

4

WHAT WE PLAN TO DO— PLANS, PROGRAMS, AND PROJECTS

4.1 INTRODUCTION

Moving Forward is built around NYMTC's Shared Vision for Regional Mobility as described in **Chapter 1**. This Shared Vision provides a strategic framework for **Moving Forward's** recommended actions and project selections, as well as its speculative vision proposals. These actions, projects, and proposals provide organizational guidance for NYMTC and a blueprint for federal transportation investments in projects and planning activities.

This chapter describes the five Vision Goals and their objectives in detail. Relevant trends and conditions are analyzed for each goal, and related existing programmatic initiatives are described. Additionally, short- and medium-term strategies and actions for each goal and its objectives are recommended. These actions were developed using the framework provided by the goals and their objectives, as well as the guiding principles that are part of the Shared Vision endorsed by each of NYMTC's member agencies. The recommended short- and medium-term strategies and actions also supplement the recommended projects, programs, and studies that are described in **Appendix A**.

4.2 VISION GOAL - SAFETY AND SECURITY

A transportation system that ensures the safety and security of people and goods across all uses and modes.

1.1.1 DESCRIPTION

This goal seeks to enhance the transportation system's safety and security in the NYMTC planning area. According to USDOT:

- **Safety** is defined as freedom from harm resulting from unintentional acts or circumstances.
- **Security** is defined as freedom from intentional harm and tampering that affects both motorized and non-motorized travelers and may also include natural disasters.

Transportation safety and security are not only regional goals but also national priorities: the planning factors defined in federal transportation legislation state that the development of transportation system projects through a long-range transportation plan will (1) increase the safety of the transportation system for motorized and non-motorized users, and (2) increase the security of the transportation system for motorized and non-motorized users.

The safety and security of the transportation system are integral to parts of NYMTC's strategic vision and are also guided by NYSDOT's SHSP, which is a major component of the federal Highway Safety Improvement Program. The evaluation of safety and security issues and trends is critical in gauging the quality and impacts of the transportation system.

4.2.1 OBJECTIVES

- Ensure that investments in existing physical assets protect the safety of, among others, passengers and freight systems.
- Promote safe streets and intersections.
- Keep transportation systems secure from threats.
- Coordinate safety management, training, and education across jurisdictional borders.
- Improve the safety and security of system operations.



4.2.2 RECENT TRENDS, CURRENT CONDITIONS, AND EXISTING INITIATIVES

RECENT TRENDS

MOTOR VEHICLE FATALITIES AND SERIOUS INJURIES

In 2018, fatalities from vehicle crashes decreased in the NYMTC planning area, with New York City experiencing a 5.3 percent reduction in fatalities from 2017; Long Island experiencing a decrease of 1.5 percent; and the Lower Hudson Valley experiencing a decrease of 30 percent.

In 2015, fatalities in the NYMTC planning area represented 51 percent of all vehicle fatalities in New York State, a proportion that gradually declined to 46 percent in 2018. Comparatively, statewide vehicle fatalities declined by 6 percent in 2018 from 2017 levels.

Motor vehicle fatalities can also be measured as a rate of occurrences per 100 million VMT. As [Figure 4-2](#) shows, since 2015, the vehicle fatality rate has also been declining in the NYMTC planning area and statewide.

Figure 4-1

Safety Metrics for the NYMTC Planning Area

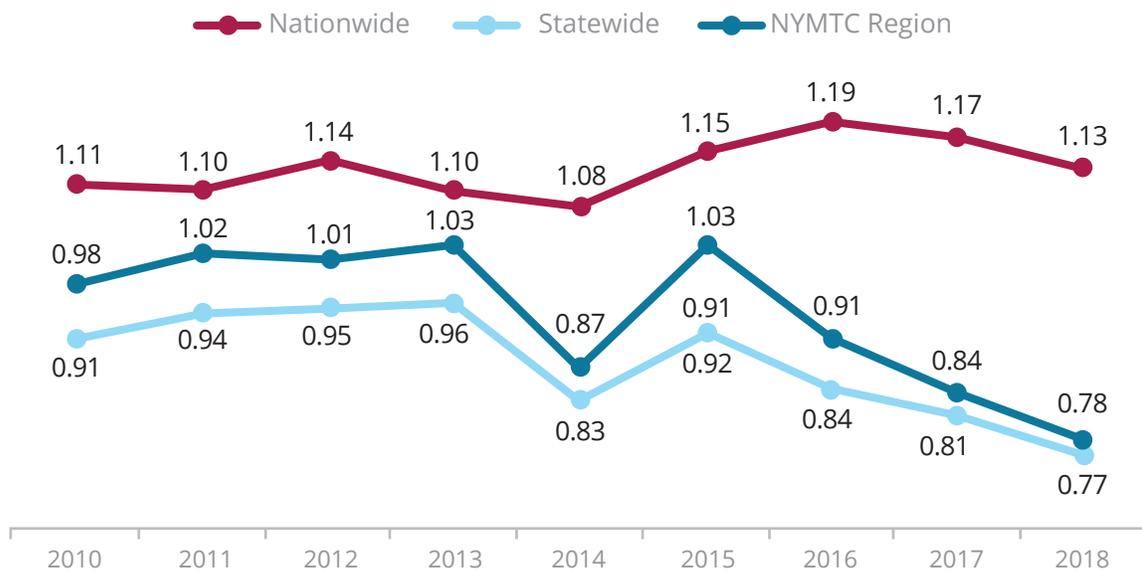
Source: NYMTC



Figure 4-2

Motor Vehicle Fatalities (per 100 Million VMT)

Source: Institute for Traffic Safety Management and Research (ITSMR)



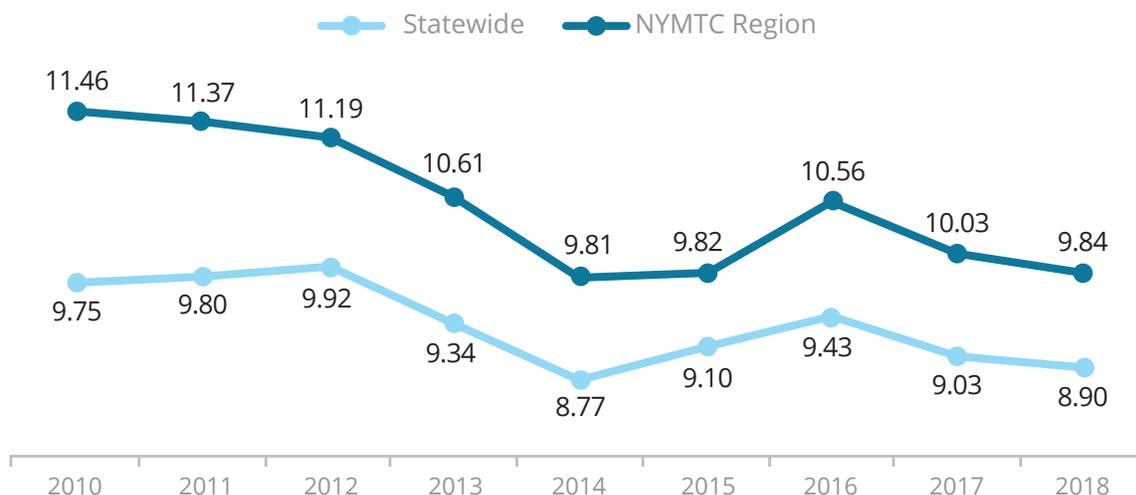
In New York City, there was a 1.2 percent decrease in serious injuries between 2017 and 2018, while Long Island saw a 2.7 percent decrease, and the Lower Hudson Valley saw a 1.8 percent increase. Overall, in the NYMTC planning, serious injuries from motor vehicle crashes decreased by 1.2 percent from 2017 to 2018; serious injuries in the NYMTC planning area represented 50 percent of serious injuries from motor vehicle crashes statewide.

[Figure 4-3](#) shows that the rate of serious injuries per 100 million VMT has been generally declining over the years.

Figure 4-3

Serious Injuries (per 100 Million VMT)

Source: ITSMR



NON-MOTORIZED FATALITIES AND SERIOUS INJURIES

In New York State, fatalities and serious injuries involving travelers using non-motorized modes (i.e., walking, bicycling) totaled 2,090 persons in 2018, of which there were 269 pedestrian fatalities, 1,733 pedestrian severe injuries, 30 bicycle fatalities, and 508 bicycle severe injuries. Non-motorized fatalities and serious injuries in the NYMTC planning area made up 91 percent of the statewide non-motorized fatalities and serious injuries in 2018.

MOTORCYCLE FATALITIES AND SERIOUS INJURIES

Motorcycle crashes continue to be of concern in the NYMTC planning area. While serious injuries have been slowly declining since 2016, fatalities have remained somewhat constant. In 2018, the NYMTC planning area accounted for 45 percent of motorcycle fatalities in New York State and 38 percent of motorcycle serious injuries statewide.

PUBLIC TRANSPORTATION SAFETY

Given the size and importance of the transit system in the NYMTC planning area, transit safety is an important aspect of transportation safety. As described in detail in [Chapter 2](#), public transportation in the NYMTC planning area is provided through an immense, inter-related system that includes 1,381 track miles of commuter rail; nearly 665 track miles of subway; hundreds of route miles of local, express, commuter, and intercity bus and ferry routes; an aerial tramway; an extensive network of passenger hubs, such as bus terminals and subway transfer facilities; ferry landings; and transportation stations where people transfer between modes. Service on this public transit network is provided through multiple jurisdictions. MTA, NJ Transit, and the Port Authority provide fixed-rail services. Bus transit operators include MTA and several public-private partnerships in which private operators provide service under contract to county and municipal jurisdictions. Examples include NICE, Suffolk County Transit, the Westchester Bee-Line System, PART, TOR, NYSDOT's Hudson Link service between Rockland and Westchester counties, and other service providers. Passenger ferry services are offered through similar arrangements or through independent private companies, except for New York City's Staten Island Ferry.

The safety and security of the passengers using these services are the responsibility of these service providers and the counties and municipalities that contract for the service. These services are policed by relevant local municipal departments, as well as by the New York State police.

FREIGHT TRANSPORTATION SAFETY

According to USDOT's National Strategic Freight Plan, increasing and shifting demand for freight transportation is straining the multimodal freight system nationally and increasing congestion and safety risks.

[Chapter 4 of Appendix H, the Regional Freight Element](#), provides a detailed description of goods movement infrastructure in the NYMTC planning area. A subset of the NYMTC planning area's roadway network, identified as "strategic freight highways," is of particular importance to freight movement. Strategic freight highways serve as major freight gateways into and out of the planning area and provide access to major freight-handling facilities such as seaports and rail intermodal terminals in New Jersey and connections between major industrial clusters and the Interstate Highway System. Most of the rail freight activity in the multi-state metropolitan region occurs west of the Hudson River in northern New Jersey. The largest carload freight yards, intermodal terminals, rail-served industries, and distribution centers are in this area. Freight volumes are lower east of the Hudson River. Additionally, the Port of New York and New Jersey is the largest container port on the U.S. East Coast, and the third largest in the United States behind Los Angeles and Long Beach.

As described earlier in this section, the nature of this infrastructure and the movement of goods throughout it results in a high proportion of goods movement via trucking mixed into the regional and local traffic flows. As can be seen in [Figure 4-4](#), when controlled for increases in truck VMT due to the emergence and growth of e-commerce and related business models, truck fatalities have generally decreased over the past two decades.

Figure 4-4

Fatalities per 100 Million Vehicle Miles Traveled by Vehicle Type

Source: Federal Motor Carrier Safety Administration

**CURRENT CONDITIONS****MOTOR VEHICLES CRASHES**

According to the NHTSA, motor vehicle crashes are the number one safety problem in American transportation. They accounted for 94 percent of transportation-related fatalities and 99 percent of transportation-related injuries in 2018. Several underlying factors or risks are responsible for most motor vehicle crashes leading to fatalities and serious injuries in the NYMTC planning area. These factors are outlined below.

Although advancements in vehicle and roadway design have continued to improve motor vehicle safety, Traffic safety statistics show that human behavior continues to be the biggest factor for motor vehicle crashes. Between 2014 and 2018, approximately 89 percent of fatal crashes in New York State included at least one contributing circumstance related to human behavior. Road user behaviors that pose safety risks include:

- **Impaired driving.** Associated behaviors include operating vehicles while under the influence of drugs and/or alcohol or while impaired due to medical conditions such as sleep apnea.
- **Distracted driving.** NHTSA defines distraction as a specific type of inattention that occurs when drivers divert their attention away from the task of driving to focus on another activity. Distractions can be technological, such as using navigation systems and cell phones, or behavioral, such as interacting with passengers and eating.
- **Vehicle operation.** The greater the rate of speed at which a vehicle is operated, the greater the chances for death or serious injury resulting from a crash. Higher vehicle speeds also mean an increase in stopping distance. Speed-related fatalities and injuries result from crashes where a driver was either driving over the posted speed limit or at an unsafe speed for conditions. In 2018, 28 percent of all fatalities statewide were due to speeding. In the NYMTC planning area, this percentage was 20 percent.

- **Age-related risks.** The SHSP defines young drivers as those 20 years old and younger. Drivers who are 65 and older represent the older driver group. Nationally, older and younger drivers have higher crash rates per VMT. For young drivers, higher rates of crash involvement are often attributed to inexperience and/or an increased propensity for risk taking. For older drivers, diminishing abilities and crash survivability are key factors to consider. Creating a culture of responsible road users is essential to making a significant impact in the reduction of crashes, fatalities, and injuries in the NYMTC planning area and in New York State, as is the continuing application of technology to reduce crashes caused by human error.

PEDESTRIAN SAFETY

In July 2020, USDOT held a summit on pedestrian safety with the goal of providing a virtual platform to discuss pedestrian safety issues and determining initiatives and actions that could improve pedestrian safety. USDOT gathered input from a diverse group of stakeholders regarding opportunities and challenges that faced pedestrian safety and raised awareness of initiatives and resources that were available for pedestrian safety.

The Governors Highway Safety Association, whose members are representatives of the state highway safety offices of the 50 states, U.S. territories, and the Indian Nations, found that many factors outside the control of state and local traffic safety officials contribute to annual changes in the number of pedestrian fatalities, including economic conditions, population growth, demographic changes, weather conditions, fuel prices, VMT, the amount of time people spent walking, and changing patterns of drug use.

NYMTC has hosted FHWA workshops for local officials in its planning area on designing for pedestrian safety. Workshop participants have learned about effective solutions and best

practices in roadway design and operations for pedestrian safety, as well as the role that planning and street design play in providing safe pedestrian environments. Participants included engineers, planners, traffic safety and enforcement professionals, public health and injury prevention professionals, and decision-makers looking for ideas and solutions for making changes to the physical environment that improve pedestrian safety.

MICROMOBILITY – AN EMERGING AREA

Micromobility describes a variety of transportation devices, including shared bicycles, shared electric scooters, and electric skateboards. Unlike cars or mopeds, micromobility modes do not require a license or registration. Many micromobility trips are taken as part of shared systems run by private operators, and rider familiarity with these conveyances may vary. These modes can approach speeds upwards of 20 miles per hour, making them too fast to comfortably share space with pedestrians. As a result, the commonly accepted area to use these devices is in bicycle lanes and other bicycle infrastructure. However, the growth in demand has often outpaced the amount of safe infrastructure available for micromobility.

According to the National League of Cities, safety is a key challenge facing micromobility. In the its report *Micromobility in Cities; A History and Policy Overview*, the National League of Cities describes these safety challenges as follows:

The emergence of micromobility options has inspired many cities to rethink the ways in which their transportation infrastructure might accommodate alternative modes. The expansion of bicycle infrastructure that accompanied the first wave of micromobility unlocked opportunities for the current wave of dockless bikes and scooters to thrive. In turn, their rapid deployment and uptake has put additional pressure on cities to accommodate new modes and consider safety of operation in mobility corridors that were largely developed to accommodate single-occupancy vehicles.

Similar safety issues exist for micromobility in suburban and rural settings. Indeed, suburban markets represent the next phase of growth for micromobility companies. If electric scooters can achieve traction in lower-density, diverse communities outside concentrated cities, they can become a staple vehicle for short-distance or short-duration travel.¹

MODAL SAFETY

Conflicts between motorists, pedestrians, and micromobility users are at the heart of many safety issues. As the National League of Cities' report indicates:

One of the main concerns surrounding the uptick in scooter and bike use is safety. Perhaps the most controversial, and greatest pain point for city leaders is scooter operation on sidewalks. Crashes between pedestrians and riders have resulted in injuries and stoked concerns in cities about liability. Some of the misuse of the dockless vehicles can be chalked up to users' unfamiliarity with the vehicles and the city's regulation of their operation.

Every city has different rules about where bikes and dockless vehicles can be operated, and ultimately, it is up to the user to educate his or herself. The bike and scooter companies have also engaged in various efforts to educate the public about local regulations and the dangers of riding on sidewalks. Another challenge inherent to micromobility usage is that many communities lack the infrastructure for alternative modes — their transportation networks are set up to accommodate cars. Once micromobility vehicles begin to occupy the street space, the car centric design of many cities might result in some dangerous or hazardous interactions. In fact, cities might find that cars present a danger to micromobility vehicles on the streets, similar to the threat that bikes and scooters pose to pedestrians on the sidewalk.

Several factors contribute to the safety issues surrounding these modal conflicts, including the following:

- Regulation
 - Insufficient regulation
 - Difficulty and inconsistency in enforcement
 - Differences in modal speeds
- Education
 - Education and training in use of micromobility modes
 - Driver, micromobility user, and pedestrian awareness
 - Driver education and attention
- Roadway Infrastructure
 - Infrastructure design and operation
 - Infrastructure maintenance and condition
 - Traveler visibility
 - Unsafe travel behavior

TRANSPORTATION SECURITY

Transportation security in the NYMTC planning area and the multi-state metropolitan region is the responsibility of many agencies and institutions. At the regional and local levels, disaster preparedness and emergency response planning are led by county, municipal, and local governments that are responsible for developing their own emergency management plans for their respective areas, as well as through the New York State Office of Emergency Management.

EXISTING INITIATIVES

NYMTC as an organization, and its members individually, have several existing initiatives in place to address the issues of safety and security in the NYMTC planning area. These initiatives (including data collection and analysis) address existing risks and consider the recommendations of the federal government, including those proposed by FHWA, FTA, and NHTSA.

LEGISLATION, POLICIES, PROGRAMS, AND PLANS

Pedestrian Safety

- **Comprehensive Pedestrian Safety Plans.** A proactive, multi-agency initiative that provides \$110 million for pedestrian safety improvements across upstate New York and Long Island during the next five years. The program will use an engineering, education and enforcement campaign to enhance safety.
- **Pedestrian Safety Campaign.** NYSDOT and the New York State Department of Health have partnered with the Governor's Traffic Safety Committee on a first-of-its-kind pedestrian safety campaign in New York State. The campaign provides a \$110 million over five years to improving pedestrian safety across upstate New York and Long Island through the engineering, enforcement, and education.
- **New York City Pedestrian Safety Study and Action Plan.** This study examined more than 7,000 records of crashes that have caused serious injuries or fatalities to pedestrians and identified underlying causes.
- **New York City's Vision Zero Pedestrian Safety Action Plans.** Plans were released in early 2015 and updated in February 2019 with newer data that reflect the impact of NYC DOT's street safety improvements. These documents, which describe the Vision Zero program, outline a framework for improving safety. They present a toolkit of engineering interventions and are NYC DOT's

comprehensive plan to address fatalities and serious injuries on the New York City's road network.

- **Pedestrian and Bicycle Safety in Nassau County.** This program teaches middle school children about general pedestrian and bicycle safety best practices. In addition, the New York Coalition for Transportation Safety continues to conduct pedestrian and bicycle safety education programs/ bicycle rodeos throughout Nassau County at schools, churches, senior centers, and at locations requested by local legislators. County staff work with injury prevention specialists at Nassau University Medical Center and Winthrop University Hospital to teach seniors how to prevent falls that they may incur when they are pedestrians.

Traffic Safety

- **New York State's Strategic Highway Safety Plan.** The SHSP establishes statewide highway safety goals. The purpose of the SHSP is to promote best practices and strategies that if implemented could have a substantial impact on reducing fatal and injury crashes.² This important statewide safety planning process directly guides and influences the safety element of *Plan 2045*.
- **National Highway Traffic Safety Grants.** These grants (referred to as Section 402 funding) are federal funds used to support state and community highway safety programs to reduce deaths and injuries. The Governor's Traffic Safety Committee Highway Safety Strategic Plan is the principal document for setting priorities, directing program efforts, and assigning resources in New York State.
- **Vision Zero.** New York City implemented Vision Zero beginning in 2014, based on the premise that traffic deaths and severe injuries are preventable and can be systematically addressed rather than

regarded as unavoidable “accidents.” Led by a coalition of New York City agencies, Vision Zero involves a comprehensive program of engineering, enforcement, and education. Current initiatives include:

- **Speed Management.** New York City, following State legislative action, has implemented the largest automated speed enforcement program in the United States, with cameras in 750 school zones; this follows a lowering of the default citywide speed limit to 25 miles per hour in 2014 and the retiming of traffic signals to encourage following this limit.
- **Street Improvement Projects.** the NYC DOT has dramatically expanded its capacity to make design interventions, including bicycle lanes, pedestrian islands, sidewalk and curb expansions, speed bumps and cushions, and left turn traffic calming installations that reduce the likelihood of crashes happening or the severity of those that do take place.
- **Expansion of the Bicycle Network.** NYC DOT has built more than 400 lane miles of bicycle lanes since the start of Vision Zero. Under the Green Wave Plan, it has committed to building 30 miles of protected bicycle lanes annually, as well as 75 lane miles in Bicycle Priority Districts by 2022.
- **Focused Enforcement.** Vision Zero is a data-focused initiative, as a result, the New York City Police Department has concentrated its traffic enforcement efforts on the offenses shown to injure and kill the most pedestrians and cyclists: speeding, failure to yield, disobeying stop signs and signals, cell phone usage (including texting), and improper turns.
- **Schools-Based Safety Education.** These specialized programs for all ages of students teach safe pedestrian behavior and responsible motor vehicle operation and include “Alive at 25,” a partnership with the National Safety Council for new teenage drivers.
- **Vision Zero Street Teams and High-Visibility Enforcement.** This partnership between NYC DOT and the New York City Police Department engages with the public in areas around priority high-crash corridors.
- **Dusk and Darkness Driver Outreach.** This education and enforcement campaign addresses the increased crash rates during evenings in the fall and winter months.
- **For-Hire Vehicle Safety.** The New York City Taxi and Limousine Commission provides comprehensive safety training for its licensed drivers and enforcement of traffic laws by its team of officers. The Taxi and Limousine Commission also provides annual recognition to the safest for-hire vehicle drivers, including those who have worked for multiple years without any violations or collisions.
- **City Fleet Safety.** To set an example for responsible professional driving, the New York City Department of Citywide Administrative Services provides defensive driving training to all employees whose job responsibilities include driving a New York City-owned vehicle. The Safe Fleet Transition Plan, released in 2017 and updated in 2018, has set out requirements for the purchase of safer vehicles for the New York City fleet. In addition, the department has undertaken the country’s largest program of side guard installations on its fleet vehicles to prevent a common type of crash involving pedestrians, and telematics systems to monitor and address dangerous driving behaviors.

- **Truck Safety Program.** Educational videos to help improve safe driving practices among delivery truck drivers.
- **Motorcycle Safety Program.** Educational outreach to motorcyclists and other road users to help improve motorcycle safety.
- **Other Programs** include safety education for senior citizens and commercial cyclists, bike helmet distribution programs, print media and radio communications campaigns targeting dangerous driving behavior, a truck safety task force, improved safety standards for trade waste vehicles licensed by or registered with the Business Integrity Commission, training for MTA bus drivers, collaborative public health research and data releases related to vehicle crashes, and targeted seizures of vehicles subject to outstanding judgments by the Office of the Sheriff.
- Westchester County's **Prom Safety Initiative and Community Traffic Safety Program** educates the public and promotes safe driving behaviors to reduce the number of injuries and fatalities. The County's Plan4Safety Community Traffic Safety Awareness grant program, funded through the Governor's Traffic Safety Committee and the NHTSA, is a community outreach program to bring the message of traffic safety and injury prevention to the community. The Police Traffic Services Block Grant provides funds to local Westchester police agencies and Westchester County Police to conduct traffic law enforcement for motorist violations based on agency jurisdictions' traffic and crash data.
- The **Police Traffic Services Block Grant Program**, underwritten by the Governor's Traffic Safety Committee, funds communities in Rockland County to bring the message of traffic safety to residents. In May of each year, the Rockland County

Sherriff's Office runs a special program called Buckle Up New York and conducts two major events annually for the Child Passenger Safety Program to ensure proper fitting and use of child car seats.

- **STOP-DWI and Other State Programs** address impaired driving in five areas: education/public information, enforcement, court-related, rehabilitation, and probation. This program is implemented in various ways in the NYMTC planning area. In addition, several other programs address aggressive driving behavior and occupant protection, including the Selective Traffic Enforcement Program, Buckle Up New York, and Child Passenger Safety. Selective Traffic Enforcement Program encourages jurisdictions to use local data to identify problem areas and to develop enforcement countermeasures that reduce crashes, injuries, and fatalities. Buckle Up New York grants are for seat belt enforcement and compliance. Child Passenger Safety grants support child passenger fitting stations, training, and child restraint education.

Multimodal Programs

- **High Crash Corridor Programs**
 - NYSDOT's "corridor approach" identifies systemic improvements to be implemented throughout a study corridor. Current corridor approach projects in the Long Island area include the Hempstead Turnpike Pedestrian Safety Study, the Sunrise Highway Pedestrian Safety Study, and the Southern Parkway Nassau County Lane Departure Crash Analysis.
 - Putnam County is undertaking a Commercial Corridors Feasibility Study for nine commercial corridors. The study will consider safety issues and other improvements.
 - New York City has designated a network of priority intersections,

corridors, and areas based on rates of pedestrians killed or seriously injured in collisions as part of its Vision Zero program.

- **Intersection Improvement Projects** range from adjusting the timing of traffic signals to major road reconstruction. Locations are studied and consider such issues as accident history and pedestrian and vehicle traffic volumes to determine the best treatment to maximize pedestrian safety. Treatments being implemented include: retiming traffic signals; adding crosswalks or upgrading existing crosswalks for higher visibility; restricting parking near the intersection; installing pedestrian signals; installing new signs, such as No Turn On Red or Turning Vehicle Yield to Pedestrians; adding pavement markings in advance of a crosswalk; and adding pedestrian refuge islands and curb extension.
- **Safe-Routes-to-School** originated in New York City and was adopted nationally as a federally funded program. Through Safe-Routes-to-School, NYC DOT has identified 270 priority schools and recommended and implemented several safety improvements citywide. On Long Island and in the Lower Hudson Valley, Safe-Routes-to-School workshops have been held in many communities and schools, and several programs and projects have been implemented. Several Westchester County municipalities and school districts have implemented Safe-Routes-to-School programs that involve capital improvements and noninfrastructure programs such as education campaigns and encouragement efforts. Within Rockland County, municipalities and school districts have received Safe-Routes-to-School grants for safety education, including surveys of students and parents and programs on safe walking and bicycling to and from school.
- **Safe-Streets-for-Seniors** is one of New York State, New York City, and NYMTC's

suburban counties pedestrian safety initiatives in place for older residents. These programs examine crash data and other variables such as senior trip generators, concentrations of senior centers, and senior housing locations, and develop and implement mitigation measures in these areas to improve the safety of seniors and all road users. NYC DOT has developed several Senior Pedestrian Focus Areas for implementation of safety projects; NYSDOT has a number of initiatives in Nassau and Suffolk counties; and Westchester County has a Livable Communities Collaborative for Aging Services that works on addressing senior pedestrian issues.

- **Safe-Routes-to-Transit** is a New York City initiative to improve pedestrian and motor vehicle movement around subway entrances and bus stops to increase the accessibility, safety, and convenience of mass transit. The Safe-Routes-to-Transit program identifies high priority locations through crash data analysis and transit rider counts. At high priority locations, NYC DOT implements safety and accessibility improvements such as curb extensions, bus boarding islands, and sidewalk construction.
- Some of NYMTC's members and several local municipalities have applied **Complete Streets** provisions in their project development process to ensure that safety, mobility, and accessibility are fully considered. The ability of municipalities to identify opportunities for Complete Streets features, and ultimately to install them, are important to achieving safer and more sustainable communities.

Public Transportation

- Transit providers in the NYMTC planning area (identified in [Chapter 2](#)) have established safety programs to achieve the highest practical level of safety for all modes of transit. To protect passengers, employees, revenues, and property, all transit systems are required to develop and implement a proactive system safety program plan.
- **Rail Crossing Safety**—at-grade rail crossing initiatives include:
 - Rockland County has developed a plan to install supplemental safety measures—primarily four-quadrant gate systems—at 14 roadway-rail grade crossings along the West Shore (River) freight line where several accidents have occurred over the years. The project uses federal grant funds and state and county funds; construction is in progress.
 - MTA’s LIRR and MNR have been working at either eliminating or improving the safety of at-grade railroad crossings. As of 2018, MTA LIRR had 296 grade crossings throughout its system where the safety markers were installed. Grade crossings have been removed as part of the MTA LIRR Expansion Project.

The Federal Railroad Administration has recognized LIRR for a nation-leading program that has dramatically improved railroad safety using flexible delineators at railroad crossings and enhanced GPS alerts. The delineators and a partnership with Google/Waze have in their first year virtually eliminated the problem of motorists inadvertently turning onto tracks. MNR is also adopting this integration program along with its ongoing safety initiatives, including traffic signal preemption and undertaking roadway/traffic

improvements that are targeted to address local traffic conditions. The implementation of all technologies has significantly enhanced safety in the communities served by MTA LIRR and MNR.

- The MNR TRACKS Program is a safety education community outreach program designed to promote safe behaviors at or around railroad grade crossings and tracks. MNR’s program provides in-classroom presentations or informational tables to schools (K-12), summer camps, community and civic groups, driving schools (professional and non-professional), and busing and trucking companies. The objective of this program is to educate as many drivers, passengers, pedestrians, and individuals that live and/or work in or around the communities that MNR serves.
- NTSDOT manages the Railway-Highway Crossings (Section 130) Program. This program provides federal funds to eliminate hazards at public railway-highway crossings. The Section 130 Program has been correlated with a significant decrease in fatalities at railway-highway grade crossings. New York’s Grade Crossing Program focuses on improving safety at existing public highway-railroad crossings primarily through the installation of warning devices, including installation or replacement of active warning devices (flashers and gates), track circuitry improvements, interconnections with highway traffic signals, and crossing surface improvements.



Freight Transportation

As part of its Vision Zero safety programs, New York City hosts a truck safety task force with private industry fleets and holds an annual Fleet Safety Forum that brings together private and public fleet operators with safety advocates and technology providers to work together to improve fleet safety. New York City also maintains a Truck Safety Toolkit for vehicle operators and fleet owners.³

New York State has adopted the Federal Motor Carrier Safety Regulations found in 49 CFR. The New York State Motor Carrier Safety Assistance Program promotes highway safety and reduces commercial vehicle related crashes and hazardous materials incidents by removing unsafe trucks, unsafe loads, and unqualified drivers from the highways.⁴

Transportation Security

NYMTC members are involved in ongoing and coordinated efforts to protect the overall transportation system and respond as required to unforeseen natural events and disasters. These efforts include yearly participation in simulation exercises of emergency situations to train personnel for such events. At the regional and local levels, disaster preparedness and emergency response planning are led by county, municipal, and local governments that are responsible for developing their own emergency management plans for their respective areas, as well as through the New York State Office of Emergency Management.

Transportation Safety Data Tools

Transportation safety data are at the center of the evaluation of safety issues and the planning and implementation of safety programs. Federal transportation legislation emphasizes a data-driven approach to safety planning. This approach involves gathering and analyzing data, identifying needs, and investing safety funds accordingly. Some of NYMTC's major tools/data systems used in safety planning are described below.

- **The Accident Location Information System** is a web-based geographic information system (GIS) application developed and hosted by NYSDOT. This system allows users to access motor vehicle crash data through custom queries and analyze the data with several reporting options and formats.
- NYC DOT developed the **Traffic Safety Data Viewer** to allow easy access to detailed data by planners, analysts, and project managers in a user-friendly interactive map format. Users can display all injury and fatality data on a map of New York City or can generate an analysis of the crash history for a given location. The Safety Data Viewer application provides functionality for post implementation effectiveness analysis to allow a quick safety impact analysis of projects to inform future work. This feature outputs a tailored report that compares age, mode, time of day, and other crash characteristics.
- The Governor's Traffic Safety Committee funded the **Institute for Safety Management and Research** to design and develop a traffic safety repository that is publicly accessible via the internet. The Institute then built a system known as the Traffic Safety Statistical Repository that captures crash and police ticket data.

4.2.3 RECOMMENDED STRATEGIES AND ACTIONS

The regulations detailed at 23 CFR 450.324 govern the development and content of the metropolitan transportation plan and contain the following requirement:

The transportation plan shall include both long-range and short-range strategies/actions that provide for the development of an integrated multimodal transportation system (including accessible pedestrian walkways and bicycle transportation facilities) to facilitate the safe and efficient movement of people and goods in addressing current and future transportation demand.

Several categories of short- and medium-range strategies and actions recommended in pursuit of this Vision Goal are described below. Additionally, specific projects, programs and studies recommended for funding in the fiscally constrained element of *Moving Forward*, as well as those recommended for future consideration in the speculative vision element of the Plan, appear in [Appendix A](#).

PLANNING AND RESEARCH INITIATIVES

- Research recommendations:
 - Assess safety and security needs in the suburban subareas modeled after the process used in New York City.
 - Inventory current and developing technology that can be used to improve safety and security.
 - Identify potential funding sources for system security and safety and security training.
 - Conduct a gap analysis on monitoring and surveillance to deter threats and identify coordination needs for transportation system security.
- Support the creation of contingency plans for disruptive events or in anticipation of major roadway or transit closures.

DATA COLLECTION, FORECASTING, AND PERFORMANCE ASSESSMENT

- Develop a comprehensive data collection and reporting system for safety and security in the planning area.

PLANNING PROCESS RECOMMENDATIONS

- Expand the Safety Advisory Working Group to include security-related agencies and organizations.
- Coordinate joint security exercises between transit agencies and neighboring jurisdictions via the Metropolitan Area Planning (MAP) Forum.
- Encourage common crosswalk standards among NYMTC's members responsible for roadway operations.
- Encourage consideration of roundabouts among NYMTC's members responsible for roadway operations.

PROGRAM RECOMMENDATIONS

- Regional guidance programs:
 - Develop a common safe streets/intersections guidebook for all jurisdictions in the planning area.
 - Coordinate customer alert systems to notify of relevant events in a timely manner.
 - Coordinate and enhance equitable safety-related traffic programs in the vicinity of schools.
- Education and training programs:
 - Expand safety education programs and public awareness campaigns.
 - Coordinate and enhance safety education and programs in the suburban subregions.
 - Execute training for multi-agency safety and security coordination and/or develop a common guidebook.
 - Expand safety and security training programs for local municipalities and communities.



4.2.4 PERFORMANCE METRICS

Regulations at 23 CFR 450.324 govern the development and content of the metropolitan transportation plan. These regulations contain the following requirement:

A description of the performance measures and performance targets used in assessing the performance of the transportation system.

The safety performance measures listed below respond to federal transportation performance management requirements (23 CFR Part 490) described in this chapter and will assist in measuring progress toward this Vision Goal and its objectives, and in informing investment decisions.

- **Number of Fatalities.** Five-year moving average of the count of the number of fatalities on all public roads for a calendar year. Data comes from NHTSA Fatality Analysis Reporting System (FARS).
- **Fatality Rate** (per 100 million VMT). Five-year moving average of the number of fatalities divided by the five-year moving average of VMT.
- **Number of Serious Injuries.** Five-year moving average of the count of the number of serious injuries on all public roads for a calendar year. Data come from NHTSA's FARS.
- **Serious Injury Rate** (per 100 million vehicle miles traveled). Five-year moving average of the number of serious injuries divided by the five-year moving average of VMT.
- **Number of Non-Motorized Fatalities and Serious Injuries.** Five-year moving average of the count of the number of non-motorized fatalities and serious injuries on all public roads for a calendar year. Data come from NHTSA's FARS.
- **Public Transportation Fatalities.** Total number of fatalities reported to the National Transit Database and rate per total vehicle revenue miles by transit mode.
- **Public Transportation Injuries.** Total number of injuries reported to the National Transit Database and rate per total vehicle revenue miles by transit mode.
- **Public Transportation Safety Events.** Total number of safety events reported to the National Transit Database and rate per total vehicle revenue miles by transit mode.
- **Public Transportation System Reliability.** Mean distance between major mechanical failures by transit mode.

4.3 VISION GOAL - RELIABLE AND EASY TRAVEL

A transportation system that is maintained, operated, and coordinated to better enable inclusive, reliable, easy, accessible, and seamless travel across the region while striving to enhance equity in the services provided..

4.3.1 DESCRIPTION

This goal seeks to maximize the service life of the existing transportation system with the resources available by systematically and strategically operating, maintaining, and replacing transportation assets based on need. It also seeks to ensure the integration of the various components of the transportation system in the NYMTC planning area to enable the reliable, accessible, and seamless movement of people and goods. The regional transportation system represents an enormous public investment that is essential to the environment, economy, and quality of life in the NYMTC planning area. Protecting this investment means maintaining the entire system in a state of good repair. Maximizing this investment means optimizing the system so that it is as integrated and seamless as practical. Doing so ensures that infrastructure, facilities, and equipment function well for their entire design life and minimize costs over their life cycle while providing reliable and accessible travel.

Maintenance includes activities such as repairing buses; maintaining landscaping; clearing snow, ice, and debris from roadways; and building and maintaining transit facilities, sidewalks, and all-season trails. Preservation includes the repair or replacement of pavement, bridges, transit equipment, and infrastructure and other infrastructure to support the safe and efficient use of these facilities. Roadway operations include incident response such as NYSDOT's Highway Emergency Local Patrol system, traffic signal operations, and operation of the regional traffic management center (including the variable message signs and advisory speeds). Transit operations include providing the day-to-day service of buses, subway, commuter rail, and various paratransit services.

National transportation goals include maintaining the highway infrastructure asset system in a state of good repair. Additionally, one of the federal transportation planning factors emphasized in *Moving Forward* and throughout the planning process is the preservation of the existing transportation system.

Federal transportation legislation requires performance measures by which states and MPOs can assess the condition of pavement on Interstate highways and the NHS, as well as the condition of bridges on the NHS. Also, as part of the performance management process, transit operators are required to produce TAM plans with performance measures and targets. Collecting data is important to the efficient preservation, maintenance, and operation of all modes and allows decision makers to make strategic and timely investments. For example, deferring pavement maintenance can result in higher needed investments in the pavement in the long term.

[Chapter 5](#) of *Moving Forward* forecasts that, on average during the planning period, roughly \$26 billion (in year-of-expenditure dollars) of reasonably expected federal, state, and local transportation funding will be spent annually for repair and replacement of the existing system, including major infrastructure such as pavement, bridges, bus and rail fleets, park-and-rides, transit stations, and stops and shelters. In addition, as [Chapter 5](#) details, facility owners and service providers will spend approximately \$31 billion in year-of-expenditure dollars annually, on average, to operate and maintain the federally supported transportation system in the NYMTC planning area.

4.3.2 OBJECTIVES

- Rebuild/replace and modernize the assets that comprise the region's vast transportation infrastructure for passengers and freight.
- Improve first- and last-mile access to transit.
- Provide more frequent and reliable transit service.
- Improve accessibility to the transportation system for users of all abilities.
- Invest in improving the integration of the multimodal transit network.
- Improve the integration of freight modes and facilities.
- Invest in collection and sharing of quality transportation data.
- Promote equitable transportation opportunities for all populations regardless of age, ability, race, ethnicity, or income.

4.3.3 RECENT TRENDS, CURRENT CONDITIONS, AND EXISTING INITIATIVES

Chapter 2 describes the various components of the transportation system in the NYMTC planning area. As can be discerned from that information, the system is extensive and requires significant investments to preserve and maintain it in a state of good repair. The following sections provide information on the current conditions, potential risks in not maintaining and/or preserving the transportation system, and existing initiatives to meet preservation needs.

RECENT TRENDS AND CONDITIONS

ROADS AND BRIDGES

The NYMTC planning area includes more than 50,000 lane miles of interstates, arterials, collectors, and local roadways that serve its residents, employees, and visitors, and move goods used by residents and businesses. Many of these roadways are heavily used despite their advanced age.

Local roadways make up 80 percent of the NYMTC planning area's public space and are used by all modes—personal vehicles, buses, cyclists, and pedestrians. Additionally, 3,284 bridges of all types serve the NYMTC planning area, including more than 30 major bridges crossing navigable waterways. Among the major bridges connecting various parts of the planning area and other parts of the region are the George Washington Bridge; the Verrazzano-Narrows Bridge; the Governor Mario M. Cuomo Bridge; the Robert. F. Kennedy Bridge; four East River bridges—the Brooklyn Bridge, the Manhattan Bridge, the Williamsburg Bridge, and the Ed Koch Queensboro Bridge; the Goethals Bridge; the Outerbridge Crossing; the Bayonne Bridge, and the Bear Mountain Bridge.

Additionally, four major vehicular tunnels provide intra- and inter-regional transportation connections: the Lincoln and Holland tunnels connect New York City with New Jersey; the Queens-Midtown Tunnel connects Queens to Manhattan; and the Hugh L. Carey Tunnel connects Manhattan and Brooklyn.

PUBLIC TRANSIT

As detailed in [Chapter 2](#), the regional transit system in the NYMTC planning area includes the following subway and commuter rail, bus, and ferry systems. The systems identified here are ones that are owned/operated by designated recipients who qualify for federal funding under Title 49 U.S.C.

SUBWAY/COMMUTER RAIL

- With 6,600 passenger cars, **MTA NYCT** has the largest fleet of subway cars in the world. The agency has more than 665 mainline track miles comprising 27 subway lines with 472 stations.
- **MTA LIRR** comprises more than 700 miles of track on 11 different branches. It serves 124 stations along 320 route miles, of which 290 route miles are electrified. It operates a fleet of 1,157 rail cars, which are a combination of electric and diesel.
- **MTA MNR** is the largest commuter railroad in the country, operating 5 lines in the New York metropolitan area over 385 route miles with a total fleet of 1,288 rolling stock units. MTA MNR serves 124 stations across New York and Connecticut. Additionally, the two lines operated by NJ Transit west of the Hudson River serve an additional 25 stations in New Jersey.

In addition to the maintenance and replacement of rolling stock and tracks and the maintenance of stations mentioned above, these operators have maintain and/or replace other parts of the infrastructure, including passenger stations; parking facilities (MTA LIRR and MNR); communications and signals; line structures such as bridges, viaducts, culverts and tunnels; power systems; shops and yards; and administrative facilities.

BUS TRANSIT

- **MTA NYCT's** 4,428 buses (running on compressed natural gas, diesel-electric, and diesel) service all five boroughs on more than 200 local and 30 express routes.
- **Westchester Bee-Line System** operates 60 routes and has a fleet of 325 vehicles (diesel and hybrid-diesel), consisting of 30-, 40-, and 60-foot buses. Paratransit service is also provided using approximately 100 paratransit vehicles.
- **TOR** provides service along 10 routes using a fleet of 43 diesel, hybrid-diesel, and gasoline buses.
- **PART** provides fixed-route service along 4 routes using a fleet of 14 diesel and hybrid-diesel buses. It also provides paratransit service using 9 paratransit vehicles.
- **NICE** has a fixed-route fleet with 278 low-emission compressed natural gas buses that operate on a network of 38 fixed routes. NICE also provides paratransit service using 108 paratransit vehicles.
- **Suffolk County Transit** includes a fixed-route system of 42 routes using a bus fleet of 113 buses and 235 cutaway buses.
- Long Island Municipal Systems
 - **City of Long Beach** operates both fixed routes and paratransit services using 11 buses and 4 paratransit vehicles.
 - **Huntington Area Rapid Transit** operates both fixed routes and paratransit services using 12 buses and 12 paratransit vehicles.

For the systems listed above, asset management includes passenger facilities (stops and stations), maintenance facilities (garages and shops), and non-revenue vehicles.

FERRY SERVICE

- **Staten Island Ferry** operates nine vessels on a dedicated 5.2-mile route between the St. George Terminal in Staten Island and the Whitehall Terminal in Lower Manhattan. The ferry system also includes maintenance facilities, passenger facilities, maintenance equipment, and non-revenue vehicles that require maintenance and/or replacement (at some point).
- **NYC Ferry** operates across New York City's waterways, connecting Manhattan to Brooklyn, Queens, Staten Island, and the Bronx. NYC Ferry has a fleet of 38 vessels, which carry passengers between more than 20 landings along six routes covering over 60 miles of waterway combined. Additionally, a summer weekend shuttle travels between downtown Manhattan and Governor's Island.

The condition of the various asset types that make up the regional transit system is critical to meeting the enormous transportation needs and demands of the NYMTC planning area. Maintaining assets in a state of good repair is key to the provision of safe, reliable, easy, accessible, and seamless public transportation. State of good repair and normal replacement of assets including operating equipment, support equipment, facilities, and other fixed assets and are guided by the internal policies of each agency with overarching guidance from FTA and the Federal Railroad Administration (in the case of MTA's LIRR and MNR). Transit agencies in the NYMTC planning area monitor their assets through their respective TAM plans.

NON-MOTORIZED TRANSPORTATION

Appendix B of *Moving Forward* fully explores the current availability and condition of the pedestrian and bicycle facilities in the NYMTC planning area. NYMTC's member agencies and the cities, towns, and villages in its planning

area have made significant strides in improving infrastructure for these non-motorized transportation modes. In the NYMTC planning area, over the last six years more than 70 miles of shared-use paths and greenways, 175 miles of on-street bicycle lanes, many miles of sidewalks and hiking trails, and various bicycle- and scooter-sharing programs have been added to more than 500 miles of existing protected on-street bicycle lanes.

TRANSPORTATION SYSTEM MANAGEMENT AND OPERATIONS

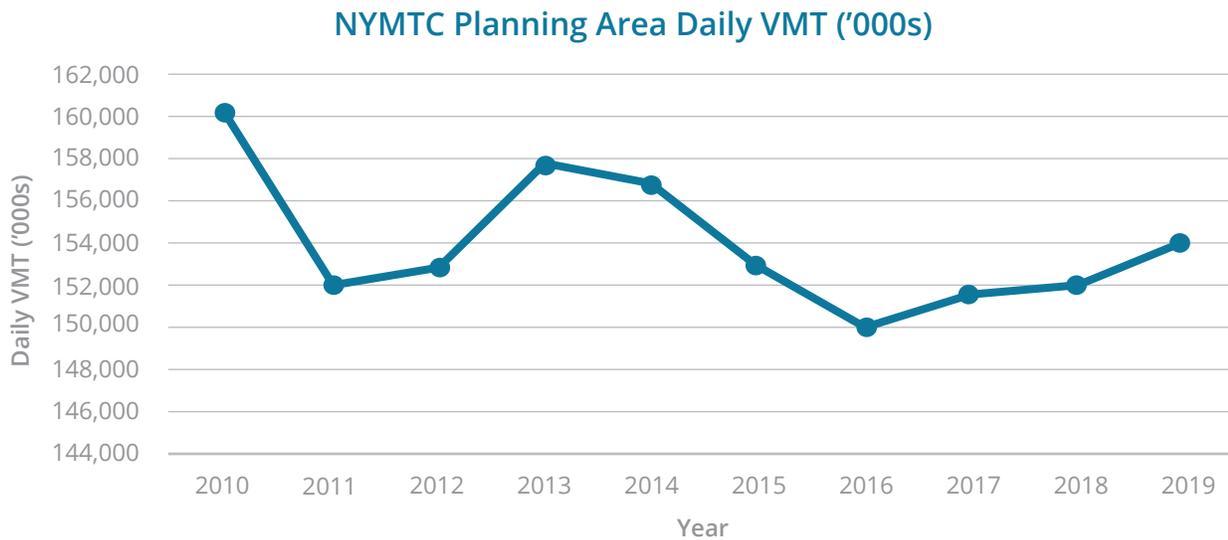
Transportation System Management and Operations (TSM&O) strategies, programs, and improvements can lead to safer roads, reduced vehicular travel demand, less traffic congestion, and higher transit utilization. Many TSM&O systems are in place in the NYMTC planning area. Expanding these systems and programs could affect VMT and help to enhance the reliability and efficiency of the transportation system and provide better accessibility to services and ease of travel. [Figure 4-5](#) shows the VMT trend in the NYMTC planning area for 2010–2019.

Among the systems implemented in the NYMTC planning area are various types of ITS, web-based traveler information services such as 511NY, more integrated roadway and transit management and operations, active transportation demand management, and programs that promote alternatives to SOV travel (e.g., transit, ridesharing, parking management programs, telework). As forecast in [Chapter 5](#), approximately \$269 million in year-of-expenditure dollars will be spent annually in supporting TSM&O programs and projects during the planning period.

Figure 4-5

VMT Trend in the NYMTC Planning Area (2010–2019)

Source: NYSDOT

**FREIGHT TRANSPORTATION**

As described in *Moving Forward's* Regional Freight Element ([Appendix H](#)), a wide range of commodities move into, out of, through, and within the multi-state metropolitan region by trucks operating on roadways, railcars operating over rail lines and through rail terminals, ships and barges operating through ports, freight and passenger aircraft operating at airports, and pipelines. The facilities and equipment involved are owned, operated, and maintained by various government agencies and private organizations. Collectively, this system moves more than 300 million tons of freight worth more than \$430 billion dollars to, from, and within the NYMTC planning area annually, with around 90 percent moving by truck.



CURRENT CONDITIONS

AGING TRANSPORTATION SYSTEM

As the NYMTC planning area continues to grow, the transportation network must be continuously maintained and modernized. Both the roadway and transit systems are old, and one of the biggest challenges has been preserving the transportation system.

Protecting and maintaining the existing aging and large transportation system includes:

- Pavement maintenance, rehabilitation, and reconstruction
- Bridge maintenance, rehabilitation, and replacement
- Preservation of the public transportation system (replacement of public transportation buses, vans, and rail cars)
- Maintenance and preservation of other transit amenities and facilities
- Preservation of other elements of the transportation system (including bicycle and pedestrian facilities and ITS)

FUNDING

The resources to maintain the transit system in a state of good repair, preserve the roadway system, and implement system enhancements continue to far outweigh available funding. This represents a major challenge in meeting the needs of the growing planning area and keeping the transportation system fully functional. Capital transportation infrastructure needs for the NYMTC planning area are estimated to total nearly \$800 billion in YOE dollars.

SAFETY AND SECURITY

As discussed above in [Section 4.2, the safety and security of the transportation system is a major challenge for NYMTC. Continued system preservation strategies will also help to keep the transportation system safer and more secure, e.g., hardening of the system will ensure that ease of travel and accessibility are achieved in the event of natural or human-made disasters.](#)

CLIMATE CHANGE

Climate-related severe weather events will continue to have impacts on regional transportation infrastructure. Continued and enhanced system maintenance, repairs, and preservation will increase the resiliency of regional infrastructure. Climate change poses an immediate and long-term threat in terms of increased extreme weather events that will affect the reliability and capacity of the transportation network. Flooding, for example, results in road closures, damage to infrastructure, disruption of traffic patterns, and an increase in travel times and VMT as drivers seek alternate routes. Also, as seen in the NYMTC planning area in the past, flooding severely affects the transit and commuter rail systems.

COORDINATION AND ACCESS

Coordination among the regional transit providers is essential to ensure that the transit system functions seamlessly and offers reliable and accessible service. Coordination efforts have included identifying opportunities for timely transfers, providing locations for transfers between paratransit services and fixed routes, and connecting services offered by different providers. This includes coordination with services that connect to areas outside the NYMTC planning area, when necessary.

FARE INTEGRATION

One of the major challenges facing the NYMTC planning area is fare integration that will allow better coordination between various transit systems and easy, reliable, and seamless travel for customers. Studies of fare integration in the United States, Western Europe, Australia, and Israel found that simplifying fare payment across multiple agencies and introducing new modes of payment resulted in notable increases in transit ridership.⁵ Additionally, New York City's *Where We Live NYC* report⁶ suggests that certain fare structures "are not designed to maximize ridership or mobility among city residents, including low-income residents who rely on public transit." Among other advantages, the integration

of fare payment systems on public transit is important for efficiency, reliability, customer satisfaction, and multimodal trip planning.

ACCESSIBILITY

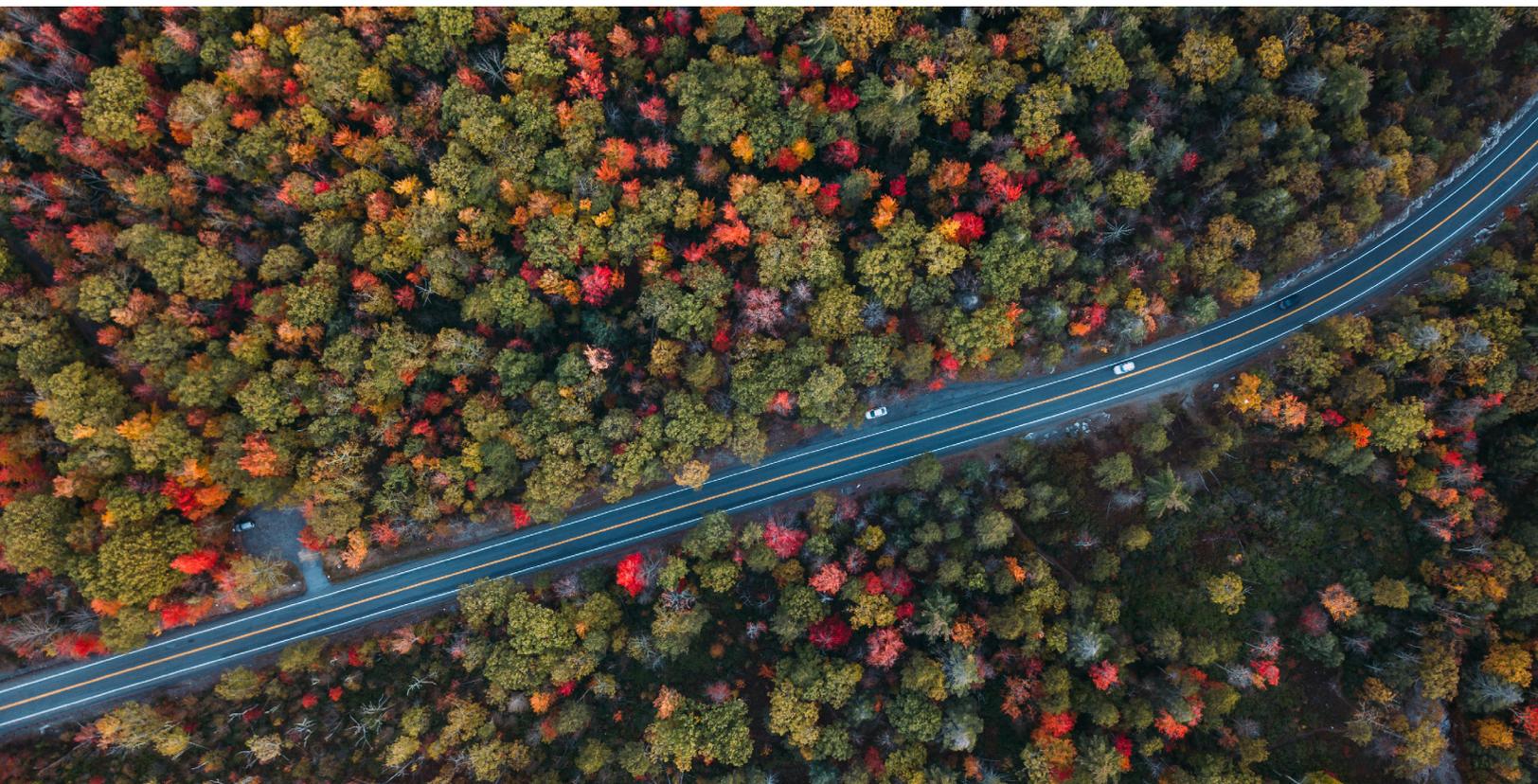
Like other metropolitan areas, public transportation access for all populations is also a challenge in the NYMTC planning area. In some areas, gaps in services may affect minority and low-income populations; in other cases, options for people with disabilities may be limited. These issues are further investigated in the Coordinated Public-Transit Human Services Transportation Plan found in [Appendix F](#).

COORDINATION WITH HUMAN SERVICES PROVIDERS

The issue of coordination with human services providers is also examined in the Coordinated Public Transit–Human Services Transportation Plan found in [Appendix F](#). The NYMTC planning area has a variety of human service options, so the need for transportation services is very real for clients of these agencies. While existing human service organizations and public transportation agencies work to coordinate transportation efforts, additional coordination is possible.

COORDINATION WITH TRANSPORTATION NETWORK COMPANIES

TNCs, such as Uber and Lyft, and other ride-hailing companies can impact local transit service. Improved coordination with these operators is necessary as the trend toward usage of these transportation choices by the public increases. This is especially important for first- and last-mile travel options for users of the transportation system. Westchester County recently completed a study on first and last mile connections, concluding that “The research and case studies presented in this report clearly demonstrate that innovative and creative approaches to addressing first/last mile connections have been implemented across the United States through the use of TNCs.”¹⁷



EXISTING INITIATIVES

Over the years, maintaining and preserving the existing transportation system has been a central theme of NYMTC as an organization and its member agencies individually. In previous versions of NYMTC's regional transportation plan and in *Moving Forward*, the largest expenditure has been/continues to be system preservation and maintenance. Existing initiatives in the NYMTC planning address existing needs. Additionally, there are efforts across the NYMTC planning area to institute plans and programs to make the transportation system more efficient and integrated.

ASSET MANAGEMENT PLANS

One of the primary goals of transportation asset management is keeping the infrastructure in a state of good repair. Federal legislation requires that owners/operators of the highway and public transportation systems have structured asset management plans in place to enable federal funding for system preservation and normal replacement of assets.

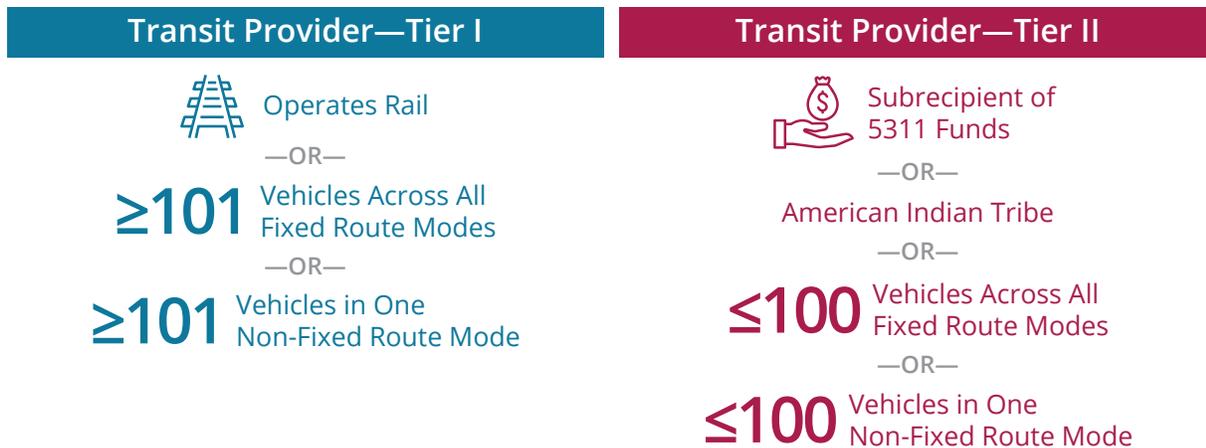
- **Transportation Asset Management Plan (TAMP) – Highways and Bridges.** The TAMP developed by NYSDOT addresses the requirements in the current federal legislation and addresses pavements and bridges on the NHS. Local agencies that maintain portions of the NHS do so by applying state and local investment strategies and available financial resources. NYSDOT owns and maintains about 74 percent of the NHS, with the remainder split between the New York State Thruway Authority and local agencies.
- The TAMP helps to guide the system preservation needs assessment and strategies. The required elements of the TAMP include the following:
 - A summary listing of the pavement and bridge assets on the NHS in the state, including a description of the condition of those assets
 - Asset management objectives and measures
 - Performance gap identification
 - Life-cycle cost and risk management analysis
 - A financial plan
 - Investment strategies
- **Transit Asset Management Plan (TAM) – Public Transportation.** Public transportation agencies that own, operate, or manage capital assets used in the provision of public transportation and receive federal financial assistance under 49 U.S.C. Chapter 53 are designated either as recipients or subrecipients and are required to develop a TAM plan. According to FTA,⁸ the TAM plan is a tool that will aid transit providers in:
 - Assessing the current condition of its capital assets.
 - Determining what the condition and performance of its assets should be (if they are not already in a state of good repair).
 - Identifying the unacceptable risks, including safety risks, in continuing to use an asset that is not in a state of good repair.
 - Deciding how to best balance and prioritize reasonably anticipated funds (revenues from all sources) towards improving asset condition and achieving a sufficient level of performance within those means.

As required, the TAM plans prepared by NYMTC members include an asset inventory, condition assessments of inventoried assets, and a prioritized list of investments to improve the state of good repair of their capital assets. The regulations grouped transit providers into two tiers as shown in [Figure 4-6](#).

Figure 4-6

Tiers of Transit Providers

Source: <https://www.transit.dot.gov/TAM>



HIGHWAY AND BRIDGE PROGRAMS

- **NYSDOT Asset Management Principles.** Based on its TAMP, NYSDOT's asset management approach focuses on system preservation and keeping as much of the system as possible in good condition. According NYSDOT, asset management must focus on a balance of the entire system, not just the NHS, and management of the entire system requires a balanced asset management approach. NYSDOT's asset management business structure is based on:
 - **Improving the quality of investment decisions** – deliver projects that impact conditions, enhance mobility, and facilitate resilience.
 - **Leveraging existing data and tools** – minimize initial investment and time needed to implement new practices by using current data and technology, more extensively and uniformly across the state.
 - **Establishing collaborative relationships across NYSDOT** – break through organizational cultures and data stovepipes.
 - **Employing transportation asset management guidance developed by the American Association of State Highway and Transportation Officials** – start with what is available now and work to improve.
 - **Adopting a systems approach** – deliver the best possible results to the most system users. The state will continue to improve its investment strategy through improvements in data collection, modeling software, organizational efficiency, management of risks, and overall asset management capabilities to ensure that it is making the best use of its available resources.

- **Fiscally Constrained Programs and Projects.** Virtually all the projects and programs in NYMTC’s TIP and the fiscally constrained element of *Moving Forward* advance NYMTC’s Vision Goal to maintain, operate, and coordinate the transportation system to better enable reliable, easy, accessible, and seamless travel across the region. This includes improving pavement conditions, bridge conditions, or sidewalk infrastructure.

See [Appendix A](#) for a full listing of proposed projects, programs, and studies.

TRANSIT PROGRAMS

- **Normal replacement programs.** As evidenced in the TIP and *Moving Forward*, all transit agencies and commuter rail systems in the NYMTC planning area are pursuing normal life-cycle replacement of their equipment and facilities based their TAM plans.
- **Contactless fare payment and fare integration.** One Metro New York (OMNY) is MTA’s new contactless fare payment system. The switch to OMNY is expected to allow for better integration with other regional transit services and will enable all-door boarding on city buses, which could significantly speed up bus service by reducing boarding times. Fare integration has already been arranged in the NYMTC planning area, for example, between MTA NYCT and Westchester’s Bee-Line System.
- **MTA’s Fast Forward Plan.⁹** This plan is built around four priorities: Transform the Subway; Reimagine the Bus Network; Accelerate Accessibility; and Engage and Empower Employees. The first three of these priorities include projects that will keep the transit system in a state of good repair and ensure the reliability, accessibility, and ease of travel in the NYMTC planning area.

- The “Transform the Subway” component includes new signal segments, accountable station management, a subway action plan, new subway cars, and the OMNY system. Additionally, communications-based train control, a state-of-the-art signal system, is being implemented.
- The “Reimagine the Bus Network” component includes new routes, installation of audio-capable bus signs, enforced bus lanes, and new buses.
- The “Accelerate Accessibility” component includes a new Access-A-Ride scheduling and dispatch system, more accessible stations, and better system information.

PROGRAMS TO IMPROVE SEAMLESSNESS AND COORDINATION

- **Transportation Demand Management (TDM).** Many TDM programs are currently in operation in the NYMTC planning area. Foremost among these is the Rideshare program. Continued operation of this program will provide travelers a more integrated, convenient, and accessible transportation network.
- **Other TSM&O Initiatives.** In addition to TDM programs, other system management and operations management initiatives include:
 - Traffic Management Centers
 - Regional operation coordination through TRANSCOM
 - Signalization programs across the NYMTC planning area
 - Incident response through the Highway Emergency Local Patrol system

- **Pedestrian/Bicycle programs.** Walking and bicycling are integral parts of life in the NYMTC planning area, providing residents with the means for commuting and travel for recreational purposes. The Pedestrian-Bicycle Element in **Appendix B** fully describes the efforts being made to maintain, operate, and coordinate non-motorized travel in the planning area to ensure that it is integrated into the transportation system.

FREIGHT PROGRAMS

As described in Chapter 6 of *Moving Forward's* Regional Freight Element (**Appendix H**), a series of existing programs and planning initiatives seek to maintain and preserve the existing freight transportation system and improve the integration of freight modes and facilities. These programs and initiatives are outlined below.

- The Port Authority has developed a regional **Goods Movement Action Program (G-MAP)** that outlines a comprehensive agenda of operational, regulatory, and investment priorities that can assure more efficient and sustainable performance of essential goods movement to support regional trade, commerce, and consumer needs.
- The primary purpose of the Port Authority's **Cross Harbor Freight Program** is to improve the movement of rail freight across New York Harbor to west-of-Hudson areas. By improving the movement of goods across the harbor, the project will provide near- and long-term improvements to the regional freight network, reduce truck traffic congestion, improve air quality, and provide economic benefits.
- The Metropolitan Rail Freight Council's **Rail Freight Action Plan** is a plan to grow rail freight capacity and volumes, invest in and preserve rail freight infrastructure, create quality jobs, promote environmental sustainability, create an infrastructure bank, and ensure a more resilient freight supply chain for the New York City metropolitan area.
- The Port Authority's **Port Master Plan 2050** is a comprehensive and flexible roadmap that charts the course for future growth and development at the Port of New York and New Jersey. The 30-year plan takes a holistic look at the port, including cargo container facilities, automobile terminals, dry and liquid bulk cargo operations, cruise terminals, and ferry landings and maps out the next generation of land use and infrastructure development projects that will allow the port to remain among the nation's leading maritime gateways.
- **New York City's Smart Truck Management Plan** is NYC DOT's plan to improve the safe, reliable, and environmentally responsible movement of goods by enhancing street efficiency.
- The New York City Economic Development Corporation's **Freight NYC** plan will overhaul New York City's aging freight system by creating thousands of jobs, modernizing infrastructure, and reducing shipping costs. These programs complement the NYC Smart Truck Management Plan.
- **JFK Air Cargo Market Analysis and Strategic Plan** is a multi-tiered cargo modernization plan for JFK Airport.

4.3.4 RECOMMENDED STRATEGIES AND ACTIONS

The regulations detailed in 23 CFR 450.324 govern the development and content of the metropolitan transportation plan and contain the following requirement:

The transportation plan shall include both long-range and short-range strategies/actions that provide for the development of an integrated multimodal transportation system (including accessible pedestrian walkways and bicycle transportation facilities) to facilitate the safe and efficient movement of people and goods in addressing current and future transportation demand.

Several categories of short- and medium-range strategies and actions recommended in pursuit of this Vision Goal are described below. Additionally, specific projects, programs and studies recommended for funding in the fiscally constrained element of *Moving Forward*, as well as those recommended for future consideration in the speculative vision element of the Plan, appear in [Appendix A](#).

PLANNING AND RESEARCH INITIATIVES

- Research recommendations:
 - Inventory current and developing technology that can be used to improve transit access and transit asset durability and monitor asset condition.
 - Assess transit services throughout the planning area to identify opportunities for increased service frequency and/or reliability.
 - Assess transit service coordination needs across jurisdictional lines and evaluate intermodal connections.

- Inventory freight facilities and services throughout the planning area and integrate the results of the freight-related land use inventory.
- Inventory potential funding sources for transit operations and improved transit accessibility.
- Identify potential funding sources for integration of freight modes.
- Develop a transit access plan for the entire planning area and perform a benchmarking exercise of transit systems across the country for transit access, service frequency, and service reliability.
- Develop a comprehensive freight integration strategy.

DATA COLLECTION, FORECASTING, AND PERFORMANCE ASSESSMENT

- Publish an annual report on accessible pedestrian signals.
- Survey pedestrian ramps to enhance maintenance programs and continue to provide for safe and accessible corners that are ADA compliant.
- Perform a passenger data needs and sources assessment of member agencies to establish a well-coordinated system.
 - Include relevant sources of “big data” and technological tools for data collection.
 - Identify data sources for key system interfaces.
- Develop the Regional Freight Data Program.

PLANNING PROCESS RECOMMENDATIONS

- Aggressively propose relevant projects for federal discretionary programs and related state-level programs.
- Identify priority multi-agency system preservation projects.
- Identify priority multimodal corridors throughout the planning area and optimize project selection for these corridors.
- Convene interagency work groups through the TCCs to address priority multimodal corridors.

PROGRAM RECOMMENDATIONS

- Regional guidance programs:
 - Coordinate suburban municipalities and appropriate jurisdictions to improve access to transit stops/stations.
 - Develop a common transit accessibility guidebook based on universal design standards and existing policies of the members agencies.
 - Fully integrate transit mapping/trip planning resources and enhance integration of suburban services into regional public information portals.
- Transit access programs:
 - Increase transit access through micromobility and shared mobility.
 - Enhance fare and service integration between suburban transit providers and MTA services.
 - Expand the availability of real time information at transit stations and stops.
 - Improve public communication on transit service status and service changes.
 - Improve transit facility accessibility for all regardless of disability status.
- Transit service enhancement programs:
 - Reduce commute times and improve transit speeds in low- and moderate-income communities underserved by transit.
 - Expand the availability of shared-use mobility services, including bike share, carshare, and rideshare that support safe, affordable, and sustainable travel choices.
- Freight access program:
 - Improve truck access to industrial areas, marine terminals, and airports.



4.3.5 PERFORMANCE METRICS

Regulations at 23 CFR 450.324 govern the development and content of the metropolitan transportation plan. These regulations contain the following requirement:

A description of the performance measures and performance targets used in assessing the performance of the transportation system

The metrics listed below respond to and are the same as the federal Transportation Performance Management requirements (23 CFR Part 490) described in this chapter and will assist in measuring progress toward this Vision Goal and its objectives, and in informing investment decisions:

Pavement and Bridge – for the metrics below, NYMTC is guided by calculations done by NYSDOT and reported to FHWA as part of the transportation performance management process.

- Pavement metrics
 - Percent of Interstate pavements in good condition
 - Percent of Interstate pavements in poor condition
 - Percent of Non-Interstate NHS pavements in good condition
 - Percent of Non-Interstate NHS pavements in poor condition

For the calculation pavement metrics, roadways are categorized as asphalt and concrete surfaces. Factors considered for asphalt pavements are: rutting, smoothness (measured by the International Roughness Index), and cracking (percent area with fatigue cracking in the wheel path) and for concrete pavements: faulting, International Roughness Index (smoothness), cracking (percent of concrete slabs with transverse cracks for jointed concrete pavement). Pavement are considered “Good” if all three metrics are good; “Poor” if two or more metrics are poor; and “Fair” for all other combinations.

- Bridge metrics
 - Percent of bridges in good condition
 - Percent of bridges in poor condition

These metrics apply to highway bridges carrying the NHS, which include on- and off- ramps connected to the NHS and NHS border bridges. Three classes are considered for bridge condition assessment—percent of deck area of bridges in good, fair and poor conditions using the lowest of the four National Bridge Inventory ratings (deck, superstructure, substructure and culverts) on a 0-9 scale: “Good” when the lowest rating is ≥ 7 ; “Fair” if lowest rating is 5 or 6; and “Poor” if lowest rating is ≤ 4 .

Transit System – the metrics below are derived from the federally required TAM plans for all recipients or subrecipients of federal financial assistance under 49 U.S.C. Chapter 53 that own, operate, or manage capital assets used in the provision of public transportation, and as submitted to NYMTC. A brief description of the TAM plans was provided in the “Existing Initiatives” section above.

- Rolling Stock – Percentage of vehicles that have met or exceeded their useful life benchmark
- Rolling Stock – Average miles of service between breakdowns for fleet
- Equipment – Percentage of vehicles that have met or exceeded their useful life benchmark
- Infrastructure – Percentage of track segments with performance restrictions
- Percentage of facilities in an asset class, rate < 3 on the Transit Economic Requirements Model scale

4.4 VISION GOAL - PLANNING FOR CHANGING DEMAND

A transportation system that efficiently serves today's population and plans for the growing number of residents, workers, and increasing amount of goods.

4.4.1 DESCRIPTION

Given the forecasted growth in population, workers, and the amount of goods moving within and through the NYMTC planning area, this goal seeks to ensure the efficiency of the transportation system by identifying and funding, to the extent possible, feasible and cost-effective investments. Additionally, efficiency will be achieved through the implementation of requisite TSM&O strategies. The application of NYMTC's CMP will also be important in ensuring that the transportation system continues to efficiently serve the projected growth of people and goods.

4.4.2 OBJECTIVES

1. Invest in system capacity to satisfy demand, relieve overcrowding, address bottlenecks, and improve performance for passengers and freight, with an emphasis on core markets and activity centers.
2. Expand the reach of the system to underserved communities and emerging markets, addressing passenger transportation as well as access to goods and freight services.
3. Encourage walking and biking, transit-oriented development, complete streets, parking and curb management, and other long-term sustainable land use strategies that support passenger and goods movement.
4. Modernize local freight networks to efficiently plan for the growth in volume of and change in product deliveries.
5. Incorporate emerging and innovative transportation services and tools into efficient network design.

4.4.3 RECENT TRENDS, CURRENT CONDITIONS, AND EXISTING INITIATIVES

Trends and conditions that may affect the ability of the transportation system to efficiently serve the growing transportation needs of the NYMTC planning area are described below.

ROADWAY CONGESTION

In 2019, New York City was the 14th most congested city in the world, up from 16th the year before; it was the 4th most congested city in the United States, down from 2nd in 2018. In all, drivers lost on average 140 hours in traffic in 2019 with a cost of \$2,072 per driver.¹⁰ This congestion extends to corridors throughout the NYMTC planning area and the multi-state metropolitan area. Between 2016 and 2019, daily vehicle miles of travel increased by nearly 3 percent across the NYMTC planning area. One contributor to this congestion is the movement of goods by trucks, as fully described in [Chapter 5 of the Regional Freight Element \(Appendix H\)](#).

TRUCK DEPENDENCE

Goods are moved by a variety of modes of transportation—truck, water, air, and rail. The movement of goods in the NYMTC planning area is heavily dependent on trucks, which move 92.5 percent of tons and 87.8 percent of value of all goods carried into and through the planning area (see [Chapter 1 of the Regional Freight Element in Appendix H](#) for additional details). The multi-state region's primary port, rail freight, and intermodal facilities are located west of the Hudson River in northern New Jersey and eastern Pennsylvania. A limited number of rail freight facilities exist east of the Hudson River serving primarily local customers, and no direct rail freight link exists across New York Harbor and the Hudson River south of Selkirk, New York, more than 100 miles north of the NYMTC planning area.

Additionally, extensive passenger rail services restrict rail freight capacity east of the Hudson River and on Long Island. A rail freight barge between Conrail's Greenville Yard in New Jersey and New York & Atlantic Railway's 65th Street Yard in Brooklyn serves a small amount of cross-harbor rail traffic, moving roughly 3,400 carloads per year with an eventual expansion planned to increase capacity to 25,000 carloads per year.

As the *Moving Forward* Freight Element indicates, other trends in goods movement in the NYMTC planning area include:

- The continued expansion of e-commerce market share
- Expansion of less-than-truckload delivery
- The evolution of automated vehicle technologies for trucking, including driver assistance, autonomous vehicles, and connected vehicles

PUBLIC TRANSIT RELIABILITY

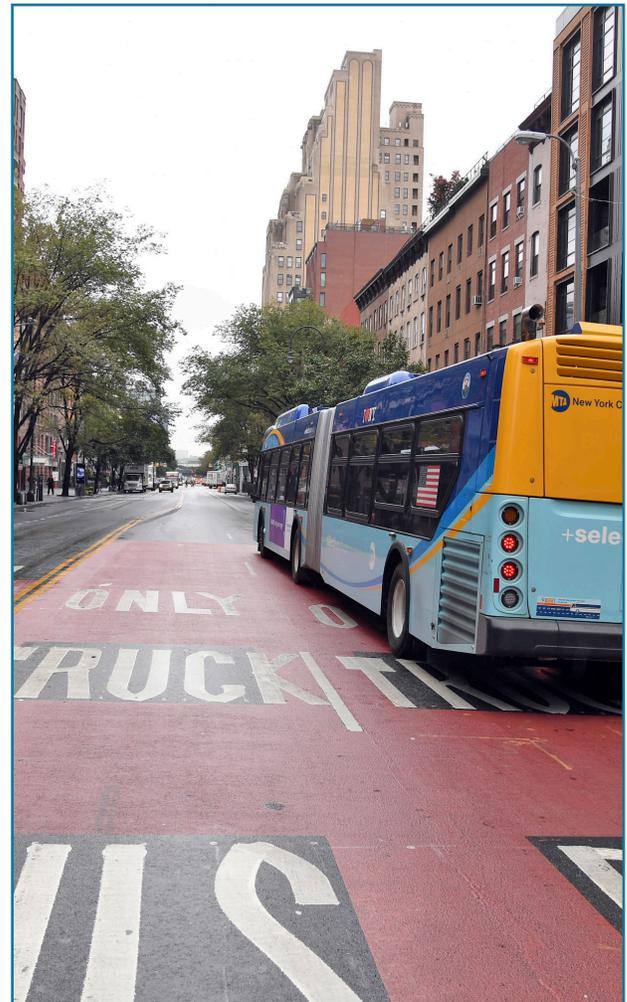
Recent enhancements to the fixed-rail transit system have improved on-time performance substantially. In 2019, on-time performance for MTA New York City Subway was 81 percent, MTA LIRR was 92.4 percent, and MTA MNR was 94.4 percent. However, average bus speeds in New York City in 2019 declined to a low of 8.1 mph, with buses in Manhattan traveling at an average of 6 mph, coinciding with a 5.5 percent decline in New York City Bus ridership. Over the last decade, cumulative suburban bus ridership in the NYMTC planning area has exhibited a marginal decline in ridership.

Subway ridership was declining by roughly 3 percent per year before the COVID-19 pandemic, due in part to the increase in ride-hail services coupled with service inconsistencies that have recently been addressed by the Subway Action Plan and Fast Forward Plan.

EMERGING NON-MOTORIZED TRANSPORTATION

According to the ACS Five-Year Estimates for 2014–2018,¹¹ 4.1 percent (245,098) of daily commuters in the NYMTC planning area either walk or ride a bicycle as a primary means of travel to work. Additionally, all commuting typically includes a walking component, typically for first/last mile access, while public transit commuting sometimes includes a bicycle component.

The NYMTC planning area has made significant strides in advancing bicycle and pedestrian infrastructure. Collectively, the region has seen the development of more than 70 miles of shared-use paths and greenways, 175 miles of on-street bike lanes, many miles of sidewalks and hiking trails, and bicycle share and electric scooter rentals. Additionally, the region is home to over 500 miles of existing protected on-street bicycle lanes.



CURRENT CONDITIONS

CHANGING DEMAND

VMT in the NYMTC planning area are forecast to increase by 11.9 percent, and VHT are forecast to increase by 14.4 percent through the Plan horizon year. Population is expected to grow by 10 percent during the period of the Plan, while growth rates for employment and civilian labor force are expected to be 13.9 percent and 11 percent, respectively.¹² As described in [Chapter 3](#), population and employment growth and commensurate changes in economic activity and travel will have significant impacts on the existing transportation network.

ASSET CONDITIONS

Preserving, maintaining, and enhancing roadway and transit assets are critical to maintaining the efficiency of the transportation system. As discussed in this chapter and in [Chapter 5](#), system preservation is a critical component of *Moving Forward* that will command a huge proportion of the future financial resources reasonably expected to accrue to the NYMTC planning area. Timely implementation of asset management plans will continue to be important in fostering improvements in the efficient movement of people and goods in the NYMTC planning area.

PUBLIC TRANSPORTATION

The public transportation network, comprising multiple modes and service providers, is vulnerable to financial shortfalls and is only partially integrated for the convenience of the traveler. However, public transit in the NYMTC planning area will need to continue to grow, innovate, and integrate to efficiently serve the current and growing population and employment projected for the planning period. Additionally, the system serves a variety of area types and land uses—high-density and lower-density urban and suburban areas of varying densities—which make increasing the reach of these services challenging in their current configurations.

Enhancing transit service will likely include expanding and improving the bus systems that serve the planning area. This includes possibly expanding geographic coverage and adding new routes and service frequency in areas already served by transit, including connections to rapid rail and commuter rail modes. Improving the public transportation system will address several possible needs, described below.

SHIFTING MODE CHOICE

The observed shift to private vehicles from public transit in the wake of the COVID-19 pandemic has created significant immediate and medium-term risks of increased traffic congestion in the NYMTC planning area and the larger multi-state metropolitan region. While traffic and congestion began to approach pre-pandemic levels in summer 2020, transit ridership remained significantly lower and is expected to continue to lag even in the urban core. With the financial shock of drastically lower ridership resulting in service reductions and capital project deferrals among service providers, the increase in mode shift to private, often SOVs is a real risk going forward. This could be partially offset by long-term adoption of telecommuting by employers in the region.

INTERMODAL FREIGHT CONNECTIONS

Commodity flows and supply chain operations in the NYMTC planning area are accomplished using a vast and mature set of modal networks—truck, rail, water, air, and pipeline—operating both independently and as linked intermodal systems. The performance of the modal networks and the intermodal facilities that connect them is critical to accomplishing safe, efficient, reliable, resilient, and equitable freight transportation for the region. The implications of these intermodal connectivity are fully explored in the [Regional Freight Element](#) (see [Appendix H](#)).

LOCAL PARTNERSHIPS

The role of transit-oriented development is increasing in significance throughout the NYMTC planning area. However, given that New York is a home-rule state, local municipal governments must be partners in addressing the challenges of planning for and supporting denser development along transit corridors. However, the willingness of local municipalities to engage in such partnerships has not been universal.

EXISTING INITIATIVES

TRANSIT IMPROVEMENTS

Numerous recent and planned transit improvements are designed to help provide alternatives to driving, reduce congestion, and improve the efficiency of the transportation system. These include:

- Continued expansion/implementation of bus priority measures in New York City, including busways, transit/truck priority streets, off-board fare payment, and bus rapid transit in suburban corridors to increase transit service speeds and reliability. These service enhancements include transit signal priority to enable buses to travel faster by adjusting traffic signals along their route in real time to minimize delays.
- Enhanced transit fare collection. In spring 2019, MTA launched a pilot program for a new tap-and-pay fare collection system to replace the MetroCard. OMNY accepts contactless bank cards (credit or debit) or smart devices linked to a digital wallet system such as Apple Pay or Google Pay to pay subway and bus fares. This new fare collection system will allow a more efficient transit system and better fare integration with suburban transit systems and other services. It is expected that by late 2020, OMNY will be fully operational across all MTA NYCT subways and buses. OMNY will be expanded to MTA LIRR and MTA MNR in 2021, after which it will be integrated with suburban bus systems.

COMPLETE STREETS

Complete Streets describes an approach to transportation planning, design, and construction that considers the needs of all potential users—motorists, pedestrians, transit vehicles and users, bicyclists, commercial freight trucks, and emergency vehicles—moving along and across roads and through intersections. Complete Streets continue to be implemented across the NYMTC planning area, including in Nassau County (the Town of Hempstead, the City of Long Beach, and Hicksville in the Town of Oyster Bay); Suffolk County (the Town of Philipstown); Rockland County (Route 45); and Westchester County (Route 119).

COORDINATED DEVELOPMENT EMPHASIS AREAS

Moving Forward identifies a variety of coordinated development emphasis areas (CDEAs) across the NYMTC planning area. These are areas where land development and transportation investment planning are/will be established to create linkages between transportation, housing, and development. Foremost among these CDEAs are areas identified for transit-oriented development, linked transit corridors, and bus rapid transit. See [Appendix A](#) for additional information.

TECHNOLOGICAL DEVELOPMENTS

Various levels of vehicle automation have been developing, for cars, vans, and trucks. The first pilot automated shuttle service commenced at the Brooklyn Navy Yard in 2019. New York City was selected by USDOT as one of three pilot sites to test the benefits of connected vehicle technology, using vehicle-to-vehicle, vehicle-to-infrastructure, and infrastructure-to-pedestrian communication to provide drivers with alerts that enable the driver to take action to avoid crashes or reduce injuries or damage. This program is currently in the late stages of design with the 18-month implementation pilot to begin in September 2020.

TSM&O include multimodal transportation strategies that improve the efficiency of the transportation system in moving people and goods. A number of these initiatives have been implemented and will continue to be implemented across the NYMTC planning area. These strategies and actions are shown below in [Figure 4-7](#).

Figure 4-7

TSM&O Strategies and Actions



Highlights of current TSM&O strategies and programs in the NYMTC planning area include:

- 511NY is a service that provides transportation information and alternatives to driving alone. NYSDOT sponsors 511NY with the goal of reducing traffic congestion and improving air quality by offering employers, commuters, and members of the public information on carpooling, vanpooling, workplace commuter benefits, public transportation, bicycling, walking, or telework.
- Shared Mobility includes services such as ride-hailing, microtransit, and micromobility, which are described in detail elsewhere in this chapter. Related initiatives in the NYMTC planning area include:
 - Integration of ride-hailing services with public transit for first/last mile connections.
 - Small-scale microtransit services for commuting.
 - Bike sharing programs, which started in New York City in May 2013 with the Citi Bike program. Bikeshare programs also exist on Long Island and Westchester County and are expected to grow in the future.

CONGESTION MANAGEMENT PROCESS

NYMTC's CMP recognizes that the impacts of congestion should and can be eased by increasing the people and freight-moving capacity of the multimodal transportation system, while minimizing future demand on the highway system. The impacts of congestion can be mitigated by implementing supportive policies and strategies described in the CMP Status Report's toolbox, including improving traffic management; more efficient use of existing highway system capacity; implementing various transit strategies; and implementing alternatives to driving alone. The CMP monitors and evaluates congestion mitigation strategies and related projects.

FREIGHT INITIATIVES

Chapter 7 of the Regional Freight Element (Appendix H) describes the ongoing and planned freight initiatives in the NYMTC planning area.

4.4.4 RECOMMENDED STRATEGIES AND ACTIONS

The regulations detailed in 23 CFR 450.324 govern the development and content of the metropolitan transportation plan and contain the following requirement:

The transportation plan shall include both long-range and short-range strategies/actions that provide for the development of an integrated multimodal transportation system (including accessible pedestrian walkways and bicycle transportation facilities) to facilitate the safe and efficient movement of people and goods in addressing current and future transportation demand.

Several categories of short- and medium-range strategies and actions recommended in pursuit of this Vision Goal are described below. Additionally, specific projects, programs and studies recommended for funding in the fiscally constrained element of *Moving Forward*, as well as those recommended for future consideration in the speculative vision element of the Plan, appear in [Appendix A](#).

PLANNING AND RESEARCH INITIATIVES

- Research recommendations:
 - Identify core markets, emerging markets, activity centers, and underserved communities using the CDEAs, socioeconomic and demographic forecasts, and Title VI/ Environmental Justice assessment to develop multimodal plans for the identified areas.
 - Identify the most efficient ways to serve emerging markets and underserved communities, particularly those in areas of low-density development where fixed-route bus service may not be effective.
 - Benchmark techniques to address fare issues for lower income riders and seniors across all transit services.

- Assess the distribution of bicycle lanes, bicycle facilities, and bike sharing opportunities throughout the NYMTC planning area in terms of equity.
- Assess late night/overnight travel needs.

- Continue to address congested links and bottlenecks identified by the CMP through multimodal planning studies.
- Develop or update transit service plans for each suburban system in the planning area given forecasts of future demand.
- Develop a comprehensive freight strategy for the multi-state metropolitan region.

PLANNING PROCESS RECOMMENDATIONS

- Encourage sharing of data to better manage truck movements throughout the region.
- Use the CDEAs as a targeting mechanism for a continuing program of community planning activities that:
 - Encourage development in centers and downtowns to reinforce walkable, aesthetically pleasing, and transit-accessible environments.
 - Encourage consideration of local transportation issues in comprehensive/master planning and community visioning processes.
 - Make walking safer and more convenient through safety and streetscape improvements.
 - Support downtown development/ redevelopment.
 - Encourage walkability, Complete Streets, and remote parking in targeted centers.
 - Complete and distribute MTA First Mile/Last Mile Station Access Toolkit.
- Convene interagency work groups through the TCCs to identify and address priority multimodal corridors; including exploring technological options.

- Convene the designated recipients of federal transit funding to explore the costs and benefits of joint procurement for transit equipment.
- Bring together relevant agencies and private sector interests through the Multi-State Freight Working Group to address identified opportunities for freight network modernization.

PROGRAM RECOMMENDATIONS

- Complete Streets programs:
 - Apply Complete Streets design principles that accommodate all users of the transportation network.
 - Improve the bus network by installing bus priority treatments such as bus lanes, traffic signal prioritization, and camera enforcement.
 - Expand the bicycle lane network and improve bike access to bridges.
 - Strive to make sidewalks, pedestrian spaces, and transit stops and stations accessible.
- Transit access programs:
 - Integrate the OMNY fare system with suburban bus systems and ferry services throughout the NYMTC planning area.
 - Expand transit fare media purchase locations.
- Shared Mobility program:
 - Expand the availability of shared-use mobility services, including bike share, carshare, and rideshare that support safe, affordable, and sustainable travel choices.

4.4.5 PERFORMANCE METRICS

Regulations at 23 CFR 450.324 govern the development and content of the metropolitan transportation plan. These regulations contain the following requirement:

A description of the performance measures and performance targets used in assessing the performance of the transportation system

The performance measures listed below will assist in measuring progress toward this Vision Goal and its objectives, and in informing investment decisions:

- **Mobility Performance Metrics** measuring transportation performance from the traveler's perspective. Metrics measuring how effectively and efficiently the integrated mobility system performs while meeting the needs of individual travelers. The objective of the performance metrics is to measure the "integrativeness" of the mobility system, primarily focusing on the effectiveness on the traveler-centric performance.¹³
- **VMT per Capita.** NYSDOT compiles VMT data for the Highway Performance Management System. These data are used extensively in the analysis of highway system condition, performance, and investment needs.
- **Person Hours of Delay.** NYMTC uses the NYBPM to calculate person hours of delay for the CMP.
- **Public Transportation System Reliability.** NYMTC members measure the mean distance between major mechanical failures by transit mode.
- **Level of Travel Time Reliability.** The LOTTR measure assesses the reliability of roadways on the Interstate and Non-Interstate (NHS) systems. FHWA defines travel time reliability as the percent of person-miles on the (Interstate/NHS) that are reliable for both Interstate and Non-Interstate.

- **Travel Time Index.** NYMTC uses the NYBPM to calculate travel time index for the CMP. The travel time index is the ratio of peak-period travel time to free-flow travel time. It expresses the average amount of extra time it takes to travel in the peak relative to free-flow travel.
- **Truck Travel Time Reliability.** TTR is the percent of the Interstate system mileage that provides reliable truck travel times. This measure is also used to report truck travel reliability under the transportation performance management requirements.



4.5 VISION GOAL - REDUCING ENVIRONMENTAL IMPACT

A transportation system that minimizes its greenhouse gas emissions and other impacts on the environment, especially the effects of climate change.

4.5.1 DESCRIPTION

The transportation system can have significant effects on the environment, including the production of various pollutants (e.g., greenhouse gas emissions), which directly contribute to climate change. According to USEPA, transportation activities accounted for 28 percent of total U.S. greenhouse gas emissions in 2018 and were the largest single source of these emissions.¹⁴ Enhancing and preserving the transportation system can also affect local and regional air quality, natural habitats, and water resources.

This goal seeks to continue to enhance the regional transportation system to minimize impacts on the environment by pursuing the objectives listed below. NYMTC members that are operating agencies have individual policies for addressing the impacts of transportation on the environment, and their objectives are consistent with, and supportive of, this shared Vision Goal.

4.5.2 OBJECTIVES

1. Encourage alternatives to SOV trips.
2. Encourage lower-emissions alternatives to trucking.
3. Modernize vehicle fleets to higher-standard and lower-emissions vehicles.
4. Efficiently manage limited roadway capacity to mitigate congestion and vehicular emissions.
5. Promote responsible environmental stewardship in transportation projects.
6. Address unequal impacts of transportation emissions on communities.



4.5.3 RECENT TRENDS, CURRENT CONDITIONS, AND EXISTING INITIATIVES

RECENT TRENDS

Over the last several decades, the effects of the transportation system on the environment have been mitigated through regulation, technological advances, and system improvements made over time using federal, state, and local funding. These efforts are directly related to the ultimate achievement of the National Ambient Air Quality Standards (NAAQS) and the mitigation of the transportation system's contributions to greenhouse gas emissions and overall environmental impact.

As demonstrated through its various regional emissions analyses, NYMTC has consistently demonstrated conformity under the Clean Air Act Amendments of 1990 with the motor vehicle emissions budgets and milestones established in New York State's State Implementation Plan for Air Quality, thus establishing steady progress toward contributing to the achievement of the relevant NAAQS. Of the four criteria pollutant non-attainment areas affecting all or part of the NYMTC planning area, one—coarse particulate matter—is now in attainment status and a second—carbon monoxide—is in maintenance status as attainment has been demonstrated and now must be maintained.

CRITERIA AIR POLLUTANTS

The Clean Air Act requires USEPA to establish NAAQS for six "criteria" pollutants in outdoor air. These standards are currently set for carbon monoxide, lead, ground-level ozone, nitrogen dioxide, particulate matter, and sulfur dioxide. USEPA calls these pollutants "criteria" air pollutants because it sets NAAQS for them based on the criteria, which are characterizations of the latest scientific information regarding their effects on health or welfare. These pollutants are found all over the United States, can harm health and the environment, and cause property damage.¹⁵

To protect human health and the environment from harm, the New York State Department of Environmental Conservation (NYSDEC) measures levels of outdoor air pollution. Along with measuring and reporting air quality data, NYSDEC also writes reports and network assessments for the public and technical community. NYSDEC measures air pollutants at more than 50 sites across New York State using continuous and/or manual instrumentation. These sites are a mix of federally mandated and supplemental monitoring networks. Real-time direct reading measurements include gaseous criteria pollutants (ozone, sulfur dioxide, oxides of nitrogen, carbon monoxide) and PM_{2.5} (fine particulate with diameter less than 2.5 microns).¹⁶

GREENHOUSE GASES¹⁷

Greenhouse gases are gases in the atmosphere that trap heat and lead to climate change. There are six greenhouse gases—carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. According to the New York State Greenhouse Gas Inventory: 1990–2016, carbon dioxide is the largest share of greenhouse gas from human activity, resulting from the burning of fossil fuels for electricity, heat, and transportation, among other energy needs. Other greenhouse gas emissions result from waste management, agriculture, and industrial activity.

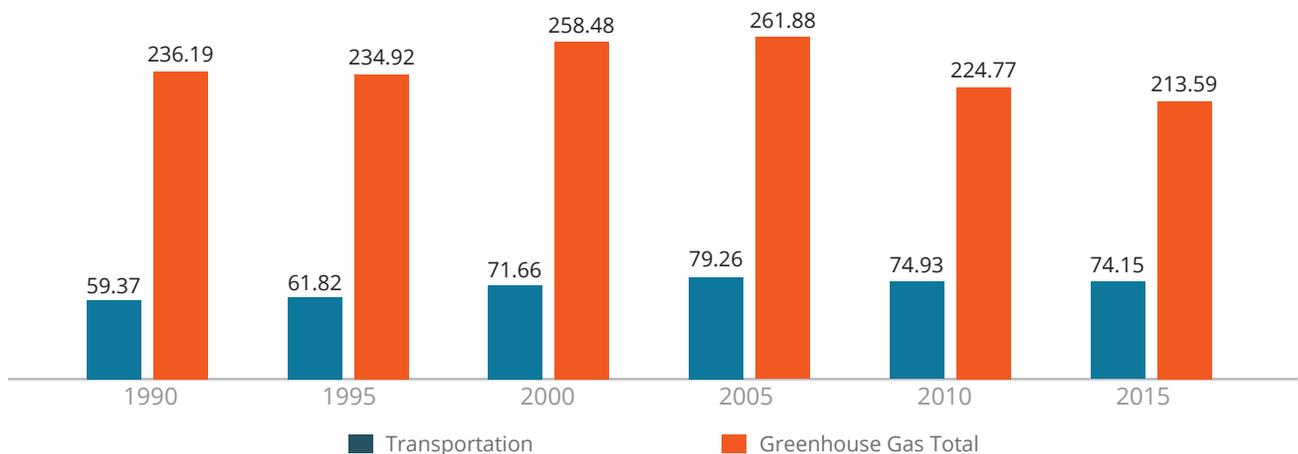
The largest contributor of all greenhouse gas emissions in New York State is vehicle fuel combustion in the transportation sector (36 percent) followed closely by on-site combustion in the residential, commercial, and industrial sectors (30 percent). Fuel combustion for electricity generation (including net imports) represents 15 percent of emissions and non-combustion sources (e.g., industrial process, agriculture, and waste) make up 19 percent of statewide emissions.

State greenhouse gas emissions gradually increased from 1990 and peaked in 2005. Since then, greenhouse gas emissions have declined, and 2015 emissions are approximately 10 percent lower than in 1990. This reduction in greenhouse gas emissions from 1990–2015 stands in contrast to a national increase in total greenhouse gas emissions of approximately 2 percent over the same period ([Figure 4-8](#)). While greenhouse gas emissions in the transportation sector increased nearly 25 percent from 1990 to 2015, transportation greenhouse gas emissions decreased 7 percent from their peak in 2005 to their 2015 level. The Climate Leadership and Community Protection Act, passed in 2019, (see page 161) has set the state on a path to 40 percent economy-wide greenhouse gas reductions from 1990 levels by 2030 and 85 percent reductions by 2050.

Figure 4-8

Greenhouse Gas Trends in New York State (in Million Metric Tons of Carbon Dioxide Equivalent)

Source: New York State Greenhouse Gas Inventory: 1990–2016; New York State Energy Research & Development Authority, July 2019



Note: The Climate Leadership and Community Protection Act calls for economy-wide greenhouse gas emissions reductions from 1990 levels of 40 percent by 2030 and no less than 85 percent by 2050.

VEHICLE MILES OF TRAVEL

VMT is the level of motor vehicle usage for trip purposes. In 2019, an average of 154 million daily VMT were measured in the NYMTC planning area. As shown in [Figure 4-9](#), average daily VMT has been fluctuating over the last decade but generally trended downwards. That said, between 2016 and 2019, average daily VMT increased by approximately 2.6 percent. Reductions in VMT have the potential to reduce motor vehicle emissions and mitigate transportation impacts on the environment. Additionally, an increase in the number of battery electric and hybrid electric vehicles in commercial, municipal, and private fleets (see [Figure 4-10](#)) has increased the proportion of “clean” VMT with the average daily VMT.

Figure 4-9
Daily VMT Trends in New York State

Source: NYSDOT HPMS

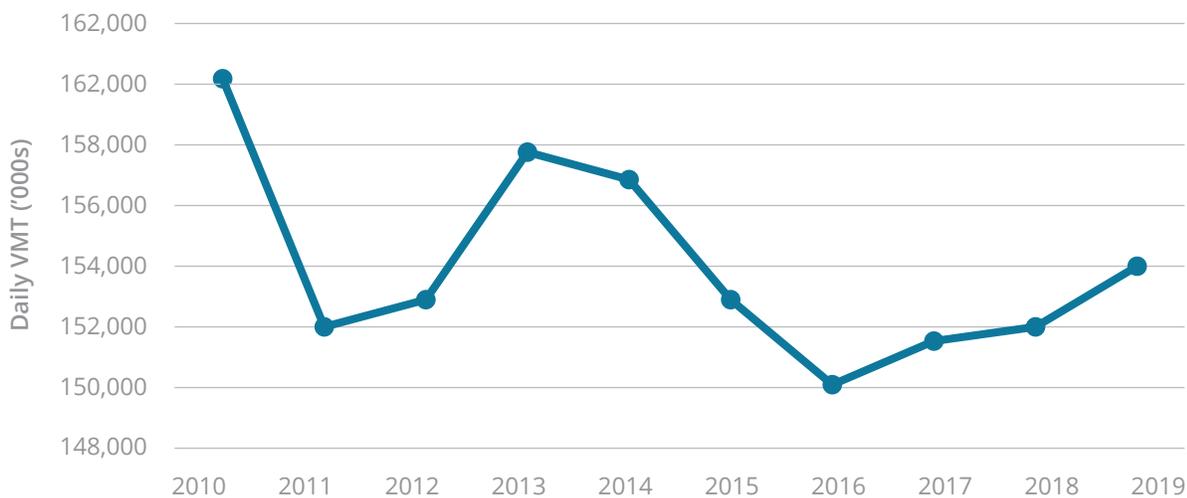
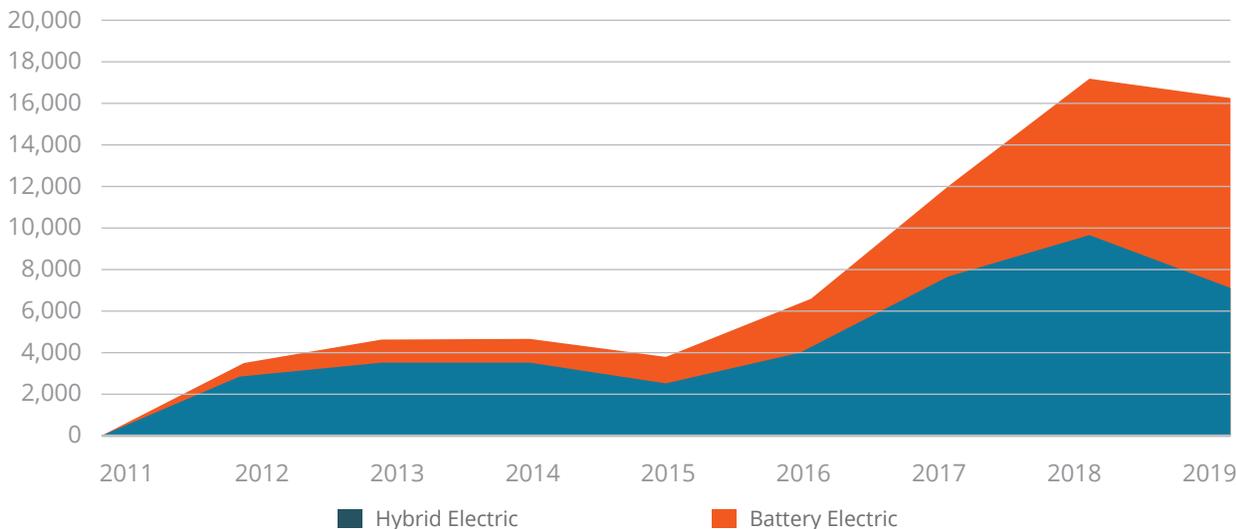


Figure 4-10
Electric Vehicle Registrations in New York State

Source: New York State Department of Motor Vehicles



CURRENT CONDITIONS

SYSTEMS CHARACTERISTICS

The topography of the NYMTC planning area, which features three large islands that are home to more than 9 million people and 6.5 million jobs and a major river bifurcating portions of the planning area on the mainland, creates a number of pinch points in the regional transportation system.

The roadways and transit lines, and the bridges and tunnels that carry both are the infrastructure connection points used to move people and goods through this topographical landscape. Apart from the limitations imposed by these connection points, deterioration of this critical infrastructure could pose problems for the movement of people and goods and lead to increased congestion and resultant impacts on the region's economy and environment.

VEHICULAR CONGESTION

Vehicular congestion occurs when the demand for road space exceeds the supply, resulting in increased motor vehicle emissions during low speed, idling, and frequent acceleration events. In addition to ongoing recurring demand, there are numerous causes of additional congestion including traffic crashes and disruptions, weather conditions, and roadway construction, as well as fluctuations in traffic volumes for special events. Recurring vehicular congestion in the NYMTC planning area is particularly acute on weekdays during the morning and evening peak travel periods (generally, between 6:00 a.m. and 10:00 a.m. and between 4:00 a.m. and 8:00 p.m., but also increasingly earlier in the afternoon period).

Table 4-1

Urbanized Area Comparisons

Source: Texas Transportation Institute, 2019 Urban Mobility Scorecard

Metropolitan Area	Population (millions)	Daily VMT/Capita (Freeway + Arterial)	Travel Time Index
Boston	4.50	19.13	1.30
New York City	19.10	12.05	1.35
Philadelphia	5.57	15.55	1.25
Washington, D.C.	5.02	17.90	1.35
Atlanta	4.90	22.41	1.30
Miami	6.04	16.58	1.31
Detroit	3.83	21.09	1.24
Chicago	8.72	15.54	1.32
Houston	5.18	20.82	1.34
Dallas	5.63	21.20	1.26
Phoenix	4.00	18.29	1.27
San Diego	3.20	19.51	1.35
Los Angeles	12.67	19.75	1.51
San Francisco	3.54	17.12	1.50
Seattle	3.40	17.15	1.37
Peer Region Average	6.35	18.27	1.33

Vehicular congestion can be measured in several ways, and these methods are fully described in NYMTC's CMP Status Report, which was published in conjunction with *Moving Forward*. One such measure is travel time index, which represents the average additional time required during peak times compared to times of optimal traffic levels.

As defined by the U.S. Census Bureau, the New York-Newark NY-NJ-CT UZA is the largest in the country by population, with nearly 7 million more residents than the Los Angeles-Long Beach-Anaheim CA UZA. Among peer UZAs, the New York-Newark NY-NJ-CT has the lowest daily VMT per capita but a higher than average travel time index. The lower VMT per capita is likely due to the greater availability and use of public transportation throughout the New York UZA. These data are presented in [Table 4-1](#).

MODAL CHOICE

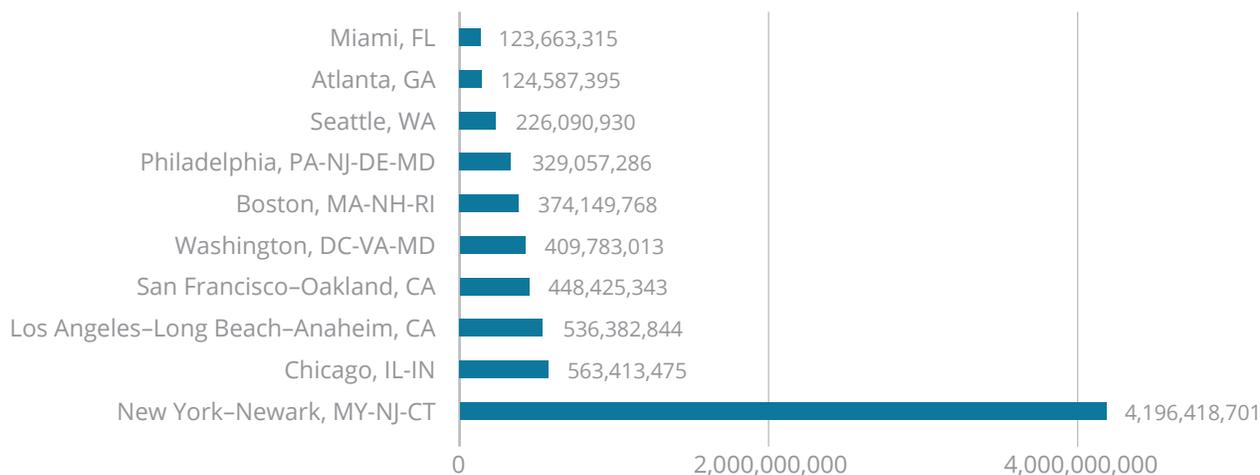
NYMTC's planning area features an extensive system of rapid transit, commuter rail transit, and bus transit provided by MTA, PATH, NJ Transit, Connecticut Transit, NYSDOT, and five suburban counties. These transit services increase the efficiency of the transportation system by providing an effective alternative to driving a private vehicle.

Prior to the COVID-19 pandemic, millions of passengers took advantage of these services on a given weekday. The availability of these transit services facilitates millions of passenger trips that would otherwise increase VMT and congestion. See [Figure 4-11](#). The extensive availability of transit in the New York metropolitan area is a major reason New York State is the state with the lowest per capita use of motor fuel in the nation.

Figure 4-11

Total Transit Ridership in the Top Ten Urbanized Areas (July 2018–June 2019)

Source: FTA, National Transit Database



THE EMERGENCE OF SHARED MOBILITY AND MICROMOBILITY

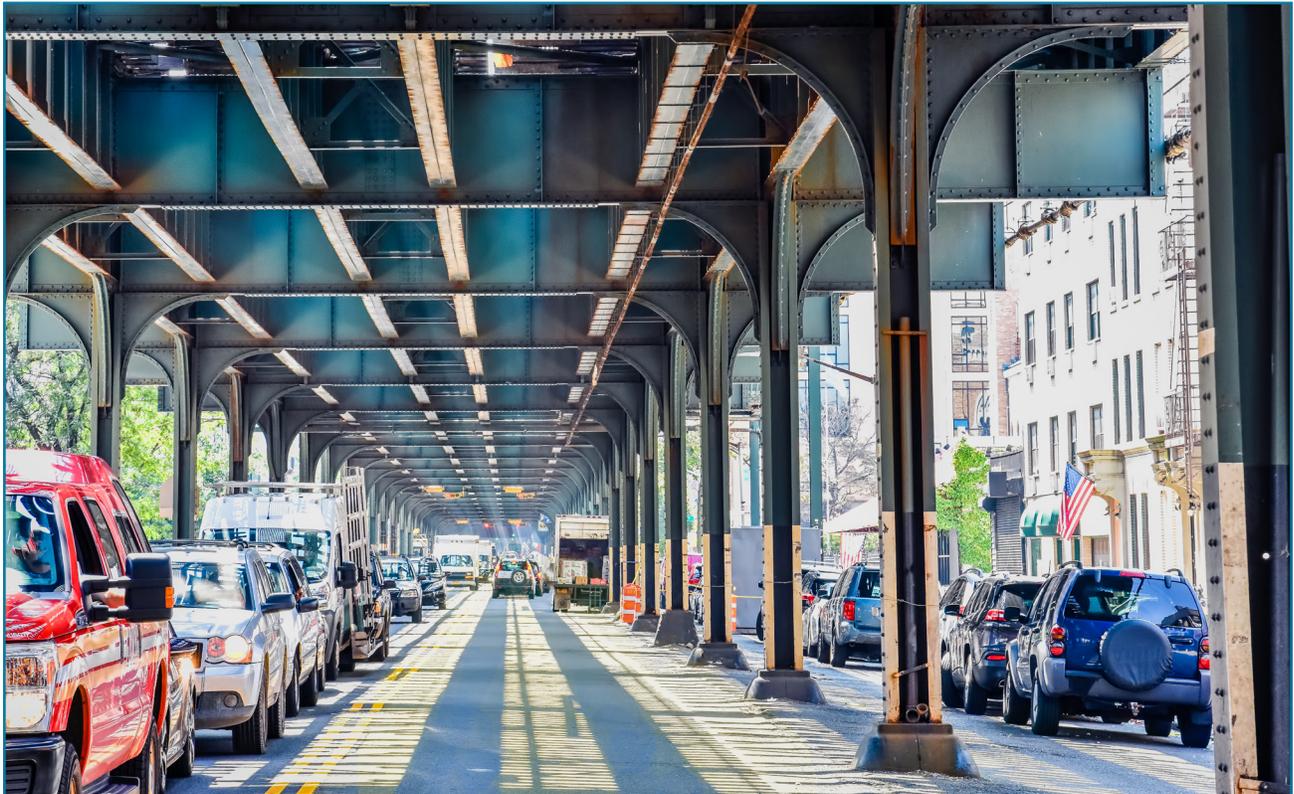
Given the recent rapid development of shared mobility and micromobility services as noted in [Chapter 3](#) in the discussion about the impacts of transformative change, several issues have arisen related to this Vision Goal that will need to be addressed as the services and technology associated with shared mobility and micromobility continue to develop during the planning period. These include the following:

- **Integration with Existing Services.** As shared mobility and micromobility services have grown and developed, service providers, computer apps, and business models have proliferated, some of which compete directly with publicly provided transportation services. To the extent that this competition reduces the capacity and efficiency of the transportation system as a whole and increases vehicular travel, it challenges the ability to achieve the Vision Goal of minimizing impacts on the environment.

- **Congestion Mitigation and Emissions Reduction.** As noted above, shared mobility services that increase vehicular travel and reduce the efficiency of the overall transportation system create issues from the perspective of this Vision Goal, given the overarching imperatives of reducing vehicular congestion and related vehicular emissions.

RELIANCE ON TRUCKS

As described in detail in *Moving Forward's Regional Freight Element (Appendix H)*, 655 million tons of freight and 51 million units (trucks and railcars) with a value exceeding \$1 trillion were moving into, out of, and within the multi-state metropolitan region in 2018. The largest shares of tonnage and value were moving inbound to the region, and the lowest were moving outbound from the region. The largest shares of units were moving within the region, reflecting the redistribution of goods between producers, warehouse/distribution facilities, and end users, with the inclusion of empty truck return moves reflected in the total.



EXISTING INITIATIVES

CLIMATE LEADERSHIP AND COMMUNITY PROTECTION ACT

On July 18, 2019, Governor Andrew M. Cuomo signed into law the Climate Leadership and Community Protection Act. New York State's Climate Act is the among the most ambitious climate laws in the world and requires New York to reduce economy-wide greenhouse gas emissions 40 percent by 2030 and no less than 85 percent by 2050 from 1990 levels. The law creates a Climate Action Council charged with developing a scoping plan of recommendations to meet these targets and place New York on a path toward carbon neutrality. Transportation is a significant source of greenhouse gases; therefore, the scoping plan that will be developed by the Climate Action Council will have a significant impact on the transportation sector moving forward.¹⁸

CONGESTION MANAGEMENT PROCESS

As a federally designated Transportation Management Area, NYMTC must maintain a CMP to forecast traffic congestion and consider congestion-reduction strategies. The CMP is intended to help NYMTC's members enhance the regional planning processes, as carried out through this Plan, the TIP, and the unified planning work program. The CMP establishes performance measures to define (1) transportation system congestion; (2) a toolbox of strategies to address congestion; a methodology to evaluate and prioritize congestion-reducing projects and strategies; and (3) a mechanism to assess the effectiveness of implemented strategies. To fulfill federal requirements, NYMTC is required to produce a CMP Status Report every four years in conjunction with the release of the regional transportation plan. Given the contribution that vehicular congestion makes to the transportation system's impact on the environment, NYMTC's CMP is a relevant ongoing initiative for this Vision Goal.

ACTIVE TRANSPORTATION AND DEMAND MANAGEMENT PROGRAM

NYSDOT administers an ongoing program that supports managing demand through ride-match, guaranteed ride, and employer partner programs. Programs also support air quality action day alerts, encouraging those in affected areas to use transit and other alternate efficient transportation modes.

TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATIONS

TSM&O refers to the integrated strategies that optimize the performance of transportation infrastructure through projects and programs designed to operationally maximize capacity and improve the safety and reliability of the transportation system. TSM&O enhancements can help provide travelers with real-time information about transportation choices in and around the region. TSM&O solutions can offer high returns on lower-cost operational projects and programs that can delay or eliminate the need for capital-intensive infrastructure projects.

Additionally, these solutions can help reduce emissions of transportation-related greenhouse gases and other mobile source pollutants by maximizing system efficiency. TSM&O also seeks to improve the safety, security, and resiliency of the transportation system. Managing demand and congestion and maximizing capacity and reliability within a safe transportation environment using TSM&O strategies can enhance air quality and the regional environment while improving mobility, system safety and security, and system resilience, and optimizing travel times and costs for all travelers.

STRATEGIC SYSTEM ENHANCEMENTS

[Table 5-5](#) in [Chapter 5](#) identifies several planned enhancements within its fiscally constrained component. These enhancements expand the federally supported transportation system's capacity through the addition of new components or through the increased ability of existing components to move people, vehicles and/or goods. These include both

major system enhancements, generally defined as transportation projects or programs that meet this definition with an estimated cost of \$100 million or greater and/or those of regional scope or impact, and minor system enhancements with lower estimated costs and/or lesser scope or impact.

CONGESTION MITIGATION AND AIR QUALITY IMPROVEMENT PROGRAM

The CMAQ program provides a flexible funding source for MPOs, states, and local governments to fund transportation projects and programs that reduce traffic congestion and/or vehicular emissions to help meet the requirements of the Clean Air Act Amendments of 1990 and the CMP. CMAQ funds are used to support transportation projects that reduce mobile source emissions in areas designated by USEPA to be in nonattainment or maintenance of the NAAQS.

As part of the federal transportation performance management requirements, NYMTC prepares a CMAQ Performance Report that analyzes progress in achieving targets set for three system performance measures related to air quality and the environment: annual hours of PHED, percent of non-SOV travel at the UZA level, and total emissions reductions for mobile sources in the relevant air quality nonattainment and maintenance areas. These measures are fully described in [Chapter 3](#) of this Plan.

CONTEXT SENSITIVE SOLUTIONS

Context Sensitive Solutions is a disciplinary approach to transportation project development that NYSDOT has adopted for many of its projects. Context Sensitive Solutions recognizes the need to develop transportation solutions that supplement and support the social, economic, and environmental context of the facility. Aesthetic treatments and visual enhancements are often important to designing a facility that is responsive to environmental and stakeholder needs. Context Sensitive Solutions provide comprehensive solutions to transportation issues to minimize negative impacts to community and environmental values and to design projects that

best fit the physical setting and work to enhance the community and environment of which they are a part.

In the NYMTC planning area, NYSDOT has fully integrated Context Sensitive Solutions into its planning and design processes by engaging in early, effective, and continuous public involvement to yield safe transportation solutions that are designed in harmony with the community. Community issues are identified through a structured format (e.g., public workshops, advisory committees) and active partnership with municipal or federal and local agencies.

COMPLETE STREETS

A Complete Street is a roadway planned and designed to consider the safe, convenient access and mobility of all roadway users. New York State's Complete Streets Law, enacted in 2011, requires state, county, and local agencies to consider the convenience and mobility of all users (e.g., pedestrians, bicyclists, public transportation riders, and motorists; children, the elderly, and persons with disabilities) when developing projects that receive state or federal funding are subject to NYSDOT oversight. Complete Street roadway design features include sidewalks, lane striping, bicycle lanes, paved shoulders suitable for use by bicyclists, signage, crosswalks, pedestrian control signals, bus pull-outs, curb cuts, raised crosswalks, ramps, and traffic calming measures. Features are tailored to the needs of the location.

CLEAN VEHICLES PROGRAMS

Clean vehicles programs are intended to reduce motor vehicle emissions by incenting the use of vehicles—both privately and by public fleets—that are electric or powered by cleaner alternative fuels. In the NYMTC planning area, these programs include the following:

- The Greater Long Island Clean Cities Coalition and Empire Clean Cities operate in the NYMTC planning area. Both are part of the U.S. Department of Energy's **Clean Cities** national network,

which is intended to build partnerships to advance affordable, domestic transportation fuels and technologies.¹⁹ The Greater Long Island Clean Cities Coalition seeks to increase the public's awareness and use of alternative fuels and alternative fuel vehicles while decreasing regional and national dependency on foreign oil. The Coalition has been awarded and distributed \$10 million in CMAQ funds and more than \$14 million in U.S. Department of Energy American Recovery and Reinvestment Act to Long Island organizations advancing the use of alternative fuel vehicles.²⁰ Empire Clean Cities (formerly New York City and Lower Hudson Valley Clean Communities, Inc.) seeks to provide citizens and stakeholders with access to reliable information about alternative fuels, advanced vehicle technologies, and green transportation practices that reduce emissions in New York City and the Lower Hudson Valley.²¹

- **Charge NY** is New York State's initiative to get more electric cars and trucks on the road by helping accelerate electric car sales. The State is focused on raising awareness of technology and supporting the installation of more charging stations to make it easy to travel anywhere in New York in an electric car using rebates, incentives, tax credits, charging stations, and infrastructure installation options.²²
- **New York Truck Voucher Incentive Program** is administered by the New York State Energy Research and Development Authority in collaboration with NYSDOT and NYSDEC, who provide funding. This program provides vouchers or discounts to fleets across New York State that purchase or lease all-electric, hydrogen fuel cell electric, plug-in hybrid electric, conventional hybrid electric, compressed natural gas, or propane medium- and heavy-duty vehicles (weight class 3 through 8) and scrap a similar older diesel vehicle that is part of their fleet.²³



- NYC DOT launched the **Hunts Point Clean Trucks Program** in 2012 to replace, retrofit, or scrap heavy-polluting diesel trucks from the South Bronx and New York City. Since its inception, the Hunts Point Clean Trucks Program has provided incentive funding for the replacement, retrofit, or scrapping of more than 622 older heavy-polluting diesel trucks from the South Bronx business communities of Hunts Point and Port Morris. In 2020, NYC DOT expanded the Hunts Point Clean Trucks Program to provide funding for applicants in program-approved New York City Industrial Business Zones across the city as the **NYC Clean Trucks Program**.²⁴
- Developed in 2009, the original **Clean Air Strategy for the Port of New York and New Jersey** outlined voluntary actions to reduce emissions from maritime-related activities at the Port of New York and New Jersey by 2020 despite any port growth. The strategy covers the Brooklyn Port Authority Marine Terminal, Howland Hook Marine Terminal, Port Newark, Port Jersey Marine Terminal, and Elizabeth Port Authority Marine Terminals.²⁵
- The **NYMTC Clean Freight Corridors Planning Study** is assessing opportunities for the development of clean freight corridors in the NYMTC planning area that are integrated within the larger multi-state metropolitan region. The study will identify a series of roadways that can be designated—formally through federal designation programs and/or through *Moving Forward*—as clean freight corridors to optimally advance high-efficiency, low-emission alternative transportation technologies for goods movement across all types of freight-related vehicles. The roadways to be assessed for this purpose may include limited access highways; major and minor arterial roadways; collector roads; and local roads that feed intermodal centers, trucking “hubs,” and areas of concentrated goods movement activity.
- **The Northeast Diesel Collaborative** is a regionally coordinated initiative to reduce diesel emissions, improve public health, and promote clean diesel technology. The Collaborative brings together the collective resources and expertise of several state environmental agencies, USEPA regional offices, and private sector companies to address the existing fleet of diesel-powered vehicles and equipment.²⁶

4.5.4 RECOMMENDED STRATEGIES AND ACTIONS

The regulations detailed in 23 CFR 450.324 govern the development and content of the metropolitan transportation plan. These regulations contain the following requirement:

The transportation plan shall include both long-range and short-range strategies/actions that provide for the development of an integrated multimodal transportation system (including accessible pedestrian walkways and bicycle transportation facilities) to facilitate the safe and efficient movement of people and goods in addressing current and future transportation demand.

Several categories of short- and medium-range strategies and actions recommended in pursuit of this Vision Goal are described below. Additionally, specific projects, programs, and studies recommended for funding in the fiscally constrained element of *Moving Forward*, as well as those recommended for future consideration in the speculative vision element of the Plan, are described in [Appendix A](#).

PLANNING AND RESEARCH INITIATIVES

- Research recommendations:
 - Investigate opportunities for better integrating shared mobility and micromobility in the transportation system.
 - Research technological options for greater freight integration.
 - Explore technologies related to environmental stewardship.
 - Consider incentives for alternative fuel vehicles/electric vehicle ownership.
- Engage in multimodal planning studies to address congested links identified through the CMP.
- Use the results of the inventory of freight-related land uses to identify opportunities for rail freight and intermodal capacity expansion.

DATA COLLECTION, FORECASTING, AND PERFORMANCE ASSESSMENT

- Monitor congested link-level performance.
- Monitor truck traffic and commodity flows.
- Report on greenhouse gas forecasts with each Transportation Conformity Determination.

PLANNING PROCESS RECOMMENDATIONS

- Continue convening relevant agencies and private sector interests through the Multi-State Freight Working Group to improve the efficiency of freight delivery.
- Develop multi-agency approaches for benchmarking and sharing vehicle specification information for public fleet procurement.
- Encourage suburban municipalities to adopt Complete Streets policies to accommodate transit, walking, and biking to reduce vehicle congestion and associated emissions.
- Develop and adopt environmental stewardship guidelines for project selection.
 - Employ bioswales where practical in watershed areas.

PROGRAM RECOMMENDATIONS

- Community planning program:
 - Include alternatives to SOV trips in the program of community planning activities.
- Commuting alternatives program:
 - Enhance and coordinate employer commuting programs throughout the NYMTC planning area.
 - Enhance outreach to major employers, the business community, hospitals, colleges, and other institutions to encourage alternatives to SOV travel.
 - Continue and enhance model programs for use at developments

such as office parks, medical facilities, and college campuses that include emerging and innovative transportation services such as shared mobility and micromobility.

- Public messaging and marketing programs:
 - Undertake initiatives that encourage use of public transit; encourage seniors to sign up for reduced fare transit services.
 - Enhance the public visibility of the 511NY service and its various components.
- Vehicular emissions program to reduce emissions from publicly and privately owned vehicle fleets:
 - Purchase either hybrid or all-electric vehicles and ferries that run with cleaner engines in transit life-cycle replacement programs.
 - Continue and expand a program of information sharing for local municipal vehicle fleets, through existing Clean Cities programs where feasible.
 - Support accelerated retirement of pre-Tier 4 diesel engines in the legacy fleet and replace with cleaner alternatives such as trucks running on renewable diesel or alternative fuels such as compressed natural gas and electric vehicles.
 - Increase access and availability of electric vehicle charging stations and other alternative fuels to support clean freight goals.
 - Encourage the use of cargo bicycles for commercial purposes.
- Innovative materials program:
 - Test permeable pavement and concrete; install green infrastructure on streets.
 - Share information on tests of permeable surfaces among NYMTC's members responsible for roadways.

4.5.5 PERFORMANCE METRICS

The regulations detailed in 23 CFR 450.324 govern the development and content of the metropolitan transportation plan. These regulations contain the following requirement:

A description of the performance measures and performance targets used in assessing the performance of the transportation system

The performance measures listed below will assist in measuring progress toward this Vision Goal and its objectives, and in informing investment decisions:

- **Criteria Air Pollutant Levels.** NYSDEC measures levels of outdoor air pollution at stations throughout the NYMTC planning area.
- **Greenhouse Gas Inventory Levels.** The New York State Energy Research and Development Authority compiles an inventory of greenhouse gas levels throughout New York State.
- **VMT.** NYSDOT compiles VMT data for the Highway Performance Management System, whose data are used extensively in the analysis of highway system condition, performance, and investment needs.
- **Vehicle Hours of Delay.** NYMTC uses the NYBPM to calculate vehicle hours of delay for the CMP and can access observed data through TRANSCOM and other available data sources.

4.6 VISION GOAL - RESILIENCY

A transportation system that is resilient and can mitigate, adapt to, and respond to chronic and acute stresses and disruptions.

4.6.1 DESCRIPTION

This goal seeks to enhance the transportation system's resilience to stressors and disruptions that will have a growing impact across the region in the longer term. These include climate change, sea level rise, and extreme weather; human-caused stressors such as cyberattacks and acts of terrorism; and public health emergencies. The goal also seeks to inform the ongoing recovery process from past and current stresses and disruptions through feasible, cost-effective strategies to reduce and manage vulnerabilities, advance the state of knowledge, and develop methods to assist agencies in the region to plan and invest for long-term, "all hazards" resilience.

ADAPTATION OPTIONS²⁷

Transportation agencies are responsible for operating the multi-state metropolitan region's transportation system day-to-day, forecasting how people and freight will use the system in the future, and making long-term investment decisions to anticipate changing future conditions. These decisions are typically based on incomplete or uncertain information. Agencies can face "analysis paralysis" from the overwhelming amount of uncertainty and a range of variables that must be considered when considering potential options to make a system more resilient.

Potential disruptions introduce risks to overall system performance, which, if not incorporated into long-term infrastructure and service planning, most likely will increase risk of premature system failures and hazards to people and personal property.

A way forward is to focus first on the characteristics of the decisions to be made and then use that information to narrow the range of disruption scenario choices to be considered. Initially, three key factors should be considered:

1. **Tolerance for risk.** How acceptable is the potential harm from climate risks? Consider both the potential consequences of harm (e.g., severity, length and extent of disruption, and criticality of the facility) and the degree to which such harm is acceptable to decision-makers and the public.
2. **Costs of adaptation and available resources.** High costs for adaptation options make it more difficult to address higher consequence/lower probability outcomes. Low marginal costs make it easier to address such outcomes.
3. **Feasibility.** Engineering and environmental constraints, community acceptance, operational implications, and economic considerations all can influence what strategies should be considered in an adaptation assessment. These considerations should be part of the decision-making process early.

MPOs and transportation organizations in the multi-state metropolitan region have taken steps to address risks. Nonetheless, there are significant barriers because of insufficient data, uncertainty about future impacts, difficulties in coordination, and insufficient funding for adaptation.

Decision-making techniques are available that consider strategies appropriate for addressing uncertain risks and consider such factors as timing of risks, the need to avoid adverse impacts, costs, and feasibility. The "state of adaptation" for the transportation sector in the multi-state metropolitan region is that a lot of good work by states, regional organizations, municipalities, and MPOs is underway. However, barriers, which if not overcome, could substantially limit the extent and effectiveness of adaptation efforts.

4.6.2 OBJECTIVES

1. Protect and fortify major transportation assets.
2. Continue to invest in sea level rise and climate change risk analyses for transportation assets.
3. Improve regional coordination on emergency and long-term responses to system-wide climate impacts.
4. Enhance the transportation network's resiliency by increasing travel options and redundancies.

4.6.3 RECENT TRENDS, CURRENT CONDITIONS, AND EXISTING INITIATIVES

RECENT TRENDS

ENVIRONMENTAL AND CLIMATE STRESSORS²⁸

In October 2012, Hurricane Sandy, also known as "Superstorm Sandy," caused catastrophic damage to much of the multi-state metropolitan region. A storm surge that coincided with the highest tide of the month caused sea levels along the New Jersey coast, on southern Long Island, and in New York Harbor to rise higher than ever before in recorded history. Many critical transportation facilities were inundated (in the case of some tunnels from floor to ceiling), and transit and roadway facilities were shut down (in some cases for weeks). The storm affected the reliability of the region's multimodal transportation system. Major power generating stations, electrical substations, emergency backup generators, oil refineries, fuel storage facilities, and other critical components of the region's electrical and fuel distribution system were affected, with associated impacts on the transportation system.

Two other storms with severe impacts—Hurricane Irene and Tropical Storm Lee—arrived in the multi-state metropolitan region within two weeks of each other in late August and early September 2011 and caused inland flooding and wind-related damage in northern New Jersey and the Lower Hudson Valley. Some roadways and transit lines

were damaged by floods and debris from Irene's winds and rain, and then were re-submerged when the same rivers and streams flooded again after Lee. In some cases, trees that survived Irene's winds were unable to withstand a second storm when waterlogged soils were unable to support the roots of larger trees once Lee arrived.

The Halloween Nor'easter of 2011 followed closely after Irene and Lee, but this third storm took a more southeasterly track, and therefore had its greatest impacts in Connecticut. In southwest Connecticut and Westchester County, New York, the Halloween Nor'easter dumped unusually large amounts of snow on trees still covered with leaves relatively early in the fall season. Combined with the weight of the accumulated snow, the winds associated with this storm toppled many trees, blocking area roadways and train lines, and tearing down power lines that supplied electricity to MTA MNR as well as traffic signals and streetlights. Parts of Connecticut, primarily in the northern part of the state, were without electricity for more than a week.

This extraordinary quartet of severe storms created different stressors for the transportation system in the multi-state metropolitan region. Taken together, these storms illustrated a range of transportation resiliency issues that has significantly altered the transportation planning process.

HUMAN STRESSORS

In addition to climate and environmental stressors affecting the resilience of the transportation system in the multi-state metropolitan region, several critical human-related stressors have emerged over the last two decades.

CYBERSECURITY

As the transportation system and its components become increasingly automated and interconnected through the internet, new potential stressors related to cyber manipulation emerge that will affect the operation of those components. Further, the ongoing technological development and transformation of the transportation system and the way people and

goods move around that system heighten the potential for cyber manipulation of the system and of various conveyances.

Transportation is becoming more connected and dependent on advanced computing systems and software. Exciting next-generation communications technology—such as connected vehicles that exchange information in real time with nearby vehicles and infrastructure to make travel safer, cleaner, and more efficient—will soon be deployed on nation’s roads and highways. In exploring the potential of connected vehicles and other advanced technologies, USDOT has identified the important role of cyber security in protecting the systems, devices, components, and communications from malicious attacks, unauthorized access, damage, or anything else that might interfere with safety functions.²⁹

TERRORIST ACTS

According to U.S. Department of Homeland Security, more than 7,400 terrorist attacks worldwide between 1970 and 2014 targeted some form of transportation, including airports and aircraft, representing 5.3 percent of all terrorist attacks. More than 460 targets of terrorist attacks between 1970 and 2014 were airports, representing 6.4 percent of all transportation targets. More than 130 targets of terrorist attacks between 1970 and 2014 were subway systems, representing 1.9 percent of all attacks on transportation targets.³⁰

The multi-state metropolitan region has experienced acts and threats of terrorism that have widely affected the transportation system and threatened its future integrity and resilience. The terrorist attacks of September 11, 2001, disrupted critical regional transportation links and part of the organizational structure of both the transportation and emergency response sectors. Threats to and thwarted plots against other regional transportation links—bridges and tunnels primarily—have led to various initiatives and programs to harden and police these potential targets, where a diverse economy spread across multiple waterbodies makes these assets critical.

PUBLIC HEALTH EMERGENCIES

The National Disaster Medical System’s Federal Partners Memorandum of Agreement defines a public health emergency as “an emergency need for health care [medical] services to respond to a disaster, significant outbreak of an infectious disease, bioterrorist attack or other significant or catastrophic event.” Public health emergency scenarios places different demands and constraints on transportation systems and services, as well as on the workforce that maintains the facilities and provides the services.

COVID-19 was first identified in December 2019 and was declared a global health emergency by the World Health Organization at the end of January 2020 and a public health emergency by the United States in early February 2020. The World Health Organization declared a global pandemic in March 2020.³¹ The first case related to the pandemic in New York City was confirmed in March 2020.³² By April 2020, the New York City metropolitan region was the worst affected area in the United States. Non-essential businesses were closed in New York State by emergency order in late March, along with a stay-at-home order for residents.³³ Similar orders were issued in Pennsylvania, New Jersey, and Connecticut, thus affecting the entire multi-state metropolitan region. The pandemic has greatly affected travel within the multi-state metropolitan region, with public transit ridership and motor vehicle travel plummeting, while teleworking arrangements have ballooned for remote-capable businesses and organizations.

Since the end of June 2020, many of the initial restrictions placed on the multi-state metropolitan region under the COVID-19 pandemic have been modified or lifted, while others remain in place. Although travel has rebounded somewhat, many teleworking arrangements remain in place, resulting in lower levels of public transit ridership and vehicle volumes than under normal circumstances. Goods movement has rebounded more quickly and is approximating pre-pandemic levels.



CURRENT CONDITIONS

ENVIRONMENTAL AND CLIMATE STRESSORS

FHWA launched the Post-Hurricane Sandy Transportation Resilience Study (Post-Sandy Study) to enhance the multi-state metropolitan region's resilience to climate change, sea level rise, and extreme weather in the longer term, while informing the ongoing recovery process. The results of the study were released in 2017.

FHWA collaborated with partners in Connecticut, New Jersey, and New York—including NYMTC and two of its members, MTA and the Port Authority—to leverage the lessons learned from Hurricane Sandy and other recent events, as well as future climate projections, to develop feasible, cost-effective strategies to reduce and manage extreme weather vulnerabilities amid the uncertainties of a changing climate.

The Post-Sandy Study compiled information on damage and disruption wrought by Hurricane Sandy in 2012 and Hurricane Irene, Tropical Storm Lee, and the Halloween Nor'easter in 2011 on the region's transportation system. The impacts of these four extreme weather events varied across the region, and considering them together provided a wide range of potential extreme weather-related consequences for the transportation system. The study also compiled climate projections and continuously monitored updates from the scientific community.

With an understanding of these impacts and projected future climate conditions, the Post-Sandy Study assessed the exposure of the transportation system to climate stressors at a regional scale, developing information that can be used by transportation agencies in the multi-state area to advance more detailed vulnerability and risk assessments.

Storm Surge

Hurricane Sandy's storm surge generated the most significant impacts to transportation infrastructure. The storm surge inundated much of the coastline in the multi-state metropolitan region and caused significant damage to transportation infrastructure, notably damaging or destroying roads and bridges along the Jersey Shore and the south shore of Long Island and flooding numerous roadway and subway tunnels under the Hudson and East rivers. The surge was compounded by a concurrent high tide.

Hurricane Irene made its initial landfall in the continental United States significantly farther south than Sandy made its landfall, and Irene approached the New Jersey shore from a shallow angle on a northeasterly track, compared to Sandy's more direct impact on a northwesterly track. Therefore, Hurricane Irene produced much smaller storm surges than Hurricane Sandy. Storm surge in the region, especially along the western shore of New York Harbor

and the Hudson River, caused rivers to back up, exacerbating the effects of riverine flooding.

Wind

Although Hurricane Sandy's storm surge caused the most damage to transportation infrastructure in the multi-state metropolitan region, the storm also resulted in widespread wind damage. Sandy's maximum sustained winds fell below hurricane levels (74 mph) as the storm came ashore, but wind gusts were significant, especially at Newark Airport (78 mph), JFK Airport (85 mph), and Long Island MacArthur Airport (90 mph).

Wind damage to transportation infrastructure in the multi-state metropolitan region was prevalent as Hurricane Irene made landfall. The storm produced significant peak wind gusts, especially in and around New York City. High gusts were experienced at LaGuardia Airport (67 mph), Sikorsky Memorial Airport (63 mph), and Long Island MacArthur Airport (62 mph). The direction of peak wind gusts was generally onshore and from the east or south; Newark's peak gust (from the west) was an exception.

Rainfall

Compared with Hurricane Sandy's storm surge, rainfall was not a significant impact of the storm on its own. However, elevated stream levels and increased discharge rates compounded flooding, especially for low-lying infrastructure near the coast. While rainfall totals from the storm were modest, most weather stations reported an intense period of rain as the storm came ashore, especially the southern and western portions of the multi-state metropolitan region. This undoubtedly compounded the flooding of transportation infrastructure in many coastal areas.

Heavy rainfall caused the bulk of damage associated with Hurricane Irene. Elevated stream levels and increased discharge rates compounded flooding, especially for low-lying infrastructure in riverine flood plains and near estuaries. Rainfall totals from the storm were generally greater than those produced by Hurricane Sandy.

Tropical Storm Lee was different from Hurricanes Sandy and Irene in that it approached from the southwest, rather than from the Atlantic Ocean, and did not meet tropical storm definitions when it moved into the area. Because the extra-tropical remnants of Lee could not feed off warm ocean waters, the rainfall, wind, and storm surge associated with the storm were much less than with Sandy and Irene. However, the timing of Lee—slightly more than a week after Hurricane Irene—meant that the region was generally much more susceptible to damage, specifically with respect to flooding. The rainfall associated with Lee was responsible for the storm's greatest impacts. While overall rainfall amounts were not as impressive as those during Hurricane Irene, soils that were still water-laden from Irene led to drastically reduced absorption rates. Swollen rivers compounded the flooding issues caused by Irene; riverine flooding caused the majorities of Lee's impacts on transportation infrastructure.

Snowfall

The Halloween Nor'easter affected the multi-state metropolitan region nearly two months after Hurricane Irene and Tropical Storm Lee, but it compounded recovery efforts in a region still reeling from the two prior storms. The main impacts came not from wind, surge, or rainfall, but from snow. Snow totals were highest in areas already hard hit by Irene and Lee—northern New Jersey and the Lower Hudson River Valley—as well as in southwest Connecticut. Many of these areas received nearly a foot of snow. Snow fell on trees that were typically still in leaf and generally weakened by the previous storms. This caused many trees and branches to topple, resulting in widespread damage to power lines in parts of the region, which in turn disabled many traffic signals. Some parts of Connecticut saw power outages that lasted more than a week. The snowfall and subsequent downed trees and power lines affected rail service within the study area. Many Amtrak trains were delayed or canceled, and NJ Transit suspended service on two lines. Additionally, MTA MNR suspended commuter rail service on several lines due to fallen trees caused by the combination of wind and snow.

ASSESSING VULNERABILITY

NEW YORK CITY

The work undertaken by New York City in the wake of Hurricane Sandy represents the most thorough vulnerability and risk assessment available in the multi-state area. The publication of *A Stronger, More Resilient New York* in 2013 and the 2015 update of the New York City Panel on Climate Change report are among the most prominent examples of policy-level and analytics-based reports published to support vulnerability and risk assessment.

As an example of the work that has been conducted to date, the City collected detailed exposure data in the wake of Hurricane Sandy that it then compared to 100-year and 500-year floodplain maps. Sea level rise, storm surge, and intense precipitation events are identified as posing the greatest risks to the City's transportation infrastructure. The 100-year flood plain encompasses:

Approximately 12 percent of the [City's] roadway network, all of the major tunnel portals other than the Lincoln Tunnel, portions of both airports, a variety of commuter rail assets, all three heliports, and a number of subway entrances and vent structures, principally in Lower Manhattan.

By the 2020s, the floodplain is estimated to encompass 15 percent of the city's roadway network, and by the 2050s, it is expected to encompass 19 percent of that network. More and more of the City's airport infrastructure will be at risk as storm surges will move from flooding outlying runways to threatening the terminal buildings, while additional subway stations will be at risk.

More intense downpours expected with climate change also pose a major risk to the transportation system. As with storm surge, heavy downpours pose the most significant challenge to subway and vehicular tunnels throughout the city, particularly in locations where tunnel entrances are located in low-lying areas or in areas with poor subsurface drainage.³⁴

Other identified risks to the City's transportation include high winds, heat waves and—by the 2050s—tidal flooding. The regional exposure analysis identified several clusters of vulnerable and critical transportation facilities in New York City, including the following:

- Lower Manhattan, including the Battery Park Tunnel and the north portal to the Hugh L. Carey Tunnel, Battery Park City and New York State Route 9A, and FDR Drive on the Lower East Side.
- The east bank of the Hudson River and the east bank of the Harlem River, including the MTA MNR Hudson Line, portions of the Amtrak Empire branch, and New York State Route 9A.
- The area around Flushing Bay in the Bronx, Queens, and Manhattan, including LaGuardia Airport, the Oak Point Rail Yard, the Hunts Point Terminal Market, portions of Interstate 678 in Whitestone, portions of the Grand Central Parkway and Northern Boulevard on the south shore of Flushing Bay, and the north approach to the Whitestone Bridge.
- The mouth of the Hutchinson River, including the U.S. Route 1 bascule bridge, the Hutchinson River Parkway bascule bridge, Amtrak Northeast Corridor bascule bridge, and the Pelham Parkway bascule bridge.
- The area around Jamaica Bay, including portions of the Belt Parkway, Cross Bay Boulevard, Flatbush Avenue, Neptune Avenue, and many other streets in south Brooklyn and southeast Queens that are part of the NHS, as well as the LIRR Far Rockaway Branch, the NYCT right-of-way south of Howard Beach, the Rockaway bus storage facility, and John F. Kennedy International Airport.
- The west shore of Staten Island along Arthur Kill, including portions of the West Shore Expressway (New York State Route 440), the Arthur Kill Railroad Bridge, and New York Container Terminal.

- Numerous moveable bridges and bridge approaches that are part of the NHS spanning Gowanus Canal and Newtown Creek.

LONG ISLAND

Sea level rise, storm surge, and extreme heat events are the climate stressors of primary concern on Long Island. The following areas have high potential for exposure today:

- All transportation facilities on the south shore of Long Island, roughly south of Merrick Road and west of the Connetquot River, may be exposed to inundation from storm surge during coastal storms (both summer/fall tropical storm events and winter Nor'easters).

A Category 1 hurricane or equivalent Nor'easter could expose Long Beach Island, Island Park, and Barnum Island to inundation from storm surge, including the major north-south evacuation routes from Long Beach: most of the Nassau Expressway; large portions of Peninsula Boulevard, Austin Boulevard, and Long Beach Road south of Sunrise Highway; sections of the Loop Parkway and Meadowbrook Parkway; and the MTA LIRR Long Beach branch.

Jones Beach Island also could be exposed, with portions of Ocean Parkway and Wantagh Parkway potentially inundated. Fire Island is vulnerable to exposure from storm surge; the southernmost portions of Robert Moses Causeway and William Floyd Parkway could be inundated, as well as the ferry terminals along both sides of Great South Bay.

- By 2050, projected sea level rise could mean that a Category 1 storm (or equivalent winter Nor'easter) would cause much more widespread flooding, and storm surge from what is considered a minor coastal storm today could inundate large areas as described above.
- Elsewhere on Long Island, low-lying portions of Montauk Highway and

the MTA LIRR Montauk branch near Napeague (between East Hampton and Montauk) are particularly vulnerable to inundation from storm surge, including overwashing as water flows between the Atlantic Ocean and Napeague Bay during severe coastal storms. Similarly, at the eastern extent of the North Fork of Long Island, portions of Main Road flood between East Marion and Orient and in Orient Point (including the Orient Point ferry terminal).

- The MTA LIRR Ronkonkoma branch is exposed to coastal flooding between Southold and Greenport. Other NHS routes potentially exposed to flooding in Category 1 hurricane (or equivalent Nor'easters) include New York State Route 114 between Sag Harbor and Shelter Island, portions of New York State Routes 24 and 25 near Riverhead, and a short segment of New York State Route 25A near Cold Spring Harbor.
- The regional and local roads serving as the sole access points to coastal communities, sewage treatment plants, and other critical infrastructure along the north and south shores of Long Island also are potentially exposed. One example is Bergen Avenue, the sole access route to the Bergen Point Wastewater Treatment Plant in East Islip.
- Major regional transportation facilities on Long Island that are more inland are less exposed to storm surge, but the impacts of sea level rise are affecting a much larger area of Long Island. The water table is so close to the surface in communities closest to the waterfront, like Freeport and Baldwin Harbor, that saltwater ponding is visible on roadways at the highest tides of the month.

Outfalls from drainage systems can be submerged during high tide, and further inland, the rising water table prevents ponds originally designed as detention ponds from draining between storms. As a result, during even

moderate rainfall events (particularly those that occur within four hours of high tide) rainwater backs up in drainage systems and/or overtops retention and detention ponds. MTA LIRR is elevating electrical substations and other critical infrastructure along the Long Beach branch due to inland and coastal flooding that is expected to become more frequent.

LOWER HUDSON VALLEY

The primary climate stressor of concern in the Lower Hudson Valley (including Westchester, Rockland, and Putnam counties) is precipitation-based flooding. By 2100, the Lower Hudson Valley may have more precipitation per year (suggesting more days with saturated soils) and up to four additional days with more than 1 inch of rainfall. The following facilities are particularly vulnerable:

- The north-south parkways, the MTA MNR Harlem Line and arterial roadways that run along and through river and stream valleys in Westchester County are particularly exposed and sensitive to flooding from heavy rainfall events, particularly those that occur when soils are already saturated and unable to soak up runoff.
 - Large stretches of the Saw Mill River Parkway between Dobbs Ferry and Pleasantville regularly close during heavy rainfall events.
 - Sections of the Bronx River Parkway from Allerton Avenue to Ardsley Road also are exposed to flooding.
- East-west roads such as New York State Route 119, Virginia Road, and Harney Avenue are exposed to flooding during these events, which impede cross-county travel.
- Sea level rise and storm surge also are a concern for roads and rail lines adjacent to the Hudson River and Long Island Sound.
- Portions of the MTA MNR Hudson Line were inundated during Hurricanes Irene and Sandy, including the Harmon Yard in Croton-on-Hudson. At various points along the right-of-way, third rail, switches, snow melters, power transformers, and communications systems were inundated and destroyed by salt water, and this infrastructure may be exposed to future storm surges.
- Portions of the CSX River Line north of Stony Point in Rockland County also are exposed to storm surge.
- The Haverstraw and Ossining ferry landings are vulnerable to sea level rise and storm surge.

HUMAN STRESSORS

Facilities and conveyances that draw people to concentrated locations also make these locations attractive targets for disrupting cyberattacks and acts of terror aimed at mass casualties. As noted by the Mineta Transportation Institute:

Open to relatively easy penetration, trains, buses, and light rail systems offer an array of vulnerable targets to terrorists who seek publicity, political disruption, or high body counts. High concentrations of people in crowded quarters are inviting fodder for those who would cause mayhem and death. The massive amounts of explosives needed for truck bombs are unnecessary in crowded train stations, bus depots, carriages, or coaches. Even without large numbers of casualties, disruptions to transit can seriously impact a region's economy and the public's faith in the government's ability to provide basic protections to its citizens.³⁵

PUBLIC HEALTH EMERGENCIES

The public health emergency provoked by COVID-19 illuminated the following organizational risks and vulnerabilities for transportation agencies and service providers.

ORGANIZATIONAL IMPACTS ON TRANSPORTATION AGENCIES AND SERVICE PROVIDERS

- **New service demands** alter established service schedules and routes as the needs of essential workers who provide medical services take precedence during an emergency. Extending existing services or establishing new or specialized services cause a considerable organizational stress as new costs are incurred, and the transportation workforce is extended.
- **Absenteeism** in the transportation workforce increases significantly during a public health emergency as a result of workers' illness or injury, workers' needs to care for ill family members, and workers' fear of infection or injury. Additionally, certain public health measures (i.e., school closings, isolation, quarantining household contacts of infected individuals) increase rates of absenteeism. Higher levels of absenteeism also affect vendors and supply chains and therefore affect facility and equipment maintenance and the provision of service.
- **Revenue shortfalls** occur during public health emergencies from reductions in transit ridership and vehicular travel as a result of quarantining measures, business closures, remote operation, or other conditions that suppress and alter travel patterns. Significant revenue shortfalls have wide-ranging impacts on transportation organizations, from service reductions and shifting of services to more essential needs to deferral of capital projects and/or day-to-day maintenance.

- **Inter-agency coordination** is a high priority issue for transportation organizations during a public health emergency to ensure effective information exchange, coordination, and decision making. Coordination issues include communicating the transportation organization's capabilities and resources to local emergency management and public health agencies and working with partners in the emergency response, including other transportation organizations and transportation providers in affected areas.
- **Supply chains** for equipment and materials are disrupted during a public health emergency with significant impacts for transportation organizations. Contemporary supply chains are complex and interconnected and can be subject to shocks and disruptions.

OPERATIONAL VULNERABILITIES FOR TRANSPORTATION AGENCIES AND SERVICE PROVIDERS

- Protection of workers and customers becomes a major operational responsibility during public health emergencies. The workforce may require personal protective equipment, as recommended by the Occupational Safety and Health Administration and the Centers for Disease Control, and engineering controls such as physical barriers or standoff zones. Personal protective equipment for passengers and travelers and social distancing in vehicles and facilities using floor signs and public announcements may also be requirements.

Additionally, containment and control strategies need to be calibrated to the nature and severity of the emergency. Employee and/or customer screening may be needed to stop the spread of diseases. Social distancing practices may be needed in employee lounges, field workplaces, and/or maintenance work

areas. Employee healthcare capacities may need to be enhanced to address physical and mental health issues. Enhanced maintenance practices include regular enhanced cleaning of facilities, vehicles and equipment, and work locations and field offices.

Finally, remote operation for non-essential staff must be considered depending on the nature and severity of the public health emergency. Remote operations require an enhanced information technology capability and adequate equipment to support the portion of the workforce that has been assigned at-home work.

- **Service delivery** is affected in some fashion during most public health emergencies as demand for transportation services changes or is reduced because of at-home work, reduced commercial activities, fear of exposure to infection in public setting, and emergency directives. In addition, prioritization of emergency services for essential workers and supplies can affect an organization's operations.
- **Communication** during public health emergencies includes both public and workforce information about service status and changes, restrictions and requirements, and changes to procedures and policies. Coordination of public messages and information with other transportation organizations and government entities is important to avoid confusion and fear among the traveling public and the workforce. Internal communication with the workforce also takes on greater importance, particularly with regard to workforce safety measures and policies.
- **Delivery of capital projects** can be interrupted during public health emergencies depending on the nature and severity of the emergency. Entire capital programs may be impacted, or the

impacts may be limited geographically. Interruptions and delays may result from revenue shortfalls, organizational limitations and constraints, and/or diversion of resources.

SUPPLY CHAINS VULNERABILITIES

- **Food supplies** can be taxed during public health emergencies because of consumer fears that essential items may not be available in the future. Panic buying can place intense pressure on food distribution and stress on supply chains by moving the inventory from stores and distribution centers to residences. Food hoarding may remove supply from those who need it at a critical time or for those who simply decided not to change their consuming behavior. The closing of restaurants and eateries may also shift additional demand towards grocers, particularly in advanced economies where a large share of food expenses is for eating out. It is important that the food production and distribution capabilities of restaurants and caterers remain available during a pandemic.
- **Energy distribution systems** can be disrupted by workforce issues and impaired transportation capabilities to supply power plants. However, depending on the severity of an emergency, a substantial drop in energy demand may result as institutional and manufacturing activities are curtailed, travel is reduced, and maritime shipping declines.
- **Medical supplies** likely experience a surge in demand during a public health emergency that will vary based on the nature and scale of the emergency. Such supplies may include medical products and equipment, diagnostic supplies and equipment, medical-grade personal protective equipment, and pharmaceutical products.

- **Other goods** can also be affected by decisions made upstream during a public health emergency that cascade down through supply chains, even affecting companies who themselves do not directly source materials.

SURFACE TRANSPORTATION VULNERABILITIES

- **Rail, bus, and marine transit services** support economic activity and key services. Because of the high density of passengers carried in close proximity, altering transit services during a public health emergency reduces the risks of contagion. Maintaining transit operations during an emergency is imperative to transport essential workers and passengers who require life-sustaining medical treatments.
- **Roads and bridges/tunnels** must remain operational during a public health emergency to allow essential travel and goods deliveries to distribution centers, retail outlets, institutions such as hospitals and specialized care facilities, and home deliveries. For more localized emergencies, the operational parameters of roads, bridges, and tunnels may need to be altered in the vicinity of the emergency. Maintaining home delivery capabilities through e-commerce is particularly important because it allows people to have access to essential supplies while minimizing contamination risks.

- **Shared mobility services** and micromobility modes, including ride-hailing and taxi services, car- and bicycle-sharing, and emerging modalities such as electric bicycles and electric scooters, experience increases in demand and use during a public health emergency relative to transit services that may be reduced or otherwise altered and possibly perceived as less safe.

OTHER MODAL VULNERABILITIES

- **Air travel demand** declines during a public health emergency as travel restrictions are implemented, events such as conferences and sports competitions are canceled, and tourists are unwilling to travel, or their travel becomes restricted. Depending on the nature and scale of the emergency, significant airlift capacity can become available to carry essential cargo on passenger aircraft. It is therefore crucial for airlines and key airports to maintain air travel capabilities with a pool of available aircraft, pilots, controllers, and ground personnel.
- **Maritime shipping** plays a fundamental role in supporting the global distribution of essential commodities (food and energy), parts, and finished goods. International military and civilian entities such as the North Atlantic Treaty Organization, the International Maritime Organization, or the Global Maritime Partnership initiative, can provide the organizational framework to protect global maritime commerce.

EXISTING INITIATIVES

ENVIRONMENTAL AND CLIMATE STRESSORS

Climate change, extreme weather events, and the impacts of sea level rise have influenced policy development in a variety of areas in the multi-state metropolitan region to address the wide range of effects associated with storm surge, heavy rainfall, wind, and the resulting erosion and flooding. Communities throughout the NYMTC planning area have undertaken the following in their recovery and resiliency planning:

- New York State's Community Risk Reduction and Resiliency Act requires decision-makers to use the best available science to proactively consider sea level rise, storm surge, and flooding when issuing certain state funding and permits. State agencies are required to assess potential future climate risks related to storm surges, rising sea levels, and any other conditions when making certain permitting, funding, and regulatory decisions.
- New York City has amended zoning text and rezoned neighborhoods in areas of high-risk flooding. The Department of City Planning created special zoning rules for floodplains to allow for recovery and promote rebuilding. Since then, several neighborhood and citywide studies have been undertaken to understand specific resiliency issues relating to residential, commercial, and industrial areas.
- New York City's Waterfront Revitalization Program established the City's policies for waterfront planning, preservation, and development projects to ensure consistency over the long term.
- Under the auspices of the New York State Governor's Office of Storm Recovery, two projects—on Long Island and on Staten Island—were funded under the U.S. Department of Housing and Urban Development's innovative Rebuild by Design competition. Other Rebuild by

Design-funded projects in New York City include The BIG U in Lower Manhattan and Hunts Point Lifelines in the Bronx.

- The Governor's Office of Storm Recovery also administers the New York Rising Community Reconstruction Program that covers housing and small business recovery, community reconstruction, and infrastructure components. The housing recovery initiatives include a Buyout and Acquisition Program. The Buyout Program improves the resiliency of the larger community by transforming parcels of land into wetlands, open space, or stormwater management systems to create a natural coastal buffer to safeguard against future storms. The coastal buffer areas are intended to address those who live in areas that regularly put homes, residents, and emergency responders at high risk because of repeated flooding.

Other notable developments include:

- The NYS2100 Commission, appointed by Governor Cuomo after Hurricane Sandy, released its report, *Recommendations to Improve the Strength and Resilience of the Empire State's Infrastructure*, in early 2013. The Commission's report includes recommendations on strengthening and increasing the resiliency of the state's infrastructure through short- and long-term strategies. The sectors addressed include transportation, land use, energy, insurance, and infrastructure financing. The report also includes cross-cutting recommendations that are common to these sectors. The recommendations are part of the effort to help protect New York from future storms and natural disasters.
- MTA has undertaken a Fix & Fortify program to repair damaged infrastructure and install flood protection measures and other measures to make the subway system more resilient to future storm events.

- The New York City Mayor’s Office of Recovery and Resiliency oversees the City’s multilayered OneNYC climate resiliency program.
- NYC DOT has been working on a broad array of resiliency-related projects and policies, ranging from flood proofing ferry terminals to partnerships with other agencies on the implementation of both interim and permanent coastal flood protection projects.
- NYSDOT recently completed its internal flooding vulnerability assessment update and will complete a system-wide assessment that also includes the local system.
- NYSDOT is also undertaking an analysis of repetitively repaired/damaged assets from declared emergency events, as required under FHWA’s TAMP rule.
- Nassau County has been planning for storm resiliency by studying and developing mitigation solutions for flood prone areas.

HUMAN STRESSORS

CyberSecurity

USDOT has several research programs dedicated to ensuring a secure connected transportation environment:

- **Vehicle Cybersecurity:** Focuses on preventing attacks from entry into vehicle systems and their components.
- **Infrastructure Cybersecurity:** Focuses on protecting against threats and vulnerabilities to the nation’s roadside equipment, devices, and systems.
- **Dedicated Short-range Communications Security:** Focuses on ensuring trusted communications between vehicles and between infrastructure and vehicles.
- **Intelligent Transportation System Architecture and Standards Security:** Focuses on the development of architecture and standards required to ensure security in the connected vehicle environment.

USDOT’s Transportation Security Administration has developed a cybersecurity toolkit for surface transportation operators. The toolkit is a collection of documents designed to provide cyber risk management information to surface transportation operators who have fewer than 1,000 employees. The materials are drawn from three primary sources:

- **National Institute of Standards and Technology Framework for Improving Critical Infrastructure Cybersecurity:** A voluntary framework for reducing cyber risks in critical infrastructure.
- **Stop. Think. Connect:** A national public awareness campaign aimed at increasing the understanding of cyber threats and empowering the American public to be safer and more secure online.
- **United States Computer Emergency Readiness Team:** Responsible for improving the nation’s cybersecurity posture, coordinating cyber information sharing, and managing cyber risks.

Cybersecurity threats are real, and they can have real consequences for an organization’s operations and profitability. Exercising cybersecurity best practices help protect from potential damaging cyberattacks.

Other developments at the federal level include the following:

- On May 15, 2019, the White House issued a new national security executive order focused on information and communications technology and the services supply chain, which impacts all modes within the transportation sector.
- The U.S. Department of Homeland Security’s new National Critical Functions list highlights those functions in the United States most at risk for a cybersecurity attacks and includes every mode of transportation.
- The Transportation Security Administration’s Cybersecurity Roadmap makes clear that it has the statutory

authority to regulate the transportation sector for cybersecurity.

- Members of Congress are expressing serious concerns over cybersecurity risks to the transportation sector, with specific concerns regarding vulnerabilities of an attack from a foreign state-owned enterprise in the mass transit market in key U.S. cities.³⁶

Counterterrorism

Countering potential threats in the multi-state metropolitan region has required innovative and extraordinary levels of coordination between transportation providers, emergency preparedness and response organizations, and law enforcement and intelligence at all levels. The January 2019 release of New York State's Counterterrorism Advisory Panel report underscores these needs for the transportation sector.

The panel conducted a preliminary evaluation of New York's counterterrorism assets, policies, and overall security posture. The panel's report commends New York for its counterterrorism efforts and recommends certain enhancements, including increased coordination among the state's counterterrorism agencies and authorities; strengthened security at airports, bridges, tunnels, mass gathering sites, and other major assets throughout the state; and additional restrictions to further limit terrorists' access to certain lethal weapons.

Transportation hubs remain one of the most attractive targets for terrorist attacks because of their high volume of traffic. Consequently, the panel recommends steps to further strengthen security and readiness at Penn Station and other hubs including JFK and LaGuardia airports. Among its recommendations, the panel calls for establishing state-of-the-art joint command centers at Penn Station and other hubs to ensure law enforcement leaders can communicate in a centralized location and access the same real-time information before, during, and after a crisis.

The panel's specific recommendations about transportation hubs include establishing unified 24/7 command centers, enhancing coordinated

crisis plans, maintaining interoperable communications, training employees on emergency protocols, and prioritizing real-time mapping to assist first responders.

PUBLIC HEALTH EMERGENCIES

In 2011, the Centers for Disease Control and Prevention established 15 capabilities that serve as national standards for public health preparedness planning. Since that time, these capability standards have served as a vital framework for state, local, tribal, and territorial preparedness programs as they plan, operationalize, and evaluate their ability to prepare for, respond to, and recover from public health emergencies. The 2018 Public Health Emergency Preparedness and Response Capabilities maintains the 15 capabilities structure, with minor revisions to capability definitions, modest revisions to function structure and definitions, and significant revisions throughout most tasks and resource elements.³⁷

During emergency situations, USDOT provides information related to transportation permits, waivers, and other regulations and authorities that are applicable. USDOT modal administrations also have defined roles. FTA provides guidance for transit operators and administers emergency funding appropriated by Congress. Similarly, FHWA oversees emergency funding, serves as a clearinghouse for road closure information, and administers emergency permits.³⁸

At the state level, the New York State Department of Health (NYS DOH) oversees community preparedness for public health emergencies in cooperation with local health departments. NYS DOH's Office of Health Emergency Preparedness is responsible for the coordination and management of all activities for public health and healthcare facility preparedness. These activities include preparedness planning and making sure that emergency plans work in drills, exercises, and real life. NYS DOH also tracks the incidence of infectious disease.³⁹ Each of NYMTC's local members' jurisdictions—New York City, Long Island, and the Lower Hudson Valley—work closely with NYS DOH in preparing for, addressing, and recovering from public health emergencies.

4.6.4 RECOMMENDED STRATEGIES AND ACTIONS

The regulations detailed in 23 CFR 450.324 govern the development and content of the metropolitan transportation plan and contain the following requirement:

The transportation plan shall include both long-range and short-range strategies/actions that provide for the development of an integrated multimodal transportation system (including accessible pedestrian walkways and bicycle transportation facilities) to facilitate the safe and efficient movement of people and goods in addressing current and future transportation demand.

Several categories of short- and medium-range strategies and actions recommended in pursuit of this Vision Goal are described below. Additionally, specific projects, programs and studies recommended for funding in the fiscally constrained element of *Moving Forward*, as well as those recommended for future consideration in the speculative vision element of the Plan, appear in [Appendix A](#).

PLANNING AND RESEARCH INITIATIVES

- Research recommendations:
 - Inventory all areas included in the U.S. Department of Housing and Urban Development Rebuild by Design Program and the New York Rising Community Reconstruction Program and related community imperatives and transportation-related proposals.
 - Inventory specific technologies related to system protection and fortification.
 - Inventory/benchmark resiliency and adaptation practices for all sectors.
 - Inventory relevant funding programs at all levels to include programs, sources, and private sector options relevant to system protection and fortification.

- Identify resources and funding sources for continuing risk analyses.

- Support the development of detailed transportation contingency plans.
- Revisit the FHWA risk analysis and monitor risk on an ongoing basis as part of the enhanced planning process.

DATA COLLECTION, FORECASTING, AND PERFORMANCE ASSESSMENT

- Identify and monitor vulnerable transportation assets throughout the planning area using the most recent available climate and sea level rise forecasts.
- Develop an annual report of regional coordination.

PLANNING PROCESS RECOMMENDATIONS

- Coordinate transit agencies and jurisdictions in developing procedures and plans to respond to emergency events.
- Support multi-agency planning and design efforts for coastal protection systems.
- Develop an enhanced resiliency planning process through the MAP Forum and the National Institute of Standards and Technology Smart Regions Collaborative.
- Explore improved travel options and redundancies through the MAP Forum's newly established working group.
 - *Promote modal redundancy.*
 - *Use information from the CMP and socioeconomic and demographic forecasts to inform the working group's exploration of travel options and redundancies.*
 - *Explore specific technologies related to travel options and redundancies.*
- Share risk analysis results with local municipalities throughout the planning area.

- Establish a working group of NYMTC's member agencies to review and enhance emergency and long-term responses to climate impacts.
- Enhance project funding mechanisms for system protection and fortification through project selection by the TCCs.
- Enhance project funding mechanisms for travel options and redundancies through project selection by the TCCs that is based on the working group's exploration.

PROGRAM RECOMMENDATIONS

- Complete a broad range of resiliency projects, including retrofits to bridges, streets, traffic signals, yards, and facilities.

4.6.5 PERFORMANCE METRICS

Regulations at 23 CFR 450.324 govern the development and content of the metropolitan transportation plan. These regulations contain the following requirement:

A description of the performance measures and performance targets used in assessing the performance of the transportation system

The performance measures listed below will assist in measuring progress toward this Vision Goal and its objectives, and in informing investment decisions:

- Number of lane miles of federal-aid roadways in the designated vulnerable transportation system and percent hardened.
- Number of federal-aid bridges/culverts in the designated vulnerable transportation system and percent hardened.
- Number of miles of trailways/bikeways/greenways in the designated vulnerable transportation system and percent hardened.
- Number of miles of grade separated bus facilities in the designated vulnerable transportation system and percent hardened.
- Number of transit and freight track miles in the designated vulnerable transportation system and percent hardened.
- Number of transit terminals/transfer stations in the designated vulnerable transportation system and percent hardened.
- Number of rapid transit/commuter rail stations in the designated vulnerable transportation system and percent hardened.
- Number of transit yards/facilities in the designated vulnerable transportation system and percent hardened Square footage of port/intermodal facilities in the designated vulnerable transportation system and percent hardened.



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