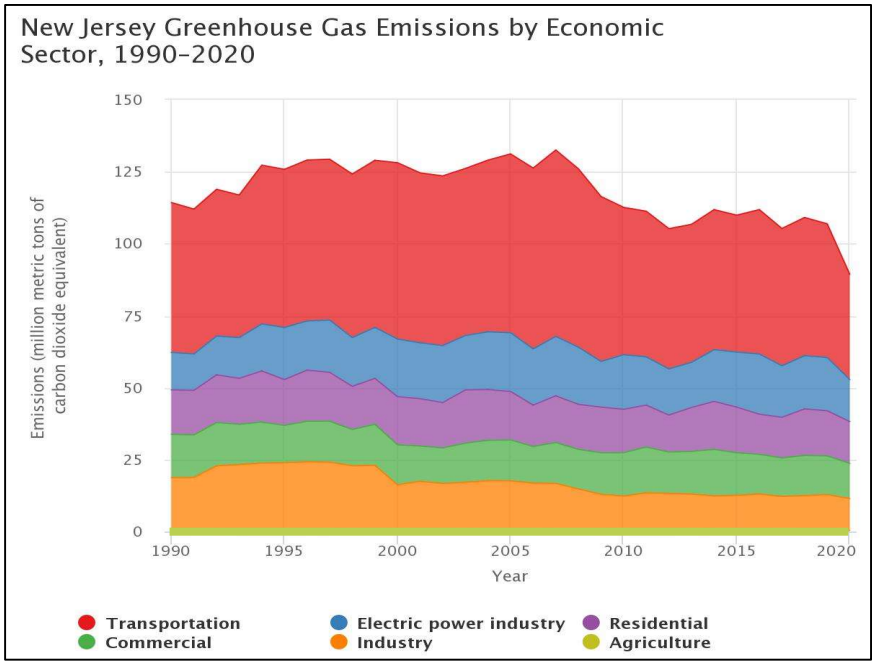
Greenhouse gases (GHG), which include CO_2, trap heat and make the planet warmer. The largest source of GHG emissions from human activities in the United States is from burning fossil fuels for electricity, heat, and transportation[2]. CO_2 is the primary GHG emitted from burning fossil fuels, and CO_2 is the focus of FHWA's CRP and NJDOT's CRS.

Climate Change Impacts to New Jersey

Climate change impacts human health, the environment, and the economy. The young, elderly, socially or linguistically isolated, economically disadvantaged, and those with preexisting health conditions are more at risk of health impacts from the combination of heat stress and poor urban air quality caused by climate change. Climate change can also affect the productivity of crops and livestock.

Overall New Jersey Emissions Reduction Goals

In 2007, the New Jersey legislature passed the Global Warming Response Act (P.L. 2007 c.112; P.L. 2018 c.197) (GWRA) establishing a target to reduce the state's GHG emissions by 80 percent from their 2006 levels by 2050 across all sectors. This target applies to all GHG emissions within the state, and it does not provide targets for individual sectors.



New Jersey emitted 89 million metric tons of CO_2 equivalent (CO_2e) in 2020[3]

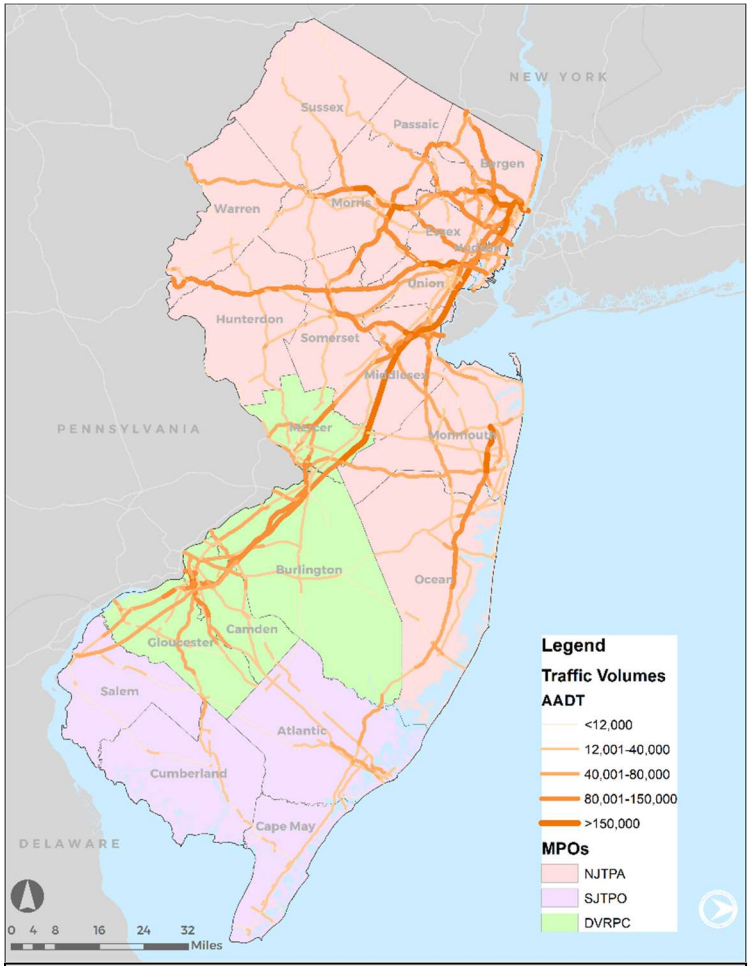
36.5 million metric tons of CO_2e emissions (41%) were from the transportation sector

CO_2e is used to measure and compare emissions from multiple greenhouse gases. CO_2e from the transportation sector is primarily comprised of CO_2.

Process

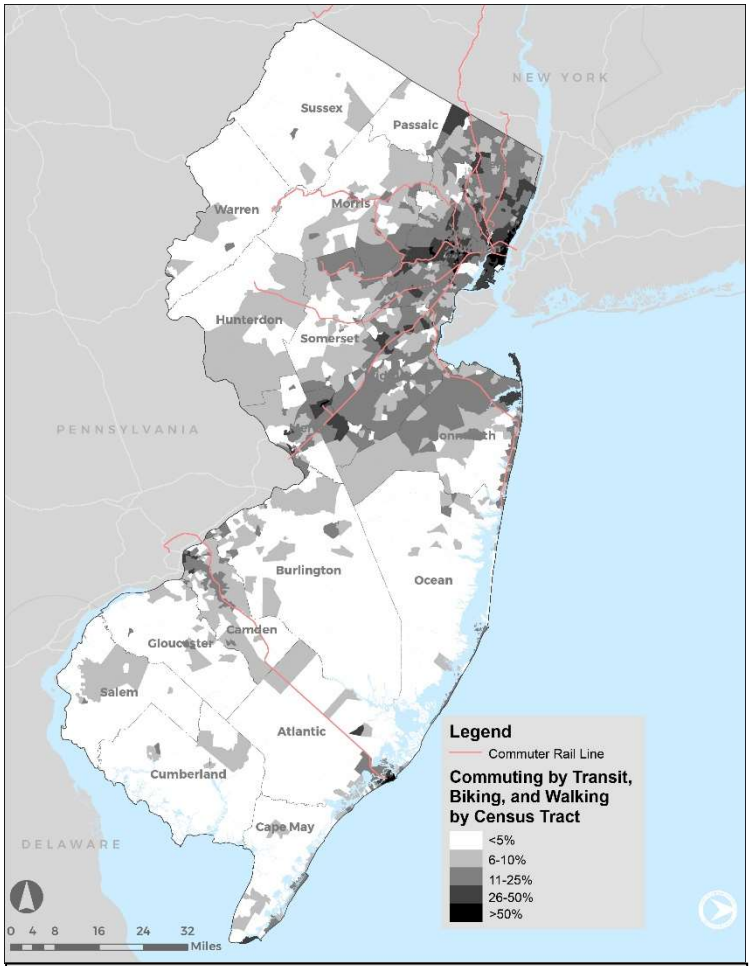
Development of the CRS was led by NJDOT, including the agency's senior leadership. More than one dozen offices and units within NJDOT participated in the process. The strategy's design and outcomes are aimed at better enabling NJDOT to reduce carbon emissions throughout the state, including through policies, infrastructure projects, and within its own fleet. The CRS was also informed by the Carbon Reduction Strategy Working Group. This Working Group was convened specifically for this study and mainly consisted of representatives from NJDOT, the state's three MPOs, and other stakeholders. The Working Group met seven times during the project's process, offering integral input and guidance and providing feedback on information shared by the consultant team. The graphic below illustrates the agencies represented in the Working Group.

MPOs and Traffic Volumes



As shown in the map above, traffic volumes (and vehicle emissions) are concentrated along several state corridors. These routes include, but are not limited to the National Highway System routes (I-78, I-80, I-295, I-287, etc.)

Transit, Biking, and Commuting



As shown in the map above, transit, biking, and walking rates vary greatly throughout the state. Rates are highest in northeast and central New Jersey, and along the PATCO Speedline. Areas with higher transit use tend to produce less carbon emissions.

Agency Roles and Funding Allocation

NJDOT

The strategies in this document will inform NJDOT's capital program development process and assist NJDOT staff in identifying the carbon reduction elements of NJDOT projects. This work will involve the following functional areas of the Department: planning, research, freight, aeronautics, maritime, traffic operations, fleet management, construction and materials, and capital program development.

Metropolitan Planning Organizations

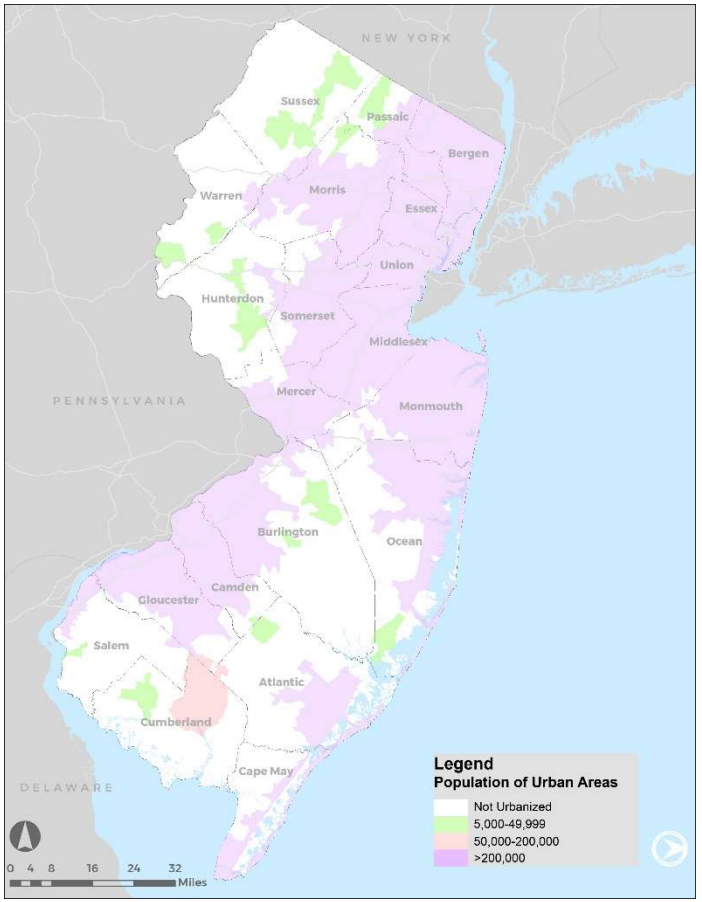
MPOs will use the strategies outlined in this document as a resource for developing their own CRP-funded regional investment strategies that will identify carbon-reducing actions. This investment strategy will be reflected in future regional transportation plans (RTPs) and transportation improvement programs (TIPs).

Municipalities, Counties, and the Public

Municipalities, counties, and members of the public will use this document as a centralized source of statewide carbon reduction activities and to better identify stakeholders and agencies to collaborate with on further innovative techniques at continuing to reduce carbon.

FHWA will apportion $154 million in carbon reduction funding to NJDOT over the five-year period between FY 2023 and FY 2027. As per FHWA requirements, 65 percent of CRP funds apportioned to New Jersey shall be obligated to urban areas, proportional to relative shares of the population. These locations are identified in the map to the right. Remaining funds can be allocated throughout the State.

NJ Carbon Reduction Program
Urban Area Suballocation



Existing Carbon Reduction Initiatives

New Jersey state agencies have taken many actions that reduce carbon emissions from the transportation sector. New Jersey is subject to federal government programs such as fuel economy standards and the National Electric Vehicle Infrastructure (NEVI) program. The following plans, regulations, and programs demonstrate ongoing initiatives within New Jersey to reduce transportation carbon emissions, including many that specifically promote electric vehicles.

Fast charging station in Lawrence Township, Mercer County
Source: EVgo

- NJDOT has developed a NEVI Deployment Plan that proposes to install fast electric chargers every 50 miles along interstate highway corridors. New Jersey expects to receive about $104 million over five years for these efforts.
- New Jersey's 2019 Electric Vehicle Law sets goals for registered electric vehicles and public fast charging stations in the state. The law aims for 200 public fast charging stations and to electrify 25% of the state's non-emergency light-duty fleet by 2025. It also sets a goal for 330,000 registered electric vehicles by 2025 and two million vehicles by 2035. The number of electric vehicles in the state increased 63.1% from 2019 to 2021 and represented 3.7% of light-duty vehicle sales in 2021. By 2025, our state transportation agencies will have converted approximately 40% of our light duty fleet to electric or electric plug-in hybrid vehicles.
- The New Jersey Department of Community Affairs published a Model Statewide Municipal Electric Vehicle Ordinance in 2021, which describes the types of electric vehicle (EV) charging stations, considerations for a municipal ordinance and approval process, and installation and cost considerations.
- NJDEP's It Pay$ to Plug In program provides grants to offset the cost of purchasing and maintaining electric vehicle charging stations. The program is designed to expand New Jersey's growing electric vehicle infrastructure network, allowing residents, businesses, and government agencies to purchase and drive electric vehicles. The state-funded program is open to businesses, governments, non-

profit organizations, educational institutions, and owners of multi-unit dwellings.

- Charge Up New Jersey promotes clean vehicle adoption by offering incentives of up to $4,000 for the purchase or lease of new, eligible battery EVs and $250 for purchasing an eligible EV charger. The program is supported by the New Jersey Board of Public Utilities.
- New Jersey is a member of the U.S. Climate Alliance, which is a bipartisan coalition of 25 governors committing to achieve the goals of the Paris Agreement to keep temperature increases below 1.5 degrees Celsius (2.7 degrees Fahrenheit).
- The New Jersey Global Warming Response Act led to the release of the New Jersey Greenhouse Gas Emissions Inventory Report in 2022. This document provides a review of existing and past emissions statistics in the state, including tracking the number of electric vehicles in the state.
- In 2022, NJDOT's Bureau of Mobility and Systems Engineering procured the hardware and software components required to complete a full Connected Vehicle system validation in a lab facility, before conducting installation and field testing at pilot locations.
- The state's three MPOs recognize the need for reducing carbon emissions in the transportation sector. Each MPO addresses GHG emissions within their Long Range Plan. They also distribute federal Congestion Management Air Quality (CMAQ) funds that often have the co-benefit of reducing CO_2 emissions.
- Municipalities, and private and non-profit entities are also collaborating to reduce carbon emissions. Many cities within New Jersey have deployed electric bikeshares and electric scooter shares to offer alternatives to driving a car.

Connected Vehicle Systems deployed at five pilot intersections

Electric Scooter Rentals in Asbury Park

Carbon Reduction Strategies

A series of incremental actions must be implemented to effectively contribute to carbon emissions reductions from the transportation network. In consultation with MPOs, NJDOT identified five categories of transportation project types that reduce emissions and are already being pursued throughout the state. The categories are based on actions NJDOT can influence by funding individual projects and programs or by integrating strategies into agency operations.

The five project categories comprising the CRS are summarized in Table 1. Each category is described in the following pages with project types eligible for CRP funding, potential reductions of CO_2 emissions, and examples of projects that have been implemented in New Jersey.

Table 1: Carbon Reduction Project Categories

Carbon Reduction Strategy Category	How Carbon Emissions Are Reduced
Promote electric and zero-emission vehicles	Support transition from fossil fuels to electricity and other alternative fuels
Increase use of mass transit and active modes	Encourages shift away from single occupancy vehicle trips
Support efficient roadway operations	Improve traffic flow and reduce delay
Incorporate efficient construction and maintenance practices	Use of recycled materials and efficient equipment operations
Enable innovative solutions	Continue to explore new methods, technologies, and more sustainable materials

Strategy 1: Promote Electric and Zero-Emission Vehicles

Nationwide, on-road gasoline and diesel-fueled vehicles are responsible for 81% of the transportation sector's total emissions[3]. The state's 80% emission reduction by 2050 target cannot be achieved without meeting the aggressive electric vehicle adoption rates outlined in the EV Law (see Project Highlights below). NJDOT can support these goals through specific project types that promote the transition to electric vehicles. In addition, NJDOT supports project types that facilitate the conversion of buses, trucks, and offroad equipment to zero-emission sources. Additional funding is available through the federal Congestion Mitigation & Air Quality (CMAQ) and National Electric Vehicle Infrastructure (NEVI) programs.

Eligible Project Types

- Acquisition, installation, and operation of publicly accessible electric vehicle charging infrastructure
- Acquisition, installation, and operation of publicly accessible hydrogen, natural gas, or propane vehicle fueling infrastructure
- Purchase or lease of zero-emission vehicles, buses, and construction vehicles
- Projects that reduce emissions at port facilities, such as electrification efforts
- Truck stop electrification systems

Table 2: Category 1 Example Projects

Example Project	Potential Reduction (MT CO_2/year)
Installation of 1 public level 2 charging station	10
Installation of 1 public DCFC charging station	50
Replace 10 delivery and vocational trucks with electric trucks	70
Replace 10 diesel-powered nonroad equipment with electric equipment	316
Replace 10 diesel buses with electric buses	420
Replace 10 heavy-duty drayage trucks with zero-emissions trucks	480
Install off-board power systems for 50 truck parking spaces	1,200

Note: MT CO_2 = metric tons of carbon dioxide. Emissions estimates are described in more detail in Appendix D.

Project Highlights

- New Jersey's Electric Vehicle Law sets targets for installation of fast charging stations, transition to zero-emission buses, and agency-owned vehicles
- NJ TRANSIT's first electric buses were deployed in 2022 as part of the agency's transition to a zero emission bus fleet
- NJDOT has led several successful efforts promoting electric and zero-emission vehicles, as listed in the earlier "Existing Carbon Reduction Initiatives" section

Strategy 2: Increase Use of Mass Transit and Active Modes

Mass transit and active transportation facilities provide alternative options to driving alone, which reduces the number of vehicles on roadways. Emissions reductions from these project types are more pronounced in the near term. As roadway users transition to electric and other zero-emission vehicles, reducing vehicle miles traveled will become less beneficial for carbon emissions due to the reduced emissions per vehicle emitted by electric modes.

Eligible Project Types

- Off-road facilities for pedestrians, bicyclists, other nonmotorized vehicles
- On-road facilities for pedestrians, bicyclists, other nonmotorized vehicles
- Ridesharing
- Public transportation service expansion, bus and rail
- Public transportation stations and parking facilities that attract new users to transit
- Public transportation loading areas, shelters, and amenities

Table 3: Category 2 Example Projects

Example Projects	Potential Reduction (MT CO_2/year)
New shared-use path parallel to arterial	30
Purchase of 20 new vanpool vehicles	70
New bike lanes adjacent to major arterial	80
Expand transit bus service by 20 additional service miles	560
Expand light rail service by 5 additional service miles	2,500

Note: MT CO_2 = metric tons of carbon dioxide. Emissions estimates are described in more detail in Appendix D.

Project Highlights

- EZ Ride shuttles provide first- and last-mile connections to major transportation hubs
- NJ TRANSIT improves rail access by deploying bicycle parking shelters and lockers
- NJDOT operates a vanpool service for employees. Each van runs at full capacity. NJDOT currently operates three vans daily.

Strategy 3: Support Efficient Roadway Operations

Congested roadways contribute to CO_2 emissions from vehicle engines that are not operating efficiently while they are idling or in stop-and-go conditions. Roadway projects that reduce vehicle idling time reduce emissions by allowing vehicles to flow more freely. Roadway projects that relieve congestion allow vehicles to travel at speeds that use vehicle engines more efficiently, which reduces fuel use and CO_2 emissions. Example projects under this strategy include those improving throughout (such as upgrading signal timing), reducing vehicle miles traveled (such as supporting telework), and routing trips from congested areas (such as variable message signs).

Eligible Project Types

- Advanced transportation and congestion management technologies (e.g., intelligent transportation systems, electronic toll collection)
- Congestion management strategies (shifting mode and timing of trips, increasing vehicle occupancy rates, other travel demand management strategies)
- Installation of vehicle-to-infrastructure communications equipment (connected vehicles)
- Traffic management facilities and programs

Table 4: Category 3 Example Projects

Example Project	Potential Reduction (MT CO_2/year)
Support for telework/teleservices for 100 employees	70
Variable message signs on highway	80
Transit signal priority on a single corridor	170
Traffic control center	170
Upgraded signal timing – individual intersection	210
Upgraded signal timing – corridor signal synchronization	300

Note: MT CO_2 = metric tons of carbon dioxide. Emissions estimates are described in more detail in Appendix D.

Project Highlights

- The South Jersey Transportation Authority (SJTA) is removing toll plazas (see top left photo) in favor of all-electronic toll collection systems on the Atlantic City Expressway.
- The PANYNJ reports an annual reduction of 11,500 MT CO_2 from cashless tolling on Port Authority crossings.
- Lane use control signals (LUCS) were used to implement hard shoulder running on the congested Route 1 corridor (see bottom left photo). As a result of the project, total congested time decreased about 29% on an average day.

Strategy 4: Incorporate Efficient Construction and Maintenance

Carbon emissions from roadway construction and roadway maintenance are a combination of exhaust from construction vehicles, equipment, and haul trucks that deliver materials to and from a work site and the emissions associated with material production. NJDOT can reduce emissions during project construction and roadway maintenance by using innovative materials and methods as an alternative to traditional hot-mix asphalt. Contractors can be encouraged to integrate similar actions when working on NJDOT projects.

Eligible Project Types

- Use of sustainable pavements and construction materials that reduce lifecycle carbon emissions
- Purchase or lease of zero-emission construction equipment and vehicles and support facilities
- Replacement of street lighting and traffic control devices with energy-efficient alternatives

Table 5: Category 4 Example Projects

Example Project	Potential Reduction (MT CO_2/year)
Replace 10 gasoline-powered landscaping equipment with electric options	18
Limit idling at project sites to 3 minutes	30
Replace 1,000 high-pressure sodium vapor (HPSV) light bulbs in streetlights, parking lots, or garages with light-emitting diode (LED) bulbs	30
Substitute hot-mix asphalt with warm-mix asphalt	134
Substitute hot-mix asphalt with reclaimed asphalt pavement (RAP)	216
Cold-in-place roadway recycling	1,080
Full-depth reclamation	1,080

Note: MT CO_2 = metric tons of carbon dioxide. Emissions estimates are described in more detail in Appendix D.

Project Highlights

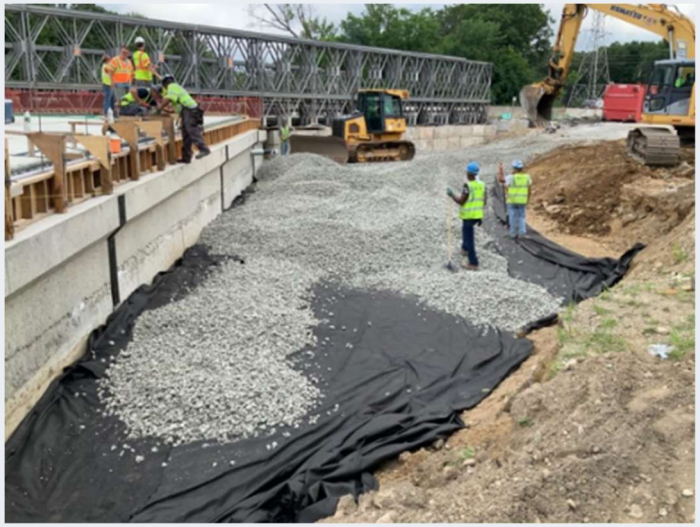

- NJDOT performed 1,157 lane miles of major pavement work in 2019
- NJDOT has used ground recycled tire rubber and reclaimed asphalt and pavement in recent projects

Strategy 5: Enable Innovative Solutions

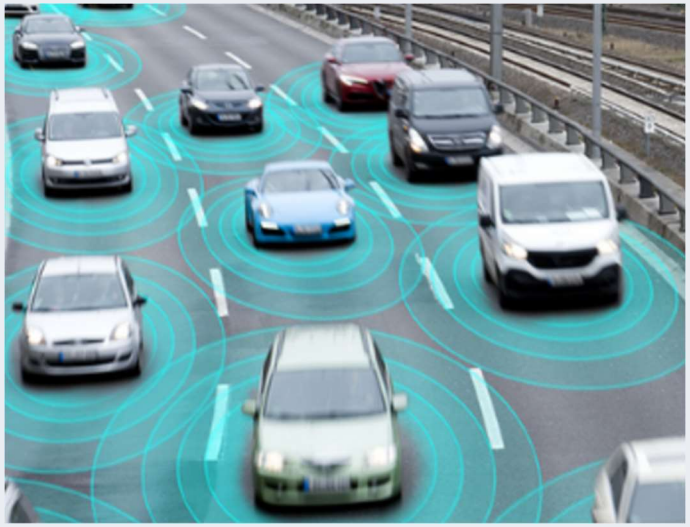
NJDOT's Innovation Program within the Bureau of Research works to identify, develop, promote, and institutionalize innovative transportation-related ideas, practices, and initiatives within the Department and beyond. NJDOT research staff work directly with university staff and other research professionals to find workable solutions to safety, mobility, and accessibility challenges by enhancing the quality and cost-effectiveness of the policies, practices, standards, and specifications that are used in planning, building, and maintaining New Jersey's transportation infrastructure. In addition, NJDOT's State Transportation Innovation Council (STIC) works to implement FHWA's Every Day Counts initiatives, some of which reduce carbon emissions.

Many of the current innovations being evaluated by NJDOT have the potential to contribute to carbon reduction. No emissions estimates were evaluated for this category of evolving technologies.

Project Highlights



NJDOT has completed projects using ultra-lightweight foamed glass aggregate, a material made from 99 percent crushed container glass that can be used as fill under roadways and bridge approaches. Carbon emissions are reduced by using recycled products and reducing the amount of truck trips required to transport the lightweight material.



Other innovative actions being pursued by NJDOT:

- Commercial Vehicle Alerts Initiative
- Deployment of connected vehicle equipment
- Participation in New Jersey Fuel Cell Task Force
- Automated Traffic Signal Performance Measures (ATSPM)

Implementation

Reduction of carbon emissions is the focus of the CRS, but all NJDOT actions include additional considerations such as cost-effectiveness, impacts to underserved communities, geographic equity, safety, resilience, and flexibility to maximize funding. These considerations are essential to incorporating carbon reduction into established planning, policy, and funding activities. NJDOT will take the following actions to implement the CRS:

Maintain Carbon Reduction Working Group

NJDOT will maintain the Carbon Reduction Working Group to assist with the implementation of the CRS and plan for the next update. This multi-agency group is an effective forum for collaboration and sharing innovative ideas to reduce carbon emissions throughout the state of New Jersey.

Act as and Provide Resources for MPOs, Counties, and Municipalities

NJDOT is well situated to act as a statewide resource and guide for promoting expertise and best practices to these agencies. The CRS and the associated carbon reduction quantifications provide a framework for agencies to develop their unique strategies to reduce carbon emissions. Actions to reduce carbon by all agencies will result in more significant carbon emission reductions throughout the state.

Continue to Fund and Deliver Projects that Reduce Carbon

NJDOT and its partner agencies have well-established processes used for multi-phase projects implemented throughout the state. Many existing projects in the Capital Program contribute to carbon reduction by improving traffic flow and providing alternatives to driving alone. Multiple projects that are part of a larger implementation scheme or suite of improvements may be far more cost-effective and capable of reducing carbon emissions than can be achieved by individual projects. For example, implementation of a single bike lane may not appear to result in substantial carbon reductions, but could have additional benefits if connecting to a transit facility or if part of a larger bike corridor.

Incorporate Carbon Friendly Elements into Existing Projects

Project design can include features that contribute to carbon reduction such as Complete Streets elements and sustainable pavement options.

Purchase Cleaner Vehicles and Construction Equipment

The transition to alternative fuel vehicles and construction equipment provides near-term carbon reduction with lasting benefits.

Evaluation

This CRS is designed to help guide NJDOT toward incorporation of carbon reduction into project development and funding decisions. Future updates to the CRS should include a discussion about the status and relative success of implemented actions.

The application of numerous evaluation metrics could be used to measure the effectiveness of implemented carbon reduction strategies. This will help balance the sometimes competing considerations of cost, effectiveness, and scalability.

NJDOT will take a collaborative approach with partner agencies to evaluating the progress of the CRS based on a combination of agency-wide achievements and individual project successes.

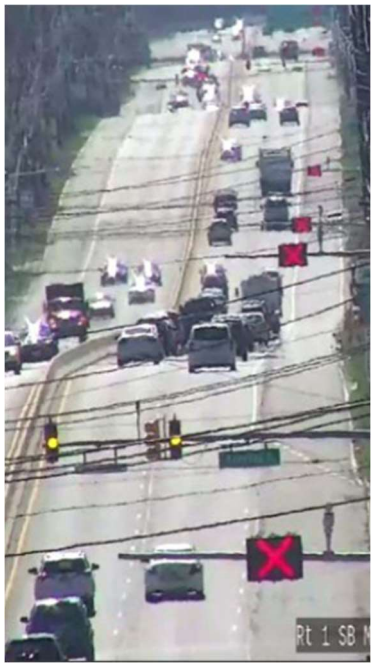
Electric garbage trucks in Jersey City

Conclusion

Climate change is not bound by state or national boundaries. This CRS establishes an initial concerted plan for NJDOT to reduce carbon emissions specific to the transportation sector with project types that can be implemented by NJDOT. The plan will be updated within four years. The CRS provides a framework for how New Jersey can effectively use its CRP funding to achieve the desired outcomes of this CRS. This strategy document outlines a series of potential project categories, appropriate to New Jersey's context. This strategy documents the factors to consider when implementing carbon reduction impacts.

The ability to reduce carbon emissions and calculate reduction's is continuing to change. The ability for NJDOT and its partner agencies to implement the project types eligible for CRP funding will depend on funding availability, cost of implementation, technical innovations and acumen, and priorities.

With the increased funding New Jersey will receive from the IIJA, we will have even more resources to accomplish our goals and to build innovation into New Jersey's robust transportation system.



Lane Use Control Signals

Cyclists on Boardwalk

Electric Vehicle Charging

Unmanned Aerial Systems

Endnotes and Sources

[1] page 4 - https://www.nj.gov/transportation/business/research/reports/NJ-2016-003.pdf

[2] page 5 - https://www.nj.gov/dep/climatechange/mitigation/index.html

[3] page 5 - Fast Facts: U.S. Transportation Sector Greenhouse Gas Emissions, 1990-2021 (EPA-420-F-23-016, June 2023), https://www.epa.gov/system/files/documents/2023-06/420f23016.pdf

Note: Acronyms and Definitions of Terms

- Active Modes – physical means of transport, including walking, biking, and scooting
- BIL – Bipartisan Infrastructure Law; enacted as part of the Infrastructure Investment and Jobs Act authorizing up to 108 billion dollars for public transportation, passed in 2021
- CAFE – Corporate Average Fuel Economy
- CRP – Carbon Reduction Program; a formula funding program established by the federal Infrastructure Investment and Jobs Act (IIJA)
- CRS – Carbon Reduction Strategy; document and plan required to be updated every four years aimed at reducing transportation sector emissions
- CO_2 – carbon dioxide
- CO_2e – carbon dioxide equivalent
- DCFC – direct current fast charging
- EV – Electric Vehicle; a vehicle that can be powered by an electric motor that draws electricity from a battery and is capable of being charged from an external source (*Alternative Fuels Data Center, U.S. Department of Energy)*
- FHWA – Federal Highway Administration; federal agency devoted to roadways, part of the United States Department of Transportation
- GHG – greenhouse gases
- HPSV – high pressure sodium vapor lamp
- IIJA - Infrastructure Investment and Jobs Act; federal act signed into law in November 2021 allocating 1.2 trillion dollars in spending
- LED – light-emitting diode
- MT CO_2/year – metric tons of carbon dioxide per year
- NEVI – National Electric Vehicle Infrastructure Formula Program; established as part of BIL to provide funding to States to strategically deploy electric vehicle charging infrastructure and to establish an interconnected network to facilitate data collection, access, and reliability
- NHTSA – National Highway Traffic Safety Administration
- NJ TRANSIT – New Jersey Transit, responsible for most of the bus, light rail, and commuter rail services in New Jersey
- NJDEP – New Jersey Department of Environmental Protection; the state's environmental agency responsible for responding to climate change, protecting the state's water, managing and promoting natural and historic resources, and protecting public health

- NJDOT – New Jersey Department of Transportation; the state's transportation agency responsible for many of the busiest roadways in the State
- NJTA – New Jersey Turnpike Authority
- Project Category – five groupings of project types and example projects established as part of this Carbon Reduction Strategy based on how the project reduces carbon reduction
- Project Example – a specific quantifiable example that falls under a project category and project type.
- Project Type – 21 means of reducing carbon emissions shared as part of the IIJA's Carbon Reduction Program
- RAP – reclaimed asphalt pavement
- SJTA – South Jersey Transportation Authority
- USDOT – United States Department of Transportation; executive department of federal government overseeing numerous agencies, including Federal Highway Administration, Federal Transit Administration, and Federal Railroad Administration

Appendices

Appendix A - List of Project Types Eligible for CRP Funding

Appendix B - New Jersey and Peer State Document Review

Appendix C - Documentation of Consultation Process

Appendix D - Emission Reduction Quantification Methodology

Appendix A – List of Project Types Eligible for CRP Funding

The Bipartisan Infrastructure Law establishes the Carbon Reduction Program (CRP), which provides funds for projects designed to reduce transportation emissions, defined as carbon dioxide (CO2) emissions from on-road highway sources. CRP funds may be obligated for projects that support the reduction of transportation emissions, including, but not limited to– [except as noted, § 11403; 23 U.S.C. 175(c)(1)]:

- a project described in 23 U.S.C. 149(b)(4) to establish or operate a traffic monitoring, management, and control facility or program, including advanced truck stop electrification systems;
- a public transportation project eligible under 23 U.S.C. 142;
- a transportation alternative (as defined under the Moving Ahead for Progress in the 21st Century Act [23 U.S.C. 101(a)(29), as in effect on July 5, 2012]), including, but not limited to, the construction, planning, and design of on-road and off-road trail facilities for pedestrians, bicyclists, and other nonmotorized forms of transportation;
- a project described in 23 U.S.C. 503(c)(4)(E) for advanced transportation and congestion management technologies;
- deployment of infrastructure-based intelligent transportation systems capital improvements and the installation of vehicle-to-infrastructure communications equipment;
- a project to replace street lighting and traffic control devices with energy-efficient alternatives;
- development of a carbon reduction strategy developed by a State per requirements in 23 U.S.C. 175(d);
- a project or strategy designed to support congestion pricing, shifting transportation demand to nonpeak hours or other transportation modes, increasing vehicle occupancy rates, or otherwise reducing demand for roads, including electronic toll collection, and travel demand management strategies and programs;
- efforts to reduce the environmental and community impacts of freight movement;
- a project that supports deployment of alternative fuel vehicles, including–
- acquisition, installation, or operation of publicly accessible electric vehicle charging infrastructure or hydrogen, natural gas, or propane vehicle fueling infrastructure; and
- purchase or lease of zero-emission construction equipment and vehicles, including the acquisition, construction, or leasing of required supporting facilities;
- a project described in 23 U.S.C. 149(b)(8) for a diesel engine retrofit;
- certain types of projects to improve traffic flow that are eligible under the CMAQ program, and that do not involve construction of new capacity; [§ 11403; 23 U.S.C. 149(b)(5); and 175(c)(1)(L)]
- a project that reduces transportation emissions at port facilities, including through the advancement of port electrification; and
- any other STBG-eligible project, if the Secretary certifies that the State has demonstrated a reduction in transportation emissions, as estimated on a per capita and per unit of

economic output basis. (Note: FHWA will issue guidance on how the Secretary will make such certifications.) [§ 11403; 23 U.S.C. 133(b) and 175(c)(2)]

Appendix B – New Jersey and Peer State Document Review

Introduction

The Bipartisan Infrastructure Bill, signed into law in November 2021, establishes a Carbon Reduction Program (CRP), which provides funds for projects designed to reduce transportation emissions, defined as carbon dioxide emissions from on-road highway sources. CRP funds may be obligated for projects supporting various means of reducing transportation emissions. At the State's discretion, the CRP can also quantify the total carbon emissions from the production, transport, and use of materials used to construct transportation facilities in the State.

This memo summarizes the initial step of reviewing previous studies to identify progress made thus far and compile best practices. Documents from agencies within New Jersey were reviewed to compile applicable resources, goals, and strategies that will be reflected in the statewide Carbon Reduction Strategy (CRS). Efforts from other states were also reviewed to provide examples of carbon dioxide (CO_2) or greenhouse gas (GHG) reduction strategies and methodologies for estimating potential emissions reductions.

Summary of Findings

Though federal legislation concerning mandated state carbon reduction strategies was only recently passed, New Jersey has long documented the negative impacts of carbon emissions on the environmental, health, social, and economic well-being of communities. Numerous documents, studies, plans, and reports have been developed inventorying existing GHG conditions, and identifying measures, metrics, and benchmarks for reducing emissions. GHG emissions in the transportation sector are particularly important as the sector represents the largest segment of emissions statewide. Documents from New Jersey, regional metropolitan planning organizations, and other States were reviewed to provide insights into New Jersey's developing CRS. This CRS will incorporate the best of each of these sources to provide a practical plan to reduce CO_2 emissions from on-road highway sources. Documents from other states are valuable to provide examples of relevant strategies and the presentation of their potential benefits.

Review of New Jersey Documents

Several state and regional documents were obtained and reviewed for their relevance to the CRS. Of particular concern in these documents were any identified carbon reduction strategies, reduction targets, priority project types, GHG inventories, and overall approaches toward addressing and discussing greenhouse gases. Each document provides unique insight into the work conducted thus far to reduce carbon emissions and expectations and tactics for continuing to reduce carbon emissions. The following points briefly characterize the current state of carbon emissions, transportation emissions, and carbon reduction strategies in New Jersey.

- Over the last 15 years, New Jersey has reduced GHG emissions by 20%, primarily because of market forces that motivated energy-generating units to transform from coal to cleaner-burning natural gas *(NJ's Global Warming Response Act 80x50 Report)*
- Overall reduction in bad air quality days from 53 in 2010 to 10 in 2019 *(NJTPA Plan 2050)*
- Goal was to reduce emissions to 1990 levels by 2020; was accomplished 11 years early *(NJ's Global Warming Response Act 80x50 Report)*
- GHG from transportation declined 20% from 2005 to 2018; overall GHG decreased 29% over this period *(NJ's Global Warming Response Act 80x50 Report)*
- The transportation sector is the primary source of GHG emissions in New Jersey; representing 42% of the state's GHG emissions *(NJ's Global Warming Response Act 80x50 Report)*

Acronyms for state and regional agencies used throughout this document are listed below:

- NJTPA – North Jersey Transportation Planning Authority, the metropolitan planning organization representing the northern New Jersey counties of Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Ocean, Morris, Passaic, Somerset, Sussex, Union, and Warren
- SJTPO – South Jersey Transportation Planning Organization, the metropolitan planning organization representing the southern New Jersey counties of Atlantic, Cape May, Cumberland, and Salem
- DVRPC – Delaware Valley Regional Planning Commission, the metropolitan planning organization representing the greater Philadelphia region, including the New Jersey counties of Burlington, Camden, Gloucester, and Mercer
- NJDOT – New Jersey Department of Transportation, the state's transportation agency
- NJDEP – New Jersey Department of Environmental Protection, the state's environmental protection agency

Main takeaways from each reviewed document helpful for developing this CRS are provided in the below sections. A table listing the reviewed documents is provided in Table 6.

Table 6: Reviewed Documents

TITLE	AGENCY	YEAR
New Jersey Long-Range Transportation Plan	NJDOT	2008
New Jersey Statewide Freight Plan	NJDOT	2017
New Jersey's Global Warming Response Act 80x50 Report	NJDEP	2020
New Jersey Greenhouse Gas Emissions Inventory Report	NJDEP	2022
New Jersey Global Warming Response Act Recommendations Report	NJDEP	2009
North Jersey Transportation Planning Authority Long Range Transportation Plan	NJTPA	2021
South Jersey Transportation Planning Organization Regional Transportation Plan 2050	SJTPO	2021
Connection 2050: Plan for Greater Philadelphia	DVRPC	2021

New Jersey Long-Range Transportation Plan

- Many of the plan's goals, policies, strategies, and actions are geared toward reducing auto-dependence and, consequently, GHG, including smart growth, public transit, efficient operations, and improved freight movement
- Both NJDOT and NJ TRANSIT are working to make their own facilities greener by exploring and adopting alternative materials and technologies, including diesel retrofit, seeking opportunities to recycle waste and by-products from projects, and continuing to strive to enhance, not just protect, environmental resources
- Methods identified to encourage energy efficiency:
    - Encourage the use of hybrid vehicles and alternative fuels to reduce GHG emissions
    - Continue clean diesel and other technological initiatives to reduce emissions for buses as well as NJDOT fleet vehicles and equipment
    - Promote and support all alternatives to driving alone

- The plan identifies expanding public transit capacity and service as crucial to conserving energy and reducing GHG

New Jersey Statewide Freight Plan

- Formula Carbon Reduction Program – formula grant program to reduce transportation emissions and develop carbon reduction strategies, including advanced truck stop electrification
- Clean Vessel Incentive Program – intends to reward operators making voluntary engine, fuel, and technology enhancements to their vessels that reduce emissions beyond regulatory environmental standards
- MAP Forum includes a Multi-State Resiliency Working Group, which builds on FHWA's post-Hurricane Sandy Transportation Resilience Study of NY, NJ, and CT to expand vehicle electrification, and reduce GHG impacts
- Truck electrification driven by governmental incentives and regulations intended to reduce GHG and NOx emissions, including both incentives facilitating electrification and more stringent requirements for traditional diesel or gasoline trucks

NJ's Global Warming Response Act 80x50 Report

- Transportation sector represents 42% of GHG; 70% of this from gasoline-fueled vehicles
- Goal to reduce GHG to 80% of 2006 levels by 2050: interim target of 50% by 2030
- To achieve 80x50, 88% of new light-duty vehicles will need to be electric vehicles by 2030; 100% by 2035
- 100% of new NJ TRANSIT buses are expected to be electric vehicles by 2032
- Complementary policies identified:
    - Increase mass transit ridership
    - Expand transit-oriented development
    - Incentivize work from home and flexible work weeks
    - Collaborate with other states on regional partnerships/strategies
- 2018 Zero Emission Vehicle Program MOU
    - With nine other states
    - Place combined 3.3 million zero-emissions light-duty vehicles on road by 2025
    - 100% of medium/heavy duty vehicles by 2050; 30% by 2030
- New Jersey is likely to experience a 1.1' increase in sea level rise by 2030, and a 2.1' increase by 2050, regardless of future reductions

NJ GHG Emissions Inventory Report

- Serves as foundation of state's strategy to mitigate climate change
- Identifies sources of GHG, measures progress to reduce emissions, and makes info more accessible to decision-makers
- Transportation accounts for 38 MMT (36% of statewide CO2 emissions); on-road gasoline accounts for 82% of on-road emissions
- Net emissions dropped from 11.4 MMT CO2 in 1990 to 98.5 MMT CO2 in 2019
- New Jersey's Global Warming Response Act requires a comprehensive greenhouse gas inventory by NJDEP every other year with interim updates in intervening years
- New Jersey is responsible for 1.6% of national GHG emissions and 0.3% of worldwide GHG emissions
- New Jersey's per capita GHG emissions is slightly more than half of the U.S. average though this may be skewed by the states significantly benefiting from emissions-generating activities in nearby states
- New Jersey transportation emissions peaked in 2007
- The number of electric vehicles in the state increased 63.1% from 2019 to 2021, representing 3.7% of light-duty sales in 2021

NJ Global Warming Response Act Recommendations Report

- 2019 Electric Vehicle Law
    - Goal to have 330,000 registered electric vehicles by end of 2025; two million by 2035
    - Electric vehicle registrations increased 63% from 2019 to 2021; represent 3.7% of light-duty sales
    - Goal of 200 public fast charging stations
    - Goal to electrify 25% of state non-emergency light-duty fleet by 2025
- 2021 Protecting Against Climate Threats Regulatory Reform
    - Requires truck manufacturers selling medium and heavy-duty vehicles in New Jersey to increase number of electric vehicles sold over time

NJTPA Plan 2050

- In New Jersey, transportation represents 42% of GHG emissions; 68% of this is generated by passenger vehicles, trucks, and motorcycles

- Funding Strategies – changes in policy to focus less on taxes levied on gasoline sales and more on vehicle miles traveled or other assessed user-based fees or taxes
- Strategies to Reduce Emissions – reducing vehicle miles traveled by encouraging transit ridership or more compact and walkable land uses
- Plan 2050 Climate Change and Transportation background paper identified key steps to combat climate change
    - Supporting electrification of vehicles and the creation of vehicle charging systems
    - Supporting partner agencies and subregions in efforts to review and revise operations to reflect both current and projected climate impacts
    - Supporting low-carbon transit and bike/walk options, transit-oriented development, and transportation demand management
    - Overseeing and modeling the impacts of planning transportation improvements on air quality
    - Supporting projects that target reducing pollutants whose emissions are tied to generation of GHGs
- Nationwide, the transportation sector contributes 28% of GHG emissions as of 2018

SJTPO Regional Transportation Plan

- Largest emission sector is transportation, representing 45.5% of gross GHG emissions in region
- Before a project is advanced for prioritizing using the project evaluation process, SJTPO assesses for air quality
- GHG emissions are associated with seasonal population swings
- Atlantic County accounts for 48% of regional GHG
- SJTPO released a Greenhouse Gas Inventory Report in 2014 that provides an inventory of emissions throughout the region

DVRPC LRP Policy, Process, and Analysis Documents

- DVRPC has a goal to attain net-zero GHG emissions by 2050
- Aims to focus growth in centers, in part to reduce auto emissions
- Identifies potential funding options for replacing the gas tax
    - Mileage-based user fees
    - Carbon tax

  - Toll existing highways
  - Vehicle registration fees
  - Tradable driving credits
  - Commercial property VMT fee
  - Parking pricing
  - Congestion pricing
- Checklist to reduce GHG emissions includes electrifying transportation
- TIP-LRP Project Benefit Evaluation Criteria weights environment the least important (7%) though notes that projects enhancing safety, reducing congestion, investing in Centers, expanding multimodal options, and improving air quality will all help to lower emissions
- Measuring GHG impacts of transportation projects requires a detailed, complex effort that is not consistent with the goal of keeping the project evaluation process simple and high-level
- The region does not meet federal NAAQS for ground-level ozone and has only recently attained standard for PM2.5

Review of Other State Documents and Programs

The Carbon Reduction Program requires each state to develop a Carbon Reduction Strategy by November 2023. While many states are still developing the Carbon Reduction Strategy, as required by the Carbon Reduction Program, there are states that have published other similar documents that address reducing greenhouse gas emissions from the transportation sector. This section summarizes information from other states to provide NJDOT with examples of ongoing work in this area.

Indiana

The Indiana Department of Transportation has developed a Draft Carbon Reduction Strategy that is posted on their website for public review and comment1. The document identifies five categories of transportation projects and strategies that can support carbon reduction in Indiana, as shown in Figure 1. Project types and strategies the support each category are summarized in tables. The document does not identify specific projects or estimate the potential reductions from the strategies.

[1] Indiana DOT Carbon Reduction Strategy. https://www.in.gov/indot/public-involvement/public-involvement/carbon-reduction-strategy/

Figure 1. Indiana DOT Carbon Reduction Categories

Oregon

The Oregon Transportation Commission developed a Statewide Transportation Strategy (STS)2 in 2013 in response to Legislative direction to identify the most promising approaches for reducing transportation related GHG emissions. The STS contains 18 distinct strategies, shown in Figure 2, found to be the most promising in reducing GHG emissions in Oregon by 2050. Oregon DOT plans to adapt this document to meet the needs of the Carbon Reduction Strategy once more federal guidance is issued. Oregon DOT's Climate Office has many ongoing projects in the areas of mitigation, sustainability, and adaption. Oregon is currently developing a methodology to quantify the GHG emissions impacts of the STIP and its wide range of project types.

[2] Oregon Statewide Transportation Strategy. https://www.oregon.gov/odot/planning/pages/sts.aspx

Figure 2. Strategies Identified in Oregon's Statewide Transportation Strategy

Vehicle and Engine Technology Advancements
1 – More Efficient, Lower-Emission Vehicles and Engines
Fuel Technology Advancements
2 – Cleaner Fuels
Systems and Operations Performance
3 – Operations and Technology
4 – Airport Terminal Access
5 – Parking Management
6 – Road System Growth
Transportation Options
7 –Transportation Demand Management
8 – Intercity Passenger Growth and Improvements
9 – Intracity Transit Growth and Improvements
10 – Bicycle and Pedestrian Network Growth
11 – Carsharing
12 – More Efficient Freight Modes
Efficient Land Use
13 – Compact, Mixed-Use Development
14 – Urban Growth Boundaries
15 – More Efficient Industrial Land Uses
Pricing, Funding and Markets
16 – Funding Sources
17 – Pay-As-You-Drive Insurance
18 – Encourage a Continued Diversification of Oregon's Economy

Colorado

On December 16, 2021, the Transportation Commission voted to approve a groundbreaking new rule, the GHG Pollution Reduction Planning Standard[3], to reduce GHG emissions from the transportation sector. Under the Standard, CDOT and the state's five MPOs are required to achieve individually set GHG reduction levels at four different time periods - 2025, 2030, 2040, and 2050, which must be demonstrated in transportation planning documents using travel modeling. Overall, the standard encourages CDOT and the MPOs to develop long range transportation plans that support travel choices that reduce GHG emissions.

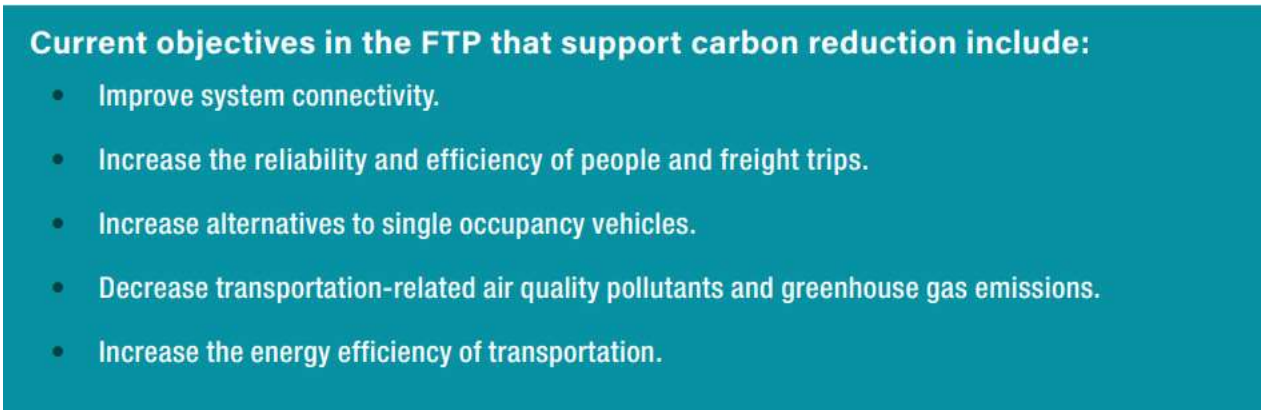
[3] Colorado DOT Greenhouse Gas Program. https://www.codot.gov/programs/environmental/greenhousegas

On May 19, 2022, the Transportation Commission voted to adopt Policy Directive 1610[4] on GHG Mitigation Measures, which establishes an ongoing administrative process and guidelines for selecting, measuring, confirming, verifying, and reporting on GHG Mitigation Measures. The Policy Directive includes a list of GHG mitigation measures that have been scored to reflect the ability of these project types to reduce GHG emissions in Colorado.

Florida

Florida DOT developed a Carbon Reduction Quick Guide[5], designed to assist MPOs in developing goals and objectives to support the reduction of transportation emissions and to identify projects that align with those goals and objectives. The Quick Guide also contains a list of resources so MPOs can easily access answers to questions regarding the implementation of the IIJA program. The guide encourages MPOs to consider goals that align with objectives within the Florida Transportation Plan that support carbon reduction, as shown in Figure 3, and provides examples of noteworthy practices around the state.

Figure 3. Florida Transportation Plan Objectives that Support Carbon Reduction



California

The California Air Pollution Control Officers Association (CAPCOA) has published a Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity[6]. This document is widely used by local governments across California to reduce GHG emissions from new land use development projects and to create climate action plans, master plans, and general plans. This document does not present a

[4] Colorado DOT Policy Directive 1610. https://www.codot.gov/programs/environmental/greenhousegas/assets/pd-1610-0-greenhouse-gas-mitigation-measures-june2022.pdf

[5] Florida DOT Carbon Reduction Quick Guide. https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/planning/policy/carbon-reduction/2022carbon-emission-reduction-guide-12-12_v5.pdf?sfvrsn=eff0c914_2

[6] CAPCOA GHG Handbook. https://www.airquality.org/ClimateChange/Documents/Final%20Handbook_AB434.pdf

statewide emissions reduction strategy, but it is a useful resource that includes factsheets, formulas, and guidance to calculate GHG reductions from over 80 GHG mitigation strategies. Information about specific strategies include GHG emissions reduction potential, co-benefits, climate resilience effects, and health and equity considerations.

Appendix C – Carbon Reduction Working Group Summaries

Brief summaries of each of the Carbon Reduction Working Group meetings are below.

Working Group Meeting #1 – December 12, 2022

The consultant team led a presentation providing an overview of the federal CRS legislation, the purpose of the Working Group, and the project schedule. The Working Group discussed the upcoming process of reviewing previous studies, how emissions reductions will be modeled, and how CRP funds will be used.

Working Group Meeting #2 – February 3, 2023

The consultant team led a presentation reminding attendees of the purpose of the federal CRS legislation and summarizing results of the literature review of previous studies. The Working Group discussed the potential scope of the CRS, and similar ongoing efforts undertaken by other states.

Working Group Meeting #3 – March 7, 2023

The consultant team led a presentation that include recapping the purpose of the CRS, presenting examples of similar documents, and discussing what can be included in the New Jersey CRS. Working Group members were encouraged to share data concerning carbon emissions and to respond to a survey concerning focus topics and each agency's efforts to reduce carbon emissions.

Working Group Meeting #4 – April 24, 2023

The consultant team led a presentation that included summarizing recent FHWA CRS webinars, updating Working Group members on the progress of the development of the CRS, and discussing next steps. The Working Group also discussed the type of projects to be included in the CRS.

Working Group Meeting #5 – May 25, 2023

The consultant team led a presentation that included recapping the purpose of and NJDOT's approach to the CRS, recapping feedback from the Working Group survey, and introducing assumptions and attempts to quantify carbon reductions of various project types.

Working Group Meeting #6 – June 29, 2023

The consultant team led a presentation that included outlining the draft CRS, summarizing the type of actions NJDOT can take to implement the CRS, and how to evaluate the effectiveness of the CRS. The Working Group discussed the need to integrate carbon reduction funding into existing processes.

Working Group Meeting #7 – July 27, 2023

The consultant team led a presentation that included summarizing the contents of the draft CRS, the document's main themes, and a schedule for the Working Group's review of the document.

Appendix D – Emissions Reduction Quantification Methodology

As part of the Carbon Reduction Strategy, NJDOT selected representative projects based on the list of eligible project types to determine the relative emissions benefits of various projects.

Since this exercise did not calculate emissions for specific projects where project details were known, the emissions were estimated using publicly available tools and methodologies that can be repeated and refined for future versions of the Carbon Reduction Strategy and any potential reporting of expected emissions reductions from specific projects under evaluation.

Resources Used

- EPA Motor Vehicle Emissions Model (MOVES) Version 3.1 was used to develop emission factors for the general vehicle fleet and passenger vehicles on the roads in New Jersey. MOVES incorporates the registered vehicle fleet mix as well as all federal emissions and fuel economy regulations in place during the analysis year. The emission factors used for the analysis were an average of MOVES results from three representative counties (Bergen, Atlantic, and Burlington). MOVES was also used to develop an emission factor for diesel-powered construction equipment and gasoline-powered landscaping equipment using the NONROAD module. The value used is an average of all commercial gasoline equipment within the landscaping category, which includes a range of equipment such as mowers, chainsaws, blowers, tractors, and chippers. https://www.epa.gov/moves
- AFLEET Version 2020 was used to develop emission factors for trucks and buses using an array of fuel options. AFLEET includes estimates for direct emissions from the vehicle tailpipe as well as upstream emissions associated with the production and transport of fuel and energy. While electric and hydrogen fuel cell vehicles do not produce tailpipe emissions, the increases in emissions from power production must be considered for a complete comparison. Emission factors were developed using AFLEET national defaults. https://greet.es.anl.gov/afleet
- AFLEET Charging and Fueling Infrastructure (CFI) Emissions Tool was used to develop emission estimates for a publicly available charging station. https://afleet.es.anl.gov/infrastructure-emissions/
- FHWA CMAQ Toolkit is a series of Excel-based modules commonly used for the Congestion Mitigation and Air Quality Program emissions reporting. Many project types that reduce emissions of CO_2 are included within these modules. The Traffic Flow Improvement Module was used to identify emission factors for vehicles traveling at specific speeds and idling. Annual bus miles of travel was retrieved from the Transit Bus Retrofit and Replacement Module. https://www.fhwa.dot.gov/environment/air_quality/cmaq/toolkit/
- The National Asphalt Pavement Association published GHG Emissions Inventory for Asphalt Mix Production in the United States in 2022. Information in this document was used to estimate the emissions reductions using different pavement techniques for a typical resurfacing project.

https://www.asphaltpavement.org/expertise/sustainability

- The California Air Resources Board (CARB) Methods to Find the Cost-Effectiveness of Funding Air Quality Projects was used to develop assumptions for how many new users would use bicycle and pedestrian facilities with various characteristics. https://ww2.arb.ca.gov/sites/default/files/2020-06/Congestion_Mitigation_Air%20_Quality_Improvement_Program_cost-effectiveness_methods_may2005.pdf

Tool Development

A Microsoft Excel-based tool was developed to perform this emissions analysis. The tool includes a tab that performs all calculations and a tab that summarizes all the inputs used and the source of that data or assumption. The following sections provide additional details and context for the calculations and assumptions used by the tool by project type.

Publicly Available Charging Stations

Emission reductions were based on one moderate utilization charging station, using AFLEET CFI defaults for the number of vehicles to access the station and fuel consumption. Emission reductions were calculated separately for level 2 (L2) charging stations and Direct Current Fast Charging (DCFC) stations. The result values could be scaled by the number of charging stations under consideration.

Vehicle Replacement

Emissions reductions were estimated by subtracting the emissions of the electric or zero-emission vehicle from emissions for an identical diesel vehicle. For the purposes of this analysis, zero-emission trucks were assumed to be the average of heavy-duty vehicles powered by electricity or hydrogen fuel cells. Electric bus emissions were calculated by comparing a new electric bus to a new diesel bus, assuming a bus at the end of its service life would be replaced one of these options. The result values could be scaled by the number of vehicles under consideration for replacement. The alternative fuel factors from AFLEET are included in the spreadsheet tool in the tab labeled “Alt Fuel Emission Factors.”

Nonroad Diesel Equipment Replacement

Annual emissions for average diesel-powered construction equipment were estimated using the NONROAD module. The value used is an average of all diesel equipment within the construction category except off-road trucks. The construction category includes a range of equipment such as graders, loaders, dozers, cranes, pavers, and tractors. It was assumed that replacement of off-road trucks would have similar emissions reductions as estimated for on-road trucks. If specific equipment is to be replaced, it is recommended that emission factors and activity specific to that equipment be identified. No upstream emissions from electricity production were included in this calculation.

Truck Stop Electrification

Emissions reductions were estimated for installation of offboard power equipment that can be used to support truck drivers' rest needs such as temperature control and running appliances onboard the vehicle without idling the truck's diesel engine or using a diesel auxiliary power system. The idling emission factor used in these calculations is an average of MOVES emission factors for extended idle and auxiliary power system factors. No upstream emissions from electricity production were included in this calculation. The result value could be scaled by the number of truck parking spots upgraded.

Active Transportation Facilities

Emissions reductions from bicycle and pedestrian facilities were developed based on the methodology described in the California Air Resources Board's Methods to Find the Cost-Effectiveness of Funding Air Quality Projects7. This methodology estimates the number of automobile trips replaced by bicycle trips for commute and other non-recreational purposes using average daily traffic of the parallel roadway, length of the project, city population, and the number of activity centers within half a mile of the project. The estimates used for this evaluation assumed the maximum number of activity centers and maximum population adjustment factors to calculate the emissions reduced from each combination of project length and roadway AADT. These calculations are detailed in the emissions workbook tab labeled "Bike Ped Assumptions." For the purposes of this analysis, the same assumptions were used for pedestrian facilities, although that is likely an overestimate. The emissions reductions were multiplied by the drive alone mode share to acknowledge that not every new user will have shifted travel from a single occupancy vehicle.

Transit Service

Emissions reductions from transit service expansion represent the reductions from increased transit use that shifts commuters away from driving alone. To estimate the passenger vehicle miles reduced, new trips per bus service mile and rail service mile were based on system-wide average data from NJ Transit's 2030 Strategic plan, and the average trip distance was based on national average data from the CMAQ toolkit. The emissions reductions were multiplied by the drive alone mode share to acknowledge that not every new user will have shifted travel from a single occupancy vehicle. The result values could be scaled by the number of service miles that would be expanded by the project.

Vanpool Service

Emissions reductions from vanpool opportunities represent the reductions from commuters shifting modes from driving alone. To estimate the passenger vehicle miles reduced, the average trip distance was based on national average data from the CMAQ toolkit, and it was assumed that vans would have capacity for 10 users. The emissions reductions were multiplied by the drive alone mode share to acknowledge that not every new user will have shifted travel from a single occupancy vehicle. The result value could be scaled by the number of vans considered for purchase or the number of expected users per van.

[7] https://ww2.arb.ca.gov/sites/default/files/2020-06/Congestion_Mitigation_Air%20_Quality_Improvement_Program_cost-effectiveness_methods_may2005.pdf

Teleworking

Emissions reductions from teleworking represent the reductions from commuters eliminating a commute trips. To estimate the passenger vehicle miles reduced, the average trip distance was based on national average data from the CMAQ toolkit. The emissions reductions were multiplied by the drive alone mode share to acknowledge that not every new user will have shifted travel from a single occupancy vehicle. The result value could be scaled based on the number of employees participating and the number of days per year spent working remotely.

Roadway Operations

Multiple project types (variable messaging signs, traffic control centers, transit signal priority, and signal synchronization) were evaluated to determine potential benefits from projects that improve efficiency on roadways by increasing vehicle speeds and decreasing travel time. Emissions benefits for these types of projects were assumed to only occur during peak hours when congestion is most likely to be relieved. Emissions of vehicles traveling average speeds of 20 to 50 miles per hour were obtained from the CMAQ toolkit. A 5 mph increase in speed was assumed to represent a 10% reduction in travel time. A 10 mph increase in speed was assumed to represent a 30% reduction in travel time.

Individual Signal Projects

Emissions reductions from an individual signal were based on the elimination of 60 seconds of idling per vehicle. Emissions benefits for project type were assumed to only occur during peak hours when congestion is most likely to be relieved. The resulting value could be scaled based on the roadway volume and seconds of delay reduced.

Replace Gasoline Powered Landscaping Equipment

Annual emissions for average gasoline-powered landscaping equipment were estimated using the NONROAD module. The value used is an average of all commercial gasoline equipment within the landscaping category, which includes a range of equipment such as mowers, chainsaws, blowers, tractors, and chippers. If specific equipment is to be replaced, it is recommended that emission factors and activity specific to that equipment be identified. No upstream emissions from electricity production were included in this calculation.

Idle Reduction

Emissions reductions can be achieved by implementing restrictions for how long construction equipment may idle at a worksite. Reductions were estimated assuming a 5-minute limit on idling for 2 idle events per day. The heavy-duty truck idling emission factor was obtained from the CMAQ toolkit. This value could be scaled based on the number of trucks affected by the idle restriction.

Streetlight Bulb Replacement

Emissions reductions were estimated for the upstream electricity reduction that could be achieved by replacing high pressure sodium (HPSV) lamps with light-emitting diode (LED)

streetlamps. The energy saved per bulb was estimated by reviewing existing studies from recent municipal projects to replace lightbulbs in city street lights8. This value was multiplied by the number of bulb replaced and the electricity emission factor provided by EPA's Emissions & Generation Resource Integrated Database (eGRID) for the RFC East subregion9. This value could be scaled based on the number of light bulbs replaced, and the emission factor should be updated if lightbulbs other than HPSV or LED are under consideration.

Resurfacing with Warm-Mix Asphalt

Resurfacing with warm-mix asphalt as an alternative to hot-mix asphalt (HMA) reduces approximately 15% of CO2 emissions associated with the energy needed for asphalt production10. The National Asphalt Paving Association's (NAPA) GHG Emissions Inventory for Asphalt Mix Production in the United States estimates that an average lifecycle emission intensity of asphalt mix in the United States ranges from 50.2 to 52.1 kg of CO2 equivalent (CO2e) per ton of mix produced, and mix production contributes to about 43% of the lifecycle emissions of HMA. The emissions reduction was determined by assuming a 15% reduction in the 43% contribution of material production, for a reduction of 3.4 kg CO2e per ton of mix. NJDOT staff indicated that a typical resurfacing project uses 40,000 tons of mix. These values were multiplied to determine the potential reduction of CO2 per resurfacing project, assuming CO2e is primarily CO2.

Resurfacing with Reclaimed Asphalt Pavement

Information from the National Asphalt Paving Association's (NAPA) GHG Emissions Inventory for Asphalt Mix Production in the United States was used to determine the reductions from scenarios that utilize reclaimed asphalt pavement (RAP). This document estimates that each ton of RAP used in asphalt mixtures in 2019 reduced GHG emissions by approximately 27 kg CO2e in the United States. NJDOT's HMA High RAP specification requires a minimum of 20% RAP. It was assumed cold in-place recycling and full-depth reclamation use 100% RAP. NJDOT staff indicated that a typical resurfacing project uses 40,000 tons of mix. Emission reductions and were calculated according to the following equation, assuming CO2e was primarily CO2:

Emissions reduction per project (kg/CO_2) = RAP emissions reduction (27 kg CO_2e/ton of mix)
* percentage RAP used (20% or 100%, depending on scenario)
* average HMA tonnage per project (40,000 ton of mix)

[8] Resources used include: https://www.pge.com/en_US/large-business/save-energy-and-money/business-solutions-and-rebates/lighting/led-street-lighting-replacement-program.page, https://cob.org/wp-content/uploads/wsdot-led-lighting-eval-10-15-13.pdf
[9] https://www.epa.gov/egrid/power-profiler#/
[10] https://www.appg-betterroads.org/wp-content/uploads/2019/09/aia-warm-mix-document-Fl.pdf