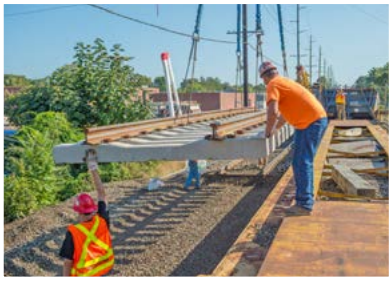
NYMTC
NEW YORK METROPOLITAN TRANSPORTATION COUNCIL

Moving Forward

Your Region, Connected



New York Metropolitan Transportation Council
Regional Transportation Plan
Adopted on September 9, 2021

Disclaimer

The preparation of this report has been financed through the U.S. Department of Transportation's Federal Transit Administration and Federal Highway Administration. This document is disseminated under the sponsorship of the New York Metropolitan Transportation Council (NYMTC) in the interest of information exchange. The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Transit Administration, Federal Highway Administration or the State of New York. This report does not constitute a standard, specification or regulation.

Title VI Statement

NTMTC is committed to compliance with Title VI of the Civil Rights Act of 1964, the Civil Rights Restoration Act of 1987, and all related rules and statutes. NYMTC assures that no person or group(s) of persons shall, on the grounds of race, color, age, disability, national origin, gender, or income status, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any and all programs, services, or activities administered by NYMTC, whether those programs and activities are federally funded or not. It is also the policy of NYMTC to ensure that all of its programs, policies, and other activities do not have disproportionate adverse effects on minority and low income populations. Additionally, NYMTC will provide meaningful access to services for persons with limited English proficiency.

NEW YORK METROPOLITAN TRANSPORTATION COUNCIL

NEW YORK METROPOLITAN TRANSPORTATION COUNCIL

RESOLUTION #2021-5
COUNCIL ADOPTION OF THE FEDERAL FISCAL YEARS (FFYs) 2022-2050 REGIONAL TRANSPORTATION PLAN AND RELATED 2021 CONGESTION MANAGEMENT PROCESS STATUS REPORT

WHEREAS, the New York Metropolitan Transportation Council (NYMTC) is a regional council of governments which is the metropolitan planning organization for New York City, Long Island, and the lower Hudson Valley; and

WHEREAS, pursuant to 23 CFR 450.324, NYMTC is responsible for the development of a Regional Transportation Plan (Plan) for its planning area; and

WHEREAS, NYMTC's existing FFYs 2018-2045 Plan was adopted by the Council on June 27, 2017, having addressed all federal planning requirements set forth in 23 CFR 450.324, and, per Federal regulations, expires on September 30, 2021; and

WHEREAS, NYMTC has prepared a draft FFYs 2022-2050 Plan, entitled *Moving Forward*, to address the federal planning requirements set forth in 23 CFR 450.324 beginning on October 1, 2021; and

WHEREAS, in conjunction with the draft Plan, NYMTC has also prepared a draft 2021 Status Report for the Congestion Management Process (CMP) to address regulations set forth in 23 CFR 450.322; and

WHEREAS, these draft products meet all applicable federal requirements and have undergone public involvement and public review per Federal regulations and NYMTC's Operating Procedures; and

WHEREAS, at its August 19, 2021 meeting, NYMTC'S Program, Finance and Administrative Committee recommended that the *Moving Forward* draft and the 2021 CMP Status Report draft be adopted by the Council.

NOW, THEREFORE BE IT RESOLVED, the New York Metropolitan Transportation Council adopts *Moving Forward*, the 2022-2050 Regional Transportation Plan, and the 2021 CMP Status Report.

This resolution will take effect on the ninth day of September, two thousand and twenty-one.

ADOPTED: September 9, 2021

"I hereby certify that the above is a true copy of Resolution #2021-5, Council Adoption of the Federal Fiscal Years 2022-2050 Regional and Related 2021 Congestion Management Process Status Report, and was motioned by Naomi Klein, representing Westchester County Executive George Latimer, and seconded by New York City Department of Transportation Commissioner Henry Gutman. This Resolution was adopted and passed unanimously."

Ron Epstein, Council Secretary

TABLE OF CONTENTS

TABLE OF CONTENTS, cont'd

TABLE OF FIGURES

TABLE OF TABLES

1

NYMTC'S SHARED VISION FOR REGIONAL MOBILITY

1.1 OUR REGION AND ITS NEEDS

Whether in Midtown Manhattan, Mount Vernon, Montebello, Mahopac, Mineola or Montauk, we all rely on the country's most robust transportation network to get us where we need to go and to make available the things that we need. Every day, millions of people are on the move in this multi-state metropolitan region—commuting to their jobs, dropping children off at school, visiting family and friends, racing to the airport to catch a flight, or just going about everyday routines. Every day, millions of tons of goods are on the move, being delivered at residences; moving to and from intermodal centers, distribution centers, and warehouses; and traveling through the region to and from adjacent areas. And while different communities may move differently across this vast region, we all collectively share our need to get around easily and safely.

1.2 OUR VISION AND GOALS

The state and local officials who make up the New York Metropolitan Transportation Council (NYMTC) recognize that mobility—the ability of people and goods to move easily and safely to, from, and between locations—is crucial to the lives of people of all abilities who live in, work in, or visit the NYMTC planning area. Therefore, we aspire to (1) ensure that the mobility provided reaches everyone in a sustainable, healthy, and equitable manner; (2) invest efficiently for these transportation needs; and (3) respond effectively to changes in transportation and mobility needs and capabilities.

When we come together as NYMTC, we form a regional council that is the federally required metropolitan planning organization (MPO) for New York City, Long Island, and the Lower Hudson Valley. As NYMTC, we will pursue our shared vision through the metropolitan transportation planning process built from this regional transportation plan. To do this, we envision a transportation system that:

Ensures the safety and security of people and goods across all uses and modes.

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.

Efficiently serves today's population and plans for the growing number of residents, workers, and increasing amount of goods.

Minimizes its greenhouse gas emissions and other impacts on the environment, especially the effects of climate change.

Is resilient and can mitigate, adapt to, and respond to chronic and acute stresses and disruptions.

1.3 OUR GUIDING PRINCIPLES

As we pursue these goals through the regional transportation planning process, the guiding principles described below inform our planning. We will:

- Consider the needs of all users in NYMTC's planning area throughout the planning process.
- Make the best use of federal resources for the regional transportation system and increase them where practical, while leveraging local resources as efficiently and effectively as possible.
- Monitor the performance of the regional transportation system as a means of prioritizing improvements and investments.
- Support multi-agency approaches that enhance the integration of independently operated components of the regional transportation system.
- Engage the public and community stakeholders.
- Harness technological advancements to improve the transportation system.

1.4 OUR OBJECTIVES IN PURSUING THESE GOALS

As we pursue our goals, the following objectives will focus our vision and help to target our activities.

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

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

2 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.

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

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

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 growth in the volume of and change in product deliveries.
5. Incorporate emerging and innovative transportation services and tools into efficient network design.

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

1. Encourage alternatives to single-occupant vehicle 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.

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

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.

2

HOW TRANSPORTATION PLANNING HAPPENS

2.1 ORGANIZATIONAL CONTEXT

Federal legislation requires that any urbanized area (UZA) with a population greater than 50,000 must have an MPO to plan for and make decisions on the use of federal transportation funding. MPOs ensure that existing and future expenditures for transportation projects and programs are based on a continuing, cooperative, and comprehensive planning process. Among other functions/requirements, MPOs cooperate with state agencies and public transportation operators to program federal funds for eligible transportation projects.

As the MPO for New York City, Long Island, and the Lower Hudson Valley, NYMTC serves as a collaborative planning forum for the five boroughs of New York City; Nassau and Suffolk counties on Long Island; Putnam, Rockland, and Westchester counties in the Lower Hudson Valley; the State of New York; and the Metropolitan Transportation Authority (MTA) to undertake the federally mandated planning process and access federal funding for transportation projects.

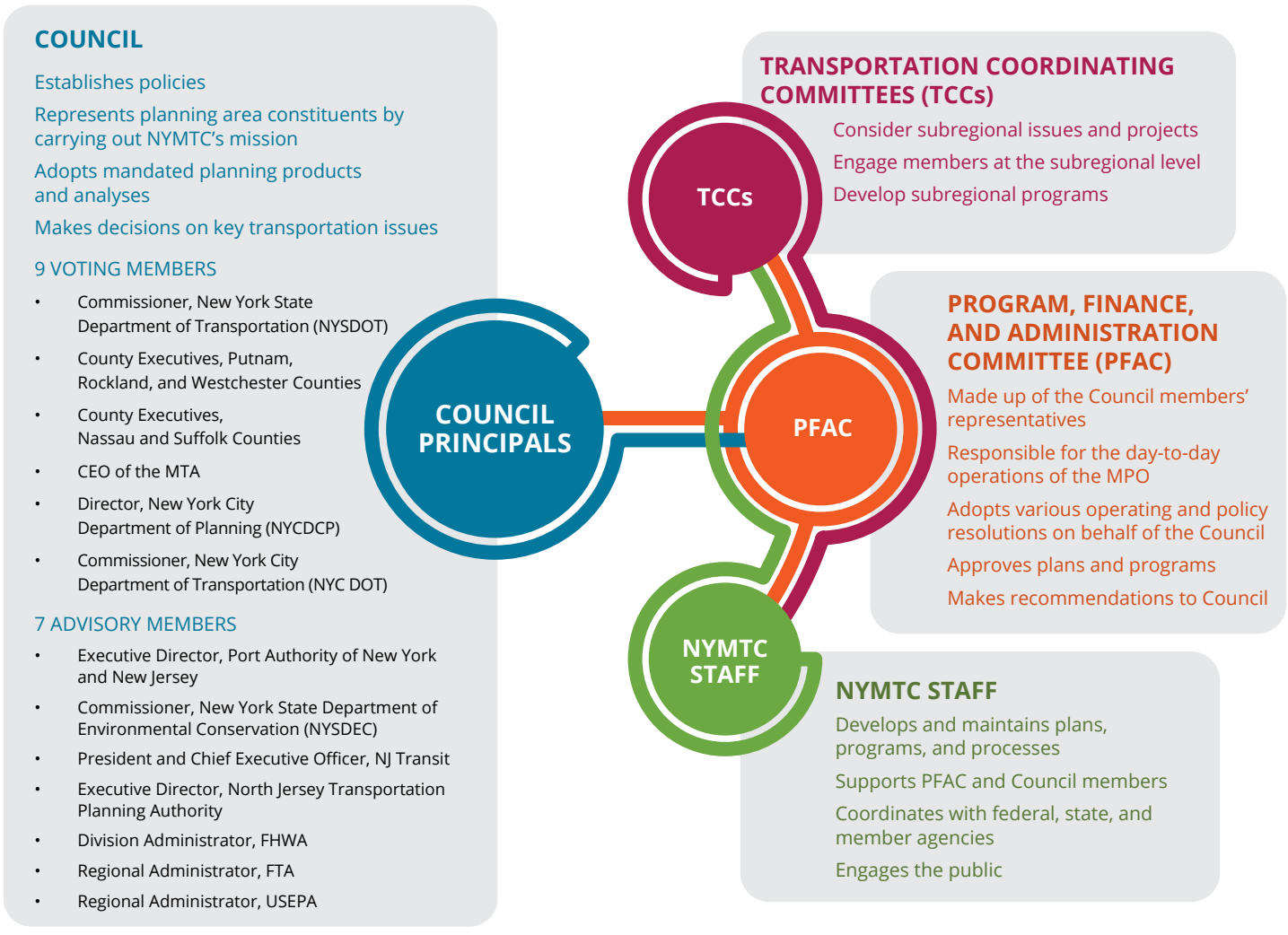
NYMTC's regional council is advised by the Port Authority of New York and New Jersey (Port Authority), New Jersey Transit (NJ Transit), and the North Jersey Transportation Planning Authority, as well New York State's Department of Environmental Conservation, the U.S. Environmental Protection Agency (USEPA), and two modal administrations of the U.S. Department of Transportation (USDOT): the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA).

NYMTC's Shared Vision for Regional Mobility, which guides *Moving Forward*, is built from a framework of these members and advisers' strategic goals; associated objectives; and related projects, programs, and studies.

2.1.1 STRUCTURE

NYMTC comprises the chief elected or appointed officials of its member agencies, which include nine voting members and seven non-voting advisory members (see ***Figure 2-1***). NYMTC operates through four standing committees: the Program, Finance, and Administration Committee (PFAC) that oversees the day-to-day operations of the organization, and three geographically based Transportation Coordinating Committees (TCCs) that provide subregional planning forums. NYMTC is supported by a professional staff that is responsible for conducting the daily business of the organization.

Figure 2-1
NYMTC Organization



As shown in ***Figure 2-2***, NYMTC's members are also divided into three geographically based TCCs to address subregional transportation needs and issues.

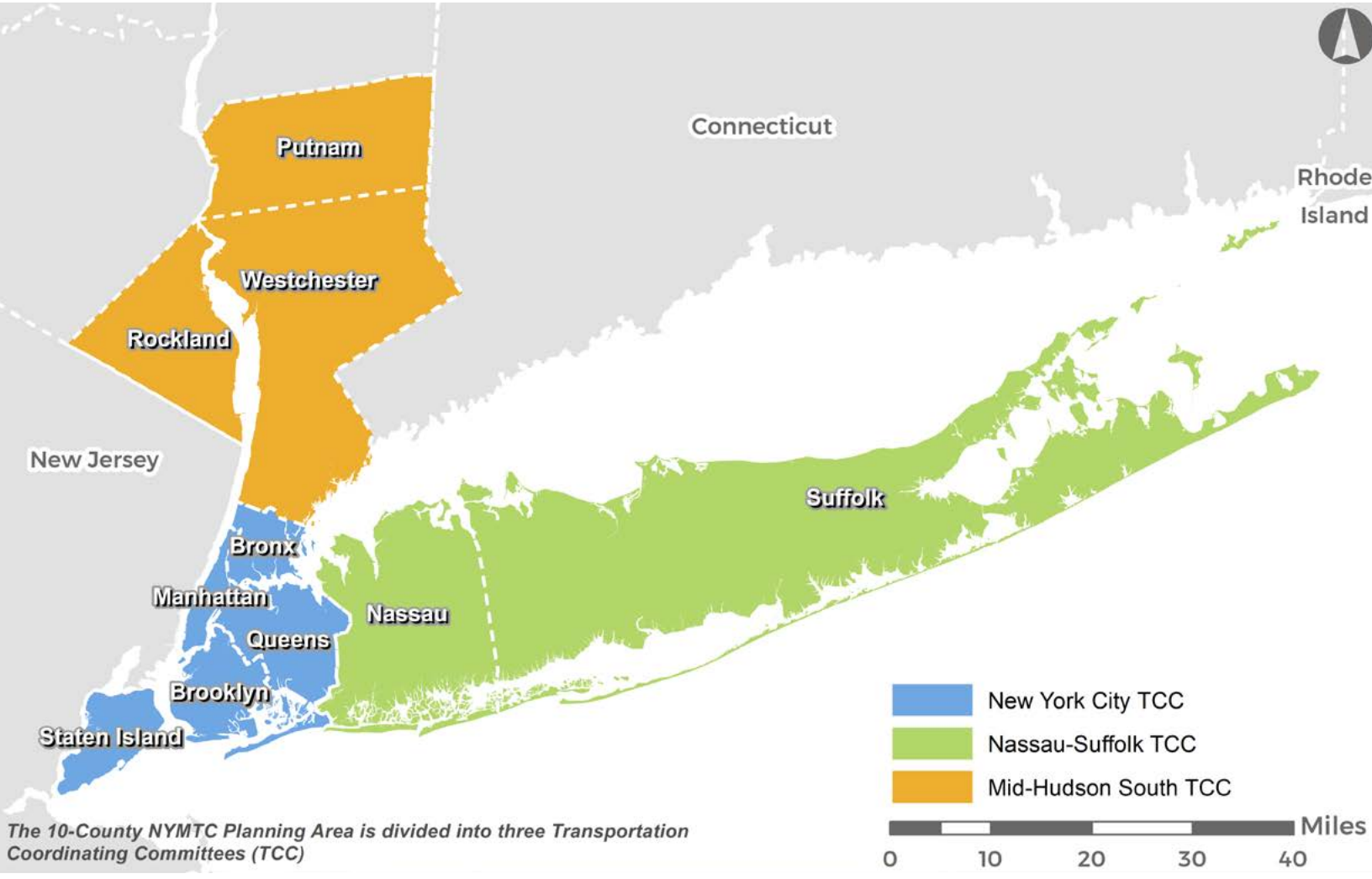
ORGANIZATIONAL RESPONSIBILITIES

Federal legislation and related planning regulations require MPOs to produce a long-range regional transportation plan, a five-year transportation improvement program (TIP), and an annual unified planning work program. *Moving Forward* is the regional transportation plan, for fiscal years 2022–2050 for the NYMTC planning area. *Moving Forward* includes forecasts of future conditions and needs and potential transportation improvements, as well as a shared strategic vision for transportation and development within the NYMTC planning area.

Thus, the Plan fulfills federal planning requirements and maintains NYMTC's eligibility for federal funding for transportation planning and improvement projects. NYMTC acts as a forum for collaborative planning from a regional perspective. It facilitates informed decision-making among its members by providing sound technical analysis and forecasts. NYMTC's collective efforts help ensure that the region is prepared to obtain the maximum federal funds available to achieve the Shared Regional Goals and to focus the collective planning activities of its members to achieve their Shared Vision for Regional Mobility.

Figure 2-2

NYMTC Planning Area and TCCs



The 10-County NYMTC Planning Area is divided into three Transportation Coordinating Committees (TCC)

2.1.2 THE METROPOLITAN TRANSPORTATION PLANNING PROCESS

Transportation issues cross the boundaries and responsibilities of individual jurisdictions and organizations, and each member agency of NYMTC brings a unique perspective and jurisdictional responsibilities to the transportation planning process. However, when these members come together as NYMTC, they collectively pursue their Shared Vision for Regional Mobility and its relationship to future growth and development in the NYMTC planning area.

FEDERAL REQUIREMENTS

The U.S. Congress authorizes funding for transportation improvements nationally through multi-year authorization legislation. Currently, the Fixing America's Surface Transportation (FAST) Act is the federal transportation legislation that authorizes funding and establishes the requirements for the metropolitan transportation planning process that governs NYMTC's activities. The FAST Act was signed into law in 2015 and carried forward most of the requirements of its predecessor legislation, including the requirement for transportation performance management.

The federally required metropolitan transportation planning process establishes a continuing, comprehensive and cooperative regional framework for multimodal transportation planning. As part of this process, NYMTC is required to produce the following products and analyses. *Figure 2-3* depicts the relationships of these products within the overall process.

FOUR PLANNING PRODUCTS

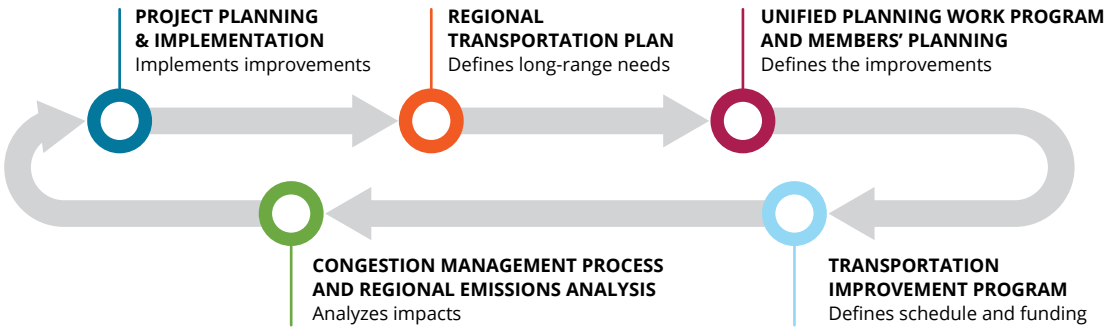
1. The regional transportation plan, (this document) describes long-range goals, objectives, and needs, typically over a 20- to 25-year horizon.
2. The TIP defines federal funding for specific transportation projects and actions, typically over a five-year period.
3. The unified planning work program determines how federal funding for planning activities will be spent over the course of a program year.
4. A public involvement plan describes and guides efforts to include communities, stakeholders and the public in the ongoing planning process.

TWO PLANNING PROCESSES

1. The congestion management process (CMP)—a process to monitor and forecast traffic congestion and consider congestion-reduction strategies in federally designated Transportation Management Areas; and
2. Transportation conformity—a quantitative demonstration of how the fiscally constrained regional transportation plan and TIP conform to future mobile source emissions milestones set in response to federally mandated air quality standards.

Figure 2-3

Metropolitan Transportation Planning Process



NATIONAL GOALS AND PLANNING FACTORS

National Goals have been established in the areas of safety, pavement and bridge infrastructure, congestion reduction, system reliability, freight movement, environmental sustainability, and project delivery. These National Goals, which appear in ***Table 2-1***, were carried forward into the FAST Act, along with related federal requirements for transportation performance management.

Table 2-1

National Transportation Goals

Source: 23 United States Code Section 150

Goal Area	National Goal
Safety	To achieve a significant reduction in traffic fatalities and serious injuries on all public roads.
Infrastructure Condition	To maintain the highway infrastructure asset system in a state of good repair.
Congestion Reduction	To achieve a significant reduction in congestion on the National Highway System.
System Reliability	To improve the efficiency of the surface transportation system.
Freight Movement and Economic Vitality	To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development.
Environmental Sustainability	To enhance the performance of the transportation system while protecting and enhancing the natural environment.
Reduced Project Delivery Delays	To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices.

IN ADDITION TO THE NATIONAL GOALS, 23 CODE OF FEDERAL REGULATIONS (CFR) 450.306 (B) INDICATES THE FOLLOWING:

The metropolitan transportation planning process shall be continuous, cooperative, and comprehensive, and provide for consideration and implementation of projects, strategies, and services that will address the following factors:

1. Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency.
2. Increase the safety of the transportation system for motorized and non-motorized users.
3. Increase the security of the transportation system for motorized and non-motorized users.
4. Increase accessibility and mobility of people and freight.
5. Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and state and local planned growth and economic development patterns.
6. Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight.
7. Promote efficient system management and operation.
8. Emphasize the preservation of the existing transportation system.
9. Improve the resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation.
10. Enhance travel and tourism.

These federal planning factors are considered in Moving Forward's shared strategic goals and related objectives and, by extension, in the strategies and actions that guide NYMTC's activities as described throughout this document. ***Table 2-2*** shows the relationships between Moving Forward's goals and objectives and the national goals and federal planning factors.

Table 2-2

Moving Forward — Strategic Consistency Assessment Matrix

Moving Forward Goals & Objectives		National Goals & Federal Planning Factors									
Goal	Objective	Support Economic Vitality	Increase Safety & Security	Increase Accessibility and Mobility	Improve Efficiency	Improve the Nat'l Freight Network	Protect and Enhance the Environment	Enhance Integration & Connectivity	Emphasize System Preservation	Improve Resiliency & Reliability	Enhance Travel & Tourism
1 **A transportation system that ensures the safety and security of people and goods across all uses and modes.**	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 safe from threats.	●	●				●				
	Coordinate safety management, training, and education across jurisdictional borders.	●	●								
	Improve the safety and security of system operations.	●	●	●	●	●	●	●		●	
2 **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.**	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 transportation and workplace access opportunities for all populations, regardless of age, ability, race, ethnicity, or income.			●				●			●

Table 2-2

Moving Forward — Strategic Consistency Assessment Matrix, cont'd

Moving Forward Goals & Objectives		National Goals & Federal Planning Factors									
Goal	Objective	Support Economic Vitality	Increase Safety & Security	Increase Accessibility and Mobility	Improve Efficiency	Improve the Nat'l Freight Network	Protect and Enhance the Environment	Enhance Integration & Connectivity	Emphasize System Preservation	Improve Resiliency & Reliability	Enhance Travel & Tourism
3 A transportation system that efficiently serves today's population and plans for the growing number of residents, workers, and increasing amount of goods.	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.	●		●	●			●			●
	Expand the reach of the system to underserved communities and emerging markets, addressing passenger transportation as well as access to goods and freight services.			●	●			●			
	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.	●	●	●	●		●	●			●
	Modernize local freight networks to efficiently plan for growth in the volume of and change in product deliveries.	●				●					
	Incorporate emerging and innovative transportation services and tools into efficient network design.			●	●	●		●			
4 A transportation system that minimizes its greenhouse gas emissions and other impacts on the environment, especially the effects of climate change.	Encourage alternatives to single-occupant vehicle trips.			●	●		●				
	Encourage lower-emissions alternatives to trucking.				●	●	●				
	Modernize vehicle fleets to higher-standard and lower-emissions vehicles.						●				
	Efficiently manage limited roadway capacity to mitigate congestion and vehicular emissions.				●		●				
	Promote responsible environmental stewardship in transportation projects.						●			●	
	Address unequal impacts of transportation emissions on communities.			●		●	●				

Table 2-2

Moving Forward — Strategic Consistency Assessment Matrix, cont'd

Moving Forward Goals & Objectives		National Goals & Federal Planning Factors									
Goal	Objective	Support Economic Vitality	Increase Safety & Security	Increase Accessibility and Mobility	Improve Efficiency	Improve the Nat'l Freight Network	Protect and Enhance the Environment	Enhance Integration & Connectivity	Emphasize System Preservation	Improve Resiliency & Reliability	Enhance Travel & Tourism
 **A transportation system that is resilient and can mitigate, adapt to, and respond to chronic and acute stresses and disruptions.**	Protect and fortify major transportation assets.		●				●		●		
	Continue to invest in sea level rise and climate change risk analyses for transportation assets.	●	●		●		●			●	
	Improve regional coordination on emergency and long-term responses to system-wide climate impacts.				●		●			●	
	Enhance the transportation network's resiliency by increasing travel options and redundancies.		●	●			●			●	

Note: There are 6 National Goals and 10 federal planning factors (safety and security are separate planning factors).

2.1.3 MEASURING PERFORMANCE

The federal transportation legislation enacted in 2012, entitled the Moving Ahead for Progress in the 21st Century Act (MAP-21), strengthened the growing focus on using performance-based approaches in transportation planning. That law required states and MPOs to establish transportation performance targets for all the national performance measures in areas such as safety, infrastructure condition, system performance, and environmental sustainability. MAP-21 further required MPOs to include in their plans "a system performance report and subsequent updates evaluating the condition and performance of the transportation system with respect to the performance targets."

The current federal transportation authorization act, the FAST Act, continues the MAP-21 requirements for using performance-based approaches in transportation planning. This requirement was further stipulated in the Metropolitan Transportation Planning Final Rule issued May 27, 2016, in section 23 CFR 450.306(d). The legislation transformed the federal-aid program by placing greater emphasis on transportation decision-making on performance-based planning, where performance measures and targets provide an objective means of informing decisions about strategies and investments.

USDOT recommended a framework for performance management that should result in a performance-based transportation plan. The framework includes four phases: (1) planning, (2) programming, (3) implementation, and (4) evaluation.

USDOT Performance Management Framework

1. **Planning**
   "Where do we want to go?"
2. **Programming**
   "How are we going to get there?"
3. **Implementation**
   "What will it take?"
4. **Evaluation**
   "How did we do?"

The planning phase consists of setting a strategic direction ("where do we want to go?"). It encompasses goals and objectives and performance measures, followed by an analysis of how a region will move forward in achieving identified goals and objectives through investments and policies ("how are we going to get there?"). The implementation phase tries to answer the question, "What will it take?" The last phase of evaluation seeks to answer the question, "How did we do?"

NYMTC is currently undertaking the phases and actions identified in this framework and, as such, undertakes a performance-based approach to its metropolitan transportation planning requirements. *Moving Forward's* Shared Vision augments this federally required framework to measure the Plan's progress toward achieving the resulting strategic framework.

2.2 REGIONAL PLANNING CONTEXT: THE MULTI-STATE METROPOLITAN REGION

The multi-state metropolitan region surrounding New York City lies at the heart of the Northeast Megaregion, the most densely populated, urbanized land in the country (see ***Figure 2-4***). The Megaregion, as defined below by the Regional Plan Association, includes the metropolitan areas of Washington, D.C., Baltimore, Philadelphia, New York City, and Boston. It is home to 49.6 million[1] people (translating to nearly 16 percent of the nation's total population) and is also a major contributor to the U.S. economy, producing one-fifth of the national gross domestic product (GDP) in 2018.

The multi-state metropolitan region is approximated by the U.S. Census Bureau's New York-Newark, NY-NJ-CT-PA Combined Statistical Area, shown in ***Figure 2-5***, the largest such area in the nation in terms of population and one of the largest in the world. The New York-Newark, NY-NJ-CT-PA Combined Statistical Area is home to more than 23 million people (2018 estimate).[2] In 2018, it had a GDP of 2.1 trillion, which would rank 10th among countries and was roughly 10 percent of the 2018 U.S. GDP of $20.5 trillion.[3]

While the multi-state metropolitan region is centered on New York City, it also contains some of the largest cities in New Jersey (i.e., Newark, Jersey City, and Paterson) and Connecticut (i.e., Stamford, Bridgeport, New Haven, and Hartford) as well as large suburban towns on Long Island (i.e., Hempstead, Brookhaven, and Babylon), the Lower Hudson Valley (i.e., Yonkers, Mount Vernon, Newburgh, New Rochelle, Poughkeepsie, and White Plains), and exurban areas of the Catskill and Pocono mountain areas north and west of New York City.

The multi-state region also includes the planning areas of various MPOs and councils of government (COGs), including:

NEW YORK STATE

NYMTC, the Orange County Transportation Council, the Dutchess Transportation Council, and the Ulster County Transportation Council

NEW JERSEY AND PENNSYLVANIA

The North Jersey Transportation Planning Authority, the Lehigh Valley Planning Commission, and the Northeast Pennsylvania Alliance

CONNECTICUT

The Western Connecticut COG, the Naugatuck Valley COG, the Connecticut Metropolitan COG, the South-Central Regional COG, the Capitol Region COG, the Lower Connecticut River Valley COG, and the Southeastern Connecticut COG

Figure 2-4

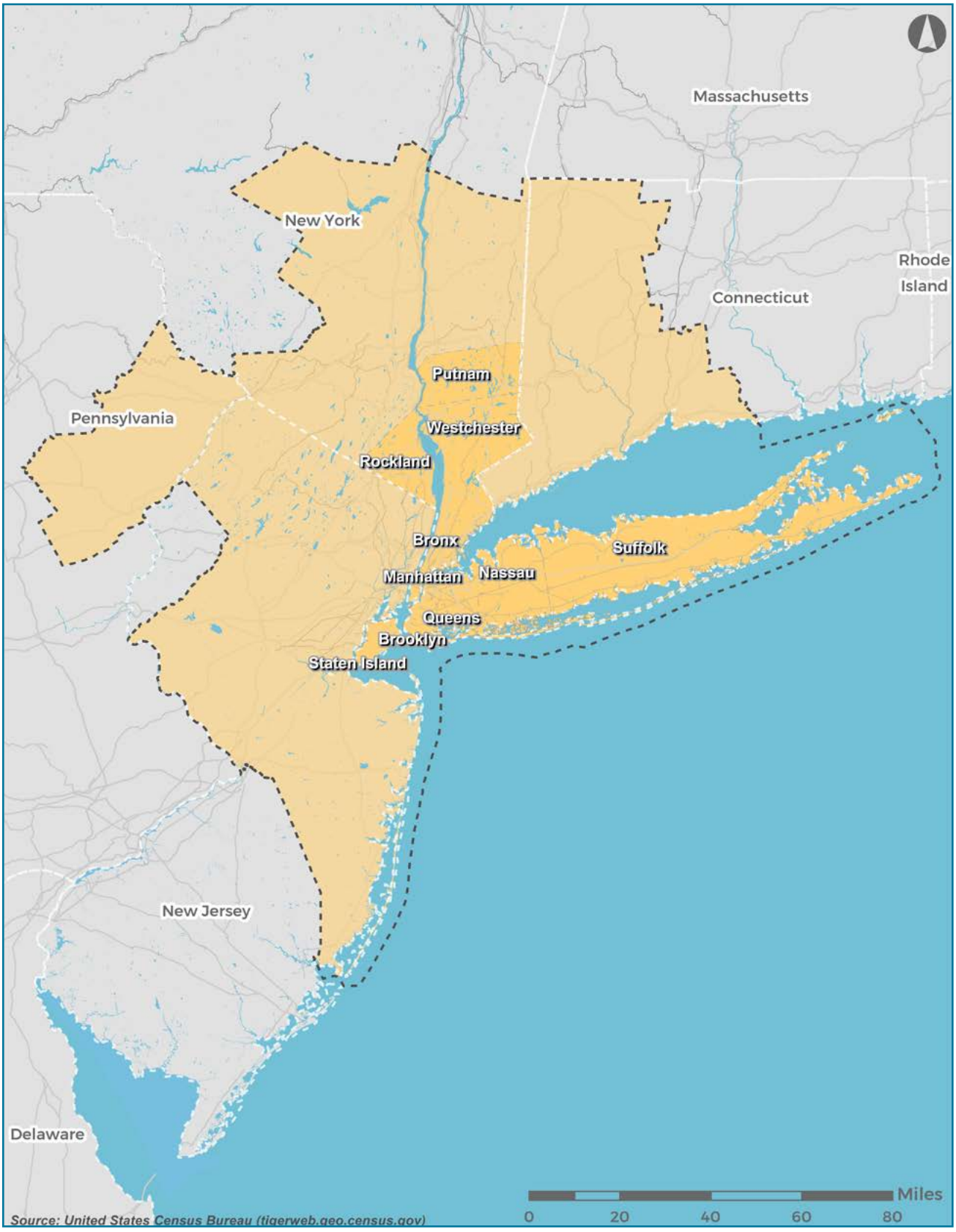
The Northeast Megaregion

Source: U.S. Geological Survey Gap Analysis Project, 2020, Protected Areas Database of the United States; Multi-Resolution Land Characteristics (MRLC) Consortium; https://doi.org/10.5066/P92QM3NT; Northeast Megaregion 2050, Regional Plan Association

Figure 2-5

New York–Newark NY–NJ–CT–PA Combined Statistical Area

Source: ***www.citypopulation.de***



2.2.1 KEY CHARACTERISTICS

GEOGRAPHY AND ENVIRONMENT

New York City comprises Manhattan Island and Staten Island, the western end of Long Island (the boroughs of Queens and Brooklyn), and part of the North American mainland (the Bronx). New York City possesses a well-used natural harbor and sits at the southern end of the Hudson River. East of Queens are Nassau and Suffolk counties in Long Island, known for their beach-lined coastline and barrier islands.

Across the Hudson River to the west of New York City is northern New Jersey, an area that contains 13 individual counties and several major cities. North of the Bronx on the east side of the Hudson River, and north of the New Jersey-New York border on the west side of the river, is the Lower Hudson Valley, a hilly region comprising seven counties (Westchester, Rockland, Putnam, Orange, Ulster, Dutchess, and Sullivan) and dotted with suburban communities of varying size. Rockland County is occupied by large swaths of natural habitat, such as Harriman and Bear Mountain State Parks. East of the Hudson Valley counties lies the southwestern portion of the State of Connecticut, across the Long Island Sound from Queens and Long Island. This area of Connecticut comprises two counties (Fairfield and New Haven), and seven of the largest communities in the state are in the area. It is characterized by a dense, urban landscape, interspersed by several wealthy suburban towns.

The Pennsylvania portion of the multi-state metropolitan region lies at the foothills of the Pocono Mountains and is characterized by the valleys formed by the Lehigh River and Delaware River, the latter of which creates the border between Pennsylvania and New Jersey, and the Susquehanna River. The southernmost portion of the multi-state metropolitan region is made up of southern New Jersey in an area southeast of Philadelphia. Southern New Jersey's coastline and barrier islands also are included in this metropolitan region.

ECONOMY

The multi-state metropolitan region's economy is large, diverse, and international. In 2018, the region produced a gross metropolitan product of $1.7 trillion,[4] the largest in the country among metropolitan regions. The multi-state gross metropolitan product would rank 11th among the nations of the world, ahead of Canada, Russia, South Korea and Spain.[5] The region's economic output is nearly twice that of the Los Angeles Metropolitan area. In 2018, a report by Oxford Economics projected that it will be the top urban economy in the world in 2035, having a GDP of $2.5 trillion, with the largest financial and business sector, while Tokyo will come in second with a GDP of $1.9 trillion and Los Angeles third with a GDP of $1.5 trillion.[6] The multi-state metropolitan region is home to numerous Fortune 500 companies and foreign corporations, with one in ten private sector jobs at a foreign company.

Although significant numbers of workers who reside in the multi-state metropolitan region commute to New York City—Manhattan in particular—Long Island, the Lower Hudson Valley, northern New Jersey, and southwestern Connecticut are all home to their own industries that contribute to the multi-state region's economy. Agriculture and tourism are important to the Long Island and Lower Hudson Valley economies. Northern New Jersey is home to the busiest port on the U.S. East Coast, the Newark-Elizabeth Marine Terminal, which handled 7,179,788 twenty-foot equivalent units (TEUs), or 4,095,454 cargo containers, in 2018. The suburban areas close to New York City also have their own economic ecosystems, often including major corporations. Westchester County in New York State and Fairfield County in Connecticut, for example, have become major business centers that draw commuters who live in New York City and elsewhere in the region. The southeastern Connecticut economy is dominated by the tourism industry and manufacturing.

Areas farther from the New York City core have varied demographic and economic profiles. Eastern Pennsylvania, for example, has historically been manufacturing-based, and is currently

the site of a variety of industrial-related firms, such as the global headquarters of Air Products and Chemicals. In Trenton, New Jersey, officials are attempting to incentivize more industrial and business development along the Route 1 corridor, using Boston's Back Streets Program and Chicago's Local Industrial Retention Initiative as models. Trenton is also looking to encourage more retail development within city limits to serve the many residents who currently travel outside the city for their shopping needs.

DEMOGRAPHICS

The multi-state metropolitan region is large and diverse. The U.S. Census Bureau estimates its 2018 population at 23.6 million.[7] While New York City is famous for its diversity, the entire region is ethnically and racially diverse, with large communities hailing from all over the world. Nearly 37 percent of the region's population in 2018 was born outside the United States.[8] In 2018, the total size of the region's work force was 9,780,299,[9] with the largest shares of jobs in educational and health services; professional and business services and trade; transportation and utilities; and leisure and hospitality.[10]

2.2.2 TRANSPORTATION SYSTEM

The transportation system of the multi-state metropolitan region is large, complex, and aging, and is tied together by a network of highways, rail lines, bridges, tunnels, and other infrastructure. As the largest metropolitan area in the nation, the multi-state region is traversed by numerous major limited access highways and rail lines that are described below.

ROADWAYS

Major roadways include Interstate highways I-78, I-80, and I-280, which extend from New York City west into Pennsylvania; I-87, which becomes the New York Thruway between New York City and Albany; I-95, a north-south highway of which a portion is the New Jersey Turnpike; and I-495, known as the Long Island Expressway.

BRIDGES AND TUNNELS

Bridges and tunnels are common throughout the multi-state region to carry roadways and rail lines across or under the large numbers of islands, rivers, and other geographic features in the multi-state metropolitan region.

RAIL FACILITIES

Rail services are provided by NJ Transit, MTA Metro-North Railroad (MNR), and MTA Long Island Rail Road (LIRR) commuter rail networks; the CT Rail Hartford Line and Shore Line East commuter rail services; MTA New York City Transit's (NYCT) subway network; the Port Authority Trans-Hudson (PATH) rail rapid transit service; and NJ Transit's Hudson-Bergen Light Rail and Newark Light Rail systems. Amtrak provides intercity rail services along the Northeast Corridor.

PORT FACILITIES

Maritime freight facilities at the Port of New York Maritime freight facilities are located at the Port of New York and New Jersey and reliever ports in Bridgeport, New Haven, and New London.

AIRPORTS

The multi-state region is served by four major commercial airports: John F. Kennedy International Airport (JFK Airport) in southern Queens, Newark Liberty International Airport (Newark Airport) in Newark, LaGuardia Airport in northern Queens, and Bradley International Airport outside Hartford. A variety of smaller commercial and general aviation airports also service the area, including Lehigh Valley International Airport in Lehigh County, Pennsylvania; Long Island MacArthur Airport in Suffolk County, New York; Westchester County Airport in Westchester County, New York; Stewart International Airport in Orange County, New York; Trenton-Mercer Airport in Mercer County, New Jersey; and Tweed New Haven Regional Airport in New Haven, Connecticut.

2.2.3 METROPOLITAN TRAVELSHED

Figure 2-6 is a representation of the daily metropolitan travelshed in the multi-state region. Daily transit and highway trips estimates are shown for 2017 and forecasted to the 2045 horizon year within and between six subregional areas: northern and central New Jersey, New York City, Long Island, southwestern Connecticut, the Lower Hudson Valley, and the Mid-Hudson Valley. These estimates are derived from the 28-county New York Best Practice Model (NYBPM), a four-step transportation demand model maintained by NYMTC.

Figure 2-6 demonstrates that most current and future trips are and will be within these six subareas, with the greatest volume of daily intra-area trips being made in northern and central New Jersey, in New York City, and in Long Island. By far, the greatest number of daily transit trips made within a subarea are and will be in New York City.

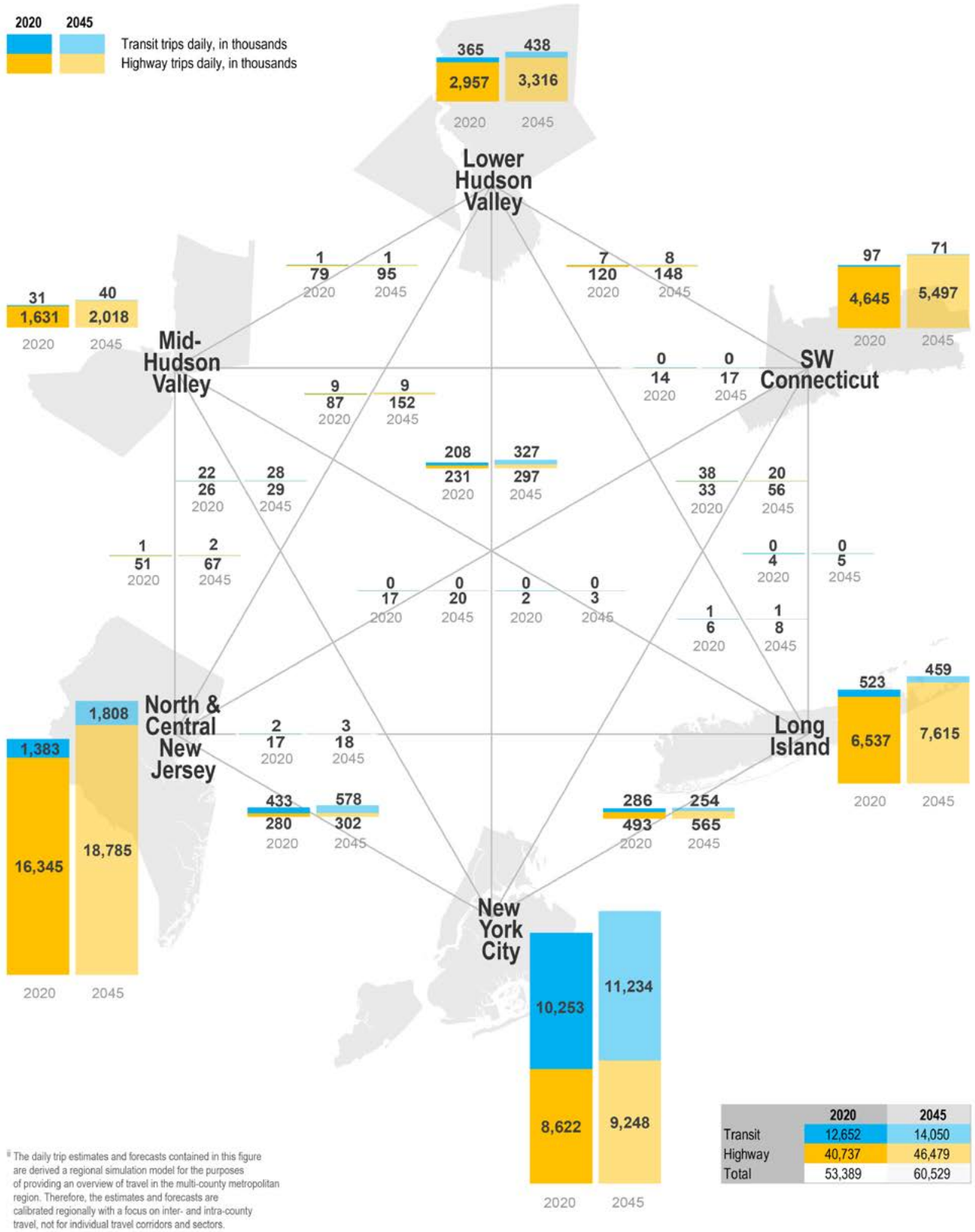
In terms of daily trips made between the subareas, most of these inter-area trips are made between New York City and northern and central New Jersey, between New York City and Long Island, and between New York City and the Lower Hudson Valley. These three sets of inter-area trips also feature significant proportions of transit trips.

The core of the multi-state metropolitan region is notable for its enormous mass transit system. It is estimated that in the United States, about one in every three users of mass transit, and two of three rail riders, use this system. New York City is served by an intensively used subway and bus system, and its more immediate suburban neighbors are served by commuter rail and local bus systems. Intercity travel is provided by Amtrak, long-haul buses, and air travel facilities. The region is the busiest airspace in the United States, serving more than 140.5 million passengers annually.[11]

Figure 2-6

Multi-State Metropolitan Travelshed

Source:



	2020	2045
Transit	12,652	14,050
Highway	40,737	46,479
Total	53,389	60,529

[ii] The daily trip estimates and forecasts contained in this figure are derived a regional simulation model for the purposes of providing an overview of travel in the multi-county metropolitan region. Therefore, the estimates and forecasts are calibrated regionally with a focus on inter- and intra-county travel, not for individual travel corridors and sectors.

2.2.4 TRANSPORTATION INVESTMENTS

As a result of the continued growth of the region and the aging state of many key pieces of infrastructure that require renewal, several regionally significant improvements to the transportation infrastructure are either planned or moving forward in the multi-state metropolitan region. Major New York City-focused projects include the second phase of the Second Avenue Subway in Manhattan, various trans-Hudson River rail and vehicular crossing improvements, and commuter rail improvements.

A range of projects in the multi-state metropolitan region are designated as "boundary projects" whose impacts cut across planning areas and state lines.

Examples include:

- **The Penn Station (New York) Access project** that would provide direct access for the MTA MNR New Haven Line to Penn Station and create four new neighborhood stations in eastern Bronx.
- **The Southeast, New York-to-Danbury, Connecticut Link Feasibility/Planning study** that is assessing the feasibility of restoring passenger rail service on the Beacon Line between Connecticut and Putnam County, New York, where it connects to the MTA MNR Harlem Line.
- **I-95 Improvement Projects** from Stamford to Bridgeport and Old Lyme to New London, New Haven Line commuter rail service improvements, and new rolling stock purchases for the Shore Line East Rail Line.
- **Various improvement projects along I-84** in Connecticut and the Hudson Valley, including a complete replacement of the I-84/Route 8 interchange in Waterbury.
- **The Route 1 Bus Rapid Transit Project** in the heavily traveled Route 1 corridor between the New York State line and New Haven.
- **West-of-Hudson transit improvements,** including improvements to the Port Jervis Line in Orange County, New York.
- **The replacement of the Lincoln Tunnel Helix** in Weehawken, New Jersey.
- **The Hudson Tunnel project** to create an additional rail tunnel that would preserve the current functionality and strengthen the resiliency of the Northeast Corridor's Hudson River rail crossing between New Jersey and New York.
- **The Amtrak Gateway Program's** strategic rail infrastructure improvements designed to improve current services and create new capacity that will double passenger trains running under the Hudson River.
- The replacement of the **Port Authority Bus Terminal, the redevelopment of Penn Station, and the completion of Moynihan Station** on Manhattan's west side.
- **The Cross-Harbor Freight Program** for rail freight across New York Harbor.
- **Airport access improvements,** including the extension of the Port Authority Trans-Hudson rail service to Newark Airport, the extension of Air Train service to LaGuardia Airport, and transit and roadway improvement for JFK Airport.

While passenger transport is critical, these important projects are not limited to the movement of people. In such a densely populated and economically active region, freight transportation is critical, and several major projects are dedicated to freight in the region. For example, the Port Authority's Cross Harbor Freight Program is working to address the difficulty of moving freight from one side of New York Harbor to the other by examining a wide range of alternatives, including railcar and truck floats, container barges, and a cross-harbor rail tunnel. After review, the enhanced railcar float and double-track rail tunnel emerged as the preferred alternatives.

2.2.5 THE TRANSPORTATION SYSTEM IN THE NYMTC PLANNING AREA

The transportation system in the NYMTC planning area includes critical components of regional and national transportation networks. The system is one of the oldest, most complex, and highly used in the world, for both people and goods. On a typical weekday, the system accommodates millions of passenger trips and thousands of tons of freight shipments. The share of passenger trips using public transportation is much higher in the NYMTC planning area than in other metropolitan regions in the United States. In addition, the planning area is an important hub of air and freight travel with three major international airports and several other reliever airports and aviation facilities. Additionally, the Port of New York and New Jersey serves a vital role in the national and international freight distribution network.

The scale of the transportation system in and adjacent to the NYMTC planning area is immense. System components include:

- A total of 1,300 track miles of commuter rail; 665 mainline track miles of subway tracks; hundreds of route miles of local, express, commuter, and intercity bus routes; and 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, including one of the most successful rail-to-airport links in the country
- As of 2019, 1,301 lane miles of bike lanes installed in New York City, ranging from shared-use bicycle trails to on-road bicycle lanes, in addition to pedestrian sidewalks, trails, and paths[12]
- More than 50,000 lane miles of roads and highways, including more than 30 major bridges crossing navigable waterways, 4 major underwater vehicular tunnels, and special lanes for high occupancy vehicles and buses
- Five commercial service airports, major passenger and air cargo operations and supporting infrastructure, and general aviation and heliport facilities
- Major deep-water seaport facilities owned and operated by a mix of public and private sector entities, plus an extensive network of marine cargo support infrastructure and services
- An extensive network of docking facilities along inland waterways supporting barge and ferry services
- More than 400 route miles of freight rail, using track miles often shared with commuter rail services
- A widespread network of freight hubs, including intermodal transfer facilities, rail yards, and truck-oriented warehouse and distribution centers
- Supporting infrastructure like rail yards and highway maintenance facilities, highway rest areas, parking lots and garages, bus depots and transit storage yards, bicycle parking areas, toll plazas, signage, signals, electronics, and other equipment

2.2.6 PUBLIC TRANSPORTATION

Subway service in and around New York City constitutes one of the largest and most complex services of its kind in the world, serving the boroughs of Manhattan, Brooklyn, Queens, and the Bronx, as well as portions of northeastern New Jersey. On Staten Island, a surface rapid rail system links 22 communities.[13]

RAPID RAIL/SUBWAY

Components include:

- **The MTA NYCT subway system** operates more than 6,684 subway cars on 27 routes, spanning 665 mainline track miles and 472 stations. In 2019, annual subway ridership increased to 1.698 billion, and average weekday ridership was 5.5 million.[14]
- **MTA Staten Island Railway** is part of the NYCT system; it offers 24-hour service on a single line of 21 stations from Tottenville at the southern end of the island to St. George Terminal in the north. Its infrastructure includes 29 track miles of mainline track, 4 track miles of yard and non-revenue track, 54 mainline switches, 2 support and maintenance shops, 29 bridge structures, and 9 power substations. In 2019, the Staten Island Railway served 4.6 million customers.
- **Port Authority, PATH** is a rapid rail system comprising 4 service routes and 13 stations in Manhattan, Hoboken, Jersey City, Harrison, and Newark. The PATH system operates 24 hours a day, 7 days a week; since 2019, it has transported more than 82.2 million passengers a year.[15]

BUS TRANSIT

Bus transit operators in the NYMTC planning area include NYCT, MTA Bus Company (MTA Bus), Nassau Inter-County Express (NICE), Suffolk Transit, the Westchester Bee-Line System, Putnam Area Rapid Transit (PART), Transport of Rockland (TOR), New York State's Department of Transportation (NYSDOT) Hudson Link service between Rockland and Westchester counties, and other service providers.

NEW YORK CITY SERVICES

- **The MTA and NYCT** provide round-the-clock bus service in New York City via 234 local, 20 Select Bus Service (SBS), and 73 express routes. In 2019, these two bus divisions served more than 2.2 million customers on an average weekday and 678 million over the course of the year.[16] All MTA and NYCT bus fleets are accessible under the Americans with Disabilities Act (ADA).
- **The MTA's Access-A-Ride** paratransit service provides public transportation for eligible customers with disabilities that prevent them from using the public buses and subways. This service operates within the five boroughs of New York City and within a three-quarter-of-a-mile corridor beyond fixed-route service and to nearby areas of Nassau and Westchester counties. The service is a shared-ride program that operates 24 hours a day, 7 days a week, 365 days a year. In 2019, the paratransit service completed 679,000 trips, and with a total ridership of 929,000.
- **SBS** is New York City's program to improve bus speed, reliability, and convenience; it was implemented as a partnership between NYC DOT and NYCT. SBS is New York City's brand of bus rapid transit, a system implemented around the world to provide a cost-effective approach to transit improvements. SBS offers an immediate improvement to New York City's bus transit network by improving mobility and reducing congestion and greenhouse gas emissions.

  SBS uses techniques and technologies such as dedicated bus lanes and queue jumps, off-board fare collection, and transit signal priority to improve the quality and performance of bus transit. SBS is also designed to make bus service easier to use, through features like bus bulbs at stop locations, high-quality passenger information, and overall attention to pedestrian and vehicular safety. Seventeen SBS routes have been implemented throughout New York City, incorporating various elements of bus rapid transit to serve the different types of bus routes and streets. This includes the 2019 initiation of the M14 SBS on 14th Street in Manhattan, which features a "busway" design that limits vehicles other than buses and trucks to ensure greater transit speeds and reliability.

  In addition to SBS, NYC DOT, as part of its Better Buses initiative, is implementing bus priority projects on other key corridors that serve multiple bus lines throughout New York City.

LONG ISLAND SERVICES

- **NICE** operates 38 fixed-route bus lines throughout Nassau County, western Suffolk County, and eastern Queens. NICE operates a fleet of 278 ADA-accessible, compressed natural gas-powered buses. In 2016, NICE introduced new service models to Nassau County with the addition of both a flexible and community shuttle service. Additionally, routes that were previously underutilized were reengineered as community shuttles offering better, more frequent service during peak hours and doubling as paratransit transit vehicles during off-peak hours.

  NICE also operates a fleet of 108 paratransit vehicles for its Able-Ride paratransit service, a shared, door-to-door service for those who cannot use the standard bus transit service. Able-Ride provides about 1,200 rides a day throughout most of Nassau County.

- **Suffolk County Transit** provides bus service throughout Suffolk County and into southeastern Nassau County. It operates a fleet of 113 buses and 235 cutaway buses, serving nearly 4.28 million passengers on fixed-route transit.[17] Suffolk County Transit also provides Suffolk County Accessible Transportation (SCAT), a curb-to-curb paratransit service of 180 gasoline and diesel-powered wheelchair lift-equipped buses servicing 700,000 passengers per year.
- **Municipal Systems** also serve Long Island. The City of Long Beach in Nassau County operates a five-route bus system (with a seasonal weekend trolley route) that serves the City of Long Beach, with one route operating east to the hamlet of Point Lookout. The Town of Huntington in northwestern Suffolk County also operates its own four-route bus system, called Huntington Area Rapid Transit.

LOWER HUDSON VALLEY SERVICES

- **PART** consists of four fixed-route bus lines that operate in the eastern part of Putnam County. One of the routes serves northern Westchester County and another connects to Housatonic Area Rapid Transit in western Connecticut. PART also operates the Croton Falls Commuter Shuttle during workdays, and the Cold Spring Trolley runs seasonally between Cold Spring and the City of Beacon in Dutchess County to the north. PART is a flag system except for the system's central transfer point at the Putnam Plaza; there are no fixed stops and passengers can flag a bus anywhere along its routes. Some stops are also "on-call," which means that passengers need to call in advance to reserve a pickup. PART Paratransit offers a transportation service for people with disabilities who are unable to use PART. Operation coincides with the hours of the transportation system.
- **TOR** is Rockland County's fixed-route bus service comprising 10 routes with a fleet of 43 buses. A municipal bus service is provided by Clarkstown Mini-Trans, which is operated by the Town of Clarkstown and has five routes operating Mondays through Saturdays. Several private bus operators offer service to and from Rockland County, primarily serving New York City-bound commuters. These include Coach USA's Rockland Coaches, the Coach USA Express, CoachUSA/ Shortline, Monsey Trails, and Saddle River Tours/AmeriBus.
- Rockland County's paratransit service, called **TRIPS**, is a curb-to-curb, shared-ride paratransit service for eligible Rockland residents. TRIPS offers two levels of service. ADA TRIPS service is designed to meet the service criteria established by the federal government and serves as Rockland's complementary paratransit bus service to the municipal, fixed routes. Regular TRIPS service is reserved for residents with physical, mental, developmental, or intellectual disabilities or older adults who are aged 60 or older who find it difficult or impossible to use municipal, fixed-route bus service.
- **The Bee-Line System** operates 60 routes in Westchester County with a service area that extends from the northern and central Bronx through Westchester and into Putnam County. All Bee-Line System routes serving the Bronx connect with NYCT subway and bus terminals. In 2019, the Bee-Line fixed-route system had annual ridership of 26.4 million or approximately 100,000 trips each weekday. The Bee-Line System operates fixed-route service with 325 buses of varying types and sizes, including 78 hybrid electric buses. Westchester County also has plans to introduce all-electric vehicles into the fleet. All Bee-Line buses are fitted with exterior bicycle racks.

  Bee-Line ParaTransit provides ADA-accessible vehicles for eligible riders. Westchester County provides paratransit service county-wide, and Bee-Line ParaTransit also provides a car-for-hire service for certain trips. Paratransit service operates with approximately 100 vehicles for 7,200 registered eligible passengers making approximately 1,400 daily trips.
- **Connecticut Transit** is a statewide public benefit corporation that operates the I-Bus express service between Stamford and White Plains seven days a week.
- **NYSDOT** sponsors several Hudson Valley services, including the Hudson Link between Rockland and Westchester counties; the Orange-Westchester Link Express between Orange County and Tarrytown and White Plains in Westchester County, and the Leprechaun Connection between Poughkeepsie in Dutchess County and White Plains.

COMMUTER BUS

New York City is a central destination for commuter bus services carrying passengers from as close as Hudson County, New Jersey, and as far as Montauk and western Pennsylvania. Most commuter buses to Manhattan from west of the Hudson River operate to/from the Port Authority Bus Terminal in midtown Manhattan, with a smaller number using the George Washington Bridge Bus Station in northern Manhattan.

NJ Transit provides commuter bus service to the Port Authority Bus Terminal and the George Washington Bus Station from destinations throughout New Jersey, while private bus carriers provide services from areas in New Jersey and New York west of the Hudson River and eastern Pennsylvania. A major bus holding company, Coach USA, operates numerous commuter bus services into New York City. Coach USA also operates the Orange-Westchester Link under contract with NYSDOT. The Orange-Westchester Link provides bus service between Monroe and White Plains, New York. Rockland Coaches, which is owned by Coach USA, operates bus routes in Rockland County, New York, and Bergen County, New Jersey, with service to both the Port Authority Bus Terminal and the George Washington Bus Station.

Other commuter bus services from Rockland County include Monsey Trails, providing service to the Port Authority Bus Terminal, Lower Manhattan, and Brooklyn; Saddle River Tours/AmeriBus, providing service to the George Washington Bus Station; and Coach USA's Shortline, providing service to midtown Manhattan, Wall Street, and the Port Authority Bus Terminal. Leprechaun Lines provides commuter bus service, partially under contract with NYSDOT, between Newburgh, Stewart Airport, and Beacon in Orange and Dutchess counties, as well as between Poughkeepsie and White Plains.

Commuters from exurban communities in the multi-state metropolitan region also have access to commuter services into New York City. Trans-Bridge Lines operates peak-directional service between Lower Manhattan and the Bethlehem/Allentown/Easton region of Pennsylvania. Similarly, Martz Trailways provides service between northeastern Pennsylvania communities such as the Poconos, Scranton, and Wilkes-Barre to the Port Authority Bus Terminal, Lower Manhattan, East Midtown, and intermediate points.

To provide additional options for commuters in Danbury, Connecticut, MTA began a shuttle bus between New Fairfield, Connecticut, and the MNR station in Southeast, New York. The service provides 5 morning trips and 11 evening trips and is operated by Connecticut's Housatonic Area Regional Transit. Housatonic Area Regional Transit provides shuttle service from Danbury, Ridgefield, and New Fairfield to MNR rail stations during peak hours. Connecticut Transit also operates the I-Bus Express service between Stamford and White Plains.

COMMUTER RAIL

Three commuter rail services operate in the NYMTC planning area: MTA LIRR, MTA MNR, and NJ Transit. MTA LIRR and MNR are subsidiaries of MTA. Compared to subway service, commuter rail services offer inter- and intra-regional transportation services with longer distances between stations, wider coverage areas, zoned fares, and a greater emphasis on rider comfort due to longer passenger trips.

- **MTA LIRR** is the busiest commuter railroad in North America, with an annual ridership of 91.1 million customers in 2019. The MTA LIRR system comprises approximately 700 miles of track situated on 11 different branches, stretching 120 miles from Montauk on the eastern tip of Long Island to Penn Station in midtown Manhattan, Atlantic Terminal in Brooklyn, and Hunterspoint Avenue in Queens.
- **MTA MNR** services 124 stations distributed across five lines in seven counties in New York State—Dutchess, Orange, Putnam, Rockland and Westchester counties in the Hudson Valley and the Bronx and Manhattan in New York City—as well as two counties in Connecticut: New Haven and Fairfield. MTA MNR also manages the Hudson Rail Link feeder bus service in the Bronx and the Haverstraw-Ossining and Newburgh-Beacon ferries, all of which connect with the Hudson Line. Total MTA MNR annual rail ridership in 2019 was 86.6 million, which was slightly above the 2018 total of 86.5 million. Service in Rockland and Orange counties—the Pascack Valley Line and the Port Jervis Line—are operated by NJ Transit under contract to MNR.
- **NJ Transit** is a statewide public benefit corporation that operates commuter rail service to/from Manhattan via Penn Station.

FERRY SERVICES

New York City is well-served by ferries that connect to various points throughout the City as well as intercity service to more distant locations in New Jersey, Connecticut, and Long Island. Major operators of ferries in New York City include NYC DOT (operator of the Staten Island Ferry), Hornblower, NY Waterway, BillyBey, NY Water Taxi, and Seastreak. Ferries access terminals at St. George Terminal in Staten Island, Whitehall Terminal, Battery Park City, and World Financial Center in Lower Manhattan, and various terminals on the East and West sides of Midtown. In 2019, New York City ferries served 6.3 million riders.

- **The Staten Island Ferry** is the busiest and most frequent water transportation service in the New York City area, with an extensive peak and off-peak schedule connecting St. George Terminal on Staten Island to Whitehall Terminal at the southern tip of Manhattan. The ferry carries approximately 25 million passengers annually on its 5.2-mile run. Nine boats make 117 weekday trips between the 2 terminals, and 96 trips each day on Saturdays and Sundays.[18] In recent years, the Staten Island Ferry has transitioned to burning ultra-low sulfur fuel and embarked upon a fleet-wide emissions reductions program with the installation of various technologies.
- **Three companies (NY Waterway, Seastreak, and Liberty Landing Ferry)** operate the trans-Hudson ferry routes in public-private partnership, mostly using publicly owned terminals. These three companies currently operate 19 trans-Hudson ferry routes, operating between 12 New Jersey terminals and 4 Manhattan terminals. Of the 19 routes, 16 routes carry passengers from landings in Bergen and Hudson counties in New Jersey to Manhattan. Three routes carry passengers between Monmouth County in New Jersey and Manhattan.
- **MTA MNR, in collaboration with NYSDOT,** operates the Lower Hudson Valley Ferry Service between the Village of Haverstraw in Rockland County and the MTA MNR station in the Village of Ossining in Westchester County. The Haverstraw-Ossining Ferry operates 14 weekday trips during morning and evening peak hours, providing service to and from the MTA MNR Hudson Line. The service is operated by NY Waterway under contract to MTA MNR.
- **Long Island Ferry Service** operates across the Long Island Sound between Orient Point on Long Island's North Fork, and New London as well as from Port Jefferson on the North Shore to Bridgeport. Other Long Island ferries connect Shelter Island with Greenport and North Haven, and Montauk with Block Island, Rhode Island, and New London. An additional ferry connects Fishers Island, New York, to New London. Improvements will be made at the Bay Shore Terminal and the Ocean Beach Terminal on Fire Island.

SHARED MOBILITY

Shared mobility can be defined as transportation services and resources that are shared among users, either concurrently or one after another. This includes public transit; taxis and limos; bike sharing; carsharing (round-trip, one-way, and peer-to-peer); ridesharing (i.e., non-commercial services like carpooling and vanpooling); ride-sourcing or ride-hailing; ride-splitting; scooter sharing (now often grouped with bike sharing under the heading of micromobility); shuttle services and microtransit; jitneys and dollar vans; and more.

Shared mobility represents a conjunction of transportation services and resources available to travelers on a pay-per-use basis. As noted by FHWA, the growing ubiquity and use of smartphone and internet-based platforms facilitates shared mobility and multimodal transportation options more broadly.

2.2.7 ROADWAYS, BRIDGES AND TUNNELS

ROADWAYS

Roadway facilities are grouped into functional classes according to the type and character of service they provide. New York State currently uses seven functional classifications, which are further distinguished as urban and rural facilities. Apart from three classes—Urban Local, Rural Minor Collector, and Rural Local—all are eligible for federal funding.

There are 32,173 lane miles of interstates, arterials, collectors, and local roadways serving residents and visitors to the NYMTC planning area. Many of these roadways are heavily used despite their age, contributing to the need for repair and upgrade work throughout the region.

Local roadways—which include city, town, and village streets—make up 80 percent of the NYMTC planning area's public space and are used by all transportation modes—private vehicles, commercial vehicles, buses, cyclists, and pedestrians. Peripheral facilities include parking, bus stops, bicycle racks, and other features to support commerce.

BRIDGES AND TUNNELS

The NYMTC planning area is home to more than 3,200 bridges of all types, 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 Verrazano-Narrows Bridge; the Governor Mario M. Cuomo Bridge; the Robert. F. Kennedy Bridge; the Brooklyn, Manhattan, Williamsburg, and Ed Koch Queensboro bridges across the East River; the Goethals Bridge; the Bayonne Bridge, the Bronx-Whitestone Bridge, and the Throgs Neck Bridge.

Additionally, four major underwater 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.

2.2.8 NON-MOTORIZED TRANSPORTATION

PEDESTRIAN AND BICYCLE FACILITIES

Walking and bicycling are integral parts of life in the NYMTC planning area, providing residents with a means for commuting and travel for recreational purposes. According to the U.S. Census Bureau's American Community Survey (ACS) Five-Year Estimates for 2014–2018, 4.07 percent (245,098) of daily commuters in the region either walk or ride a bicycle as a means of travel to work. Most of these trips, 3.2 percent (192,644) of commuting trips, were walking trips while bicycle trips represented 0.87 percent (52,454) of all commuting trips in the region.[19]

The NYMTC planning area 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 bike share and electric scooter rentals. The region is home to more than 500 miles of existing protected on-street bike lanes. Between 2013 and 2018, the number of people who bicycled to work in New York City grew nearly two times faster than other major cities; daily bicycle trips now exceed 510,000, which is an increase of 35 percent over the last five years.

In 2019, NYC DOT as part of the Vision Zero Initiative released a new long-term citywide vision, Green Wave, a plan aimed at both improving cyclist safety and creating a more convenient and enjoyable and equitable riding experience.[20] As part of the plan, NYC DOT has committed to increasing the mileage of protected bicycle lanes it installs annually, from approximately 20 miles to 30 miles. Since 2014, New York City has increased the miles of bicycle lanes by more than a quarter from 911 to 1,301, including 501 lane miles of protected lanes installed in New York City as of 2019.[21]

Suffolk County has 571 miles of hiking and walking trails, and 47 miles of shared-use paths.[22] Sidewalks exist in each of the 10 towns in Suffolk County and are primarily located in more densely populated areas close to downtowns and central business districts. Suffolk County has 358 miles of on-road bicycle routes including 109 miles of on-road bicycle lanes. Additionally, Suffolk County has 60 miles of mountain biking trails.

The NYSDOT Long Island Region (Region 10) has 128 miles of on-road bicycle routes and 40 miles of off-road shared use paths representing more than a third of Long Island's 477 miles of bicycling facilities.

Nassau County has 11 miles of on-road bicycle routes and nearly 73 miles of shared-use paths. Additionally, Nassau County has nearly 20 miles of significant hiking trails. A compilation of bicycle facilities by ownership is provided in the **Pedestrian-Bicycle Element (Appendix B).**

The development of exclusive bikeways in Nassau County has primarily been oriented toward recreational use. Complete Streets projects have been a focus for the county. Nassau County is also planning for the launch of a regional bike share program that aims to expand mobility and first-last mile connectivity between various destinations, including transit stops, jobs, schools, health care, restaurants, retail, parks, museums, and cultural facilities.

The City of Long Beach has a high population density (in comparison to other Long Island communities) and limited parking supply. These factors encourage residents and visitors to use public transportation and walk and bicycle to travel around Long Beach.

The existing regional bicycle and pedestrian trailways and pathways in Westchester County consist of off-road paths, road shoulders, and formal bicycle routes along selected roads. Most off-road paths are multi-use, though some are restricted for pedestrians only. Westchester County's bicycling and hiking trail system has been developed along parkways and on former railroad and aqueduct rights-of-way to provide a county-wide trail network connecting employment centers, downtowns, schools, and parks.

Putnam County has an 11.85-mile-long paved bicycle and pedestrian path known as the Putnam Trailways. This facility is located primarily within the right-of-way of the former Putnam Division of the New York Central Railroad. The Trailways begins at the Westchester County border and is an extension of the North County Trailways, which is 22 miles long.

2.2.9 GOODS MOVEMENT

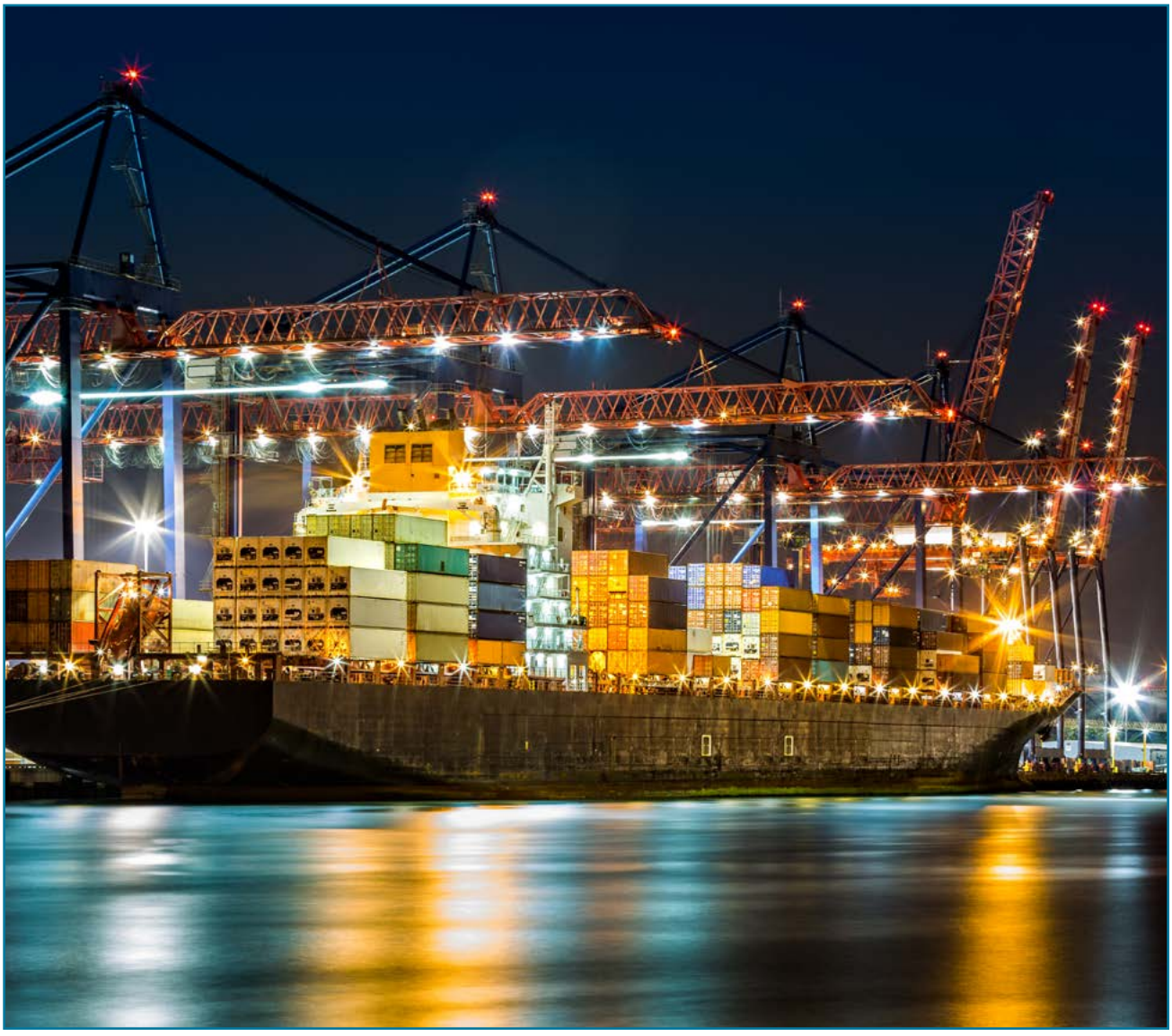
Chapter 4 of Appendix H, the Regional Freight Element, provides a detailed description of goods movement infrastructure in the NYMTC planning area. Information from the Regional Freight Element is excerpted below. A subset of the NYMTC planning area's roadway network, identified as "Strategic Freight 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. Strategic Freight Highways therefore link to:

1. Freight-generating facilities such as manufacturing and resource-extraction facilities;
2. Freight-handling facilities such as JFK Airport and other intermodal terminals and warehouses/distribution centers; and
3. Routes that can accommodate large and heavy loads to support emergency response.

Most of the rail freight activity within 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. East of the Hudson River, freight rail volumes are lower, yet rail serves an important role in carrying bulk commodities such as stone, sand, and liquids. Three Class I railroads operate in the multi-state region, along with five short line railroads. Within the NYMTC planning area, only a handful of carload service freight yards and terminals remain, with most previous facilities either converted to non-rail or non-freight rail uses.

The Port of New York and New Jersey is the largest container port on the East Coast, and third largest in the United States behind Los Angeles and Long Beach. It comprises public terminals under the management of the Port Authority (which leases property to private terminal operators) as well as privately owned/privately operated freight terminals and docks. In addition to the port facilities noted above, the U.S. Army Corps of Engineers "Master Docks" database reports 132 other marine cargo facility locations in the NYMTC planning area. This count includes facilities with a stated purpose of shipping or receiving waterborne freight and excludes facilities with occasional shipments or receipts, vessel fleeting or storage areas, and maritime support services such as repair, refueling, and drydocking.

Of the larger New York area airports in the NYMTC planning area—JFK Airport, LaGuardia Airport, Westchester County Airport, Long Island MacArthur Airport, and Republic Airport—only JFK has significant air cargo activity, and it is ranked among one of the top air cargo gateways in the country. LaGuardia Airport, while handling significant domestic passenger traffic, does not handle any significant amount of air cargo. Westchester County Airport is a regional commercial and general aviation airport, and any cargo is incidental to the passenger and charter services operated there. The NYMTC planning area is also served by air cargo through Newark Airport and Stewart International Airport, both of which have significant air cargo volumes but are outside the NYMTC planning area.



2.2.10 AVIATION

AIRPORTS

The Port Authority operates the busiest airport system in the Americas, serving nearly 139 million passengers and handling more than 2.3 million tons of cargo in 2019.

The Port Authority operates five airports:

- **JFK Airport** is one of the world's most iconic aviation facilities and the metropolitan region's busiest airport with more than 62 million annual passengers. JFK is the number one U.S. gateway for international travelers and handles the bulk of the region's air cargo.
- **Newark Airport**, which is adjacent to NYMTC's planning area in northern New Jersey, currently ranks 12th in passenger traffic with more than 46 million annual passengers in 2019. It is also the region's small-package hub.
- **LaGuardia Airport** is the region's premier short-haul domestic airport with more than 30.1 million passengers in 2019. It has the distinction of handling more passengers per square mile per year than any other airport in the world.
- **New York Stewart International Airport** is the gateway to the Hudson Valley, serving 0.69 million passengers in 2018.[23]
- **Teterboro Airport** is the busiest general and corporate aviation airport in the country and serves as an important reliever airport for the region. Couriers and small package cargo shippers operate, while serving as a receiving point for hearts and other human organs used for life-saving transplant operations performed at medical centers throughout the region.

Another relevant airport in the NYMTC planning area is Westchester County Airport, a county-owned airport classified as a small hub airport by the Federal Aviation Administration. In 2018, enplanements at Westchester County Airport numbered 789,283; deplanements totaled 771,398. This airport serves the Lower Hudson Valley and southwestern Connecticut.

HELIPORTS

New York City has three main public heliports—Downtown Manhattan/Wall Street, East 34th Street, and West 30th Street—generating more than 55,000 flights per year. Many of these flights were for air tour service, followed by commercial, corporate, itinerant, news gathering, and public safety operations.

2.2.11 OTHER TRANSPORTATION MODES

TAXIS AND FOR-HIRE VEHICLES

In New York City, the New York City Taxi and Limousine Commission licenses more than 130,000 vehicles that collectively transport over a million passengers each day. Several taxi services exist in the counties outside New York City (e.g., 9 taxi companies in Putnam County and 33 in Suffolk County).

App-based, high volume for-hire vehicles through Uber, Via, and Lyft also provide travelers in the region with mobility options. Uber was launched in New York City in May 2011; Via was launched in September 2013, and Lyft was launched in July 2014; however, these services were not approved to operate in Long Island and the Hudson Valley until 2017. On June 29, 2017, New York State legislation took effect allowing ride-hailing companies to provide services statewide.[24] The rapid growth of Transportation Network Companies (TNCs) may be attributable to the numerous advantages and conveniences that TNCs provide over other modes of transportation, including point-to-point service, ease of reserving rides, shorter wait times, lower fares (relative to taxis), ease of payment, and real-time communication with drivers. The availability of this new travel alternative improves mobility for some residents, including those with special needs, workers, and visitors.

LONG-DISTANCE AND INTER-CITY BUSES

New York City is a major hub for long-distance and intercity bus services, with buses traveling to destinations like Washington, D.C.; Boston, Massachusetts; and Lancaster, Pennsylvania; and more distant locations like Arlington and Norfolk, Virginia; Atlanta, Georgia; and Toronto, Canada. Many of the intercity buses travel in and out of the Port Authority Bus Terminal and the George Washington Bridge Bus Station in Manhattan and other locations throughout the NYMTC planning area. Following extensive growth in curbside intercity buses, a significant share of the intercity service now operates from curbside locations in Midtown, Chinatown, and outer borough stops.

Intercity bus travel gained popularity because of discount Chinatown operators, also known as "curbside" operators, which led to other competing services offered by companies like Megabus, a Coach USA brand started in 2006, and BoltBus, owned by Greyhound Lines. Megabus and BoltBus offer discount express city travel between New York and various cities throughout the eastern United States and Canada, including Washington, D.C., Boston, Philadelphia, Albany, and Toronto. Other bus companies such as Vamoose Bus and Go Buses offer less variety in destinations (mostly to the Washington, D.C., and Boston areas) and similar amenities. A number of these discounted services arrive and depart from on-street locations in Midtown Manhattan instead of the Port Authority or George Washington Bridge Bus Station. Both Megabus and BoltBus depart from locations near the Jacob K. Javits Center. "Chinatown" buses, which began providing intercity service in the late 1990s, also provide frequent, inexpensive bus services from primarily Manhattan's Chinatown, the West Side of Manhattan, and outside boroughs to the Washington, D.C., and the Boston area. Lucky Star and FlixBus also offer services to Washington, D.C., and Boston at a lower rate.

OurBus relaunched a direct New York–metropolitan Boston route formerly operated by Coach Company, now one of its partners, serving Worcester, Methuen, and Lowell, Massachusetts. In June 2020, it added a New York–Boston Back Bay route, followed by a college-oriented pop-up route between Long Island and Boston and another pop-up, connecting Hyannis, Massachusetts; Providence, Rhode Island; and New York.[25]

INTER-CITY PASSENGER RAIL

Since 1971, Amtrak has been the provider of intercity, long-distance passenger rail service in the NYMTC planning area. Amtrak serves four stations in the NYMTC planning area: Penn Station, New Rochelle, Yonkers, and Croton-Harmon. Penn Station served nearly 10 million Amtrak passengers beginning or ending their trips in 2018.

Amtrak's services include:

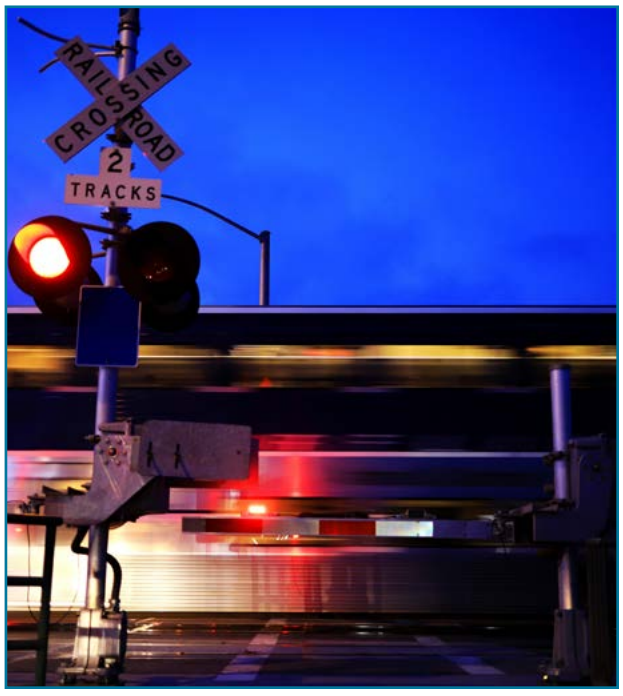
- **Acela/Northeast Regional Service** between Boston and Washington, D.C., Acela service uses a dedicated fleet of trains to provide higher-speed express service along the corridor, while Northeast Regional trains use standard Amtrak equipment and generally make more stops. Amtrak's Northeast Regional and Acela services carried approximately 12.1 million passengers in 2018.
- **Empire Corridor Service** between New York City and Albany with daily service to Buffalo and Niagara Falls.
- **Northeast Corridor through Services** to, from, or through Penn Station that travel along the Northeast Corridor to access other state corridor routes. These include through trains to the New Haven-Hartford-Springfield corridor; the Vermonter service to St. Albans; numerous Northeast Regional extensions to Virginia points (Norfolk, Roanoke, Richmond, and Newport News); the Carolinian to Raleigh, Greensboro, and Charlotte; the Pennsylvanian to Pittsburgh; and frequent Keystone Service to Lancaster and Harrisburg via Philadelphia.
- **Amtrak** also operates **Long-Distance Services** to and from New York. These include the Silver Service from New York to the Carolinas, Savannah, and Florida points; the Crescent to Atlanta, Birmingham, and New Orleans; the Lake Shore Limited to Cleveland, Toledo, and Chicago; the Cardinal to Cincinnati, Indianapolis, and Chicago; and the Palmetto to Savannah. All these trains operate once daily except for the Cardinal, which originates or terminates in New York on Sundays, Wednesdays, and Fridays.

ROOSEVELT ISLAND TRAM

The Roosevelt Island Tram operates between the island and Manhattan and supplements subway service. Originally opened in 1976 pending the completion of a subway station, the Tram, operated by the state-run Roosevelt Island Operating Corporation, now carries more than 6,000 people per day between two stations, ending fiscal year March 2020 (March) with a total ridership of more than 2.3 million, an increase from the prior fiscal year (March 2019) ridership of 2.25 million.

TOUR BUSES

Tour buses in New York City serve tourists who are either riding in a closed loop or using a system of "hop on-hop off" routes to visit specific attractions or neighborhoods. Although bus tourism has historically been confined to the Manhattan Central Business District with occasional forays into Brooklyn, tour buses are now a more common sight in Upper Manhattan, Brooklyn and the Bronx. Both Gray Line and City Sights tours' uptown loops now include the Bronx, Harlem, and Brooklyn. The bus tour industry has also expanded to include topic-specific tours, often centered on popular TV shows, local foods, or specific cultural sites.



ENDNOTES

1 U.S. Census Bureau. 2018. American Community Survey, 2018 American Community Survey. Table ID: S0101 Product: 2018: ACS 5-Year Estimates. ***data.census.gov.***

2 U.S. Census Bureau. 2018. American Community Survey, 2018 American Community Survey. Table ID: S0501 Product: 2018: ACS 5-Year Estimates. ***data.census.gov.***

3 U.S. Bureau of Economic Analysis. 2018. ***www.bea.gov/data/gdp.***

4 U.S. Bureau of Economic Analysis. 2018. CAGDP2 Gross domestic product (GDP) by county and metropolitan area. ***https://apps.bea.gov.***

5 American Enterprise Institute. Perry, J. Mark. February 28, 2019. Putting America's huge $20.5T economy into perspective by comparing US state GDPs to entire countries. ***https://www.aei.org/carpe-diem/putting-americas-enormous-20-5t-economy-into-perspective-by-comparing-us-state-gdps-to-entire-countries-2/.***

6 Oxford Economics. 2018. *Which cities will be leading the global economy in 2035?* ***https://resources.oxfordeconomics.com/global-cities-2035.***

7 U.S. Census Bureau. 2018. American Community Survey, 2018 American Community Survey: Table ID: S0101 Product:2018: ACS 5-Year Estimates. ***data.census.gov.***

8 U.S. Census Bureau. 2018. American Community Survey, 2018 American Community Survey: Table ID: S0101 Product:2018: ACS 5-Year Estimates. ***data.census.gov.***

9 U.S. Census Bureau. 2018. American Community Survey, 2018 American Community Survey Table ID: S0101.

10 Office of the New York City Comptroller Scott M. Stringer. March 6, 2020. NYC quarterly economic update. ***https://comptroller.nyc.gov/reports/new-york-city-quarterly-economic-update/.***

11 Port Authority New York and New Jersey. 2019. *2019 Airport Traffic Report.* ***https://www.panynj.gov/content/dam/airports/statistics/statistics-general-info/annual-atr/ATR2019.pdf.***

12 City of New York Department of Transportation. 2019. *Cycling in the city.* ***https://www1.nyc.gov/html/dot/html/bicyclists/cyclinginthecity.***

13 MTA New York City Transit. ***http://web.mta.info/mta/network.htm.***

14 MTA New York City Transit. *Subway and bus facts 2019*. ***https://new.mta.info/agency/new-york-city-transit/subway-bus-facts-2019***.

15 Port Authority of New York and New Jersey. 2018. ***https://www.panynj.gov/path/en/about.html.***

16 MTA. Subway and Bus Facts. April 14, 2020. ***https://new.mta.info/agency/new-york-city-transit/subway-bus-facts-2019***.

17 Suffolk County Government. June 2018. Mobility study. *Strategies for Suburban Transportation.* ***https://www.suffolkcountyny.gov/Portals/0/formsdocs/ecodev/Suffolk%20County%20Mobility%20Study_Final%20_20180702_optimized_TIFF%20cover.pdf?ver=2018-10-20-112215-423.***

18 City of New York Department of Transportation. 2020. *Staten Island ferry facts.* ***https://www1.nyc.gov/html/dot/html/ferrybus/ferry-facts.shtml.***

19 U.S. Census Bureau. 2018. American Community Survey Journey to Work 2018.

20 NYC DOT. July 2019. *Green Wave: A Plan for Cycling in NYC. New York.* ***https://www1.nyc.gov/html/dot/downloads/pdf/bike-safety-plan.pdf.***

21 NYC DOT. July 2020. *Cycling in the City. Cycling Trends in NYC July 2020* [PowerPoint slides]. ***https://www1.nyc.gov/html/dot/downloads/pdf/cycling-in-the-city-2020.pdf.***

22 Suffolk County. 2020. *Hike and Bike Plan, 2020.* ***https://www.connectli.org/docs/Suffolk%20County%20Hike%20Bike%20Master%20Plan_FinalReport.optimized.pdf.***

23 Port Authority of New York and New Jersey. 2018. ***https://www.panynj.gov/content/dam/airports/statistics/statistics-general-info/annual-atr/ATR2018.pdf.***

24 New York State Department of Motor Vehicles. June 27, 2017. DMV announces approval for Lyft and Uber to offer ride sharing services in Upstate New York and on Long Island. *More than 20,000 Drivers to Take Part in the Initial Launch on Thursday.* [Press release] ***https://dmv.ny.gov/press-release/press-release-06-28-2017-0.***

25 Schwieterman, J. P., & Antol, B. 2020. *MAKING CONNECTIONS 2020 Outlook for the Intercity Bus Industry in the United States.* The Chaddick Institute. ***https://las.depaul.edu/centers-and-institutes/chaddick-institute-for-metropolitan-development/programs/Documents/Bus%20Study%202020_official.pdf.***

3

A CONTEXT FOR OUR PLANNING—SYSTEM PERFORMANCE AND FUTURE NEEDS

3.1 OVERVIEW

Moving Forward *defines NYMTC's Shared Vision for Regional Mobility and describes the recommended approaches, actions, and investment of resources in projects, programs, and studies to pursue this shared vision during the planning period. These recommended actions and investments—both speculative and defined—use the shared vision as a strategic framework. However, before advancing the vision, it is important to assess the current performance of the transportation system and forecast future conditions in the NYMTC planning area and the larger multi-state metropolitan region. Chapter 3 describes performance and anticipated future conditions to provide an important context for the* ***Moving Forward's*** *recommended actions and investments.*

3.2 MEASURING SYSTEM PERFORMANCE

Under federal metropolitan planning regulations, NYMTC must apply a transportation performance management approach in carrying out its federally required transportation planning and programming activities. The process requires the establishment and use of a coordinated, performance-based approach to transportation planning and programming in support of national goals for federal-aid highway and public transportation programs.

As mandated, the System Performance Report is an element of *Moving Forward* that evaluates the condition and performance of the transportation system, sets performance targets, and reports on current progress in meeting the targets. In addition, as required, the Systems Performance Report included in this chapter addresses: highway safety, bridge and pavement, system performance, transit asset management, and transit safety performance assessments and targets.

3.2.1 HIGHWAY SAFETY PERFORMANCE

FHWA's final Safety Performance Management rule requires that performance targets be set for the following measures:

- Number of fatalities
- Fatality rate (per 100 million vehicle miles traveled [VMT])
- Number of serious injuries
- Serious injury rate (per 100 million VMT)
- Number of non-motorized fatalities and serious injuries

The following steps were used in setting the current statewide safety targets for calendar year 2021.

1. **Estimation of existing trend** as recommended by FHWA, a linear trendline was estimated using a five-year moving average (current year plus four preceding years).
2. **Adjustment for reasonability** having considered the percentage change between 2017 and 2021 and between 2014 and 2018, a cap allows for a target that forecasts a significant reduction but recognizes that large decreases are difficult to sustain year after year.
3. **Consideration of external and other factors** external and other factors such as VMT, population, and safety programs were considered in the development of the targets.

Once the statewide performance targets were established, NYMTC chose to support the statewide targets for Highway Safety Performance. These targets are shown in ***Table 3-1.***

Table 3-1

2021 Highway Safety Performance Targets

Statewide (Source)	NYSDOT Target 5-Year Moving Average 2021
Traffic Fatalities (Fatality Analysis Reporting System [FARS])	1,012.7
Fatalities per 100 Million VMT (FARS/FHWA)	0.824
Serious Injuries (NYS Accident Information System [AIS])	10,896.8
Serious Injuries per 100 Million VMT (AIS/FHWA)	8.865
Number of Non-Motorized Fatalities and Non-Motorized Serious Injuries (FARS/AIS)	2,583.5

ASSESSMENT OF PROGRESS IN ACHIEVING TARGETS

New York State's 2017–2022 Strategic Highway Safety Plan (SHSP) contains an overall goal of reducing "the number of fatalities and serious injuries resulting from motor vehicle crashes on public roads in New York State." The SHSP guides statewide efforts to address safety and defines a framework for implementation activities. NYSDOT's Highway Safety Improvement Program focuses on the planning, implementation, and evaluation of the SHSP. It emphasizes data-driven approaches to improving highway safety, focuses attention on relevant emphasis areas, and implements a range of SHSP strategies and countermeasures. As part of this process, NYSDOT produces an annual report that documents the statewide performance targets.

In supporting the statewide Safety Performance Management targets, NYMTC continues to program federal funding for projects and activities that address fatalities and serious injuries within its planning area through this Plan and through the TIP. NYMTC supports a host of safety programs designed to reduce fatal and serious injury crashes including the Highway Safety Improvement Program, New York City's Vision Zero, and the NYSDOT Pedestrian Safety Action Plan.

At this writing, the current federal fiscal years (FFYs) 2020–2024 TIP includes a description of the anticipated effects of its program of projects in achieving the above-mentioned targets, effectively linking investment priorities to safety targets. Additionally, *Moving Forward's* Shared Vision for Regional Mobility includes a Vision Goal to address transportation system safety and security with objectives and medium-term actions that integrate performance measures and targets into NYMTC's transportation planning process.

3.2.2 PAVEMENT AND BRIDGE CONDITION PERFORMANCE

FHWA's final Pavement and Bridge Condition Performance Management (PM2) rule requires that performance targets be set for six performance measures for pavement and bridge condition on Interstate and non-Interstate National Highway System (NHS) roads:

- 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
- Percent of NHS bridges (by deck area) classified as in good condition
- Percent of NHS bridges (by deck area) classified as in poor condition

The four pavement condition measures represent the percentage of lane miles on the Interstate and non-Interstate NHS that are in good or poor condition. The PM2 rule defines NHS pavement types as either asphalt, jointed concrete, or continuously reinforced concrete pavement and defines five pavement condition metrics for states to use to assess pavement condition:

- **International Roughness Index (IRI)**—an indicator of roughness; applicable to all three pavement types.
- **Cracking percent**—percentage of the pavement surface exhibiting cracking; applicable to all three pavement types.
- **Rutting**—extent of surface depressions; applicable to asphalt pavements only
- **Faulting**—vertical misalignment of pavement joints; applicable to jointed concrete pavements only.
- **Present Serviceability Rating**—a quality rating that is applicable only to NHS roads with posted speed limits of less than 40 miles per hour (mph) (e.g., toll plazas and border crossings). A state may choose to collect and report Present Serviceability Ratings for applicable segments as an alternative to the other four metrics.

For each pavement metric, a threshold is used to establish good, fair, or poor condition. Using these metrics and thresholds, pavement condition is assessed for each one-tenth of a mile section of the through travel lanes of mainline highways on the Interstate or the non-Interstate NHS, as follows:

- Asphalt segments are assessed using the IRI, cracking, and rutting metrics; jointed concrete segments are assessed using IRI, cracking, and faulting. For these two pavement types, each segment is rated good if the ratings for all three metrics are good, and poor if the ratings for two or more metrics are poor.
- Continuous concrete segments are assessed using the IRI and cracking metrics. A segment is rated good if both metrics are rated good; it is rated poor if both metrics are rated poor.
- If a state collects and reports Present Serviceability Ratings for any applicable pavement segments, those segments are rated according to the Present Serviceability Rating scale.

For all three pavement types, sections that are not good or poor are rated fair. The good/poor pavement condition measures are expressed as a percentage and are determined by summing the total lane miles of good or poor highway segments and dividing by the total lane miles of all highway segments on the applicable system. Pavement in good condition suggests that no significant investment is needed. Pavement in poor condition suggests reconstruction investment is needed in the near term.

The two bridge condition performance measures refer to the percentage of bridges by deck area on the NHS that are in good or poor condition. Bridge owners are required to inspect bridges on a regular basis and report condition data to FHWA. The measures assess the condition of four bridge components: deck, superstructure, substructure, and culverts.

Each bridge component has a metric rating threshold to establish good, fair, or poor condition, and each bridge on the NHS is evaluated using these ratings. If the lowest rating of the four metrics is greater than or equal to seven, the structure is classified as good. If the lowest rating is less than or equal to four, the structure is classified as poor. If the lowest rating is five or six, it is classified as fair.

The bridge condition measures are expressed as the percent of NHS bridges in good or poor condition. The percent is determined by summing the total deck area of good or poor NHS bridges and dividing by the total deck area of the bridges carrying the NHS. Deck area is computed using structure length and either deck width or approach roadway width.

Bridges in good condition suggests that no major investment is needed. Bridges in poor condition are safe to drive on; however, they are nearing a point where substantial reconstruction or replacement is needed.

ASSESSMENT OF PROGRESS IN ACHIEVING TARGETS

Pavement and bridge condition performance is assessed over a series of four-year performance periods. The first performance period began on January 1, 2018, and runs through December 31, 2021. NYSDOT must report baseline performance and targets at the beginning of each period and update performance at the midpoint and end of each performance period.

The PM2 rule requires performance targets for all six measures as follows:

- Four-year statewide targets for the percent of Interstate pavements in good and poor condition
- Two-year and four-year statewide targets for the percent of non-Interstate NHS pavements in good and poor condition
- Two-year and four-year targets for the percent of NHS bridges (by deck area) in good and poor condition

The two-year and four-year targets represent expected pavement and bridge condition at the end of calendar years 2019 and 2021, respectively.

NYSDOT established statewide PM2 targets on May 20, 2018. In supporting the targets, NYMTC programs federal funding for projects and activities that help to achieve the targets.

During the October 2020 mid-period performance review of the targets, NYSDOT maintained the targets set in in 2018. *Table 3-2* presents baseline, two-year targets, and mid-period performance for each PM2 measure for New York and for the NYMTC planning area as well as the four-year statewide targets established by NYSDOT and supported by NYMTC.

Table 3-2

Pavement and Bridge Condition (PM2) Performance and Targets

Performance Measures	Baseline	2-Year Target	2-Year Condition/ Performance	4-Year Target	Significant Progress Made? (Y/N)
Percentage of Pavements of the Interstate System in Good Condition*	*	*	51.1%	47.3%	N/A
Percentage of Pavements of the Interstate System in Poor Condition*	*	*	1.1%	4%	N/A
Percentage of Pavements of the Non-Interstate NHS in Good Condition**	36.7%	**	37.2%	**	Yes
Percentage of Pavements of the Non-Interstate NHS in Good Condition (Full Distress + IRI)**	**	14.6%	**	14.7%	Yes
Percentage of Pavements of the Non-Interstate NHS in Poor Condition**	26.7%	**	26.3%	**	Yes
Percentage of Pavements of the Non-Interstate NHS in Poor Condition (Full Distress + IRI)**	**	12.0%	7.5%	14.3%	N/A
Percentage of NHS Bridges Classified as in Good Condition	22.8%	23.0%	26.0%	24.0%	Yes
Percentage of NHS Bridges Classified as in Poor Condition	10.6%	11.6%	9.6%	11.7%	Yes

**For the first performance period only, baseline condition and 2-year targets are not required for the Pavements on the Interstate System measures.*

***For the first performance period, states were evaluated based on the IRI performance for this measure. NYSDOT has established targets based on the full distress measure and IRI.*

System preservation is a major focus of both *Moving Forward* and of NYMTC's TIP, as described in the financial forecasts contained in ***Chapter 5*** and as evidenced by the proportion of funding proposed for this purpose.

To support progress toward approved pavement and bridge targets, *Moving Forward* forecasts a total of $87 billion to address system preservation during the planning period, an average of approximately $3 billion per year in year-of-expenditure dollars.

3.2.3 SYSTEM PERFORMANCE, FREIGHT, AND CONGESTION MITIGATION AND AIR QUALITY IMPROVEMENT PROGRAM PERFORMANCE

FHWA's final System Performance, Freight, and Congestion Mitigation and Air Quality (CMAQ) Program Performance Management (PM3) rule established six performance measures to assess the performance of the NHS, freight movement on the Interstate system, and traffic congestion and on-road mobile source emissions for the CMAQ program. The performance measures are:

- Percent of person-miles on the Interstate system that are reliable, determined through Level of Travel Time Reliability (LOTTR)
- Percent of person-miles on the non-Interstate NHS that are reliable, determined through LOTTR
- Truck Travel Time Reliability Index (TTTR)
- Annual hours of peak hour excessive delay per capita (PHED)
- Percent of non-single occupant vehicle travel (non-SOV)
- Cumulative two-year and four-year reduction of on-road mobile source emissions for CMAQ-funded projects

Each performance measure listed above is described in more detail below.

Level of travel time reliability (LOTTR) refers to the consistency or dependability of travel times on a roadway from day to day or across different times of the day. For example, if driving a certain route always takes about the same amount of time, that segment is reliable. It may be congested most of the time, not congested most of the time, or somewhere in between, but the conditions do not differ very much from time period to time period. On the other hand, if driving that route takes 20 minutes on some occasions but 45 minutes on other occasions, the route is not reliable.

LOTTR is defined as the ratio of the longer travel times, represented at the 80th percentile of

all trips, to a normal travel time measured at the 50th percentile of all trips over applicable roads during four time periods that cover the hours of 6:00 a.m. to 8:00 p.m. each day (AM peak, midday, PM peak, and weekends). LOTTR is calculated for each roadway segment, which is judged as reliable if its LOTTR is less than 1.5 during all four periods. If one or more periods has a LOTTR of 1.5 or above, that segment is unreliable.

These two LOTTR measures are expressed as the percent of person-miles traveled on the Interstate or non-Interstate NHS system that are reliable. By using person-miles, the measures consider the total number of people traveling in buses, cars, and trucks over these roadway segments. To obtain total person-miles traveled, the length of each segment is multiplied by an average vehicle occupancy for each type of vehicle on the roadway. The sum of person-miles on reliable segments is divided by the sum of person-miles on all segments to determine the percent of person-miles traveled that are reliable.

Truck travel time reliability (TTTR) assesses travel time reliability for trucks traveling on Interstate roadway. TTTR is calculated by dividing the 95th percentile of truck travel time by a normal travel time at the 50th percentile for each segment of the Interstate system over five periods throughout weekdays and weekends (AM peak, midday, PM peak, weekend, and overnight). The periods cover all hours of the day.

For each Interstate segment, the highest TTTR value among the five periods is multiplied by the length of the segment. The sum of these length-weighted segments is then divided by the total length of Interstate to generate the TTTR Index.

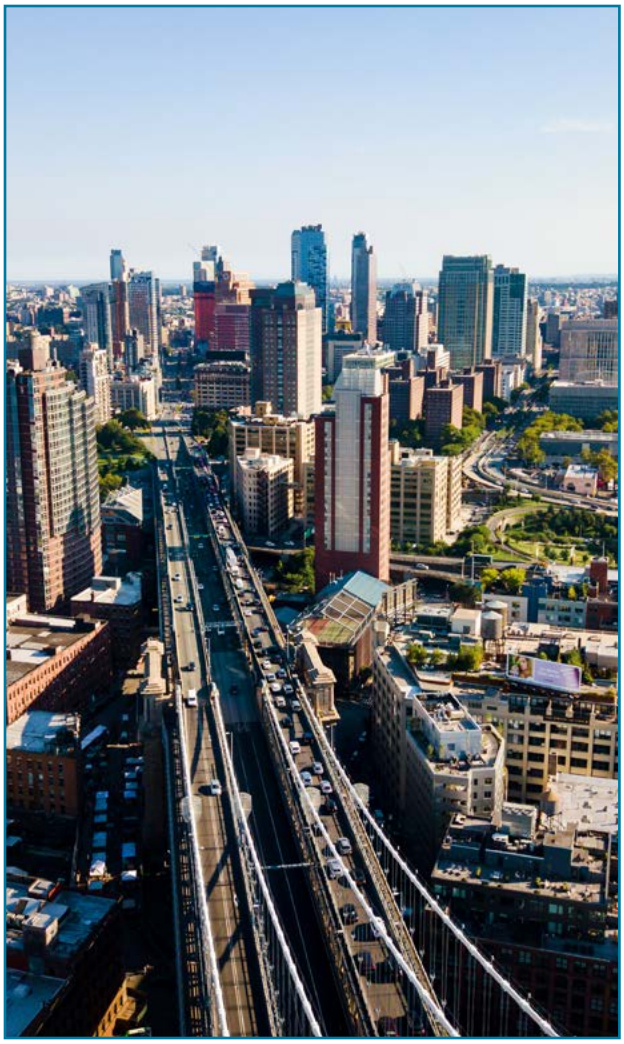
FHWA provides the travel time data used to calculate LOTTR and TTTR via the National Performance Management Research Data Set, which contains historical travel times, segment lengths, and annual average daily traffic for Interstate and non-Interstate NHS roads.

Peak hour excessive delay (PHED) represents the hours of delay resulting from traffic congestion on the NHS during morning and afternoon peak travel times on Mondays through Fridays. FHWA defines the morning peak travel hours as 6:00 a.m. to 10:00 a.m. and the afternoon peak as either 3:00 p.m. to 7:00 p.m. or 4:00 p.m. to 8:00 p.m. FHWA also defines excessive delay as travel time at 20 mph on a segment or 60 percent of the posted speed limit, whichever is greater, during 15-minute intervals that cover peak travel times on Mondays through Fridays for the entire calendar year. Excessive delay is totaled and is then weighted by vehicle volumes and occupancy to be expressed as the annual hours of excessive delay during the peak hours on a per capita basis to measure person-hours of delay rather than vehicle-hours.

Non-SOV travel represents the percentage of person travel within the UZA not undertaken in an SOV. Non-SOV travel, includes ridesharing via carpool and commuter van, as well as travel using public transportation, commuter rail, walking and bicycling, and telecommuting. The percentage non-SOV travel for the New York-Newark, NY-NJ-CT UZA is calculated using the U.S. Census Bureau's ACS five-year dataset of journey-to-work trips for residents of the UZA. While all trips (not just journey-to-work) would be ideal to track, this regularly updated, approved dataset is recognized as the best available input to the calculation of the measure. The data reflects five-year averages, with a time lag. Thus, the two-year target refers to 2014–2018 and the four-year target refers to 2016–2020.

CMAQ emission reduction represents the total on-road mobile source emissions reductions of applicable criteria pollutants (as defined by the Clean Air Act Amendments of 1990) and their precursors resulting from all CMAQ-funded projects and programs. Total reduction is calculated by summing the cumulative two-year and four-year emission reductions of applicable pollutants resulting from CMAQ projects and is expressed in kilograms per day.

The NYMTC planning area is part of several nonattainment or maintenance areas designated under the Clean Air Act Amendments of 1990 for mobile source emissions of ground-level ozone, carbon monoxide, and fine particulate matter ($PM_{2.5}$). As such, for NYMTC the measure applies to two ozone precursors (i.e., volatile organic compounds and nitrogen oxides), as well as carbon monoxide and $PM_{2.5}$ emissions.



ASSESSMENT OF PROGRESS IN ACHIEVING TARGETS

PM3 performance is assessed over a series of four-year performance periods. States must report baseline performance and targets during the first part of the performance period and update performance at the midpoint and end of each performance period.

For the LOTTR, TTTR, PHED, and non-SOV travel measures, the first performance period began on January 1, 2018, and runs through December 31, 2021. For the CMAQ emission reduction measure, the first performance period began on October 1, 2017, and ends on September 30, 2021.

The PM3 rule requires that agencies establish performance targets for each measure and monitor progress towards achieving the targets. Two-year and four-year targets must be established for the Interstate LOTTR, TTTR, non-SOV travel, and CMAQ emission reduction measures, while four-year targets must be established for the non-Interstate NHS LOTTR and PHED measures.

The current two-year and four-year targets represent expected performance at the end of calendar years 2019 and 2021, respectively. For the CMAQ emission reduction measure, the two-year and four-year targets represent cumulative emission reductions from CMAQ-funded projects from October 1, 2017, to September 30, 2019 (for the two-year target) and October 1, 2017, to September 30, 2021 (for the four-year target).

The PHED and non-SOV travel measures apply to an UZA as defined by the U.S. Census Bureau. For these measures, states and MPOs are required to work together to mutually establish a single, unified PHED and non-SOV travel target for the UZA within their boundaries, as a whole or in part. Two- and four-year targets must be established for the non-SOV travel measure, and a four-year target must be established for the PHED measure. For the New York-Newark, NY-NJ-CT UZA, coordination between NYMTC, the North Jersey Transportation Planning Authority, the Delaware Valley Regional Planning Commission, and the state departments of transportation of New York and New Jersey is needed to establish PHED and non-SOV travel.

NYMTC supports statewide PM3 performance targets by programming federal funds for projects and programs that assist in achieving the targets. The statewide targets set in 2018 did not change at the mid-performance period review.

Table 3-3 presents baseline performance for the LOTTR, TTTR, and CMAQ emission reduction measures for New York and for the NYMTC planning area as well as the two- and four-year targets established by NYSDOT. Baseline performance and two- and four-year targets for PHED and non-SOV travel measures for the New York-Newark, NY-NJ-CT UZA are also provided.

Table 3-3

System Performance, Freight, and CMAQ (PM3) Performance and Targets

Performance Measures	Baseline	2-Year Target	2-Year Condition/ Performance	4-Year Target	Significant Progress Made? (Y/N)
Percent of Person-Miles Traveled on the Interstate that are Reliable	83.2%	73.1%	78.8%	73.0%	Yes
Percent of Person-Miles Traveled on the Non-Interstate that are Reliable*	N/A	N/A	80.3%	63.4%	N/A
TTTR Index	1.39	2.00	1.47	2.11	Yes
Annual Hours of Peak Hour Excessive Delay per Capita (UZA 1)**	N/A	N/A	22.3	22.0	N/A
Percent of Non-SOV Travel (UZA 1)	51.6%	51.6%	51.6%	51.7%	Yes
Total Emission Reductions PM2.5 (daily kilograms)	5.480	10,740	89.576	20.484	Yes
Total Emission Reductions Nitrogen Oxide (daily kilograms)	83.606	160.523	925.308	294.914	Yes
Total Emission Reductions Volatile Organic Compounds (daily kilograms)	32.452	62.957	602.290	117.088	Yes
Total Emission Reductions PM10 (daily kilograms)	12.885	25.512	N/A***	49.642	N/A***
Total Emission Reductions Carbon Monoxide (daily kilograms)	611.939	1,199.401	1,5117.400	2,298.835	Yes

**For the first performance period only, baseline condition and 2-year targets are not required for the Non-Interstate NHS reliability measure.*

***There was no evaluation of this measure in the first performance period.*

****FHWA does not evaluate the performance of this measure.*

The targets for the PHED and non-SOV travel were jointly developed by the participating states and MPOs that are part of the New York-Newark, NY-NJ-CT UZA. The methodologies employed ensured that there was full agreement from each member on policies, programs, and assumptions used in developing the targets. The UZA achieved its two-year target for non-SOV travel. In spring 2020, the UZA-participating states and MPOs met and agreed that given current progress and many uncertainties, the UZA would not adjust the four-year targets for PHED and non-SOV travel.

Moving Forward includes projects, programs, strategies, and actions to address system performance, freight reliability, mobile source emissions, and traffic congestion. The Plan identifies funding for targeted improvements in these areas. NYMTC supports the statewide PM3 targets and will continue to monitor and track the current performance of the roadway network. NYSDOT and NYMTC, working with the Albany Visualization and Informatics Lab at SUNY have combined National Performance Management Research Data Set data with other data sources, such as traffic count and employer data. These

tools allow NYSDOT and NYMTC to better understand the sources of back-ups (e.g., bottlenecks) and the impacts of accidents and analyze the benefits of infrastructure investments and operational strategies through before and after analyses. Incorporation of the system performance measures into existing planning and data monitoring processes for the roadway network are ongoing, as it the collaboration within the UZA for the relevant performance measures.

3.2.4 TRANSIT ASSET PERFORMANCE

Federal transit asset performance regulations apply to all recipients and subrecipients of federal transit funding that own, operate, or manage public transportation capital assets. A variety of transit service providers that receive transit funding serve the NYMTC planning area. These provides include:

- MTA
- Nassau County (NICE), Suffolk County (Suffolk County Transit), the City of Long Beach (City of Long Beach Transit), and the Town of Huntington (Huntington Area Rapid Transit) on Long Island
- Putnam County (PART), Rockland County (TOR), and Westchester County (Bee-Line System) in the Lower Hudson Valley
- NYC DOT (Staten Island Ferry)

Figure 3-1 shows the Transit Asset Management (TAM) plan elements that are required by Tier I and Tier II providers as defined by their service levels. The tiers are established by the size of the transit system that is submitting the TAM plan.

Figure 3-1

Transit Asset Management Plans

1. Inventory of Capital Assets	Tier I & II
2. Condition Assessment	
3. Decision Support Tools	
4. Investment Prioritization	
5. TAM and State of Good Repair Policy	Tier I Only
6. Implementation Strategy	
7. List of Key Annual Activities	
8. Identification of Resources	
9. Evaluation Plan	

All assets used by these providers for public transit services are expected to be included in the TAM plan asset inventory. This includes (except for equipment) assets that are owned by a third party or shared resources. The inventory must include all service vehicles and any other owned equipment assets over $50,000 in acquisition value. Agencies only need to include condition assessment for assets for which they have direct capital responsibility.

TAM plans must measure the current condition and forecast the future conditions of the transit assets contained in the inventory. ***Table 3-4*** identifies the federal transit asset performance measures.

Table 3-4

FTA Transit Asset Management Performance Measures

**Only for assets for which the agency has direct capital responsibility.*

Asset Category*	Performance Measure and Asset Class
Rolling Stock Revenue vehicles by mode	Percentage of revenue vehicles within a particular asset class that have either met or exceeded their useful life benchmark
Equipment Non-revenue support-service and maintenance vehicles	Percentage of non-revenue, support-service, and maintenance vehicles that have met or exceeded their useful life benchmark
Infrastructure Only rail fixed-guideway, track, signals, and systems	Percentage of track segments with performance restrictions
Facilities Maintenance and administrative facilities; and passenger stations (buildings) and parking facilities	Percentage of facilities within an asset class rated below condition 3 on the Transit Economic Requirement Model (TERM) scale

ASSESSMENT OF PROGRESS IN ACHIEVING TARGETS

Public transportation agencies are required to establish and report TAM targets annually for the following fiscal year. Each responsible public transportation provider must share its targets, TAM, and asset condition information with NYMTC. In turn, NYMTC is required to establish TAM targets within 180 days after the public transportation providers establish initial targets and update its targets when it adopts a new regional transportation plan or TIP. When establishing TAM targets, NYMTC can either agree to program projects that will support the transit provider targets or establish separate regional TAM targets for its planning area.

The public transportation providers in the NYMTC planning area have established the TAM targets listed in the following tables. NYMTC is supporting the providers' individual TAM targets for each of the nine transit providers in the NYMTC planning area. *Tables 3-5* through *3-15* describe the targets for the *Tier I* and *Tier II* operators for each of the four TAM performance measures.

TIER I PROVIDERS

Table 3-5

MTA Selected Systems

Source: MTA

		NYCT		Staten Island Railway		MTA Bus	
Asset Category - Performance Measure	Asset Class	ULB (Years)	Targets	ULB (Years)	Targets	ULB (Years)	Targets
Rolling Stock Age - % of revenue vehicles within a particular asset class that have met or exceeded their Useful Life Benchmark (ULB)	Articulated buses	12	0%	N/A	N/A	12	0%
	Over the road buses	12	9%	N/A		12	96%
	Buses	12	8%	N/A		12	46%
	Heavy rail passenger cars	40	11%	40	100%	N/A	N/A
Equipment Age - % of non-revenue vehicles within a particular asset class that have met of exceeded their ULB	Trucks and other rubber tire vehicles	7-11	20%	7-11	44%	7-11	12%
	Steel wheel service vehicles	Various	58%	15-35	29%	N/A	
	Automobiles	7-11	18%	7-11	17%	7-11	15%
Infrastructure % of track segments with performance restrictions (as applicable)	Rail fixed guideway track	25-65	2%	28	0%	N/A	N/A
Facilities Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	Passenger facilities	Various	53%	Various	70%	N/A	N/A
	Parking facilities	N/A	N/A	N/A	N/A	N/A	N/A
	Maintenance & administration facilities	Various	57%	Various	22%	75	5%

Table 3-6

MTA Long Island Rail Road

Source: MTA

Asset Category - Performance Measure	Asset Class	ULB (Years)	Targets
Rolling Stock Age - % of revenue vehicles within a particular asset class that have met or exceeded their ULB	RS - Commuter rail, self-propelled passenger car	39	0%
	RP - Commuter rail passenger coach	39	0%
	Commuter rail locomotive	39	0%
	Heavy rail passenger cars	31	0%
Equipment Age - % of non-revenue vehicles within a particular asset class that have met of exceeded their ULB	Trucks and other rubber tire vehicles	14	14%
	Steel wheel service vehicles	25	74%
	Automobiles	8	14%
Infrastructure % of track segments with performance restrictions (as applicable)	Rail fixed guideway track	25-65	1.65%
Facilities Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	Passenger/parking facilities	Various	15.9%
	Administrative/maintenance facilities	Various	38.3%

Table 3-7

MTA Metro-North Railroad

Source: MTA

Asset Category - Performance Measure	Asset Class	ULB (Years)	Targets
Rolling Stock Age - % of revenue vehicles within a particular asset class that have met or exceeded their ULB	RS - Commuter rail, self-propelled passenger car	35	0%
	RP - Commuter rail passenger coach	35	0%
	RL - Commuter rail locomotive	35	34%
Equipment Age - % of non-revenue vehicles within a particular asset class that have met of exceeded their ULB	Trucks and other rubber tire vehicles	8-14	61%
	Steel wheel service vehicles	35	73%
Infrastructure % of track segments with performance restrictions (as applicable)	Track segments, signals, and systems	25-65	2%
Facilities Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	Passenger facilities	Various	40%
	Parking facilities	Various	24%
	Administrative facilities	Various	34%
	Maintenance facilities	Various	28%

Table 3-8

Nassau Inter-County Express (NICE) Bus

Source: Nassau County

Asset Category - Performance Measure	Asset Class	ULB (Years)	Targets
Rolling Stock Age - % of revenue vehicles within a particular asset class that have met or exceeded their ULB	Bus	14	5%
	Cutaway bus	10	5%
	Articulated bus	14	5%
	Van	8	10%
	Automobile	8	10%
Equipment Age - % of non-revenue vehicles within a particular asset class that have met of exceeded their ULB	Sedans/SUV	6-8	15%
	Van/trucks and other rubber tire vehicles	10-13	15%
Infrastructure % of track segments with performance restrictions (as applicable)	Rail fixed guideway	N/A	N/A
Facilities Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	Passenger and parking	3	0%
	Administrative and maintenance	3	10%

Table 3-9

Suffolk County Transit

Source: Suffolk County

Asset Category - Performance Measure	Asset Class	ULB (Years)	Targets
Rolling Stock Age - % of revenue vehicles within a particular asset class that have met or exceeded their ULB	Bus	14	10%
	Cutaway bus	10	10%
Equipment Age - % of non-revenue vehicles within a particular asset class that have met of exceeded their ULB	Non-revenue/service automobile	8	20%
Infrastructure % of track segments with performance restrictions (as applicable)	Rail fixed guideway	N/A	N/A
Facilities Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale		N/A	N/A

Table 3-10

Westchester County Bee-Line System

Source: Westchester County DOT

Asset Category - Performance Measure	Asset Class	ULB (Years)	Targets
Rolling Stock Age - % of revenue vehicles within a particular asset class that have met or exceeded their ULB	Fixed-route buses	14-17	11%
	Paratransit vehicles	5-6	
Equipment Age - % of non-revenue vehicles within a particular asset class that have met of exceeded their ULB	Non-revenue/service automobiles	10	45%
	Trucks and other rubber tire vehicles	8-10	40%
	Maintenance equipment	40-50	20%
Infrastructure % of track segments with performance restrictions (as applicable)	Rail fixed guideway track	N/A	N/A
Facilities Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	Maintenance-related assets	N/A	50%

Table 3-11

New York City Department of Transportation

Source: NYC DOT

Asset Category - Performance Measure	Asset Class	ULB (Years)	Targets
Rolling Stock Age - % of revenue vehicles within a particular asset class that have met or exceeded their ULB	Ferryboat	42	11%
Equipment Age - % of non-revenue vehicles within a particular asset class that have met of exceeded their ULB	Non-revenue/service automobiles	7-8	45%
	Trucks and other rubber tire vehicles	8-10	40%
	Maintenance equiptment	40-50	20%
Infrastructure % of track segments with performance restrictions (as applicable)	Rail fixed guideway track	N/A	N/A
Facilities Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	Maintenance-related assets	N/A	50%

TIER II PROVIDERS

Table 3-12

Putnam Area Rapid Transit (PART)

Source: NYSDOT

Asset Category - Performance Measure	Asset Class	ULB (Years)	Targets
Rolling Stock Age - % of revenue vehicles within a particular asset class that have met or exceeded their ULB	Fixed Route	5	0%
	Paratransit	5	5%
Equipment Age - % of non-revenue vehicles within a particular asset class that have met of exceeded their ULB	Maintenance Related Assets	15	30%
Facilities Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	All Facilities	40	33%

Table 3-13

Transport of Rockland (TOR)

Source: NYSDOT

Asset Category - Performance Measure	Asset Class	ULB (Years)	Targets
Rolling Stock Age - % of revenue vehicles within a particular asset class that have met or exceeded their ULB	BU1 35 and 40 feet	10	61%
	CU - TRIPS BUSES	5	25%
	BR1	12	0%
	CU - CMT	5	77%
	BR1 - Monsey	12	0%
	BR1 - ShortLine	12	0%

Table 3-14

Huntington Area Rapid Transit

Source: NYSDOT

Asset Category - Performance Measure	Asset Class	ULB	Targets
Rolling Stock Age - % of revenue vehicles within a particular asset class that have met or exceeded their ULB	BU1 - Bus (5307)	350,000 miles	9.10%
Equipment Age - % of non-revenue vehicles within a particular asset class that have met of exceeded their ULB	All Equipment (5307)	8 years	100%
Facilities Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	Maintenance (5307)	N/A	0%

Table 3-15

City of Long Beach Transit

Source: NYSDOT

Asset Category - Performance Measure	Asset Class	ULB	Targets
Rolling Stock	BU1 - Bus (5307)	350,000 miles	25%
Age - % of revenue vehicles within a particular asset class that have met or exceeded their ULB			
Facilities	Maintenance (5307)	N/A	100%
Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	Passenger Facilities	N/A	0%

Moving Forward's Vision Goals include the goal of preserving the existing transportation system. As part of the ongoing coordination efforts to fulfill TAM requirements, the progress of the transit providers toward achieving their TAM targets will be monitored and reported. Additionally, federal funding will be programmed toward achieving the TAM targets of the transit providers.

Moving Forward forecasts the cost of transit system preservation over the life of the Plan at approximately $664 billion, or roughly 88 percent of the Plan's total projected system preservation costs for the entire transportation system in the NYMTC planning area. The Plan estimates that most of these costs will be met through a combination of federal, state, and local resources.

3.2.5 TRANSIT SAFETY PERFORMANCE

FTA-established transit safety performance management requirements in the Public Transportation Agency Safety Plan final rule require providers of public transportation systems that receive federal financial assistance under 49 U.S.C. Chapter 53 to develop and implement a Public Transportation Agency Safety Plan based on a Safety Management Systems approach.

Each Public Transportation Agency Safety Plan includes performance targets for the performance measures established by FTA in the National Public Transportation Safety Plan, including:

- Total number of reportable fatalities and rate per total vehicle revenue miles by mode
- Total number of reportable injuries and rate per total vehicle revenue miles by mode
- Total number of reportable safety events and rate per total vehicle revenue miles by mode
- System reliability measured as the mean distance between major mechanical failures by mode

The targets set by some of the transit operators in the NYMTC planning area are displayed in Tables ***3-16*** through ***3-21***. Other will be added as they become available. It should be noted that the FTA Public Transportation Safety Plan Rule 49 CFR Part 673 states "Pursuant to § 673.11(f), agencies that operate passenger ferries regulated by United States Coast Guard (USCG) or rail fixed guideway public transportation service regulated by Federal Railroad administration (FRA) are not required to develop safety plans for those modes of service." As a result, targets for MTA LIRR, MTA MNR, and ferries are not reported here.

Table 3-16

Metropolitan Transportation Authority (MTA) Bus Systems

	Fatalities	Customer Accident Injury Rate (per million customers)	Collisions with Injury Rate (per million vehicle miles)	Employee Lost Time & Restricted Duty Rate (per 100 employees)	System Reliability: Mean Distance Between Failures (miles)	System Reliablility (% of completed trips)
MTA New York City Transit	0.00	1.19	6.47	5.42	6,413.00	99.40
MTA Bus Company	0.00	1.06	5.51	6.67	6,880.00	99.40

Table 3-17

Metropolitan Transportation Authority (MTA) Subway

	Fatalities	Injuries	Safety Events	System Reliability Mean Distance Between Failure
Employee Safety Performance Targets	Reduction by 5%	Reduction by 5%	Reduction by 5%	150,000 Miles
MTA Bus Company	Reduction by 3%	Reduction by 3%	Reduction by 3%	N/A

Table 3-18

Westchester County – Bee-Line System

Mode of Transit Service	Fatalities (Total)	Fatalities (Rate)	Injuries (Total)	Injuries (Rate)	Safety Events (Total)	Safety Events (Rate)	System Reliability (Miles Between Major Failures)
Fixed-Route Bus	0.0	0.0	63.0	8.2	48.0	6.2	3,600
Paratransit	0.0	0.0	4.0	1.2	4.0	1.2	40,000

Table 3-19

Nassau Inter-County Express (NICE)

Mode of Transit Service	Fatalities (Total)	Fatalities (Rate)	Injuries (Total)	Injuries (Rate)	Safety Events (Total)	Safety Events (Rate)	System Reliability (Miles Between Major Failures)
Fixed Route	0.0	0.0	43.0	0.42	76.00	0.80	9,000
Paratransit	0.0	0.0	3.0	0.16	18.00	0.95	28,702

Table 3-20

City of Long Beach

Mode of Transit Service	Fatalities (Total)	Fatalities (Rate)	Injuries (Total)	Injuries (Rate)	Safety Events (Total)	Safety Events (Rate)	System Reliability (Miles Between Major Failures)
Fixed Route / Deviated Route	0	0	0	0	0	0	0
Paratransit	0	0	0	0	0	0	0

Table 3-21

Town of Huntington

Mode of Transit Service	Fatalities (Total)	Fatalities (Rate)	Injuries (Total)	Injuries (Rate)	Safety Events (Total)	Safety Events (Rate)	System Reliability (Miles Between Major Failures)
Fixed Route / Deviated Route	0	0	0	0	0	0	0
Paratransit	0	0	0	0	0	0	0

3.3 AN OVERVIEW OF THE FORECASTS

NYMTC's socioeconomic and demographic (SED) forecasts establish the likelihood that the multi-state metropolitan region will experience significant growth in population, jobs, economic activity, and travel over the planning period. This likelihood presents a challenge to the regional transportation system and highlights the importance of accommodating future growth while safeguarding the quality of life and health of residents and visitors.

The following sections describe the wide range of historical and current SED trends for the region, with a focus on the NYMTC planning area and, as applicable, contextualize these data within a broader 31-county forecasting region drawn from New York City's multi-state metropolitan area. Typically, NYMTC uses U.S. Census data to describe trends and to serve as a basis for forecasting methods that project these trends to the Plan's horizon year. Additional technical detail is available in **Appendix C**.

Although the forecasts incorporate recent SED trends, the COVID-19 pandemic, whose impacts in the forecasting region were first felt in March 2020, has significantly disrupted these trends as of this writing. While adjustments have been made to the forecasts to reflect this short-term impact and resulting economic uncertainty, the ongoing conditions and effects of the pandemic are largely speculative. Nonetheless, the primary purpose of the forecast is the long-term outlook, which is less suspectable to short-term volatility. As new data become available regarding the impacts of the pandemic on regional employment and population trends, it will be incorporated in the next set of SED forecasts.

The current SED forecast produces metrics including population, employment, labor force, and number of households, in five-year intervals projected out to the Plan's horizon year. The forecast geography comprises 31 counties in the multi-state metropolitan region, consisting of the following subregions:

- New York City
- Long Island
- Lower- and Mid-Hudson Valley
- Northern New Jersey
- Southwestern Connecticut

Although the SED forecast produces data for the entire 31-county forecasting region, much of this chapter will focus on the 10-county NYMTC planning area, which is disaggregated into the following subregions:

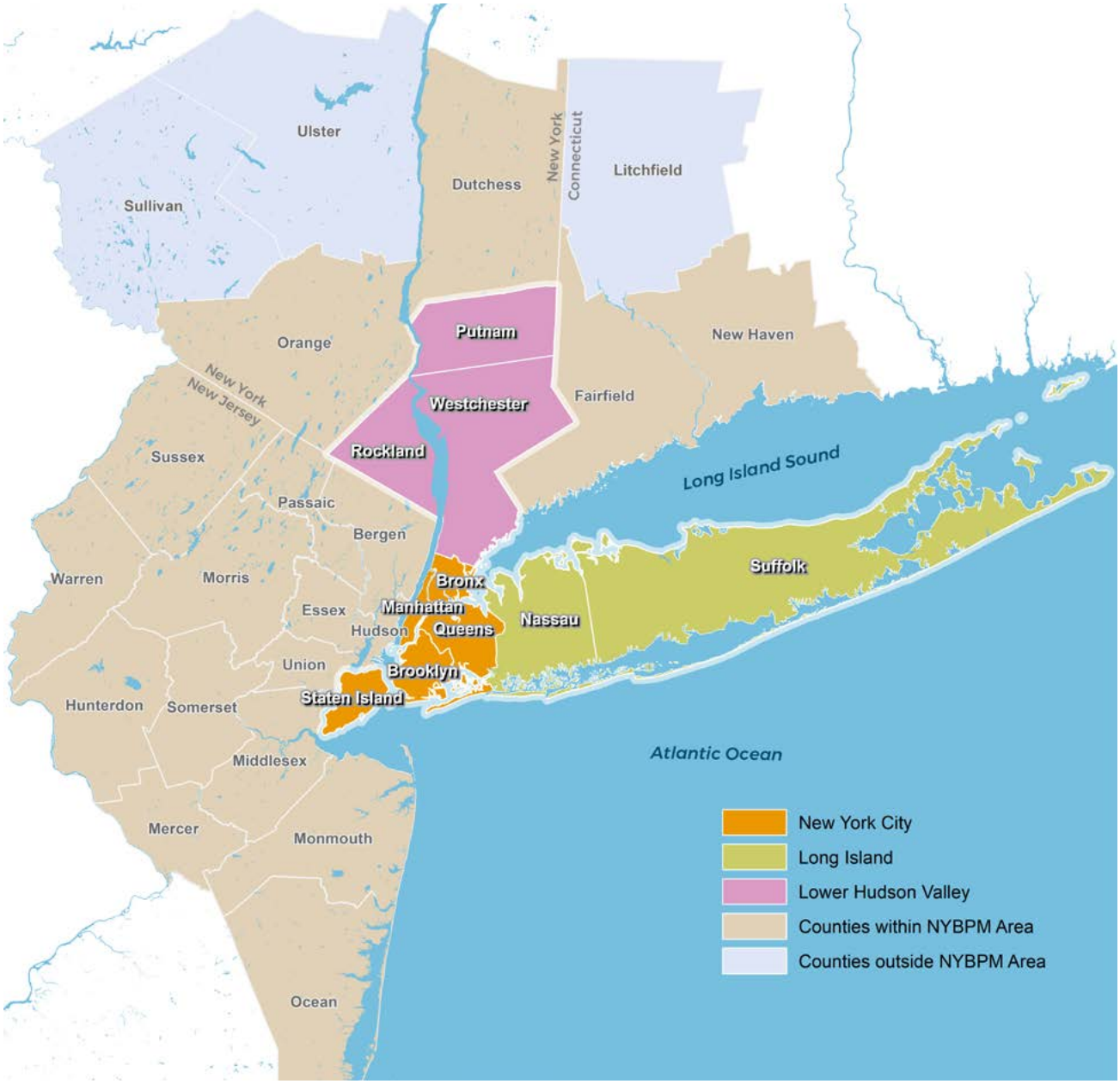
- New York City, consisting of Bronx, Queens, Manhattan, Brooklyn, and Staten Island
- Long Island, consisting of Nassau and Suffolk counties
- The Lower Hudson Valley, consisting of Putnam, Rockland, and Westchester counties

A map of the 31-county forecasting region and the NYMTC planning area is shown in ***Figure 3-2*** on the next page.

Figure 3-2

31-County Forecasting Region and NYMTC Planning Area

Source: NYMTC



Because of the interdependencies between the 31-counties and the NYMTC planning area, forecasting for the broader 31-county region is important for understanding the NYMTC planning area's prospective SED trends and future needs. In addition, understanding potential regional growth patterns will help strengthen integrated development and achieve more balanced growth.

The 31-county region will continue to experience population and employment growth through the planning period, but this growth will slow slightly over time as a result of perceived growth constraints across the region. As a mature region, new population and jobs are being absorbed into built out areas, slowing their rates of growth. However, as a large region, slowing growth rates still represent large absolute gains; by 2050, the region is expected to be home to a population of 25.5 million people, representing a population gain of 2.6 million over the 2017 base year, and 13.6 million jobs, an increase of 1.6 million from 2017.

The forecasts also assume a modest reversion to balanced regional growth between New York City and the surrounding suburban counties. Throughout the second half of the 20th century, population and employment growth in the forecasting region heavily favored suburbs where low-density housing and auto-oriented office campuses were prevalent. During the last decade, population and employment growth concentrated disproportionately in New York City, and to a lesser extent, in close-in suburban areas. A combination of housing and transportation constraints in the core, combined with planned land use and market improvements in other areas, results in forecasts that anticipate more even splits of growth within and outside New York City.

Within the NYMTC planning area, population is expected to grow by 10.2 percent over the 2017 base year through 2050, representing an additional 1.3 million residents. Meanwhile, growth rates for employment and the civilian labor force are expected to be about 14 percent and 11 percent, respectively. The breakdown of these metrics for the NYMTC planning area and their forecasts for 2017 and 2050 is shown in ***Table 3-22.***

Table 3-22

Aggregate SED Forecasts for the NYMTC Planning Area

	2017	2050	Percent Change 2017 to 2050
Population	12.82 million	14.13 million	10.23%
Employment	7.08 million	8.07 million	13.95%
Civilian Labor Force	6.50 million	7.22 million	10.99%
Average Household Size	2.75	2.71	-1.38%

Among the NYMTC subregions, Long Island is expected to have the highest rate of growth in population and civilian labor force, increasing by 11.7 percent and 12 percent, respectively. New York City is forecast to experience the highest rate of job growth and add the highest total numbers for all indicators except average household size, adding more than 850,000 to its population, more than 770,000 jobs, and 300,000 more people to the civilian labor force. Average household size is expected to decrease for all three subregions and will shrink by 1.38 percent across the NYMTC planning area.

Table 3-23 presents the SED forecasts for the NYMTC planning area disaggregated by subregion. When considering the broader 31-county forecasting region, growth rates in northern New Jersey are expected to exceed that of any part of the NYMTC planning region. From 2017 to 2050, northern New Jersey is forecast to experience growth of 15 percent for total population, 13 percent for labor force, and 13 percent for employment. Southwestern Connecticut's growth is expected to grow by a comparatively slower rate, with population increasing by 10 percent, labor force by 6 percent, and employment by 8 percent over the planning period.

Although the NYMTC planning area is expected to experience significant growth, growth in the surrounding region influences growth in the NYMTC planning area and future travel patterns. The SED forecast implies that larger shares of New York City jobs will be filled by in-commuters from the region because of population growth constraints in New York City. Northern New Jersey will experience the highest rate of population and civilian labor force growth through the planning period and will likely play a significant role in supplementing New York City's labor force demand (***Table 3-23***) on the next page.

Table 3-23

SED Forecast for the NYMTC Planning Area by Subregion

		2017	2050	Percent Change 2017 to 2050
Population (in millions)	New York City	8.56	9.41	10.0%
	Long Island	2.86	3.19	11.7%
	Lower Hudson Valley	1.39	1.52	8.7%
Employment (in millions)	New York City	5.11	5.89	15.2%
	Long Island	1.32	1.46	10.8%
	Lower Hudson Valley	0.64	0.78	10.6%
Civilian Labor Force (in millions)	New York City	4.30	4.76	10.7%
	Long Island	1.48	1.66	12.0%
	Lower Hudson Valley	0.71	0.78	10.4%
Average Household Size	New York City	2.57	2.53	-1.6%
	Long Island	2.93	2.89	-1.5%
	Lower Hudson Valley	2.75	2.72	-1.1%

3.4 HISTORICAL AND CURRENT TRENDS

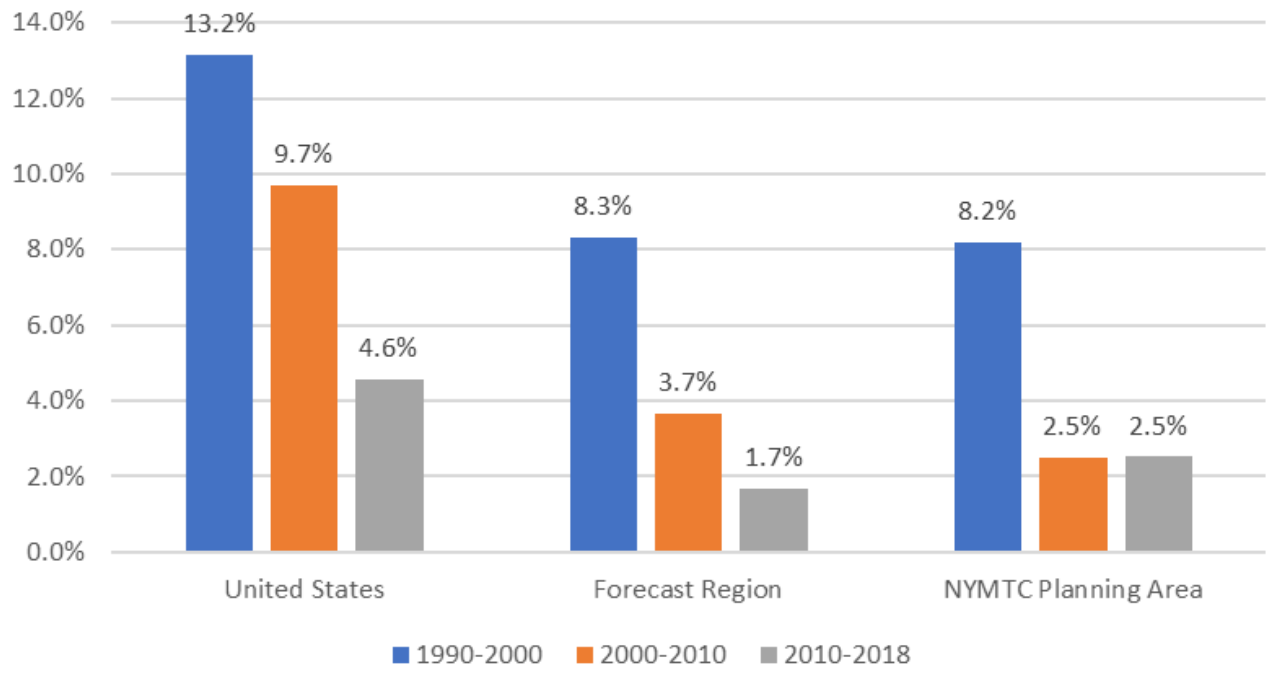
The historical trends described below provide a context and a basis for the long-term SED forecasts. However, it should be noted that trends in population, employment, and income are largely discussed through the 2017 base year of the forecasts. As noted earlier, the COVID-19 pandemic has significantly disrupted the described trends. With the pandemic still altering economic and social life in the forecasting region as of this writing, it is important to note that the trends described below have been interrupted in the immediate term.

3.4.1 POPULATION

Population growth across the NYMTC planning area has experienced similar growth patterns as the forecasting region and the United States, but with varying proportions (See ***Figure 3-3***). The decade of the 1990s saw rapid population growth across the United States. From 1990 to 2000, the national population grew by 13.2 percent. Similar to the NYMTC planning area and the forecasting region, national population growth slowed during the decade of the 2000s, but less dramatically. From 2000 to 2010, national population growth slowed to approximately 9.7 percent. Between July 2010 and July 2018, national population growth continued to slow, increasing by 4.6 percent. This represents an average annualized population growth of 0.6 percent, compared to an average of 0.9 percent last decade, and 1.2 percent between 1990 and 2000.[1]

Figure 3-3

Percent Growth of Total Population, 1990–2018



U.S. population growth is a function of natural increase (or births minus deaths) plus net migration, with the largest contribution through natural increase. However, since 2009, the natural increase of the U.S. population has been slowing overall, with international migration increasing in proportion.[2] Since 2016, international migration has been declining each year, with the result that the population growth rate has slowed.[3] Between 2018 and 2019, net international migration (net exchanges with the rest of the world) added 595,000 to nation's population, the smallest number this decade. This is a significant drop, compared to the decade high of 1.04 million between 2015 in 2016.[4]

In addition, the U.S. population continues to age, with the number of people age 65 and older growing rapidly as a proportion of the population over most of the 20th century and into the 21st century. In 2018, there were 52 million people age 65 and older, representing 16 percent of the U.S. population, compared to 35 million in 2000, which was 12.4 percent of the nation's population.[5] This trend is likely to continue in the coming decades, with the Baby Boom generation increasingly moving into older age cohorts.

The forecasting region experienced sizable population growth from 1990 to 2000. In 2000, the total population of the 31-county region grew to about 21.4 million, an increase of 8.3 percent over 1990 levels. Between 2000 and 2010, population growth in the forecasting region slowed to about 3.7 percent. The population growth in the forecasting region continued to slow to about 1.7 percent between 2010 and 2018, reaching a total population of 22.6 million. This represents an average annualized population growth of 0.2 percent, compared to an average of 0.4 percent during the 2000s, and 0.8 percent between 1990 and 2000.

The NYMTC planning area experienced rapid population growth in 1990s. The total population of the NYMTC planning area grew to roughly 12.1 million in 2000, an increase of 8.2 percent over 1990 levels (an annualized growth rate of 0.79 percent). Between 2000 and 2010, population growth in the NYMTC planning area slowed to 2.5 percent, but that growth rate persisted from 2010 to 2018. However, since 2015, population growth in the NYMTC planning area, similar to the United States and the forecasting region, slowed every year relative to the previous. In 2018, the population in the NYMTC planning area decreased by 1.1 percent, which aligns with patterns of population decline in the northeast United States during the same time period.[6]

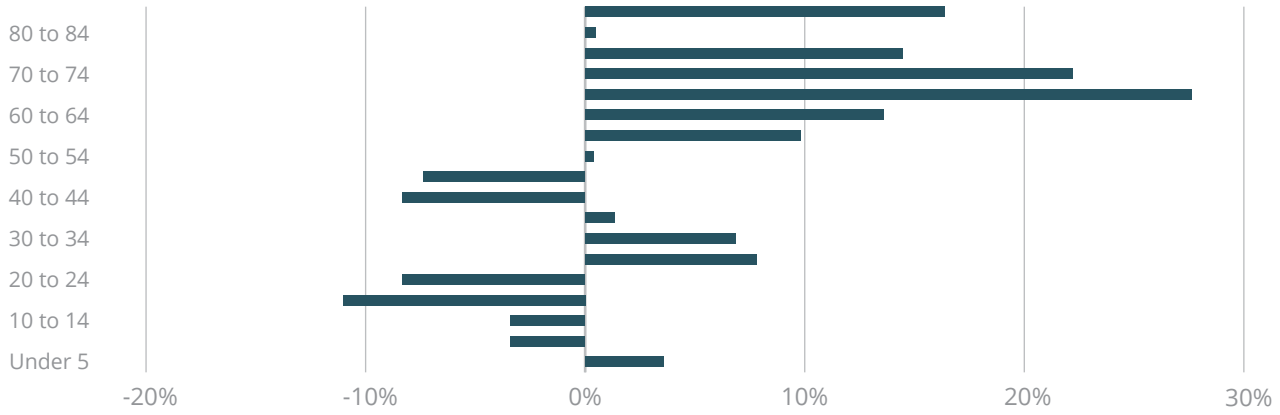
International migration is a major contributor of population growth in the forecasting region and the NYMTC planning area, even though net migration (i.e., the sum of net domestic migration and net international migration) continues to be negative for the region. International migration has resulted in larger shares of foreign-born residents across the forecasting region. In 2018, foreign-born residents represented 27 percent of the forecasting region's total population, compared to 18.5 percent in 1990, and 24.2 percent in 2000. However, like the U.S. trend, international migration has slowed within the forecasting region since 2010.

Due to lower birth rates, less immigration, and aging populations living longer and aging in place, the forecasting region and the NYMTC planning area have experienced an overall increase in its older populations since 2010. From 2010 to 2018, the most significant population growth occurred within the 55-to-79 and 80-and-over age cohorts, with significant decreases observed in the population of young children and teenagers for the NYMTC planning area (see ***Figure 3-4***). **Appendix C** contains additional information on aging populations.

Figure 3-4

Change in Population by Age Cohort in the NYMTC Planning Area, 2010–2018

Source: 2006–2010 ACS; 2014–2018 ACS



3.4.2 EMPLOYMENT

In 2017, approximately 7.1 million jobs were located within the NYMTC planning area, representing an increase of approximately 740,000 jobs, or 11.6 percent, over 2010 employment levels. The NYMTC planning area's employment growth was comparable during this period to the U.S. average and was greater than employment growth in other major city metropolitan areas along the East Coast. However, this growth was slower than metropolitan regions in the West and Southwest. Approximately 72 percent of all the jobs in the NYMTC planning area in 2017 were in New York City. Roughly 2.8 million jobs were in Manhattan, more than the rest of New York City combined and about a quarter of all regional jobs.

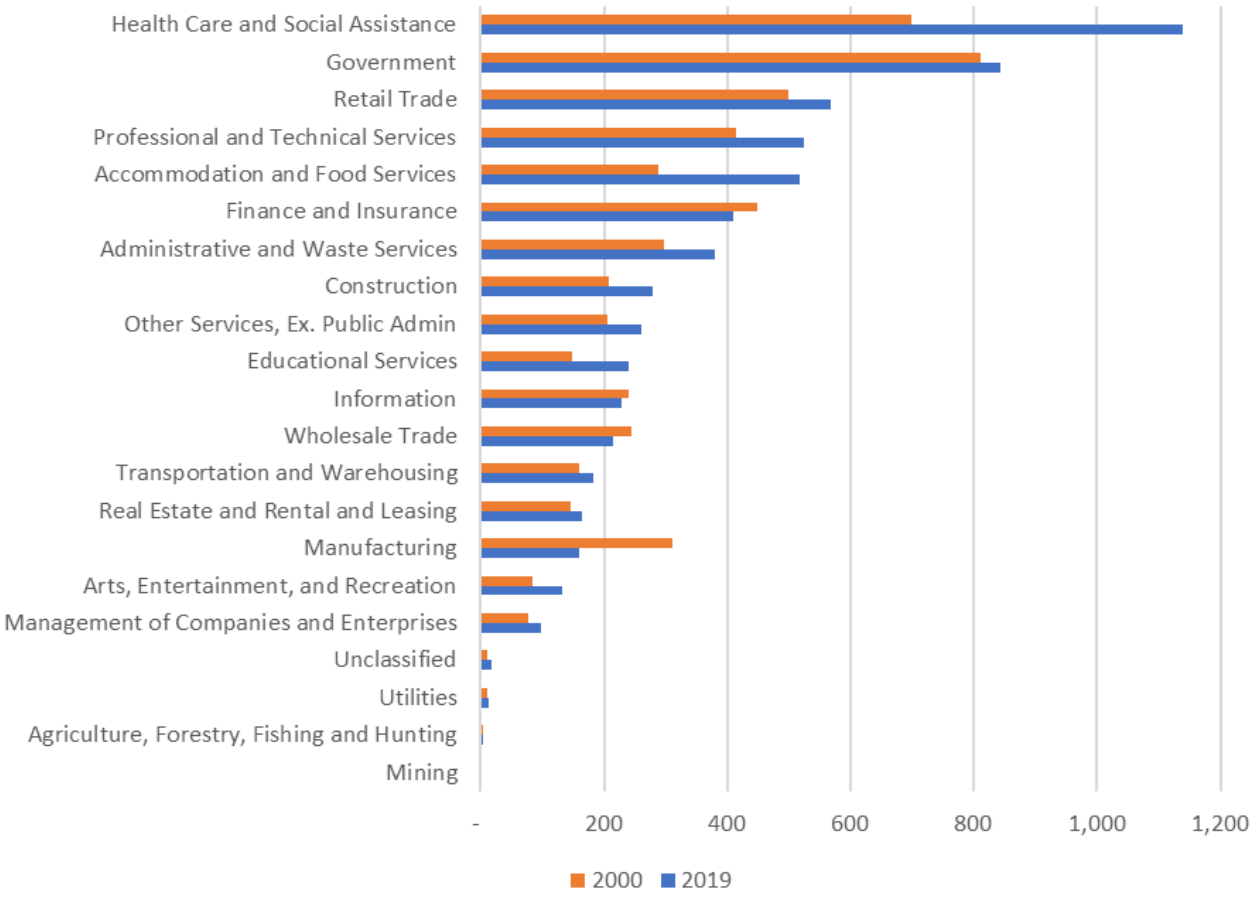
Over the period 2010 to 2017, the number of jobs in all three subregions of the NYMTC planning area grew, but 79 percent of the jobs added during this period were in New York City, representing a shift from prior periods. Within New York City, job growth remained strong in Manhattan, in addition to strong job growth in the outer boroughs. Manhattan jobs, which were the largest share in the NYMTC planning area in 2017, increased by 344,000, or by 13.8 percent, from 2010 to 2017, while the other boroughs gained approximately 244,000 jobs, roughly half of which were in Brooklyn.

Manufacturing employment continues to decline in the nation and the forecasting region, continuing a global realignment towards goods manufacture in low-cost areas. Manufacturing jobs in the nation declined by approximately 26 percent between 2000 and 2019, while the NYMTC planning area lost close to 49 percent of its manufacturing jobs, with a decline from more than 300,000 to approximately 160,000 jobs (see ***Figure 3-5***).

Figure 3-5

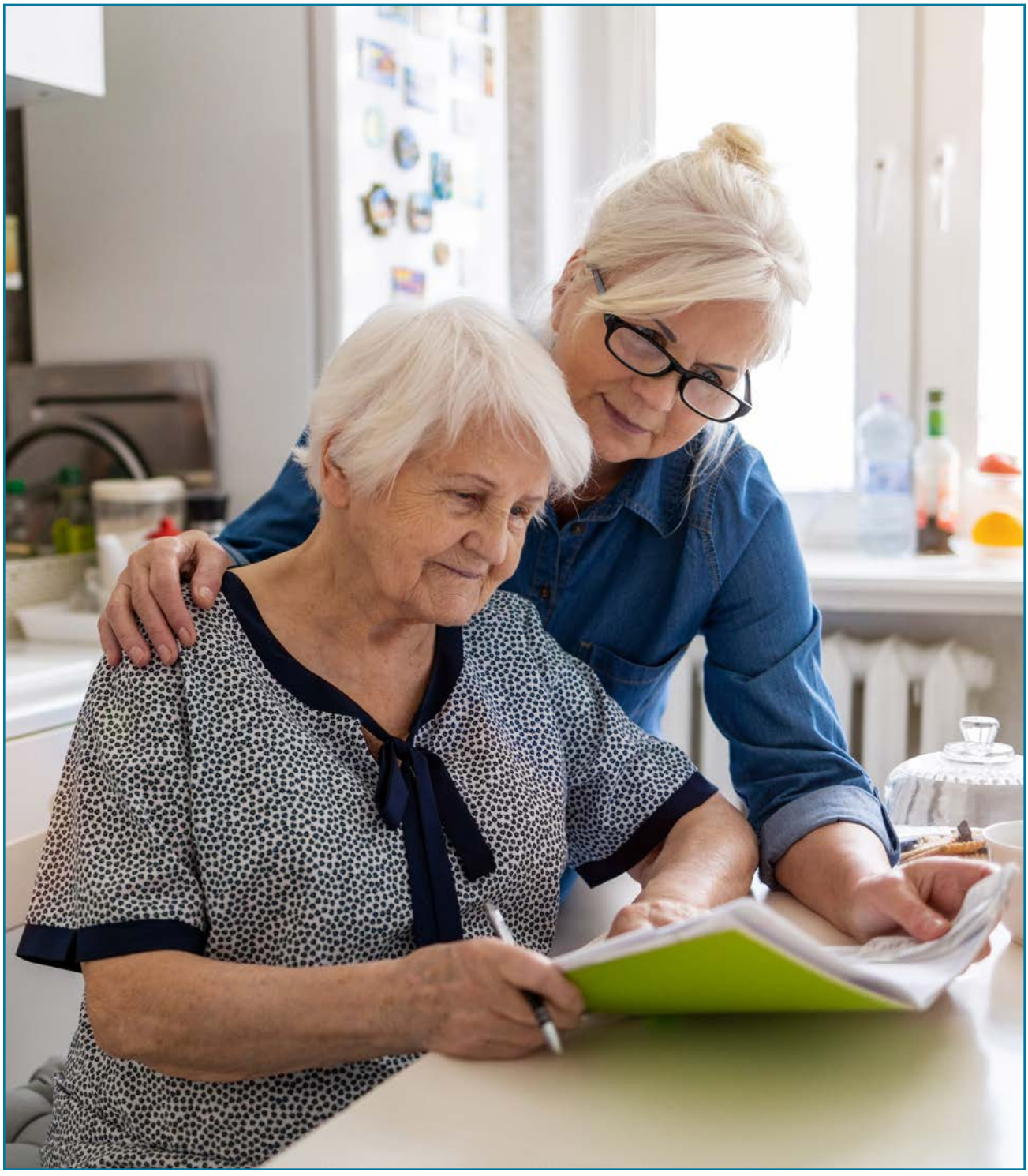
Total Number of Jobs by Major Industry in the NYMTC Planning Area, 2000–2019 (in 000s)

Source: BLS QCEW



The NYMTC planning area has experienced the most job growth in services. Employment in the Accommodation and Food Services industry has the highest percentage increase of all major service industries, while Health Care and Social Assistance had the greatest increase in the number of jobs and total employment since 2000.

Retail trade still plays a significant role in the NYMTC planning area's economy, but job growth in the retail trade sector has slowed dramatically over the past four years, as the sector undergoes fundamental changes in the way business is conducted.[7]



3.4.3 INCOME

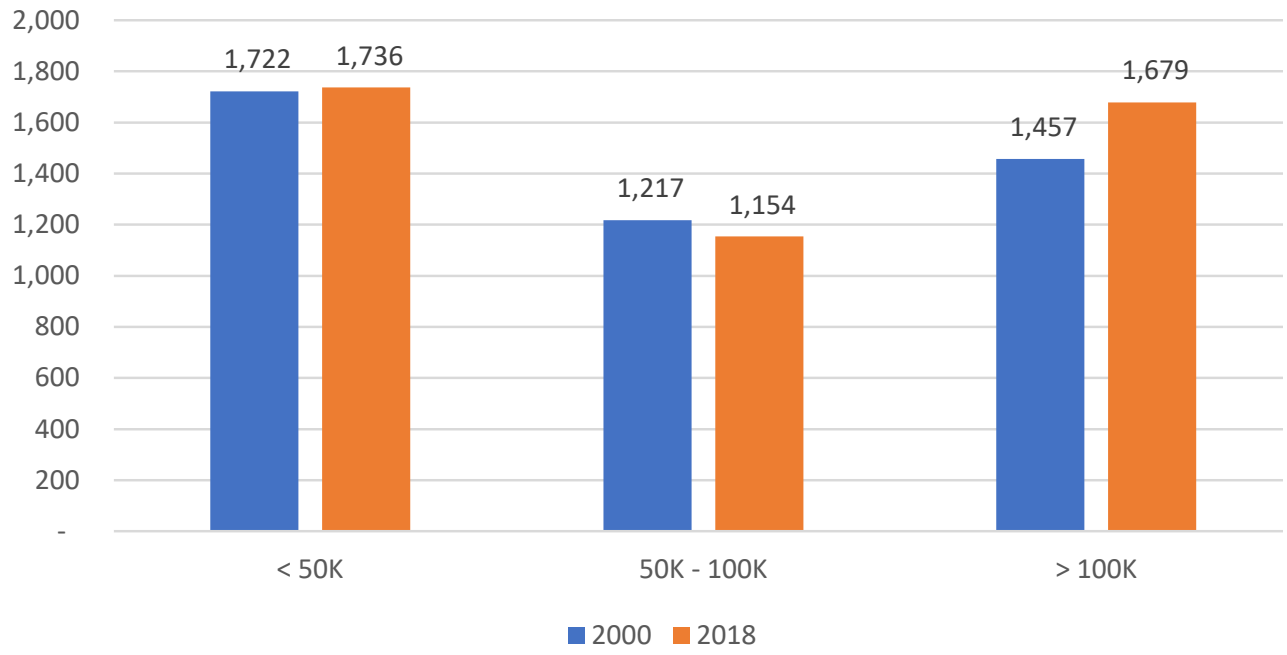
In 2018, real median household income in the NYMTC planning area was $87,824, well above the U.S. average of $60,293. Similar to U.S. trends, median household income for the NYMTC planning area has been increasing since 2013. By 2018, median household income surpassed 2010 median household income for the planning area. In 2018, the suburban Long Island subregion had the largest median household income at $103,958 of the three subregions in the NYMTC planning area, followed by the Lower Hudson Valley at $95,351 and New York City at $64,163. Nassau County had the highest median household income at $111,240, while the Bronx had the lowest at $38,085.[8]

Additionally, over the period from 2000 to 2018, there was a moderate change in the distribution of household income across the planning area. In 2000, nearly 40 percent of the region had household incomes less than $50,000, followed by 33 percent with household incomes greater than $100,000, and 28 percent with household incomes between $50,000 and $100,000. By 2018, the share of households with incomes over $100,000 (38 percent) was nearly on par with the share of households with incomes less than $50,000 (37 percent). From 2000 to 2018, there was a marginal increase of 0.8 percent in households with incomes less than $50,000, a 5 percent decrease in households with incomes between $50,000 and 100,000, and an increase of 15 percent in households with incomes over $100,000, as shown in ***Figure 3-6***.[9]

Figure 3-6

Total Number of Households in Each Income Bracket for the NYMTC Planning Area (in 000s)

Source: U.S. Census Bureau, 2000 Census; 2006–2010 ACS; 2014–2018 ACS



The New York City subregion continues to have the highest share of households with incomes less than $50,000, while Long Island further distanced itself from the Lower Hudson Valley as the subregion with the greatest share of households with incomes greater than $100,000 (*Table 3-24*).

Table 3-24

Percent Share of Household Income by Subregion

Source: U.S. Census Bureau, 2000 Census; 2006–2010 ACS; 2014–2018 ACS

		<$50,000	$50,000–$99,999	>$100,000
2000	New York City	46%	28%	26%
	Long Island	22%	28%	50%
	Lower Hudson Valley	26%	26%	48%
2018	New York City	43%	26%	31%
	Long Island	24%	25%	51%
	Lower Hudson Valley	29%	24%	47%

3.5 FORECASTS THROUGH 2050

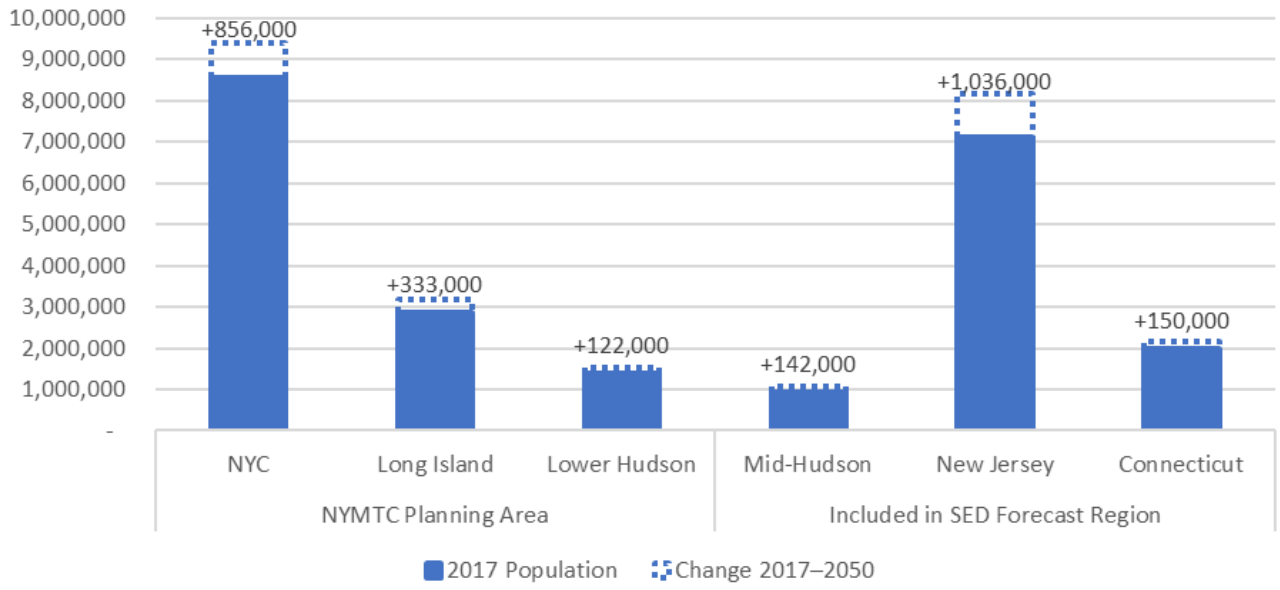
As described above, NYMTC's SED forecasts incorporate recent economic and demographic trends. However, the immediate effects of the COVID-19 pandemic have significantly disrupted those trends. Therefore, adjustments have been made to the forecasts to reflect short-term economic uncertainty brought on by the pandemic. However, the ongoing, longer-term impacts of the economic crisis caused by the pandemic are largely speculative. The primary purpose of the forecasts is the long-term outlook through the Plan's horizon year, which is less suspectable to short-term volatility. As new data become available regarding the pandemic impacts on regional employment and population trends, they will be incorporated in the next set of SED forecasts.

3.5.1 POPULATION

Population is expected to grow over the next three decades, but at a slowing rate (***Figure 3-7***). The NYMTC planning area's population is forecast to increase by 10.2 percent, or by almost 1.31 million people from 2017 to 2050. The New York City subregion is forecast to grow by approximately 10 percent, adding 856,000 people in the next three decades. The population on Long Island is expected to grow by 11.7 percent, or by about 333,000 people. The Lower Hudson Valley subregion is expected to grow by 8.7 percent, or by almost 122,000 people. Although the projection is showing overall growth for the region, the rate of growth is expected to slow through 2050.

Figure 3-7

Population Growth by Subregion, 2017–2050



Forecast population growth rates in Long Island and the Lower Hudson Valley are expected to exceed recent historical averages, while New York City's population is expected to grow at a decreasing rate (***Table 3-25*** and ***Figure 3-8***). Population growth in each subregion is based in part on market conditions, local housing pipelines, as well as an assessment of future potential land use conditions that may enable or constrain growth. In New York City, the large number of housing units produced or permitted in the previous decade increased short-term population forecasts, while long-term constraints affect the slowing growth over time. In Long Island and the Lower Hudson Valley, stronger growth is anticipated in the coming decade, with longer-term growth constraints.

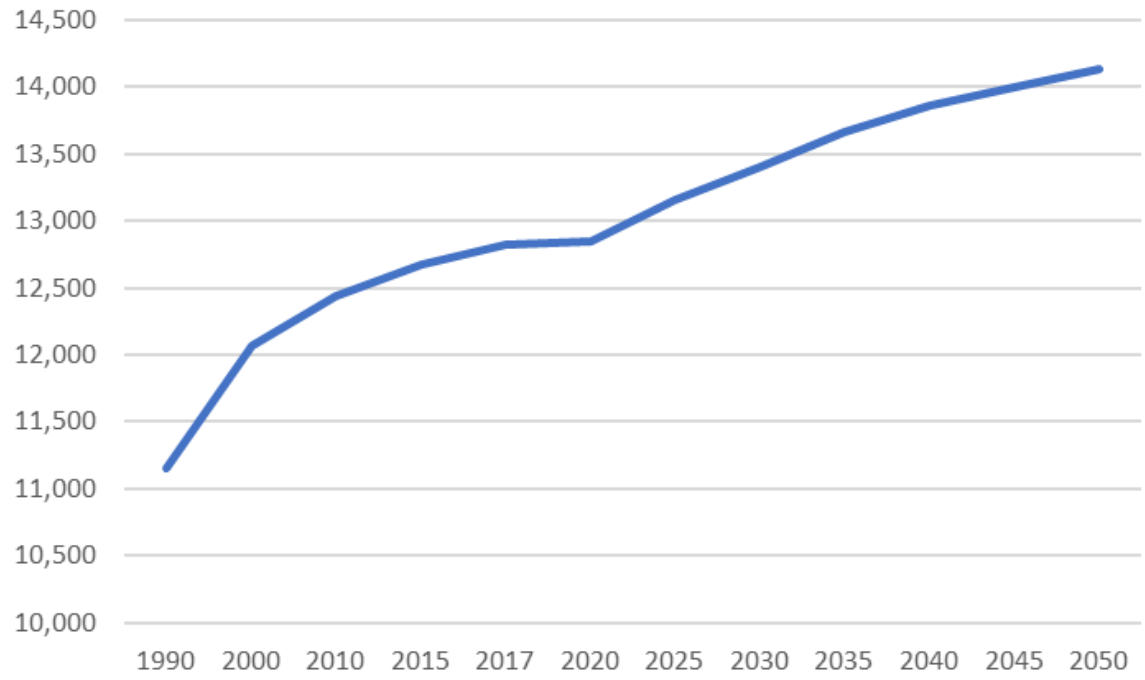
Table 3-25

Population Trends and Forecasts by County/Borough and Subregion (in 000s)

Area Name	1990	2000	2010	2015	2017	2020	2025	2030	2035	2040	2045	2050
New York City	7,322	8,008	8,242	8,425	8,562	8,604	8,883	9,063	9,171	9,261	9,349	9,418
Bronx	1,203	1,332	1,385	1,423	1,443	1,454	1,515	1,548	1,573	1,595	1,616	1,633
Brooklyn	2,300	2,465	2,552	2,593	2,650	2,647	2,760	2,820	2,860	2,894	2,928	2,956
Manhattan	1,487	1,537	1,585	1,636	1,663	1,668	1,698	1,735	1,754	1,768	1,781	1,791
Queens	1,951	2,229	2,250	2,294	2,323	2,349	2,418	2,463	2,483	2,500	2,517	2,528
Staten Island	378	443	468	477	482	484	491	495	498	502	505	507
Long Island	2,609	2,753	2,832	2,855	2,860	2,855	2,879	2,918	3,034	3,112	3,146	3,194
Nassau	1,287	1,334	1,339	1,354	1,363	1,354	1,363	1,383	1,440	1,479	1,493	1,520
Suffolk	1,321	1,419	1,493	1,501	1,497	1,500	1,515	1,535	1,593	1,632	1,653	1,673
Lower Hudson Valley	1,224	1,305	1,360	1,387	1,399	1,389	1,400	1,420	1,459	1,491	1,507	1,521
Putnam	83	95	99	99	99	98	99	101	104	106	107	108
Rockland	265	286	311	320	325	321	332	343	360	376	390	405
Westchester	874	923	949	967	975	968	969	975	995	1,008	1,009	1,008
Region	11,156	12,068	12,436	12,669	12,823	12,849	13,163	13,401	13,665	13,865	14,003	14,134

Figure 3-8

Population Forecast for the NYMTC Planning Area



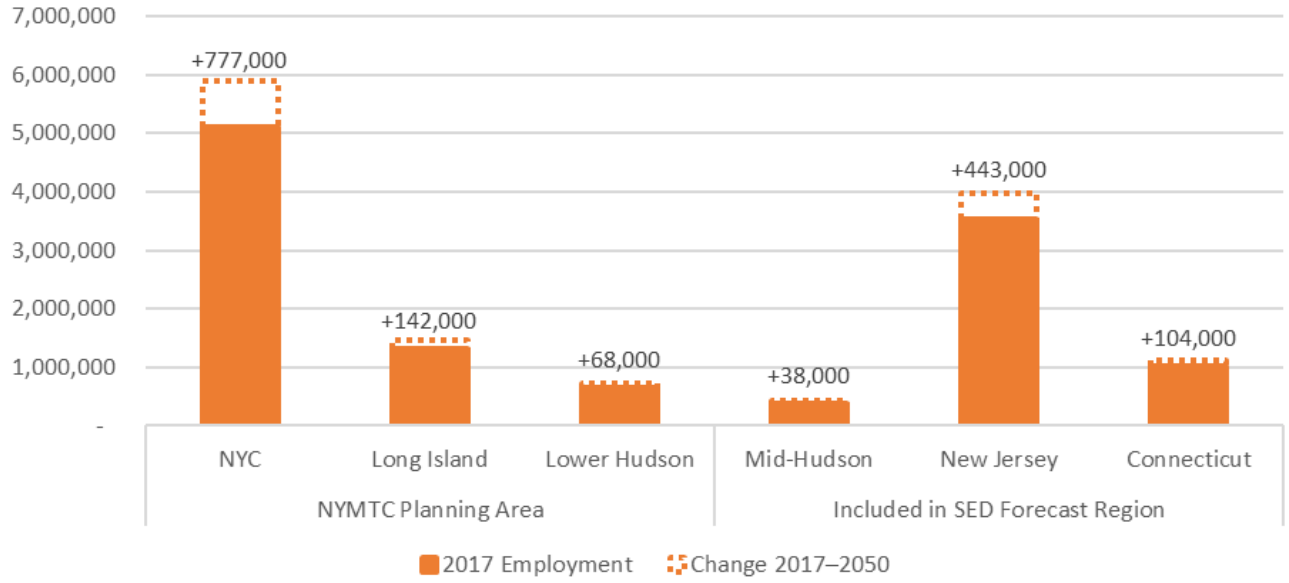
3.5.2 EMPLOYMENT

Employment growth is forecast to continue over the planning period in a slower and more balanced pattern than seen in the past. Overall, the forecasting region grew at 0.9 percent annually from 2008 through 2018, and this explosive growth is forecast to moderate over the planning period to 0.4 percent a year through 2050, factoring in assumptions of several economic cycles over the next three decades. This annual growth results in a total increase of 13 percent, or 1.57 million jobs, from 2017 to 2050.

Employment in the New York City subregion is forecast to grow by 777,000 between 2017 and 2050 (*Figure 3-9*). Within New York City, the centralization of job growth in the Manhattan core is anticipated to moderate, although Manhattan will continue to see the largest numerical increase in jobs. Employment growth in the outer boroughs is expected to continue as Brooklyn and Queens grow as regional job centers. Nearly half of the total number of jobs added during this period are forecast to be in New York City.

Figure 3-9

Employment Change by Subregion, 2017–2050



Continued strong employment growth is also expected outside New York City, and the employment forecast anticipates some rebalancing of growth throughout the NYMTC planning area. Employment in suburban Long Island and the Lower Hudson Valley are each forecast to grow by 11 percent, while the Mid-Hudson and southwestern Connecticut subregions are expected to grow by 10 percent each. Northern New Jersey is expected to see the largest numerical and proportional increase in jobs, with nearly 13 percent growth between 2017 and 2050. *Table 3-26* and *Figure 3-10* summarize employment growth forecasts for each subregion of the NYMTC planning area. Note that given the immediate economic uncertainty related to the COVID-19 pandemic, employment forecasts were lagged in the near term to acknowledge the economic slowdown caused by the pandemic and subsequent assumed recovery.

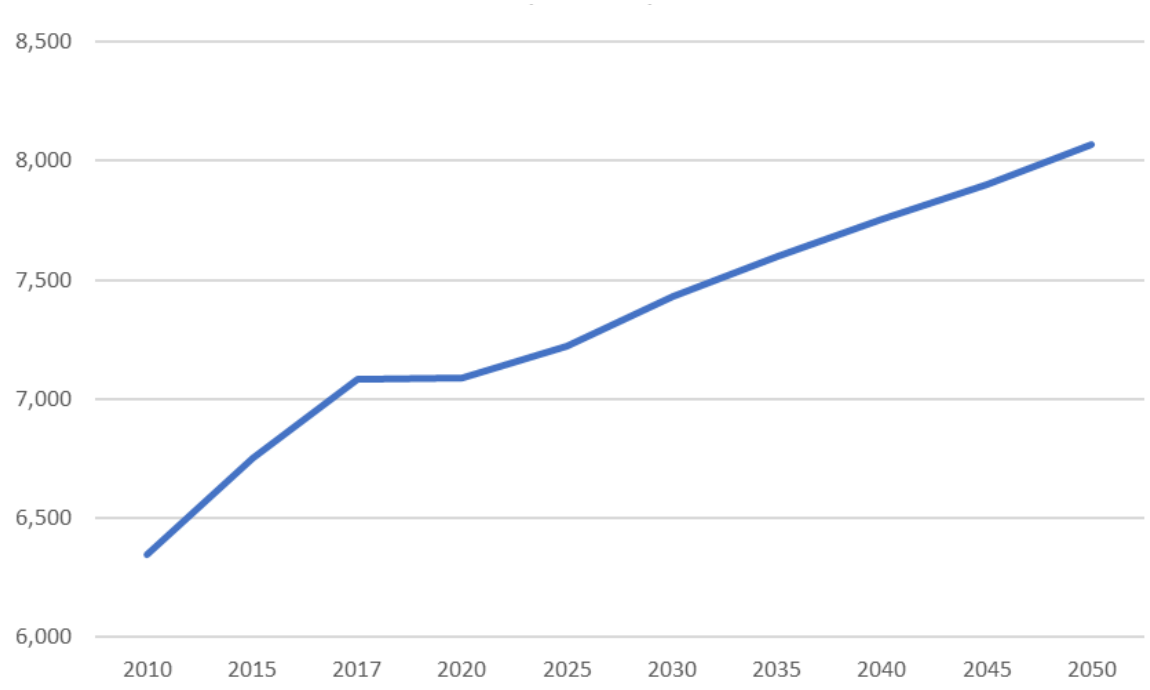
Table 3-26

Employment Trends and Forecast by County/Borough and Subregion (in 000s)

Area Name	2010	2015	2017	2020	2025	2030	2035	2040	2045	2050
New York City	4,527	4,850	5,114	5,144	5,242	5,395	5,520	5,641	5,752	5,891
Bronx	380	401	413	417	431	447	462	474	487	508
Brooklyn	822	902	940	942	973	1,013	1,049	1,084	1,116	1,149
Manhattan	2,488	2,654	2,832	2,860	2,890	2,942	2,983	3,010	3,038	3,066
Queens	708	753	787	784	803	841	869	911	945	998
Staten Island	126	138	140	140	143	150	155	159	164	168
Long Island	1,227	1,284	1,323	1,306	1,331	1,370	1,402	1,423	1,443	1,465
Nassau	590	613	631	625	639	664	684	697	710	723
Suffolk	636	671	692	680	691	706	718	725	733	742
Lower Hudson Valley	589	618	645	638	651	665	679	690	704	713
Putnam	28	29	29	29	29	30	31	31	31	32
Rockland	116	122	129	130	134	138	142	145	148	151
Westchester	444	466	485	478	486	496	505	513	524	529
Region	6,344	6,753	7,083	7,090	7,225	7,431	7,602	7,755	7,900	8,071

Figure 3-10

Employment Forecast for the NYMTC Planning Area, in 000s



3.5.3 HOUSEHOLDS

The number of households in the NYMTC planning area is projected to increase by 12.0 percent between 2017 and 2050, translating to approximately 564,000 new households. The number of households on Long Island is predicted to grow by 13.2 percent, which is slightly faster than the average growth rate in households for the region. The number of households in New York City and in the Lower Hudson Valley is predicted to grow by 12 percent and 9.6 percent, respectively. New York City, in absolute terms, is expected to add more than 390,000 households—the most of all three subregions. Although the Lower Hudson Valley is forecast to have the slowest growth, Rockland County is projected to have the largest percent increase (23.6 percent) in the number of households of all counties in NYMTC planning area (see ***Table 3-27***).

At the subregional level, average household sizes are expected to decline marginally between 2017 and 2050 from 2.75 to 2.71. Household size in the Lower Hudson Valley subregion is expected to shrink from 2.75 to 2.72, in Long Island it is expected to shrink from 2.93 to 2.89, and New York City is expected to shrink from about 2.57 to 2.53 (see ***Figure 3-11***).

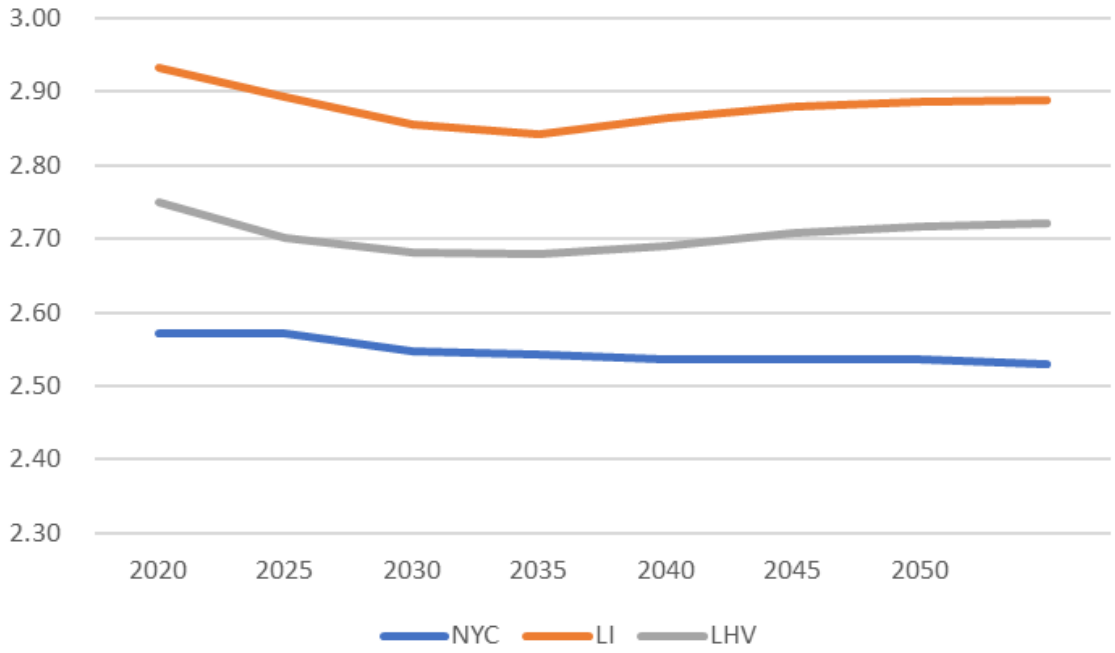
Table 3-27

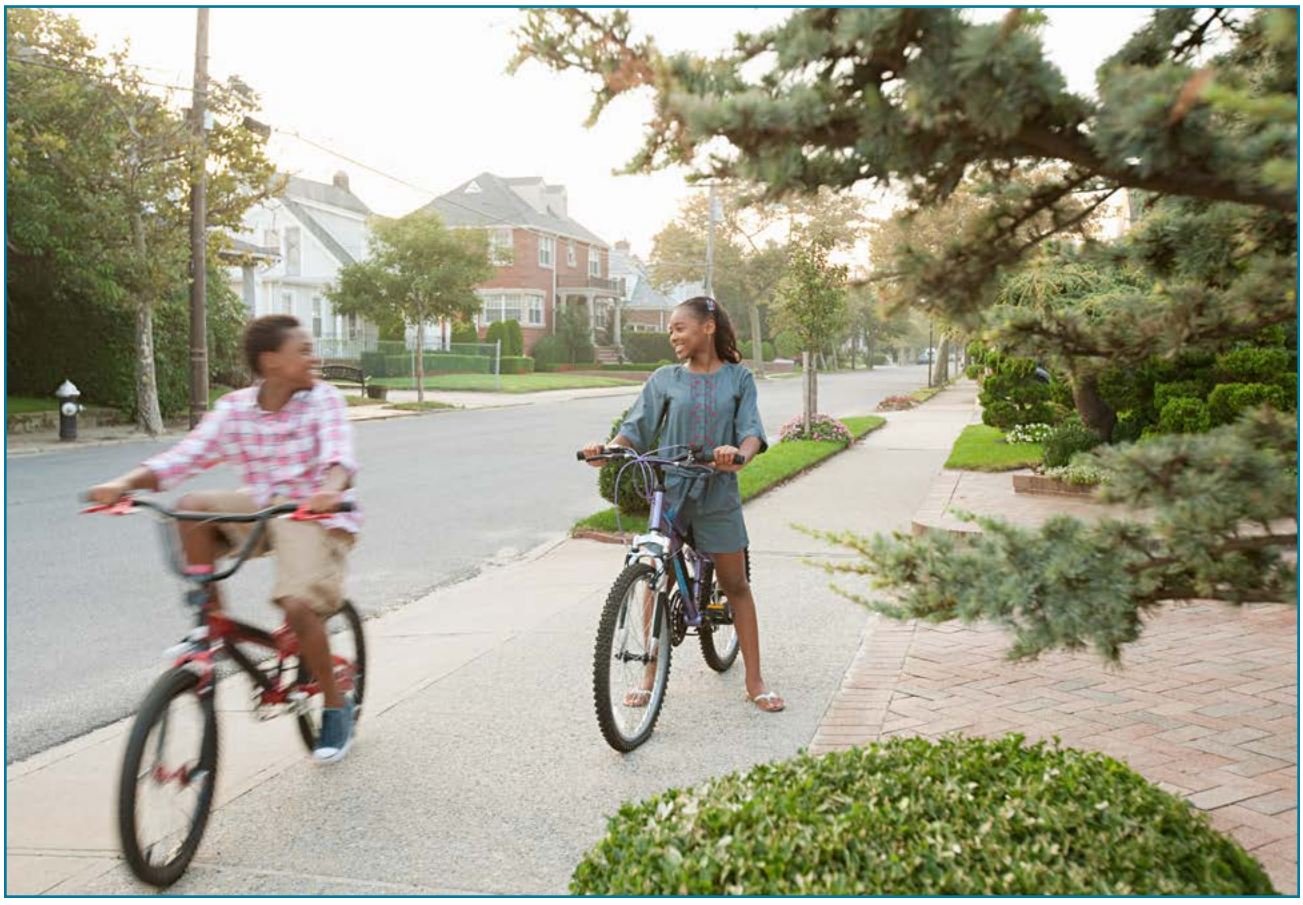
Total Number of Households by County/Borough and Subregion (in 000s)

Area Name	2010	2015	2017	2020	2025	2030	2035	2040	2045	2050
New York City	3,135	3,201	3,258	3,273	3,414	3,492	3,541	3,577	3,613	3,648
Bronx	483	494	501	506	530	542	551	558	566	573
Brooklyn	934	958	981	979	1,031	1,056	1,074	1,089	1,103	1,118
Manhattan	763	778	793	795	826	845	855	861	867	872
Queens	787	801	812	821	853	872	883	889	896	903
Staten Island	165	167	169	170	173	174	176	177	178	180
Long Island	948	954	957	968	989	1,007	1,039	1,059	1,068	1,083
Nassau	448	451	449	453	460	468	481	490	494	503
Suffolk	499	503	507	514	528	539	557	568	574	580
Lower Hudson Valley	481	495	495	499	507	514	526	534	538	542
Putnam	35	35	35	36	37	37	38	39	39	39
Rockland	99	102	103	103	106	109	114	119	123	127
Westchester	347	357	356	359	363	366	373	376	376	375
Region	4,565	4,651	4,711	4,741	4,911	5,014	5,107	5,171	5,219	5,275

Figure 3-11

Average Household Size by Subregion





3.5.4 LABOR FORCE

Overall, the number of eligible workers in the NYMTC planning area is predicted to grow to 7.2 million in 2050. The labor force is predicted to grow by 11 percent from 2017 to 2050, slightly slower than the rate of the number of jobs for the region (see ***Figure 3-12*** and ***Table 3-28***). The largest growth in labor force during this period is expected to occur in Long Island, at 12 percent. The lowest rate is expected to occur in Lower Hudson Valley, at approximately 10.4 percent. New York City's labor force growth rate of 10.7 is slightly greater than Lower Hudson Valley's, but New York City will account for almost 65 percent of the total NYMTC labor force growth, translating to approximately 462,000 eligible workers (see ***Table 3-28***). Across the region, an aging workforce is expected to contribute to labor force growth. In 2017, approximately 51 percent of the region's total population was in the labor force, and the percentage is expected to remain stable through 2050.

Employed residents refers to residents of a place who are employed regardless of job location, whereas "employment" is a measure of the number of jobs in the region. NYMTC's forecast also predicts that the number of employed residents in the region will increase to approximately 6.8 million in 2050 (see **Appendix C** for more details). The growth of employed residents is expected to outpace the growth of the labor force, which could indicate an economic recovery for the planning area throughout the projection horizon.

Figure 3-12

Labor Force Change by Subregion (in 000s)

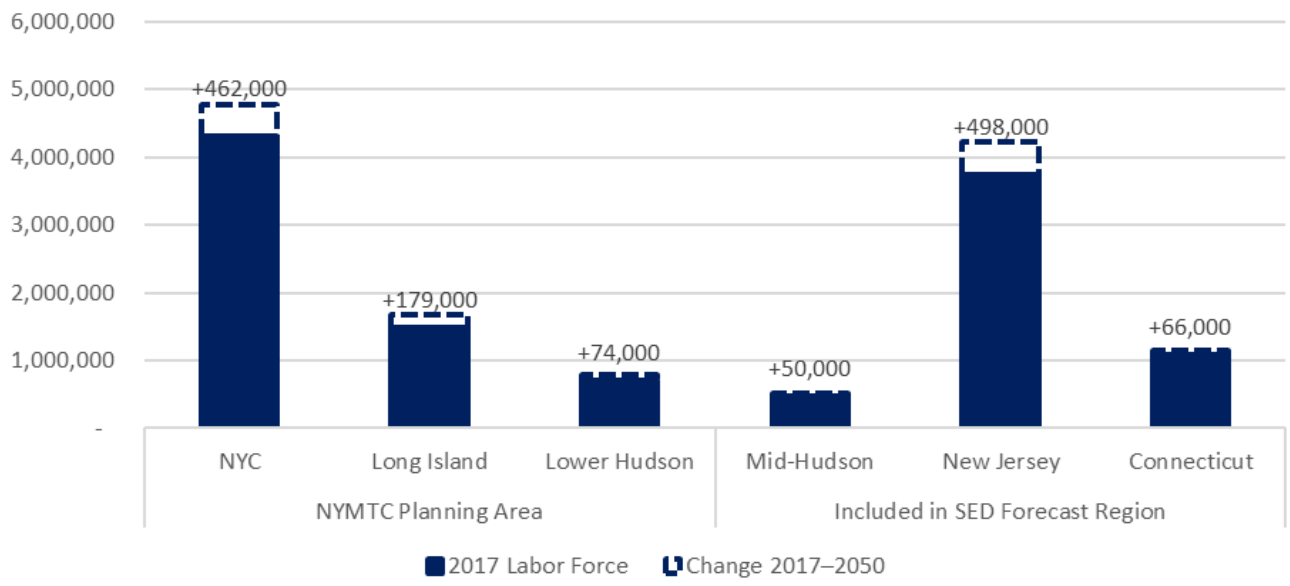
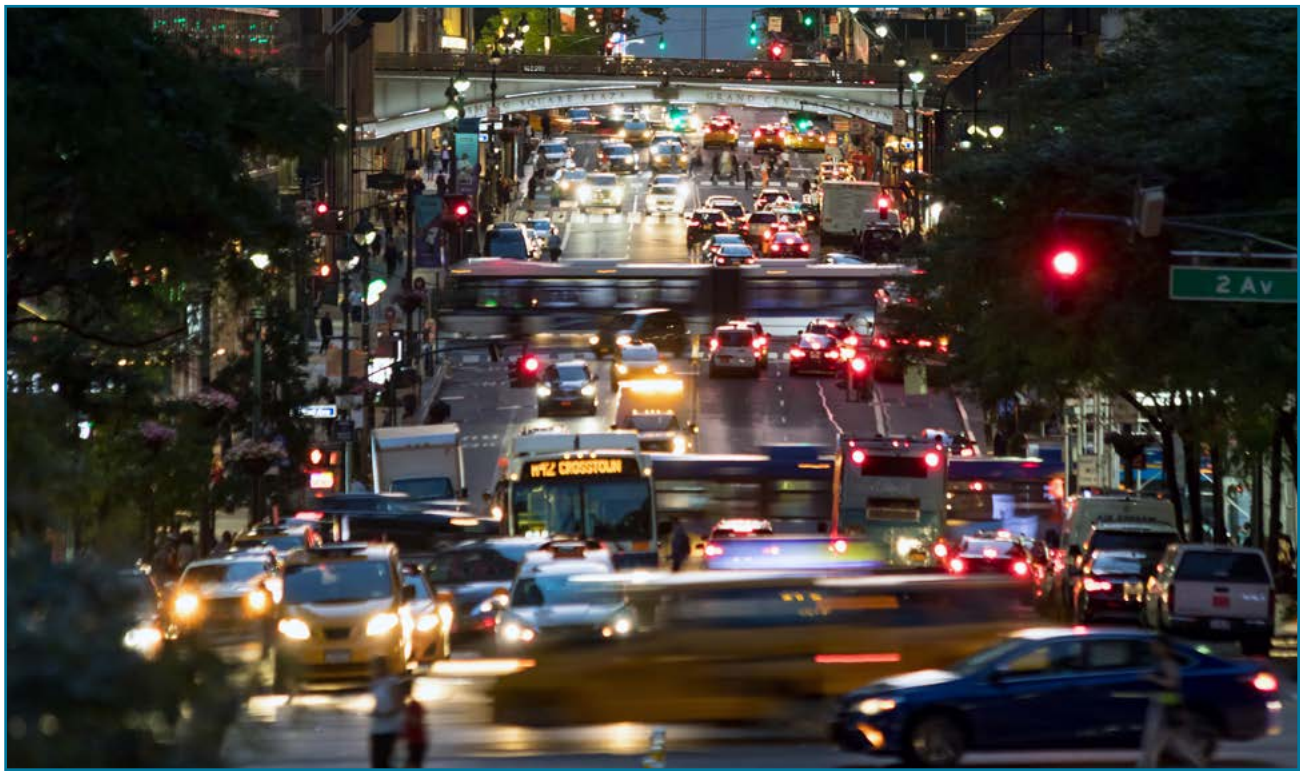


Table 3-28

Labor Force Trends and Forecasts by County/Borough and Subregion (in 000s)

Area Name	2010	2015	2017	2020	2025	2030	2035	2040	2045	2050
New York City	4,179	4,339	4,306	4,247	4,525	4,584	4,640	4,703	4,749	4,768
Bronx	617	664	664	662	718	730	743	757	769	777
Brooklyn	1,236	1,281	1,269	1,247	1,339	1,360	1,383	1,403	1,415	1,418
Manhattan	921	961	949	929	985	999	1,012	1,027	1,039	1,041
Queens	1,185	1,205	1,198	1,185	1,254	1,266	1,274	1,284	1,292	1,296
Staten Island	217	226	224	221	227	226	227	229	232	234
Long Island	1,473	1,495	1,487	1,475	1,481	1,477	1,546	1,594	1,625	1,667
Nassau	688	709	704	697	702	706	751	778	791	812
Suffolk	784	785	783	778	778	770	794	815	834	854
Lower Hudson Valley	703	715	712	708	714	720	738	756	771	781
Putnam	54	57	53	52	52	52	52	54	55	56
Rockland	150	159	157	156	160	166	175	184	193	202
Westchester	497	503	501	499	501	502	510	518	522	527
Region	6,355	6,551	6,506	6,432	6,721	6,782	6,925	7,054	7,146	7,221



3.6 WHERE GROWTH WILL OCCUR

The NYMTC planning area is forecast to continue to experience population and employment growth throughout the planning period; however, the rate of growth is forecast to slow slightly over time. This slowdown is mainly the result of likely growth constraints across the planning area. The forecast also assumes more balanced geographic growth, compared to the last 10 years of more centralized growth in the core of the planning area.

3.6.1 SUBREGIONAL GROWTH PATTERNS

At the subregional level, the New York City subregion will likely experience the most growth in employment, while northern New Jersey will see the largest growth in population, civilian labor force, and total households during the planning period. As a result, New York City's employment will increasingly rely on regional in-commuting, and New Jersey will supplement New York City's labor force demand. In the long term, suburban Long Island will experience rising job growth through 2050 supported by transportation investment, while the Lower Hudson Valley will grow more steadily as new workers are attracted to the subregion. In addition, new job centers will appear across the region to help support the increase in the labor force.

3.6.2 COUNTY/BOROUGH GROWTH PATTERNS

At the county/borough level, Brooklyn will likely lead all counties/boroughs in population growth, total household growth, and civilian labor force growth during the planning period, while Manhattan will lead employment growth. Brooklyn and Queens will likely grow as centers of regional employment, with projected increases of more than 200,000 jobs added in each borough through 2050. The Bronx will experience the highest proportional increases in population, total households, and civilian labor force in the New York City subregion through 2050.

For the Long Island subregion, Nassau County will likely experience significant growth in employment and the civilian labor force, while Suffolk County will experience most of its growth in population and total household trends. In the long term, suburban Long Island counties will see steadily rising job growth through 2050 supported by transportation investment.

In the Lower Hudson Valley, Rockland County will experience the highest proportional increase in population, total households, and average household size through 2050. It will also experience a large proportional increase in job growth, with only the four outer boroughs of New York City experiencing greater proportional growth. Westchester County is forecast to add the most jobs through 2050.

Outside the NYMTC planning area, Hudson County in northern New Jersey is expected to have the most population and employment growth, while in southwestern Connecticut, Fairfield County is anticipated to see the most growth overall.

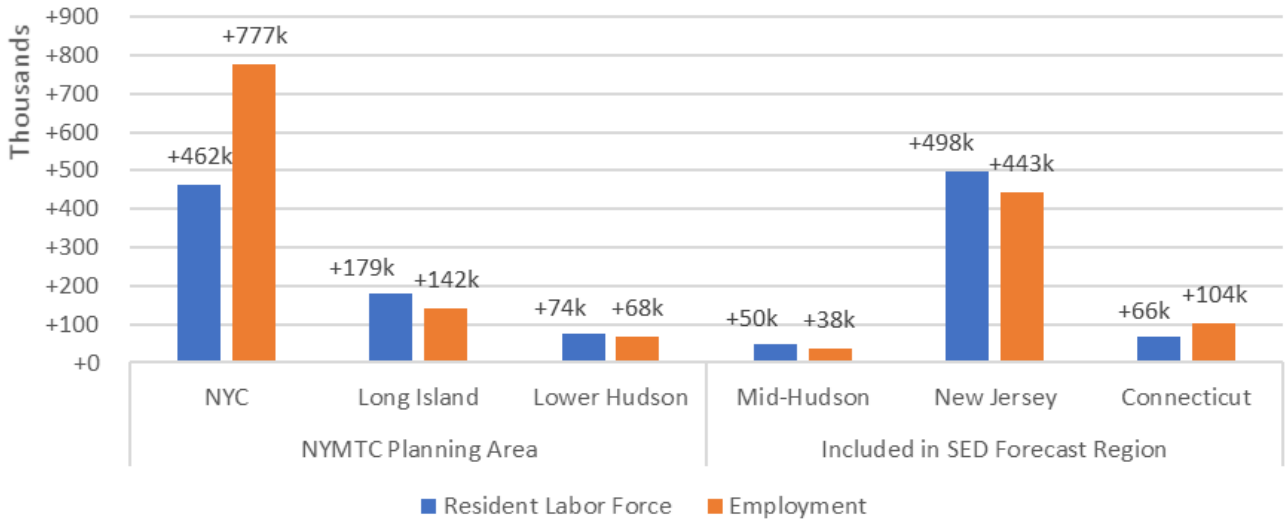
3.6.3 EMPLOYMENT AND LABOR FORCE GROWTH BALANCE

Comparing the forecasted growth in employed residents versus employment provides insight into how commuting patterns might change in the region (***Figure 3-13***). New York City job growth is expected to outpace the number of employed residents, suggesting increased reliance on commuters from outside New York City to fill its workforce. Much of New York City's employment growth is expected to be sourced from increases in the resident labor force west of the Hudson River, increasing New York City's long-term labor force dependence on northern New Jersey. Long Island and the Lower Hudson Valley are expected to see resident labor force growth exceed that of employment through 2050 (see **Appendix C**).

In addition to changes in commuting patterns, other factors—such as increases in labor force participation rates, residents staying in the workforce longer, and increases in the rates of residents holding multiple jobs—are expected to play a role in filling workforce demand.

Figure 3-13

Labor Force Growth vs. Employment Growth in the Forecasting Region, 2017–2050 (in 000s)



3.7 TRAVEL DEMAND TRENDS AND FORECASTS

SED trends and forecasts are the basis for forecasts of travel demand in the NYMTC planning area. The SED forecasts described above (and in more detail in **Appendix C**) are key inputs into the NYBPM, the travel demand simulation model used to generate forecasts of passenger and freight travel demand. NYMTC forecasts travel for people and goods in the multi-state metropolitan using complex algorithms that predict the travel and modal choices made by each household and consequently each person who resides in the NYBPM coverage area. The model also forecasts auto trips coming from outside the coverage area or passing through, as well as all truck and commercial vehicle trips. Forecasts of travel, average travel time, travel origins and destinations, and modal choice are aggregated for the NYMTC planning area as a whole and then by subregion and county/borough.

3.7.1 IMPACTS OF THE COVID-19 PANDEMIC

The COVID-19 pandemic has disrupted travel patterns and trends throughout the forecasting region with large shares of the workforce working remotely and/or shifting travel modes. While transit ridership fell off dramatically—up to 90 percent on some systems—during the first wave of the pandemic in spring 2020, ridership levels have slowly grown, although they are still well below normal levels. Given the nature of the pandemic and uncertainty at this writing regarding when and how it will ultimately end, it is too early to determine its medium- and long-term impacts on travel patterns. As noted above, adjustments have been made to the SED forecasts to account for the impacts of the pandemic and posit a recovery period. Future SED forecasts, which will incorporate new employment and population data and updated labor force projections, will better ascertain these impacts and forecast future travel probabilities.

3.7.2 HISTORICAL TRENDS

VEHICLE MILES TRAVELED

VMT, which is the sum of distances traveled by all vehicles in a specified area, is a metric that defines the extent of vehicular use on a daily or annual basis. In the NYMTC planning area, forecasts of daily VMT are an important indicator of the effects of growth as defined through the SED forecasts.

In 2018, almost 2.72 million households in the NYMTC planning area had regular access to a vehicle, which was about 59.7 percent of all households in the planning area (or an aggregate number of about 4.6 million vehicles accessible to households in the NYMTC planning area). Compared to 2000, households with vehicle access increased by 5 percent, or by an additional 131,100 households. The aggregate number of vehicles in the planning area increased by 7 percent, or an additional 323,000 vehicles.

Even though there has been an increase in households with regular access to a vehicle, there has been little change in the proportion of households with such access (see ***Table 3-29*** and ***Figure 3-14***). In addition, the share of total vehicles available for each subregion has not changed: 43 percent in New York City, closely followed by suburban Long Island at 40 percent, and the Lower Hudson Valley at 17 percent. In the forecasting region, 39 percent of vehicles are in northern New Jersey, a share that has increased between 2010 and 2018. These trends in the increased access to vehicles and the growth in the total number of vehicles will most likely persist long term and may in fact be amplified by the COVID-19 pandemic.

Table 3-29

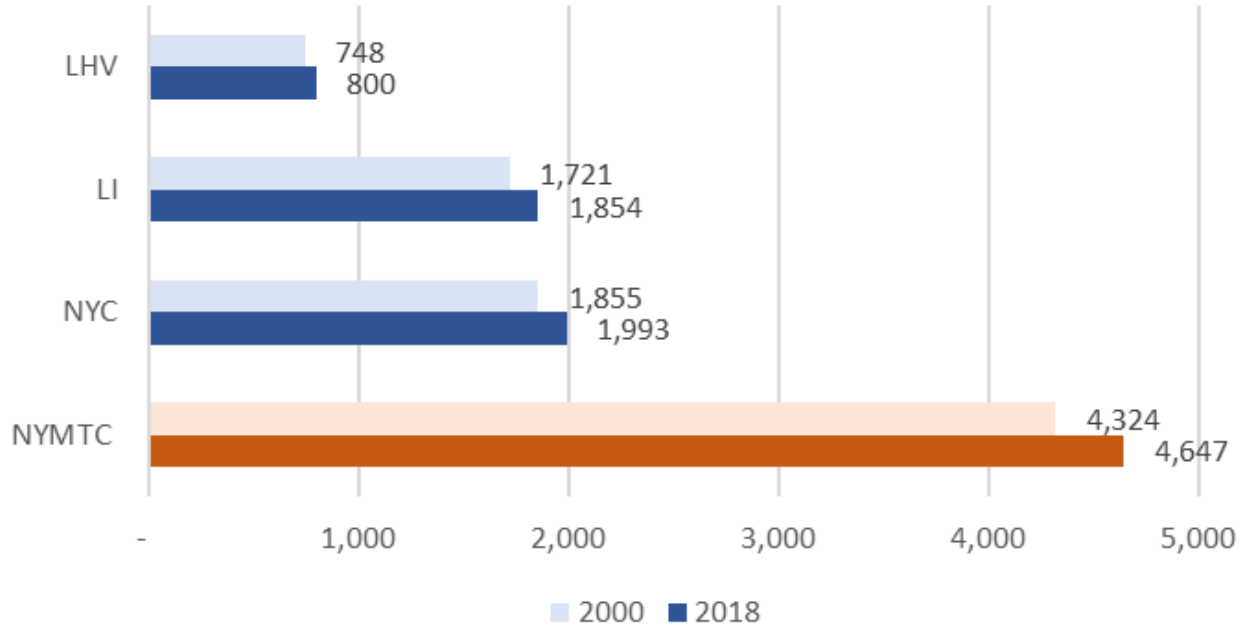
Percent Change of Households with Vehicle Access by Subregion, 2000–2018

Source: U.S. Census Bureau, 2000 Census; 2006–2010 ACS; 2014–2018 ACS

	2000	2010	2018
New York City	44.3%	45.4%	45.4%
Long Island	93.5%	94.0%	93.9%
Lower Hudson Valley	86.9%	87.5%	87.0%

Figure 3-14

Aggregate Number of Vehicles to Households in the NYMTC Planning Area by Subregion (in 000s)



As described earlier, the NYMTC planning area is forecast to experience a significant increase in the total number of households and jobs through the forecast period, which will contribute to a greater number of vehicles being used for work and non-work-related trips. This is especially true for the Lower Hudson Valley and Long Island subregions, which have a much higher proportion of vehicular travel relative to shared ride modes and public transit.

In 2018, except for Manhattan and the Bronx,[10] automobiles were the predominant mode choice for trips within and between subregions in the forecasting region. Moreover, predicted job growth in New York City generally and Manhattan specifically will likely lead to higher in-commuter trips from across the region. Additionally, the subregions in the forecasting region outside the NYMTC planning area have experienced higher rates of growth in the total number of vehicles over the preceding decades compared to the NYMTC planning area, especially within northern New Jersey. New York City jobs will continue to rely on in-commuters, especially from northern New Jersey, to fill workforce demand. So, although public transit and other alternative modes should continue to grow in usage, VMT will likely continue to grow as the total number of households increases, especially in areas that are not well served by transit, and as New York City job growth attracts more in-commuters from the region.

PUBLIC TRANSIT USAGE

Up until the onset of the COVID-19 pandemic, NYMTC's planning area had experienced a steady increase in public transit ridership. From 2000 to 2018, the number of people using public transit has increased by 30 percent or nearly 575,000 people according to U.S. Census figures (*Table 3-30*). This is largest increase for all travel modes used for work during this time period. New York City residents' accessibility to various jobs centers by public transit is a significant contributor to the continued growth in public transit usage in the NYMTC planning area.

Table 3-30

Means of Transportation to Work for the NYMTC Planning Area, 2000–2018

Source: U.S. Census Bureau, 2000 Census; 2014–2018 ACS

Year	Car, Truck, or Van	Public Transportation	Bicycle	Walked	Taxicab, Motorcycle, or Other Means	Worked at Home
2000	50.7%	37.9%	0.4%	7.5%	0.6%	3.0%
2018	44.4%	41.6%	0.9%	7.4%	1.4%	4.2%

Public transit ridership for residents in the Long Island and Lower Hudson Valley subregions is also forecast to increase due to service improvements and worsening traffic congestion. For most of the NYMTC planning area, residents who live in areas underserved by rail with low automobile accessibility rates rely heavily on bus transit. Increases in public transportation ridership in preceding decades have also been accompanied by increases in cycling and alternate modes to work.[11] As the planning area continues to grow, the availability of public transit and other alternative modes will continue grow in importance.

COMMUTING PATTERNS

U.S. Census Bureau data provide a snapshot of recent commuting patterns (See ***Table 3-31***). In 2015, in the five boroughs of New York City, the majority of workers commuted within their home county or to Manhattan.[12] In 2018, approximately 84 percent of Manhattan resident-workers commuted within Manhattan.[13] Staten Island, the Bronx, Queens, and Putnam County had the highest percentages of workers who commuted outside their home county/borough.[14] In addition to workers from within the NYMTC planning area, a significant number of travelers from other areas in the forecasting region commute to New York City each day. For example, in 2018, approximately 12 percent of New Jersey workers and 16 percent of workers from Fairfield County, Connecticut, were employed in New York City.[15]

The large influx of in-commuters to New York City, roadway congestion, and long-distance travel contribute to long commutes for a significant portion of NYMTC planning area workers. In 2018, more than a third of workers employed in New York City and 40 percent of Manhattan workers made commutes of longer than 60 minutes in each direction.[16] These commuting patterns are evidence of the continued imbalance between the locations of the NYMTC planning area's labor force and its employment opportunities (***Table 3-31***).

Table 3-31

Top Work Location by Residence, 2015

Source: U.S. Census Bureau, 2011–2015 ACS

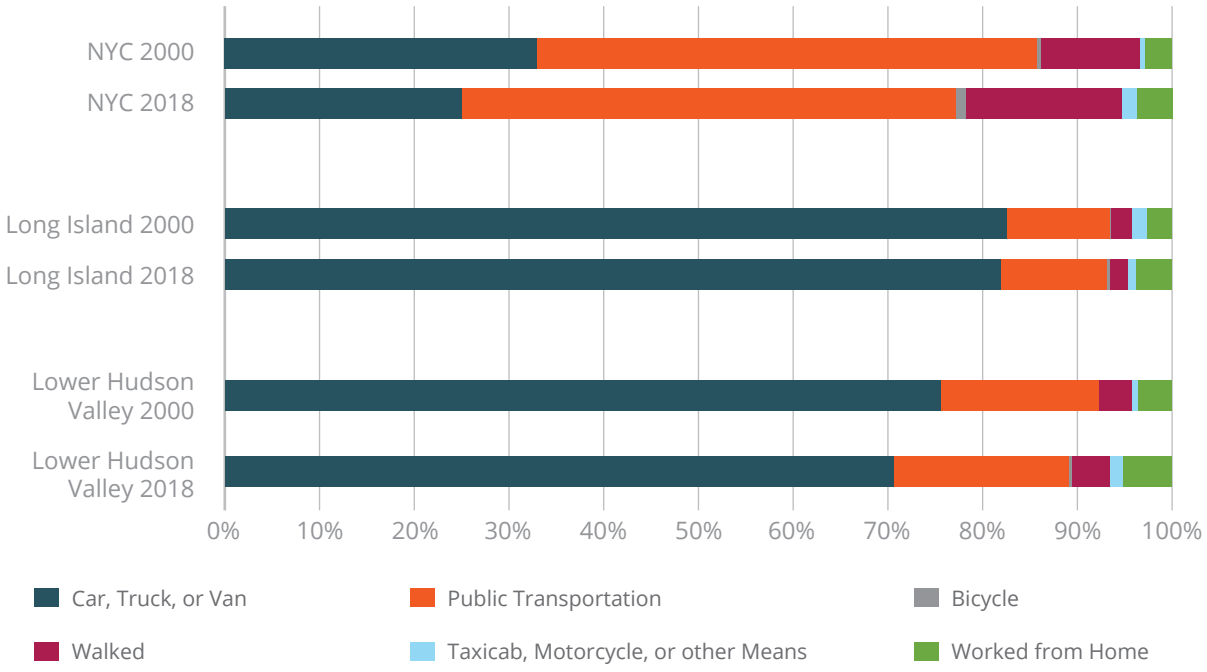
Residence	Work Location	Share of Total Workers
Bronx	Bronx	44%
	Manhattan	37%
Brooklyn	Brooklyn	50%
	Manhattan	38%
Manhattan	Manhattan	84%
	Bronx	3%
Queens	Queens	42%
	Manhattan	36%
Staten Island	Richmond	51%
	Manhattan	24%
Nassau	Nassau	58%
	New York	15%
Suffolk	Suffolk	76%
	Nassau	12%
Putnam	Westchester	40%
	Putnam	29%
Rockland	Rockland County	59%
	Manhattan	11%
Westchester	Westchester County	62%
	New York County	19%

Other notable commuting trends include the increase in the number of people working from home. Between 2010 and 2018, the NYMTC planning area saw an increase in workers who worked from home from approximately 216,000 to 254,000, an 18 percent increase.[17] This trend will most likely see a spike because of COVID-19 on worker preferences and telework capability (*Figure 3-15*).

Figure 3-15

Transportation Mode Choice for Daily Commuting Trips by Subregion

Source: U.S. Census Bureau, 2000 Census; 2014–2018 ACS



3.7.3 TRAVEL FORECASTS

TRAVEL DEMAND

Figure 3-16 displays NYBPM travel forecasts for the planning period. Growth in travel is expected to occur in the NYMTC planning area and its subregions across all modes. Total daily trips are forecast to reach approximately 31 million by 2050, an increase of nearly 10 percent. Daily auto trips are expected to grow by 8 percent, while daily transit trips are forecast to grow by 12 percent. Growth in daily VMT and vehicle hours traveled (VHT) is expected to continue, as more trips taken on the transportation system add to vehicle use and congestion (*Table 3-32*).

Figure 3-16

Travel Forecasts for the NYMTC Planning Area

Source: NYMTC

	2019	2050
Total Daily Trips	28,187,462	31,205,281
Daily Auto Trips	17,304,150	18,831,966
Daily Transit Trips	10,883,313	12,373,315
Daily VMT	116,635,983	130,504,446
Daily VHT	3,347,283	3,830,484

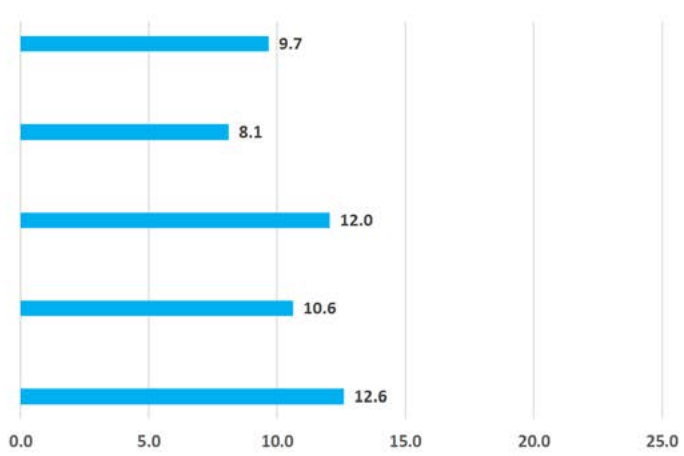


Table 3-32

Daily Auto Trip Origins and Destinations

Source: NYMTC

2019	Manhattan	Queens	Bronx	Kings	Staten Island	Nassau	Suffolk	Westchester	Rockland	Putnam
Manhattan	1,635,737	165,215	105,297	70,955	17,312	13,733	6,026	20,079	4,770	1,973
Queens	193,862	1,574,275	43,909	216,396	14,022	300,216	35,949	21,806	4,823	1,992
Bronx	104,918	44,008	746,871	26,172	4,921	17,873	5,033	159,612	4,645	1,455
Kings	63,234	216,921	26,100	1,715,177	33,641	66,986	14,390	7,976	3,478	1,105
Staten Island	19,594	16,399	5,611	38,463	367,227	6,513	2,316	2,605	676	140
Nassau	7,329	286,741	18,823	64,129	5,088	2,259,984	332,478	2,767	747	352
Suffolk	3,923	33,554	5,516	15,562	2,507	334,419	3,062,679	1,404	561	213
Westchester	14,660	22,548	147,590	8,793	2,553	3,185	1,484	1,737,510	41,637	35,365
Rockland	4,153	4,674	4,342	3,595	659	707	444	48,121	435,360	1,783
Putnam	1,703	2,070	1,479	1,196	152	341	187	36,201	2,074	128,402

2050	Manhattan	Queens	Bronx	Kings	Staten Island	Nassau	Suffolk	Westchester	Rockland	Putnam
Manhattan	1,619,668	145,702	105,763	72,667	12,358	23,455	21,086	25,253	3,693	1,823
Queens	160,944	1,746,117	47,646	250,510	13,693	316,981	44,897	25,594	3,637	2,411
Bronx	102,768	47,427	852,166	31,136	4,960	16,901	6,111	173,680	3,704	1,704
Kings	62,628	248,303	31,275	1,937,911	26,069	70,467	17,906	9,424	2,383	1,317
Staten Island	9,889	14,847	5,181	26,541	357,332	5,991	2,647	2,588	627	135
Nassau	9,575	308,745	17,669	66,193	4,766	2,508,709	378,415	3,513	590	322
Suffolk	11,590	40,592	6,689	19,432	2,896	382,980	3,482,947	1,716	605	209
Westchester	17,344	26,016	161,513	10,354	2,530	4,016	1,837	1,740,707	38,592	35,155
Rockland	2,656	3,455	3,283	2,393	599	588	478	43,921	583,093	1,947
Putnam	1,537	2,453	1,688	1,413	133	334	180	36,210	2,206	139,269

VEHICULAR USAGE

Daily VMT is expected to rise by approximately 11.9 percent during the planning period (*Table 3-33*). At the subregional level, Long Island is projected to have the highest percentage growth in VMT at 17.0 percent based on an additional 7.6 million daily VMT by 2050. Daily VMT for the Lower Hudson Valley is forecast to increase by 10.0 percent, followed by New York City with a forecasted daily VMT increase of 3.5 million or 8 percent.

Table 3-33

Daily VMT By County/Borough and Subregion

Source: NYMTC

	2019	2050	Change
Bronx	6,597,978	7,534,060	14.2%
Brooklyn	10,660,200	11,423,249	7.2%
Manhattan	7,779,894	7,908,354	1.7%
Queens	16,156,802	17,814,638	10.3%
Staten Island	3,239,365	3,288,452	1.5%
New York City Total	44,434,238	47,968,753	8.0%
Nassau	20,240,591	23,311,277	15.2%
Suffolk	24,462,524	28,980,730	18.5%
Long Island Total	44,703,115	52,292,007	17.0%
Putnam	2,818,118	2,872,551	1.9%
Rockland	6,216,861	7,307,444	17.5%
Westchester	18,463,651	20,063,691	8.7%
Lower Hudson Valley Total	27,498,630	30,243,686	10.0%
NYMTC Planning Area	116,635,983	130,504,446	11.9%

VHT reflects the efficiency and reliability of vehicular travel, primarily in terms of travel speed. In the NYMTC planning area, VHT is projected to rise by 14.4 percent by 2050. Among the subregions, Long Island will experience the greatest percentage growth in VHT, increasing by nearly 22 percent by 2050, compared to 12.6 percent for the Lower Hudson Valley and 10 percent for New York City (*Table 3-34*).

Table 3-34

Daily VHT by County/Borough and Subregion

Source: NYMTC

	2019	2050	Change
Bronx	193,282	227,713	17.8%
Brooklyn	423,874	466,155	10.0%
Manhattan	397,996	413,163	3.8%
Queens	515,738	586,032	13.6%
Staten Island	88,083	88,368	0.3%
New York City Total	1,618,973	1,781,431	10.0%
Nassau	530,693	638,218	20.3%
Suffolk	598,456	736,072	23.0%
Long Island Total	1,129,149	1,374,290	21.7%
Putnam	54,122	54,983	1.6%
Rockland	132,601	163,435	23.3%
Westchester	412,437	456,346	10.6%
Lower Hudson Valley Total	599,160	674,764	12.6%
NYMTC Planning Area	3,347,283	3,830,484	14.4%

COMMODITY FLOWS

The Regional Freight Element of *Moving Forward* is contained in **Appendix H**. The Freight Element contains a detailed discussion of recent trends and forecast for commodity flows during the planning period.

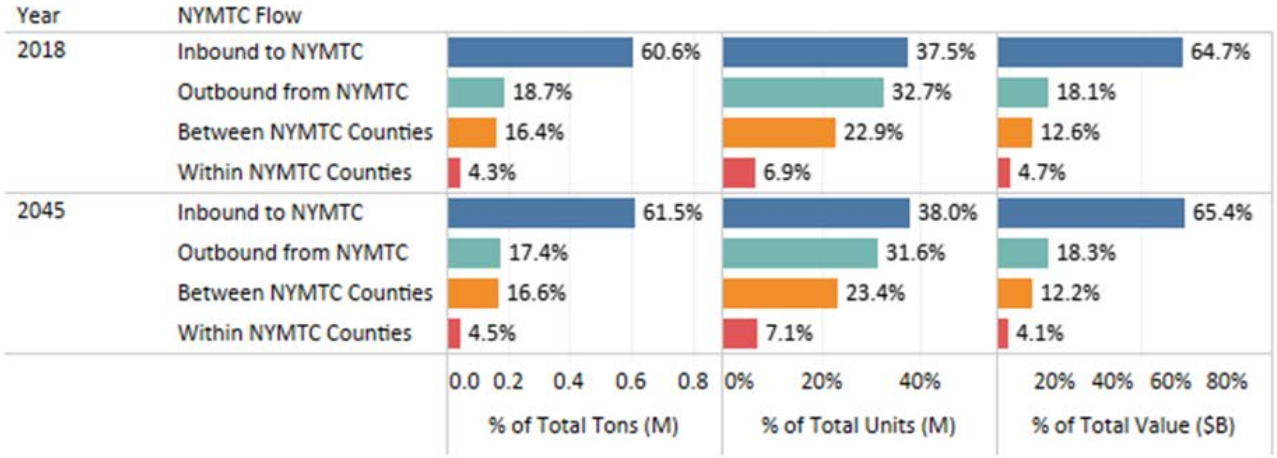
Overall, more than 300 million tons of domestic freight worth more than $430 billion moves into, out of, and within the NYMTC planning area by truck, rail, water, air, and pipeline annually; around 18 million tons of international freight worth $211 billion is imported to and exported from the NYMTC planning area annually. Trucks are responsible for moving more than 92 percent of domestic tonnage and nearly 88 percent of domestic value. Around 61 percent of tonnage and 65 percent of value is moving inbound to the NYMTC planning area; around 19 percent of tonnage and 18 percent of value is moving outbound; and the remainder is moving between or within NYMTC counties (*Figure 3-17*).

Figure 3-17

Region-Level Domestic Freight Flows by Direction (2018 and 2045)

Source: Analysis of NYSDOT Transearch Data

Year	NYMTC Flow	Tons (M)	Units (M)	Value ($B)
2018	Inbound to NYMTC	183.0	9.09	$278.53
	Outbound from NYMTC	56.6	7.93	$77.76
	Between NYMTC Counties	49.4	5.54	$54.12
	Within NYMTC Counties	13.1	1.68	$20.32
	Total	302.1	24.24	$430.72
2045	Inbound to NYMTC	263.7	13.20	$476.94
	Outbound from NYMTC	74.7	10.99	$133.68
	Between NYMTC Counties	71.4	8.12	$88.91
	Within NYMTC Counties	19.1	2.45	$29.74
	Total	429.0	34.77	$729.27



By far the largest trading partners for inbound and outbound tonnage and value are the states of New York, New Jersey, and Pennsylvania; however, there is substantial trade with the remainder of New England and the East Coast, as well as the Midwest states. The NYMTC planning area is expected to gain another 127 million tons of domestic freight worth nearly $300 billion by 2045 and experience substantial growth in international freight.

TOURISM

Like other generators of travel demand, the COVID-19 pandemic severely affected tourism throughout the NYMTC planning area. As of this writing, with the uncertainty surrounding the current and future status of the pandemic and recovery period that will follow, it is not possible to reasonably predict when and how the trends described will resume. However, the pre-pandemic trends are instructive when considering the longer-term future.

Tourism was a significant travel generator in the NYMTC planning area prior to the pandemic, and it played an important role in the regional and subregional economies by contributing tax revenues, driving purchases at businesses, and helping to create or sustain jobs. Tourism also contributed to travel demand, sometimes significantly.

New York State's tourism economy expanded in 2018 with a 6.2 percent growth in traveler spending, reaching a new high of $71.8 billion.[18] The New York State Industry Association identified tourism as New York's third-largest private sector industry, supporting 959,900 jobs in 2019 and local tax revenues of $9.1 billion, or the equivalent of $1,248 per New York State household.[19]

In 2020, the COVID-19 pandemic was responsible for 47.6 percent decline in the Leisure and Hospitality industry. Looking at New York State Department of Labor's Current Employment Statistics 12-month comparison from December 2019 to 2020 in the Leisure and Hospitality Industry, Long Island showed a drop of 30.7 percent,[20] while the Hudson Valley experienced a 36.2 percent drop.[21]

SUBREGIONAL TRAVEL IMPACTS

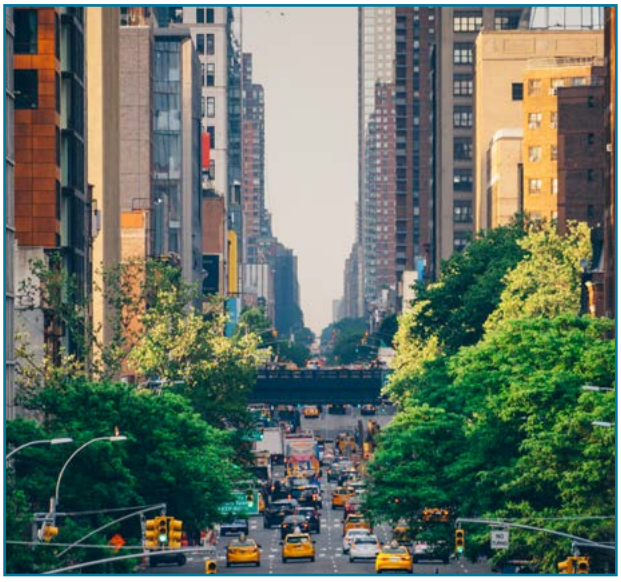
Prior to the COVID-19 pandemic, New York City was a major tourist destination, consistently ranking as one of the most visited cities in the world. In 2019, New York State had 265 million visitors, the tourism industry had $73 billion in direct spending due to tourism, and the total economic impact of tourism in New York City was $117 billion.[22] According to NYC and Company, New York City began 2020 with a strong performance in the travel industry for January, February, and March, prior to closures due to the pandemic.[23]

Tourism affects travel in New York City. In fact, some the New York City's iconic transportation infrastructure and services are tourist destinations themselves, including the Staten Island Ferry and Grand Central Terminal. Various tour bus operators offer "hop-on, hop-off" tours for visitors and make curbside stops throughout Manhattan. Tourists also joined commuters on subway, buses, and commuter rail systems, in addition to taxis and ride-hailing services. Some international travelers to New York City took regional rail or bus service to attractions in other parts of the multi-state metropolitan region.

One of the main impacts of tourism on Long Island was an increase in vehicular traffic and rail and bus ridership. Many of Long Island's attractions are dispersed, and private vehicles were the preferred mode of travel to these locations. In the warmer months, the MTA LIRR and ferry services experience increased ridership for access to popular beaches and barrier islands. In 2018, visitors spent $6.1 billion on Long Island. There are more than 60 wineries on Long Island's North and South Forks, drawing more than 1.3 million annual visitors to the region, 45 licensed craft breweries, beautiful beaches, parks, wildlife, and a 300-year old history of farming and fishing.[24]

The Lower Hudson Valley experienced marked growth in its tourism sector, and now ranks third in visitor spending in New York State (behind New York City and Long Island). According to Tourism Economics, traveler spending in 2018 for the Hudson Valley was $4.4 billion, with 45 percent of the region's tourism sales coming from Westchester County, $2.0 billion in traveler spending, and $1.1 billion in labor income.[25]

The Lower Hudson Valley is well known for its hiking trails, historic estates and sites, national parks, farms and farmers markets, and innovative art. Westchester County has seen significant growth in its agritourism sector. The 17-mile "Westchester-Grown" Farm Trail is a New York State designated route that provides visitors with a chance to explore more than a dozen farms in Westchester County.



3.8 FUTURE CHANGES LIKELY TO AFFECT TRANSPORTATION

3.8.1 OVERVIEW

During the planning period, it is likely that technological, behavioral, economic and environmental changes, the beginnings of which are evident today, will affect the region's overall mobility. Some of these changes will be the result of the COVID-19 pandemic. Others have been underway and will carry forward once the pandemic is over. These trends have the potential to transform the nature and means of travel for people and goods in the multi-state metropolitan region.

The increasing uncertainty that transformative change introduces into future forecasts is not simply a methodological issue. Planning the future mix of transportation infrastructure and services, as well as the design of specific improvement projects, depends on reasonable assumptions of how transformative change will influence how, when, where, why, and how often people and goods will be moving in and around the multi-state region.

A reasonable understanding of the potential for transformative change is crucial not only to developing a constructive response to that change but also to shaping that change to meet regional goals. In the book Three Revolutions, author Daniel Sperling and various contributors underscore this imperative in their description of possible futures resulting from transformative change:

> *In one vision of the future, the three revolutions (i.e., shared, clean, automated vehicles) are steered toward the common good with forward-thinking strategies and policies. Citizens have the freedom to choose from many clean transportation options…Now imagine a very different future that could come about if our community is unprepared for the three revolutions. Traffic congestion gets worse… greenhouse gas emissions increase…transit services diminish.*[26]

Simply put, anticipating future transformative change and shaping its outcomes are significant challenges to the NYMTC planning process. They are also challenging to the NYMTC members' shared vision of a more equitable and efficient transportation future with a smaller carbon footprint in the face of climate change.

3.8.2 DRIVERS OF TRANSFORMATIVE CHANGE

The development of reasonable expectations for future transformative changes is essential to *Moving Forward's* role in identifying transportation needs and guiding the preservation and enhancement of the transportation system. The following are significant drivers of anticipated transformative change.

THE COVID-19 PANDEMIC

As of this writing, the regional, national, and global economic impacts of the COVID-19 pandemic have been severe. According to the Brookings Institute, COVID-19–related job losses wiped out 113 straight months of job growth, with total nonfarm employment falling by 20.5 million jobs in April. The COVID-19 pandemic and associated economic shutdown created a crisis for all workers, but the impact was greater for women, people of color, lower-wage earners, and those with less education. The COVID-19 crisis also led to dramatic swings in household spending and damaged U.S. industrial production.[27]

The scale of the crisis brought about by the pandemic has resulted in major disruptions to many of the drivers of transformative change described above. With the pandemic entering a pronounced second (or third in some cases) wave in fall 2020 and on into winter 2021, the nature and pace of recovery from these severe economic and social shocks is simply unknown.

In the multi-state metropolitan region, as travel declined significantly, the pandemic has triggered a financial crisis for providers of transportation services and operators of transportation facilities. A largely successful ad hoc experiment in large-scale telework has eased some of the

economic pain, while a high proportion of telework persists among the remote-capable workforce despite the phased reopening of the regional economy. The essential workforce, including transportation and public transit workers, have paid a high price in terms of exposure to the virus.

PERSONAL MOBILITY

Personal mobility is the capacity for individuals employed, residing, or having business in the NYMTC planning area to move about using available transportation services, including privately owned or shared vehicles or conveyances. The factors described below are important to transformative change in personal mobility.

THE EVOLUTION OF SHARED MOBILITY

Shared mobility can be defined as transportation services and resources that are shared among users, either concurrently or one after another. This includes public transit; taxis and limos; bikesharing; carsharing (round-trip, one-way, and peer-to-peer); ridesharing (i.e., non-commercial services like carpooling and vanpooling); ride-sourcing or ride-hailing; ride-splitting; scooter sharing (now often grouped with bikesharing under the heading of micromobility); shuttle services and microtransit; jitneys and dollar vans; and more.[28]

Advances in electronic and wireless technologies have made sharing transportation assets easier and more efficient. Automobile manufacturers, rental car companies, venture-backed start-ups, and government-sponsored programs have sprung up with new solutions ranging from large physical networks to mobile applications designed to alter routes, fill empty seats, and combine fare media with real-time arrival and departure information.[29]

There is overlap between the definition of shared mobility and other terms used to describe broadly similar groupings of services and resources. *Moving Forward* includes these terms in the overall category of shared mobility:

- **Mobility management** is an approach to designing and delivering transportation services that starts and ends with the customer. (National Center for Mobility Management)
- **Mobility-on-Demand** is an innovative, user-focused approach that leverages emerging mobility services, integrated transit networks and operations, real-time data, connected travelers, and cooperative intelligent transportation system (ITS) to allow for a more traveler-centric approach. (USDOT)
- **Mobility-as-a-Service** is the integration of various forms of transport services into a single mobility service accessible on demand. (MaaS Alliance)

Shared mobility represents a conjunction of transportation services and resources available to travelers on a pay-per-use basis. As FHWA indicates, the growing ubiquity and use of smartphone and internet-based platforms facilitate shared mobility and multimodal transportation options more broadly.

As a means of personal transportation, shared mobility has developed and will likely continue to develop at a rapid pace. A 2016 report from Deloitte forecasts that personally owned driver-driven cars will still have seven-eighths of the market in 2025. By 2050, shared mobility will account for 80 percent of the market, according to the report's forecast. Further:

> *If shared and autonomous vehicles are adopted as quickly as other technologies (like smartphones, cellphones, and the Internet), our modeling finds that significant change will begin within five years and that the market for personal mobility could transform dramatically over the next 25 years.*[30]

Indeed, that shift has already begun and can be seen in the following statistics:

- High Volume for Hire Vehicles, which include companies such as Uber and Lyft, have more than doubled the overall size of the for-hire ride services sector since 2012, making the for-hire sector a major provider of urban transportation services.
- High Volume for Hire Vehicles ridership is highly concentrated in large, densely populated metro areas. Riders are relatively young and mostly affluent and well-educated.
- High Volume for Hire Vehicles dominate for-hire operations in large urban areas. Residents of suburban and rural areas, people with disabilities, and those without smartphones continue to be reliant on traditional taxi services.[31]

THE PACE OF TECHNOLOGICAL DEVELOPMENT

Technology is an influential current driver of transformative change for personal mobility. The pace of the adoption of a technology can be represented as an "S" curve that shows market penetration over time and represents the technology adoption life cycle over which a new product or innovation is adopted, according to the demographic and psychological characteristics of defined adopter groups. The model indicates that the first group of people to use a new product are "innovators," followed by "early adopters." Early majority and late majority follow, and "laggards" are the last group to eventually adopt a product.[32]

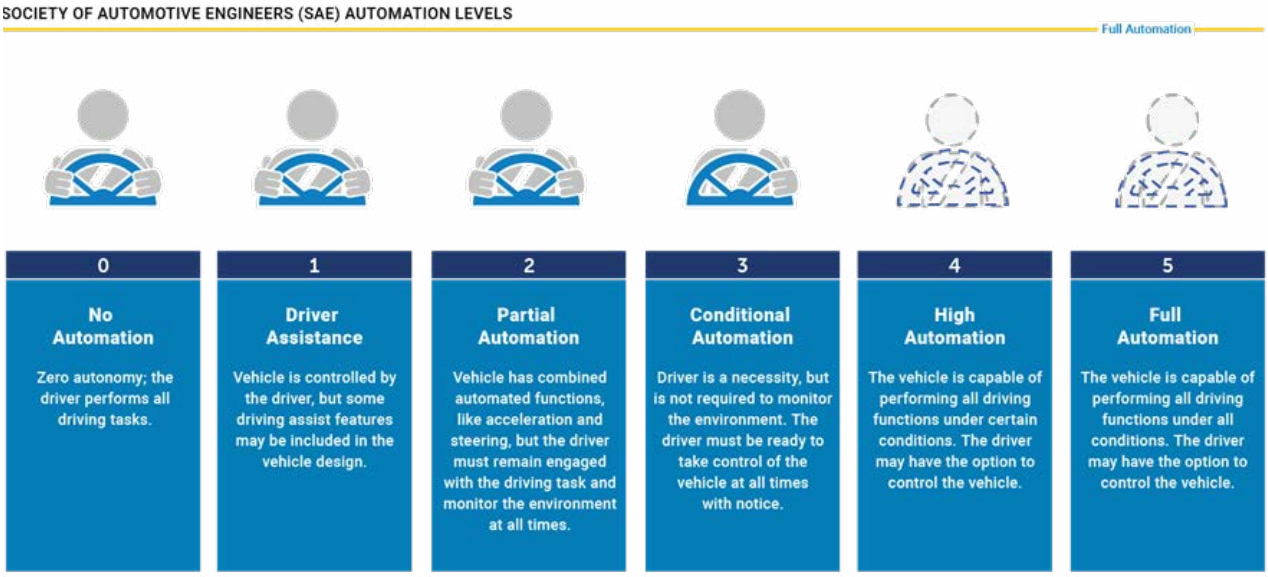
For example, the relatively rapid adoption of smartphone technology over the last two decades has made possible the emergence of transportation network companies offering ride-hailing services of all types, as well as car- and bike sharing, and e-commerce. Similarly, the development of global positioning system (GPS) technology and its adoption by vehicle manufacturers and computer application developers, among others, has made enhanced trip planning capabilities available to travelers, either in-vehicle, via those same smartphones, or through tablet, laptop or desktop computers.

Apart from further enhancements to computer applications or the accessibility of wireless data over various computer types, the continued development of vehicle automation and cleaner vehicle power systems via electricity or other sources could be two of the most influential technology drivers of future transformative change. Of the two, full vehicle automation (i.e., levels 4 and 5 according to ***Figure 3-18***) could have a large impact on the future of personal mobility and the movement of goods, particularly when integrated with more well-developed computer, data, and GPS technologies. Therefore, the vehicle automation adoption life cycle could be a particularly significant to future forecasts of transformative transportation change.

Figure 3-18

Levels of Automation

Source: NHTSA



THE DEVELOPMENT OF VEHICLE AUTOMATION

In the early 2010s several automotive and tech companies, among them Tesla and Waymo, announced plans to develop consumer-ready vehicle automation technology in a short timeframe.[33, 34] These aggressive timelines did not materialize,[35] with several carmakers and technology companies stating that vehicle automation is going to be harder, slower, and costlier than they thought.

Like other ground-shifting technologies, vehicle automation struggles to climb the curve of adoption because the complexities (and therefore costs) involved are not fully understood or even visible until the later stages of technology development. Several automation road tests conducted by researchers highlighted how the unpredictable nature of other human drivers and other road users like pedestrians are a substantial challenge for a self-driving car. Additionally, safety concerns must be addressed for the technology to be fully developed.

Most states do not yet have clear regulations governing the safety testing and deployment of driverless cars. The National Highway Traffic Safety Administration (NHTSA) released new federal guidelines for automated driving systems in 2019, but these guidelines are currently voluntary. Regulating entities are faced with the challenge of a new and complex issue. For example, automated vehicles that are not fully autonomous present the "hand-off" problem: the technology itself is likely to make drivers less attentive and thus less likely to respond to a vehicle's notice of a potential problem. As a result, the intermediate phases can be even more complicated to regulate. Creative legal problem-solving will be needed to navigate the road through global, national, state, and local laws, regulations, and policies, and to guide industry standards and best practices for automated vehicles and connected cars.

The trajectory of vehicle automation adoption is complex and uncertain. It faces many hurdles beyond technological development, including legal and regulatory developments, consumer acceptance and human behavior, public opinion on safety and liability, taxation, and infrastructure funding. Forecasts for automation adoption rates vary, but most seem to agree that the share of automated vehicles on American roads will only be a couple percentage points in 2020–2030. After that, automated vehicles might start penetrating the market, until they reach 100 percent in the long term. Most studies do not expect this to happen before 2050–2070, with a 10–30 percent adoption rate by 2035, and a 30–50 percent adoption rate by 2045.[36, 37, 38, 39] The Victoria Transport Policy Institute posits that vehicle automation will likely be adopted most quickly for transportation services in which a driver is a significant cost factor, such as long-haul trucking, ride-hailing, and possibly public transit. However, other factors—such as public transport worker unions—could play a significant role in curbing the near- and medium-term adoption of vehicle automation.

While most research focuses on the positive impact of vehicle automation, it is critical to consider how this new technology could negatively affect the future of mobility. Sam Schwartz, who served as New York City's traffic commissioner in the 1980s, addresses several issues linked to future automation technology.[40] Schwartz notes that while automation is likely to reduce traffic fatalities, it will exacerbate the conflict of shared space between cars and pedestrians/bicyclists, potentially creating even more segregation of the right-of-way between vehicle lanes and sidewalks or bikeways.

Another critical impact of wide adoption of automation is the risk of increasing VMT and encouraging urban sprawl as riders acquire a greater tolerance for long commutes. Vehicles might also run empty to look for new riders or avoid parking fees. Several studies estimate an increase in VMT,[41, 42, 43] with some ranging up to 50 percent[44] if little regulation is applied. Other concerns include the impact driverless vehicles will have on the work metro areas are doing to encourage transit to reduce VMT. People who can catch a ride door-to-door might not want to walk to or wait for buses and trains, let alone pay premium rents to live or work near subway stations.

A study[45] of the potential energy consumption impacts of automated vehicles concludes that while individual vehicle efficiency may improve, this does not imply a system-wide fuel consumption decrease. Existing research predicts that the cumulative energy impacts accounting for all the potential changes could range from a 90 percent decrease to a 200 percent increase in fuel consumption by 2050. While automation is often touted to cause fewer crashes and smoother traffic flow, it may also lead to increased highway speeds, a greater willingness to commute long distances, and an increased demand for delivery services. This might translate to high and unsustainable energy usage, unless vehicle automation includes electric/hybrid and the energy comes from renewable sources.

GOODS MOVEMENT

The companies and agencies that carry, send, receive, or manage the movement of goods within the NYMTC planning area and around the world are developing and deploying new technologies and new processes to improve the efficiency of goods movement, reduce costs, comply with regulatory or customer-driven demands, and/or improve profitability. New business models are being developed and will likely continue to be developed to adapt to and capitalize on opportunities that technological developments create.

The extent to which such technologies and processes are adopted and implemented, and the potential effects on goods movement demand and travel patterns within the NYMTC planning area specifically, are difficult to gauge. Additionally, a recent Reuters report that surveyed nearly 600 supply chain executives revealed that 58 percent of logistics service providers had shortened their technology roadmaps because the COVID-19 pandemic has accelerated the adoption of new technologies and innovative business processes that improve supply chain efficiency and resilience. The pandemic has been pulling demand away from services towards goods and placing greater demands on supply chains.[46]

E-COMMERCE AND DISTRIBUTION INNOVATIONS

The Freight Element of *Moving Forward* (see **Appendix H**) contains a full description of the current and anticipated impacts of e-commerce on the movement of goods in and around the NYMTC planning area. E-commerce shipments are defined by the U.S. Census Bureau as online orders for manufactured products where price and terms of sale are negotiated over the internet or another online system. U.S. e-commerce sales have been rapidly expanding since the late 1990s, rising from $4.5 billion in the fourth quarter of 1999 to $130.9 billion in the third quarter of 2018, according to data from the U.S. Census Bureau. Growth in online sales has widely outpaced overall retail sales growth. Between the fourth quarter of 1999 and the third

quarter of 2018, quarterly e-commerce sales increased by an average of 18.9 percent year-over-year, compared to a pace of just 3.4 percent for total retail sales. As a result, e-commerce accounted for nearly 10 percent of total U.S. retail sales prior to the pandemic, compared to less than 1 percent in 1999. Moreover, recent years have not indicated a slowdown in e-commerce's penetration of the retail market. On the contrary, the e-commerce portion of overall retail sales increased by nearly 1 full percentage point during each of the last three years for which data are available; the impacts of the pandemic are likely accelerating this trend.

The rise in e-commerce and direct-to-consumer (D2C) retail is having significant repercussions on product distribution and delivery, with many more shipments going directly to individual residences, rather than brick-and-mortar storefronts. D2C refers to selling products directly to customers, bypassing any third-party retailers, wholesalers, or any other middlemen.[47] In 2019, D2C e-commerce sales reached $14.28 billion in the United States and were forecasted to grow by 24.3 percent in 2020 before the onset of the COVID-19 pandemic, to $17.75 billion.[48] Many retailers are using large package delivery companies such as UPS, FedEx, and USPS to handle these deliveries, significantly altering the business model for such companies. For example, D2C shipments now represent more than 50 percent of UPS's total domestic volumes.

The shift toward D2C delivery has forced many retailers to focus more on last-mile logistics, which is generally considered to be the most complex and costly portion of the delivery process. While many continue to outsource this service to one of the big three delivery companies (UPS, FedEx, and USPS), some are opting for their own delivery service. The result of these developments is that the rise in e-commerce has produced a significant number of new participants in the distribution network, as well as additional vehicles and vehicle types on the road delivering goods.

While durable goods led e-commerce sales prior to the COVID-19 pandemic, many consumable goods, most notably groceries, experienced significant growth—a trend that is expected to continue and be amplified by the pandemic. According to Unata's 2018 Grocery E-commerce Forecast, 36 percent of people surveyed planned to order groceries online in 2018, up from the 22 percent who reported grocery shopping online in 2017, a growth rate of 64 percent. Amazon's purchase of Whole Foods in 2017 is undoubtedly contributing to the expansion. Wal-Mart has also been aggressive in the online grocery space, announcing plans in early 2018 to expand its online grocery delivery service to 100 metropolitan areas by year's end. At the same time, Kroger is in the testing stage for the first fully self-driving grocery delivery service with no human being in the vehicle.

Prior to the pandemic, the rapid growth in e-commerce and the D2C market combined with faster delivery standards was having significant repercussions on warehouse location decisions. There was a notable shift away from the practice of using a small number of enormous facilities located at a considerable distance from the urban areas they serve, toward using more numerous, smaller industrial spaces located closer to the end consumer. For the NYMTC planning area, this has resulted in several new facilities in the outer boroughs of New York City. One result of this trend is greater stress and congestion on local roadways, both from trucks and small vehicles.

DISTRIBUTED MANUFACTURING

The Freight Element of *Moving Forward* (see **Appendix H**) also contains a full description of current and anticipated impacts of distributed manufacturing on the movement of goods in and around the NYMTC planning area. Distributed manufacturing refers to the potential for three-dimensional (3D) printing to permit efficient production of goods near the points of demand, leading to many small factories situated in and serving many local markets. This contrasts with the long-standing imperative for factories to achieve economies of scale through mass

production and to locate large plants in limited numbers where the availability of raw materials, affordable skilled labor, vendors, or other factors of production make the achievement most efficient. Shipments to the NYMTC planning area of large volumes from some external sites in the United States or abroad could be replaced by local shipments from points of production inside NYMTC's planning area.

3D printing is a type of additive manufacturing (AM) by which products are formed by layering materials, as opposed to subtractive (cutting away) or formative (molding) techniques (AM and 3D are terms used interchangeably, although technically the latter is a category of the former). The 2019 AM industry, consisting of all AM products and services worldwide, grew 21.2 percent to $11.867 billion. The Wohlers Report 2019 projected that AM industry revenues would hit $35.6 billion by 2024.[49] When the AM market is compared to the $13 trillion in economic activity from global manufacturing, its small size understates its significance because it is a radically different form of production.

Dedicated 3D manufacturing requires industrial printers purchased by producers, whether for higher volume components or for integration into a larger manufacturing process. The scale of the factory can be smaller, depending on the other tooling required, because of the versatility of the technology. This helps in urban locations with expensive real estate. The deeper question is the business strategy companies employ to exploit the virtues of AM. Supply chain managers are rethinking their sourcing in the face of AM and could rethink their production methods. Concurrently, the management consultants AT Kearney[50] argue that the intrinsic advantages of 3D and its offsetting of lower foreign production costs could on-shore to United States manufacturing $330-500 billion in import product value in five sectors—automotive, aerospace, consumer products, health care and medical devices, and general industrials. This would reflect 3D penetration claiming between 23 and 40 percent of production in these sectors over the next 10 years.

3.8.3 POTENTIAL IMPACTS OF THESE DRIVERS

THE COVID-19 PANDEMIC

In some cases, the pandemic appears to have accelerated some of the drivers described above. Some shared mobility options have seen some growth as conveyances for personal mobility during the emergency. Initial attempts at greater integration of shared mobility modes with public transit have been accelerated in some cases. Although supply chains have been stressed by the COVID-19 pandemic, e-commerce and D2C retail have experienced new and heightened demands as a result of both the pandemic and requirements for social distancing. Additionally, AM has been called into play to fill some production gaps, notably for personal protective equipment.

Although it is not possible at this writing to predict the end of the COVID-19 pandemic, the length of the recovery and any long-term impacts of these unprecedented and ongoing events on the drivers of transformative change, it appears at least likely that the economic, social, and technological impacts of the pandemic will have some impacts on business practices and residential and commercial development patterns at least into the medium-term future.

PERSONAL MOBILITY

Given the research undertaken to date, the following developments are possible during the period of the Plan with regard to vehicle automation and its integration with shared mobility and the potential application of Autonomous Traffic Management, a research field of ITS that aims to decrease traffic congestion based on vehicle automation's cooperation and capacities.[51]

DURING THE DECADE OF THE 2020s

- The legal/regulatory framework for vehicle automation will likely continue to develop at the federal and state levels, while vehicle automation pilots will likely continue and expand.
- It is likely that full vehicle automation (levels 4 and 5, in ***Figure 3-18***) will be introduced in services (i.e., ride-hailing, long-haul trucking) where the driver is a cost factor.
- Shared mobility will likely continue to evolve and expand, while the companies providing services may consolidate around a smaller number of profitable companies.
- Micromobility legal/regulatory issues will be resolved and usage of the relevant modes will likely increase while transportation facilities adapt to increased usage.
- Shared mobility and generational changes will likely increasingly affect private vehicle ownership.
- Shared mobility will likely continue to become increasingly integrated with public transit services.
- Transportation network companies and shared mobility companies will either reach profitability or in some cases cease providing services. Consideration will likely be given to possible public financing of these services.

2030 AND BEYOND

- Vehicle automation will likely expand in market share to perhaps as high as 50 percent of vehicle travel by the mid-2040s.
- Automated vehicles will likely comprise an increasing proportion of the shared and private vehicle fleets (i.e., ride-hailing, taxis and car services, long-haul trucking).
- The legislative/regulatory framework will likely continue to evolve to accommodate a mixed human-operated/automated fleet.
- Infrastructure improvements/ innovations will likely be implemented to accommodate a mixed human-operated/ automated fleet.
- Autonomous Traffic Management will also likely evolve to accommodate a mixed human-operated/autonomous fleet and eventually be optimized for a majority automated fleet during the decade of the 2050s.
- Greater integration with vehicle automation will emerge in ride-hailing, public transit, and goods movement.

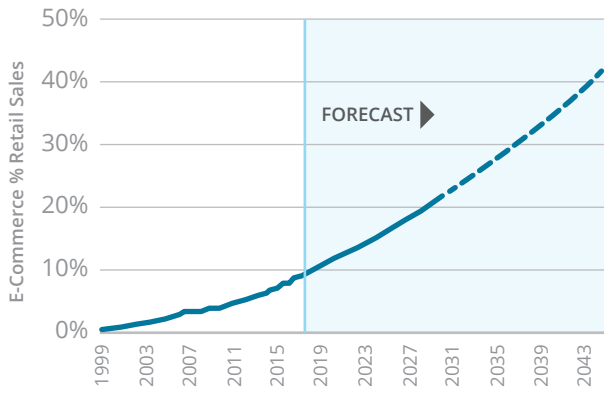
E-COMMERCE

Accelerated by the COVID-19 pandemic, technological advances will likely continue to support online sales growth by allowing consumers greater access to product information; quick and easy price comparisons; and faster, cheaper, personalized delivery options. Moreover, as same-day delivery and free shipping on returns become more commonplace, the allure of brick-and-mortar stores will diminish further. Thus, there is little reason to expect a slowdown in the growth of online sales market penetration in the next five years. Indeed, eMarketer is forecasting a continuation of robust growth, with online sales expected to account for more than 15 percent of total retail sales by 2022 (***Figure 3-19***). While there is no doubt a saturation point in terms of e-commerce as a percent of overall retails sales, it is unlikely to be reached soon.

Figure 3-19

Long-term Forecast for E-commerce Retail Sales

Sources: eMarketer, CBRE Research, US Census Department, Cheng Solutions LLC



The continued rise in e-commerce sales has significant implications on warehouse demand. The D2C market translates into fewer goods inventories in retail stores and greater volumes of goods on warehouse racks for delivery. CBRE Research estimates that for every $1 billion increase in e-commerce sales, an estimated 1.25 million square feet of warehouse space is needed to keep up with demand. Using eMarketer's online sales forecast, CBRE estimates that e-commerce generated warehouse demand could grow, nationally, by an additional 191 million square feet from 2018 to 2020.[52] That additional warehousing could generate 115,000 additional daily truck trips in the United States.[53]

There are significant barriers to the commercial integration of levels 3-5 (***Figure 3-18***) automated trucks. In terms of technology, the hardware issues, such as sensors, vehicle-to-vehicle communication, and vehicle control, are relatively minor. However, the software issues, including spatial issues, human-machine-interface, and mapping and path planning/control, need advanced development.[54] Significant infrastructure, legal, and liability issues also must be resolved.

DISTRIBUTED MANUFACTURING

Additive Manufacturing is an actively evolving technology: in printers, materials, applications, and in accumulated experience of its use for the fabrication of goods. It makes a decidedly minor contribution to manufacturing processes today, yet its contribution is larger for some goods, and its use is growing rapidly. Adoption is stimulated by delivered cost advantages for local, domestic production versus overseas sourcing. Adoption could be accelerated by the risks to trade brought on by tariff policies and the International Maritime Organization fuel mandate.

In sum, the course of development should play out over 10 to 20 years. However, the growth curve could become steeper because of trade factors. In the recessionary economic shock and economic restructuring generated by the COVID-19 pandemic and resulting public health emergency, the demand for goods has dropped, but the business need for competitive advantage has risen. The medium-term impact of this global emergency could create another stimulus for adoption of 3D technology, with the volume effects not felt until economic recovery begins.

3.8.4 LARGER-SCALE DISRUPTERS

NYMTC's planning area, along with the multi-state metropolitan region, will continue to face challenges from the impacts of the following larger-scale disrupters.

CLIMATE CHANGE AND EXTREME WEATHER EVENTS

Mandated at least every four years by the Global Change Research Act of 1990, the U.S. National Climate Assessment documents climate change related impacts and responses for various sectors and regions, with the goal of better informing public and private decision making at all levels.[55]

According to the fourth U.S. National Climate Assessment in 2018:

> *Earth's climate is now changing faster than at any point in the history of modern civilization, primarily as a result of human activities. The impacts of global climate change are already being felt in the United States and are projected to intensify in the future—but the severity of future impacts will depend largely on actions taken to reduce greenhouse gas emissions and to adapt to the changes that will occur.*[56]

Among the assessment's key findings of the assessment regarding transportation:

> *Transportation is the backbone of economic activity, connecting manufacturers with supply chains, consumers with products and tourism, and people with their workplaces, homes, and communities across both urban and rural landscapes. However, the ability of the transportation sector to perform reliably, safely, and efficiently is undermined by a changing climate.*
>
> *Transportation is not only vulnerable to impacts of climate change but also contributes significantly to the causes of climate change. In 2016, the transportation sector became the top contributor to U.S. greenhouse gas emissions. The transportation system is rapidly growing and evolving in response to market demand and innovation. This growth could make climate mitigation and adaptation progressively more challenging to implement and more important to achieve. However, transportation practitioners are increasingly invested in addressing climate risks, as evidenced in more numerous and diverse assessments of transportation sector vulnerabilities across the United States.*[57]

As the fourth assessment underscores, it is prudent to assume an increase in extreme, climate-related weather events over the course of the planning period. This assumption is especially significant to the NYMTC planning area, given (1) its location along several coastlines; (2) the configuration of the coastal New York Bight; and (3) the topography of islands and river valleys throughout the planning area. During the decade of the 2010s, extreme weather events increased consideration of resiliency and climate adaptation at all levels of planning, changing the way system-wide transportation planning is being conducted as transportation agencies look for ways to better prepare for extreme events. This imperative will surely continue through the period of the Plan and will likely need to remain dynamic as new challenges arise or are anticipated.

Technological development can help enhance the resiliency of the transportation system in the NYMTC planning area to extreme weather events and improve emergency response, infrastructure robustness, and redundancy in extreme weather situations. Techniques to harden or equip transportation infrastructure against weather effects such as inundation, flooding, and extreme heat are becoming available or are being developed to protect the region's transportation assets. Additionally, simulation modeling technology will continue to enable planners to identify vulnerabilities in the transportation system, target infrastructure and equipment for hardening, and develop emergency plans in response to extreme events.

ENERGY TRANSFORMATION

According to the U.S. Bureau of Labor Statistics, gasoline prices (all types) in the New York-Newark-Jersey City, NY-NJ-PA Metropolitan Statistical Area exceeded $3 per gallon on a monthly basis from November 2010 through November 2014. During that period, the average monthly price exceeded $4 for three individual months in 2012. The $3 threshold was again exceeded from May through July 2018 and hovered above $2.80 through November of that year. The May through July period also saw prices approach $3 per gallon before leveling off at approximately $2.70.

Gasoline price variability over the last decade, along with periods of consistently high prices, have placed an onus on improved fuel-efficiency. According to USEPA, average real-world fuel economy for all vehicle types reached 25.4 miles per gallon for the 2018 model year compared with 22.6 miles per gallon for the 2010 model year, a 12.4 percent increase.

Energy prices have also resulted in increased manufacture and sales of vehicles propelled fully or partially by electric motors powered by rechargeable battery packs. Electric vehicles (EVs) can be charged from standard electricity sources. Hybrid electric vehicles (HEVs) combine an internal combustion engine with an electric motor. Both EVs and HEVs also convert energy from coasting and braking into electricity, which is stored in the batteries. Compared to regular vehicles, EVs have greater energy efficiency, produce lower emissions, and cost less to operate. However, there are still issues with the range of EVs that limit their practicality.

In the medium-term, hybrid and plug-in EVs and supporting infrastructure could have a great impact on personal and commercial transportation. These EVs and HEVs have gained presence in the NYMTC planning area: the first hybrid electric buses and taxis entered service in New York City in 2004 and 2005, respectively.[58] New York State's initiative to get more electric cars and trucks on the road, ChargeNY, has supported the installation of over 2500 charging stations[59] for EVs and HEVs since 2013. New York State has also revised regulations to clarify charging station ownership rules and supported research and demonstration projects on new EV technologies and policies.[60] The cost of electric charging infrastructure for public transit services can be significant.

CHANGING DEMOGRAPHICS AND LIFESTYLE/ WORKSTYLE EXPECTATIONS

Demographic changes over the past decade have altered the way people travel, resulting in the emergence of new patterns and demands. One of the most prominent demographic trends during the period of this Plan will be the aging of the population in NYMTC's planning area. In 2018, the population 65 years and older living in the NYMTC planning area was 1.9 million or 14.9 percent of the total residential population.[61] This figure is expected to continue to increase with the aging of the Baby Boom generation and continued development of longevity medicine. According to the NYMTC population forecasts, by 2050 nearly 17 percent of the population in the NYMTC planning area is projected to be 65 and older.

Changes to the age structure of the population will likely influence travel patterns in the region. In general, older adults have a higher incidence of disabilities and a lower rate of workforce participation, which results in an overall reduction in travel and a higher demand for assisted and accessible transportation. In 2013, AARP reported that more than 20 percent of adults over the age of 65 do not drive and do not have good access to public transit facilities,[62] although earlier reports found that they are using public transit more and more.[63] According to FHWA, the percentage of licensed drivers who were 65 and older in 2018 in New York was 21 percent. In the United States, 45 million licensed drivers were 65 and older in 2018.[64]

Measures that can accommodate an aging population's mobility needs include more specialized public transportation, Complete Streets, older driver safety measures, and accessible design at public transportation stations. Generational changes will also

likely affect the acceptance and use of new technologies, which in turn can affect travel patterns. The future development of application-based, demand-responsive transportation services will continue to be influenced by their acceptance by younger generational cohorts. Taken as a whole, these technologies have and will continue to change Americans' travel behavior.

Another trend distinguishing younger Americans is their preference for transit and active transportation, such as walking and biking. Research shows that Millennials (those born between 1980 and 2000) tend to drive less, take transit more, bike and walk more, and seek out places to live in cities and walkable communities that encourage walking and biking.[65] According to the Urban Land Institute, 19 percent of Millennials bike at least once a week, compared with 16 percent of Generation X and 12 percent of Baby Boomers.[66]

Other research has found that Millennials, although they rode fewer vehicles than Baby Boomers (those born between 1946 and 1964), had more vehicle miles traveled. The results suggest that while Millennial vehicle ownership and use may be lower early on in life, these differences are only temporary and, in fact, lifetime vehicle use is likely to be greater.[67]

Generation Z, also known as Zoomers and iGen, (born between 1997 and 2015) tend not to have the same connection as older generations to vehicles. They are starting to try different modes of transportation, including shared mobility like Millennials. A working paper published by Econstor showed that:

> *Millennials and those in the younger cohort of Gen Z are more than twice as likely than Gen X (1964-81) and Boomers to question whether they need to own a vehicle going forward and are less willing to buy a car than other generations (Vitale et al., 2019). Only 64% of Millennials said that their preferred mode of transport was the car they own, in comparison to 81% of consumers from other generations.*[68]

A report by Allison & Partners based on a 2019 online survey of 1,035 people in the United States over the age of 16 also showed that:

> *70 percent of Gen Z respondents do not have their driver's licenses and 30 percent of those who do not currently possess their driver's license have no intention or desire to get one. This decline in driving sentiment points to evidence that alternatives to personal transportation have gained momentum. In fact, nearly one-third of those surveyed (31 percent) reported regular use of rideshare services as an alternative method of transportation, and more than half (56 percent) used public transit.*[69]

In terms of work styles, the 2018 *Future of Jobs Report* of the World Economic Forum included the following relevant findings for employers: technological change drivers and accelerated technology adoption; a changing geography of production, distribution and value chains; changing employment types due to automation; and a reskilling imperative.[70]

Employment and productivity have a significant impact on the transportation network because demand is determined in large part by the number of people who need to travel for work, the volume of goods that need to be transported, and where those goods originate and are destined.

Changes in methods and locations of production will affect travel demand. In particular, 3D printing could supersede supply chains and distribution networks for certain types of goods and allow more decentralized production. Similarly, changes in the form of employment that may be brought about by evolving technologies will affect where, when, and how people are employed and perform their work, thus affecting their mobility needs. Related economic factors that would be affected include tax rates and bank regulations, which influence business location decisions and thus where general economic activity and population growth occur.

CHANGING LAND USE PATTERNS

Various factors, including continued regional growth, local land use preferences, real estate market conditions, the development of transportation technologies and services, and the impacts of sea level rise and extreme weather events will likely influence land development patterns, which in turn influence the type and amount of travel demand.

According to the U.S. Census Bureau's annual population estimates, New York City's population growth slowed and began to reverse over the decade of the 2010s. New York City's population grew at roughly 1 percent from 2010 to 2011. By 2016, that annual growth had slowed to roughly 0.1 percent over 2015. The 2016–2017 and 2017–2018 comparisons showed small population losses—0.4 percent and 0.5 percent, respectively. In that same 2017–2018 period, suburban population growth in the New York-Newark-Jersey City, NY-NJ-PA Metropolitan Statistical Area was 0.15 percent, which was roughly the same level of annual suburban growth at the beginning of the 2010s. These data suggest the beginnings of a reversal of the previous period of significant growth in New York City and the re-emergence of a level of suburbanization.

In the NYMTC planning area, significant transit-oriented development initiatives have been undertaken or are under development by New York State, New York City, suburban counties and municipalities, MTA, and private developers as a way to achieve more sustainable development patterns. Examples on Long Island include Wyandanch Rising, which is transforming one of Long Island's most economically distressed communities into a transit-oriented downtown with excellent access to the MTA LIRR, affordable housing units, and commercial uses offering daily amenities. Similar concepts are in progress or under study in East New York and the east Bronx in New York City; and around MTA MNR stations in the Lower Hudson Valley suburban cities of Yonkers, Mount Vernon, and New Rochelle.

Additionally, the advent of shared mobility and e-commerce is beginning to affect land use patterns and may continue to do so. Information and communication technologies, as well as vehicle technologies, could significantly influence future locations and distribution of residential, commercial, and industrial land uses. This is particularly true given the growth of e-commerce, which is altering commercial land use at various locations in New York City's multi-state metropolitan region through siting of intermodal centers, warehouses, and distribution centers, as well as industrial properties.

Climate change and the impacts of sea level rise and extreme weather events are also beginning to impact land use patterns, particularly in the wake of Hurricane Sandy in 2012 and Hurricane Irene and Tropical Storm Lee in 2011. Taken together, these extreme storms subjected the NYMTC planning area and the multi-state metropolitan region to a wide range of weather impacts from storm surge, heavy rainfall, wind, and resulting erosion and flooding. Communities throughout the NYMTC planning area have been considering land use patterns in their recovery and resiliency planning. Several examples are listed below:

- New York State's Community Risk Reduction and Resiliency Act requires decision-makers to use the best available science in order 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 undertaken zoning text amendments and neighborhood rezonings in areas of high-risk flooding. The Department of City Planning created special zoning rules for the floodplain to allow for recovery and promote rebuilding. It has also undertaken several neighborhood and citywide studies to understand specific resiliency issues relating to residential, commercial, and industrial areas.

- New York City's Waterfront Revitalization Program establishes New York 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 & Urban Development's innovative Rebuild by Design competition.
- The New York State Governor's Office of Storm Recovery also administers New York Rising Communities Reconstruction and its 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, creating 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 due to repeated flooding.

While land use patterns are determined by many factors, including generational preferences, local land use policies, changing business models, regional transportation infrastructure, and real estate cost trends, it is clear that land use patterns are important drivers of change by determining where people live, and where and how they travel.[71]

3.8.5 *MOVING FORWARD'S* ASSUMPTIONS ON TRANSFORMATIVE CHANGE

While acknowledging the disruption brought about by the COVID-19 pandemic, *Moving Forward* recognizes both the continuing transportation transformation *for the longer term,* as well as the impacts of major global trends on future mobility, through the following assumptions:

- Personal mobility is assumed to continue to evolve toward shared mobility—with an increased use of shared, on-demand, and ultimately cleaner and more automated vehicles of all types, ranging from micromobility options such as scooters and bicycles to ride-hailing using cars and microtransit arrangements using vans to trunk services through public transit options using buses, and light and heavy rail.
- Technological development will continue to be a driver of transformative change in areas such as personal mobility, goods movement, and adaptation to climate change.
- Technological changes such as AM (also known as 3D printing), commercial vehicle automation, the continuing automation of goods production and shipment, and the emergence of new delivery modalities such as drones and cargo bikes will affect the movement of goods. Changes in business models and practices will also impact how commodities move, such as the continuing growth of e-commerce and multi-stage distribution, reverse logistics, sprawl development of fulfillment centers, and shared use lockers.
- Challenges from the impacts of major global trends are assumed to continue to impact NYMTC's planning area, along with the multi-state metropolitan region. These trends include climate change, the future availability and cost of energy, the

development of new technologies and energy sources, changing demographics and lifestyle/workstyle expectations, and changes in land use patterns, brought about at least in part by extreme weather events and sea level rise.

In positing these assumptions about transformative changes, *Moving Forward* acknowledges the continuing impracticality of attempting to quantitatively predict their impacts on its forecasts for the transportation system. However, there is a significant degree of certainty that transformative changes will alter the demand for transportation and/or the way transportation services are provided in some fashion during the planning period. This section will explore those potential impacts.

Moving Forward also acknowledges that a degree of caution must be exercised. Despite current trends implying that continued technological, economic, and societal developments will transform how, when, where, why, and how often people and goods move, different perspectives remain and must be considered when assessing the future impacts of transformative changes. For example, the Victoria Transport Policy Institute has identified significant reservations concerning the duration and pace of the development of vehicle automation and related behavioral change.

In comparison, the evolution of shared mobility and e-commerce may be somewhat more predictable than vehicle automation in the short and medium term, given current trends and the reality that much of the enabling technology is already in place. Yet there are still risks of both overestimating and underestimating future transformational changes, particularly because there is little consensus on the pace of that change among researchers, planners, technology experts, and policy makers.

3.8.6 IMPLICATIONS FOR THE TRANSPORTATION PLANNING PROCESS

Transformational changes and the future of mobility will influence *Moving Forward's* strategic framework. Some possible outcomes will likely influence how NYMTC as an organization and its members individually seek to fulfill the goals of their Shared Vision for Regional Mobility. Other potential outcomes, such as evolving forms of shared mobility, will affect the way these goals are pursued. *Moving Forward* attempts to lay the groundwork for anticipating these developments and formulating approaches. However, greater attention will be needed going forward to better understand current trends, potential futures, and possible outcomes, as outlined below.

EQUITY

As the transportation systems evolve, equity among all citizens, particularly on those who have been underserved by the current transportation system, is an increasing focus. The concept of equity implies a fair distribution of costs and benefits that serve users.

An ideally equitable transportation network, for example, would provide transportation that serves the needs of those who are low-income, racial/ethnic minorities, older individuals, or who have physical and cognitive disabilities. The biggest challenges about new transportation technologies and services involve cost and access. While these transformations in the movement of goods and people bring more options, there are uncertainties regarding where and to whom the benefits will accrue.

UNCERTAINTY

As noted above, various attempts have been made to anticipate the impact of transformative changes on the methods and amount of future travel. However, it is not yet possible to comprehensively assess the effect of these predictions on the socioeconomic and demand forecasts described earlier in the Plan or on the operation of the transportation system in the NYMTC planning area. However, preliminary

predictions suggest that transformational changes will affect the future demand for transportation and/or the way transportation services are provided.

The transformational changes and their potential impacts outlined above are important and emerging realities that will continue to shape the future of transportation globally, nationally, regionally, and within the NYMTC planning area. In general terms, NYMTC's members will continue to monitor these changes and respond as needed to make the regional transportation system safer, more sustainable, more equitable, and more efficient during the planning period. Additionally, transportation planning as practiced through the NYMTC process and individually by NYMTC's members will itself be transformed, as data and technical tools are modified or overhauled in response to changing technological and operational capabilities.

Although quantitative predictions of the impacts of transformational changes on future transportation demand and supply remain elusive, *Moving Forward* acknowledges the following qualitative assessment of change during the planning period.

THE PLAN'S FIRST 10 YEARS

It is likely that the impacts of transformative change on the Plan's socioeconomic and transportation demand forecasts will be somewhat muted during the first 10 years of the Plan (FFYs 2022 through 2031), due mainly to the recovery from the COVID-19 pandemic, the pace of development of relevant technologies, *and* the behavioral change that will mature along with the technologies and through generational change. Specifically:

- Given the forecasts presented earlier in this section and the acceleration experienced during the pandemic, the continued growth in e-commerce seems to be the most certain and impactful possibility during this initial period, adding potentially significant new truck/commercial travel to the network.
- Less certain will be the growth in shared mobility, which has itself been impacted by the pandemic, along with greatly reduced usage of public transit ridership. A rebound in shared mobility amidst continuing safety concerns about public transit in the aftermath of the pandemic could add significantly to vehicular travel during this initial period.
- Although vehicle automation during this period will emerge and is likely to grow, the forecasts indicate that automated travel will likely not reach significant levels during this period.
- Although fossil fuel costs or supply constraints cannot be confidently predicted during this initial period, particularly in light of the economic shocks caused by the pandemic, electric vehicle technology will likely show increasing growth that will require attention to supporting facilities and infrastructure as a result of greater production levels that lower costs and increased regulation in response to climate change.
- Finally, during this initial period of the Plan, continued impacts from sea level rise and extreme weather will likely be felt.

Additionally, generational changes that are already manifesting themselves in altered economic and travel behavior will continue and mature during this initial period:

- The mid-range of the Baby Boomers will be moving into their 70s during this period and the vanguard will be in their early-to-mid 80s. As these number increase, new mobility needs will present themselves, which will likely translate into a higher demand for specialized transportation services.
- The vanguard of the Millennials will be moving into and past their 50s during this period and their travel behavior and locational preferences will likely be modified as they age, as will the mid-

range of the cohort moving towards and into their 40s.

- The vanguard of the following generation—often referred to as *Gen Z*—will be in the work force during this period and the mid-range of this cohort will begin to enter it. It is unclear how they will adapt to the developing technology, although higher adoption rates are probable.

THE BALANCE OF THE PLANNING PERIOD

Beyond this initial 10-year period (beginning with FFY 2032) and onward through the 2050 horizon year, the impacts of transformational changes on transportation demand and supply are increasingly uncertain. Some of these impacts may be far reaching, but it is not yet possible to reasonably forecast when and how the drivers of transformational change will mature, what they will ultimately become, and whether new unanticipated drivers—technological, economic, social—will emerge and in what form.

A case in point is AM (3D printing). This technology has the potential for far reaching, even transformative commercial impacts that could revolutionize economic activity and the movement of goods. Similarly, vehicle automation, shared mobility, and micromobility also have the potential to significantly change personal mobility in the longer term, moving away from a vehicle-based system into a more trip-based system in which private ownership of vehicles is greatly reduced and private and public transport have been melded together entirely. And finally, the continued evolution of the "Internet of Things" may transform both the mobility needs of people *and* the efficiency with which transportation resources are used.

This longer-term uncertainty argues for a degree of sensitivity testing for the period beyond the first 10 years of *Moving Forward*, since it is generally unknowable whether and how the most transformative of these changes will be realized within the planning period.

NEW RESEARCH

Exploring research that has measured recent changes in mobility attributable to transformational change is an important step in preparing for the next planning cycle. Prominent examples of recent efforts include the following:

- **The University of California's Davis Institute of Transportation Studies** completed the first-ever study with representative data from major cities across the United States on online ride-hailing services and their impact on travel decisions. The research suggests that ride-hailing complement public transit, but the net effect is an overall reduction in public transit use and a shift towards travel by lower occupancy vehicles. One caveat to this overall finding is that the study found that the complementary effect has been greatest with commuter rail service, so that it can be inferred that the impacts across the NYMTC planning area likely vary with location. The study also found that land use mix and population/job density impact the frequency of use of ride-hailing services.
- **Schaller Consulting (2017)** completed a detailed analysis of online ride-hailing services in New York City from 2014 to 2016. The analysis found that ride-hailing ridership tripled between June 2015 and fall 2016 and that ride-hailing services accounted for the net addition of 600 million miles of vehicular travel to New York City's roadway network during this period.
- **Walker Consultants (2017)** found that a strong correlation exists between high parking costs in urban metropolitan areas and ride-hailing market penetration. Strong markets for ride-hailing services are found in dense urban centers with a bigger pool of potential customers and in places where parking costs become prohibitive.

IMPROVED PREDICTIVE CAPABILITIES

Several aspects of future mobility warrant additional research and improved predictive capabilities so that the planning process can anticipate future conditions and potential scenarios. These include:

- **Vehicle Technology:** Legal and technical developments in vehicle technology must be monitored closely to define future scenarios for market penetration by connected and automated vehicles and the potential impacts of that market growth through 2050. These future scenarios would involve assumed timeframes for connected and automated vehicles to be in operation as a proportion of overall vehicle fleets—personal, public, and commercial. As these vehicles become an increasing proportion of the vehicle fleets in operation, advanced traffic management technologies could increase the throughput of roadways and bus transit facilities and significantly influence both transportation demand and supply. Additionally, pilot testing of various levels of vehicle autonomy for automobiles, trucks, vans, and buses must be monitored to track the evolution of the technology as a means of predicting its possible maturation. Similar attention must be paid to scenarios for the expanded use of electricity and lower-carbon fuels like hydrogen, renewable natural gas, and renewable diesel to power light- and heavy-duty vehicles.
- **Shared Mobility:** New data on and analyses of the impacts of the continuing evolution of shared mobility on key metrics such as VMT, transit ridership, carsharing and bikesharing rates, and private vehicle ownership must be monitored. This information will be used, where feasible, to adjust NYMTC's forecasting tools for such key parameters as trip-making characteristics, trip generation rates, and modal choice characteristics to improve forecasts of travel demand as a basis for this Plan.
- **E-commerce:** The companies and agencies that carry, send, receive, or manage the movement of goods are developing and deploying new technologies and new processes to improve the efficiency of goods movement, reduce costs, comply with regulatory or customer-driven demands, and/or improve profitability. This could result in increased goods movement demand and/or greater concentration of that demand in certain areas and requires monitoring.

- **Land Development:** The advent of shared mobility and e-commerce is beginning to affect land use patterns and may continue to do so in the future. Information and communication technologies, as well as vehicle technologies, could significantly influence future locations and distribution of residential, commercial, and industrial land uses. This is particularly true given the growth of e-commerce, which is altering commercial land use at various locations in the multi-state metropolitan region through siting of intermodal centers, warehouses, and distribution centers, as well as industrial properties, often in a manner that increases regional sprawl and contributes to increases in VMT.

3.8.7 ADAPTING THE PLANNING APPROACH

Specific tools, techniques, and approaches can be employed during the period of the Plan to better anticipate the impacts of transformative change on the future of mobility, including the following:

- **Planning for Uncertainty:** Several tools and techniques need to be employed to accommodate future uncertainties, including the following, which are neither mutually exclusive nor listed in order of priority:
  - Using "big data" for monitoring trends and defining potential future conditions. The availability of new data sources—crowd-sourced through social media, collected by mobile phone operators and through GPS, and gathered from the "Internet of Things"—will be critical to adapting NYMTC's forecasting tools and simulation models to better predict potential changes in future travel.
  - Using sensitivity analyses and developing alternate future scenarios. These planning techniques alter key parameters in future forecasts to test the impact of these changes on outcomes such as travel patterns, transit ridership, goods movement, and VMT.
  - Benchmarking and networking with similar organizations in other metropolitan regions across the country. Such collaboration will take on increased importance in providing guidance for defining uncertain futures. Greater collaboration will also assist in monitoring trends and emerging concepts.
- **Upgrading Analytical Tools and Predictive Capabilities:** As described earlier, deployment and market penetration of new technologies take time and, in many cases, require legal, policy, behavioral, and societal adaptations. Transformational technologies that have only minor impacts in the short term may result in major impacts to land use and transportation in the long term. To better predict the transportation outcomes of these changes, NYMTC's analytical tools and forecasting capabilities will need to be upgraded to account for transformational changes that are expected to impact travel demand. Travel surveys and the use of big data to measure travel activity and monitor trends will need to explore metrics specific to shared mobility, e-commerce, and socioeconomic factors. This will continue to be a challenging, and to some degree speculative, task given the uncertainties of how current trends will sustain themselves over the long term.
- **Planning Integration:** Better planning integration among different levels of government—local, county, regional, state, and federal—can enable more cohesive approaches between policy areas, planning jurisdictions, or functional areas, and between neighboring jurisdictions or planning areas with

shared interests in infrastructure, resources, or both. In recent years, NYMTC and its members have explored this kind of planning integration through innovative study methodologies and outreach approaches and through partnering. Given future uncertainty about the scale of the mobility changes that may occur through technological, economic, and societal developments, greater planning integration between jurisdictions and policy areas will likely be needed to accommodate and shape the future of mobility.

- **Improved Public-Private Partnerships:** Proactively engaging and developing public-private partnerships will increase in importance. These partnerships can inform and anticipate needs of the transportation system for mobility of people and goods. Proactive engagement of businesses, tech companies and start-ups, and real estate development can help to support the development and transportation to service those needs.

ENDNOTES

1 Johnson, Sandra Leigh. December 30, 2019. New estimates show U.S. population growth continues to slow. U.S. Census Bureau. ***https://www.census.gov/library/stories/2019/12/new-estimates-show-us-population-growth-continues-to-slow.html.***

2 U.S. Census Bureau. December 30, 2019. Slower growth for the nation's population. ***https://www.census.gov/library/visualizations/2019/comm/slower-growth-nations-pop.html.***

3 Knapp, Anthony. December 30, 2019. Net migration between the U.S. and abroad added 595,000 to national population between 2018 and 2019. U.S. Census Bureau ***https://www.census.gov/library/stories/2019/12/net-international-migration-projected-to-fall-lowest-levels-this-decade.html.***

4 Johnson, Sandra Leigh. December 30, 2019. New estimates show U.S. population growth continues to slow. U.S. Census Bureau. ***https://www.census.gov/library/stories/2019/12/new-estimates-show-us-population-growth-continues-to-slow.html.***

5 American Counts Staff. December 10, 2019. ***https://www.census.gov/library/stories/2019/12/by-2030-all-baby-boomers-will-be-age-65-or-older.html.***

6 Johnson, Sandra Leigh. December 30, 2019. New estimates show U.S. population growth continues to slow. U.S. Census Bureau. ***https://www.census.gov/library/stories/2019/12/new-estimates-show-us-population-growth-continues-to-slow.html.***

7 Office of the New York State Comptroller. New York State Employment Trends. ***https://www.osc.state.ny.us/files/reports/osdc/pdf/report-1-2020.pdf.***

8 U.S. Census. 2018. S1903: Median income in the past 12 months (in 2018 inflation-adjusted dollars); NHGIS median household income.

9 U.S. Census. 2018. S1903: Median income in the past 12 months (in 2018 inflation-adjusted dollars), 2014–2018 ACS 5-Year Estimates; Steven Manson, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. IPUMS National Historical Geographic Information System: Version 15.0 [median household income]. Minneapolis, MN: IPUMS. 2020. ***http://doi.org/10.18128/D050.V15.0.***

10 U.S. Census. 2018. B08006: Sex of workers by means of transportation to work, 2014–2018 ACS 5-Year Estimates.

11 U.S. Census. 2018. B08006: Sex of workers by means of transportation to work, 2014–2018 ACS 5-Year Estimates.

12 U.S. Census. 2015. Residence county to workplace county commuting flows for the United States and Puerto Rico Sorted by Residence Geography, 2011–2015 ACS 5-Year Estimates.

13 U.S. Census. 2018. S0802: Means of transportation to work by selected characteristics, 2014–2018 ACS 5-Year Estimates.

14 U.S. Census. 2018. B08603: Travel time to work for workplace geography, 2014–2018 ACS 5-Year Estimates.

15 U.S. Census. 2018. B08534: Means of transportation to work by travel time to work for workplace geography, 2014–2018 ACS 5-Year Estimates.

16 U.S. Census. 2018. B08534: Means of transportation to work by travel time to work for workplace geography, 2014–2018 ACS 5-Year Estimates.

17 U.S. Census. 2018. B08006: Sex of workers by means of transportation to work, 2014–2018 ACS Survey 5-Year Estimates.

18 Tourism Economics. 2018. The Economic Impact of Tourism in New York. 2018 Calendar Year. Hudson Valley Focus.https://highlandscurrent.org/wp-content/uploads/2019/09/tourism-impact-2018-hudson-valley.pdf.

19 Making the case for tourism: Advocacy talking points. (n.d.). New York State Tourism Industry Association. ***https://www.nystia.org/our-role/making-the-case-for-tourism-advocacy-talking-points#:~:text=Tourism%20has%20grown%20to%20be,per%20New%20York%20State%20household.***

20 Patel, S. December 2020. [Press Release] Data for the Long Island Region Nonfarm Employment by Industry (NAICS). Department of Labor Department of Labor. ***https://statistics.labor.ny.gov/lon/pressrelease/index.shtm***.

21 Johnny, N. 2020. Labor statistics for the Hudson Valley region - New York State Department of Labor. Department of Labor Department of Labor. ***https://dol.ny.gov/labor-statistics-hudson-valley-region.***

22 McElhiney, H. G. November 25, 2020. Tourism | Empire State development. Empire State Development. ***https://esd.ny.gov/industries/tourism#:~:text=Tourism%20Industry%20is%20Crucial%20to%20New%20York%20State%20Growth&text=A%20record%2Dhigh%20265.5%20million,in%20major%20tourism%20infrastructure%20projects.***

23 NYC & Company Global Communication Staff. November 18, 2020. Fact Sheet: NYC travel trend outlook 2020–2024. Official Marketing, Tourism & Partnership Organization | NYC & Company. ***https://business.nycgo.com/press-and-media/press-releases/articles/post/nyc-travel-trend-outlook-2020-2024/.***

24 Long Island | Empire State development. June 26, 2020. ***https://esd.ny.gov/regions/long-island***.

25 Tourism Economics. 2018. The Economic Impact of Tourism in New York. 2018 Calendar Year. Hudson Valley Focus. ***https://highlandscurrent.org/wp-content/uploads/2019/09/tourism-impact-2018-hudson-valley.pdf.***

26 Sperling, Daniel, and Anne Brown. 2018. Three Revolutions: Steering Automated, Shared, and Electric Vehicles to a Better Future. Washington, DC: Island Press.

27 Bauer, Lauren, Kristen E. Broady, Wendy Edelberg, and Jimmy O'Donnell. September 17, 2020. Ten Facts about COVID-19 and the U.S. Economy.

28 ***https://sharedusemobilitycenter.org/*** .

29 ***https://sharedusemobilitycenter.org/*** .

30 Corwin, Jameson and Willigmann Pankratz. September 2016. The future of mobility: What's next? Deloitte Insights.

31 Schaller, Bruce. July 2018. The New Automobility: Lyft, Uber and the Future of American Cities. Schaller Consulting.

32 Kumbar, S. February 3, 2017. What is technology adoption life cycle and chasm? Medium.

33 The Guardian. 2015. Self-driving cars: from 2020 you will become a permanent backseat driver.

34 Business Insider. 2016. 10 million self-driving cars will be on the road by 2020.

35 CNBC. 2019. Self-driving cars were supposed to be here already—here's why they aren't and when they should arrive.

36 Victoria Transport Policy Institute. 2020. Autonomous Vehicle Implementation Predictions.

37 World Economic Forum. 2018. We're not ready for driverless cars.

38 MRCagney. 2017. Autonomous Vehicles Research Report.

39 Forbes. 2019. The big challenges in regulating self-driving cars.

40 Schwartz, S. 2018. No one at the wheel – driverless cars and the road to the future.

41 Kara Kockelman, et al. 2017. An assessment of autonomous vehicles: Traffic impacts and infrastructure needs. The University of Texas At Austin Center for Transportation Research.

42 Anderson, J., N. Kalra, K. Stanley, P. Sorensen, C. Samaras, and T. Oluwatola. 2016. Autonomous vehicle technology, a guide for policymakers.

43 Ezike, R., J. Martin, K. Catalano, and J. Cohn. 2019. Where are self-driving cars taking us?

44 Huang, Y, M. Kockelman, and N. Quarles. 2020. How will self-driving vehicles affect U.S. megaregion traffic?

45 U.S. Energy Information Administration. 2017. Study of the potential energy consumption impacts of connected and automated vehicles.

46 Reuters. January 5, 2021. U.S. factory activity approaches 2-1/2-year high; COVID-19 hitting supply chains.

47 Winkler, Nick. September 10, 2019. Direct to consumer vs wholesale: Customer experience over competition.

48 eMarketer. 2020. US direct-to-consumer ecommerce sales will rise to nearly $18 billion in 2020. ***https://www.emarketer.com/newsroom/index.php/us-direct-to-consumer-ecommerce-sales-will-rise-to-nearly-18-billion-in-2020/.***

49 Wohlers Report 2020, Wohlers Associates, quoted in Forbes, 5/20.

50 AT Kearney. 2017. 3D Printing and the Future of the US Economy.

51 El Hamdani, S. June 2018. Autonomous traffic management: Open issues and new directions; Conference Paper.

52 US Market Flash Warehouse Demand to Grow with Rising E-commerce Sales (CBRE).

53 Estimated using the Institute of Transportation Engineers standard warehousing truck trip generation rate of 0.6 trucks per 1,000 square feet. It is important to note that the development of more trip-intensive cold storage and use of less-than-truckload for delivery could result in a larger number of trips.

54 Automated Trucks The next big disruptor in the automotive industry?

55 ***https://www.ncdc.noaa.gov/climate-information/climate-change-and-variability.***

56 Jay, A., D.R. Reidmiller, C.W. Avery, D. Barrie, B.J. DeAngelo, A. Dave, M. Dzaugis, M. Kolian, K.L.M. Lewis, K. Reeves, and D. Winner, 2018: Overview. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 33–71. doi: 10.7930/NCA4.2018.CH1.

57 Michael Culp, U.S. Department of Transportation Jennifer M. Jacobs, University of New Hampshire Lia Cattaneo, Harvard University (formerly U.S. Department of Transportation) Paul Chinowsky, University of Colorado Boulder, Anne Choate, ICF, Susanne DesRoches, New York City Mayor's Office of Recovery and Resiliency and Office of Sustainability Scott Douglass, South Coast Engineers Rawlings Miller, WSP. (n.d.). Fourth national climate assessment: Chapter 12: Transportation. Retrieved from ***https://nca2018.globalchange.gov/chapter/12/.***

58 MTA Regional Bus Operations Bus Fleet. Wikipedia. Web. ***https://en.wikipedia.org/wiki/MTA_Regional_Bus_Operations_bus_fleet***; Austin Considine. May 21, 2006. Is That a Tinge of Green on New York's Yellow Cabs? The New York Times. ***http://www.nytimes.com/2006/05/21/automobiles/21TAXI.html?scp=8&sq=hybrid%20taxis%20new%20york%20city%20-harlem&st=cse.***

59 *Alternative fuels data center: Data downloads*. (2021, February 3). ***https://afdc.energy.gov/data_download.***

60 New York State Energy Research and Development Authority. October 2, 2015. ChargeNY. ***https://www.nyserda.ny.gov/All-Programs/Programs/ChargeNY.***

61 U.S. Census Bureau. 2018. Population 65 years and over in the United States: 2013-2018 ACS 5-Year Estimates.

62 AARP. 2013. The benefits of public transportation options in an aging society. ***http://www.aarp.org/content/dam/aarp/livable-communities/old-learn/transportation/benefits-of-public-transportation-aarp.pdf.***

63 Lynott, Jana, and Carlos Figueiredo. How the travel patterns of older adults are changing: Highlights from the 2009 National Household Travel Survey. AARP. Apr. 2011. Web. Mar.2016. ***http://www.aarp.org/home-garden/transportation/info-04-2011/fs218-transportation.html.***

64 U.S. Department of Transportation Federal Highway Administration. September 11, 2019. *Highway statistics 2018 - Policy | Federal highway administration*. Section 6 – Travelers. ***https://www.fhwa.dot.gov/policyinformation/statistics/2018/.***

65 Dutzik, Tony, Madsen, Travis, Baxandall, Phineas. October 2014. Millennials in motion: Changing travel habits of young Americans and the implications for public policy. U.S. PIRG Education Fund, Frontier Group. ***http://uspirg.org/sites/pirg/files/reports/Millennials%20in%20Motion%20USPIRG.pdf.***

66 Urban Land Institute. 2013. America in 2013: A ULI Survey on Housing, Transportation and Community: Appendix A. ***http://uli.org/wp-content/uploads/ULI-Documents/America_in_2013_web.pdf.***

67 Knittel, C.R., and E. Murphy. 2019. *Generational trends in vehicle ownership and use: Are millennials any different?*

68 Cohen, Kathleen. 2019. Human behavior and new mobility trends in the United States, Europe, and China, Working Paper, No. 024. 2019, Fondazione Eni Enrico Mattei (FEEM), Milano ***https://www.econstor.eu/bitstream/10419/211183/1/ndl2019-024.pdf.***

69 Allison+ Partners. 2019. The birth of mobility culture technology's influence on how we get from here to there. ***https://www.allisonpr.com/insights/the-birth-of-mobility-culture.html.***

70 World Economic Forum. 2018. *Insight Report Centre The Future of Jobs Report 2018*. ***https://www.weforum.org/reports/the-future-of-jobs-report-2018***.

71 Litman, Todd and Rowan Steele. August 2015. Land use impacts on transport: How land use factors affect travel behavior. Victoria Transportation Policy Institute. ***http://www.vtpi.org/landtravel.pdf***.

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.

4.2.1 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.

4.2.2 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.

4.2.3 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

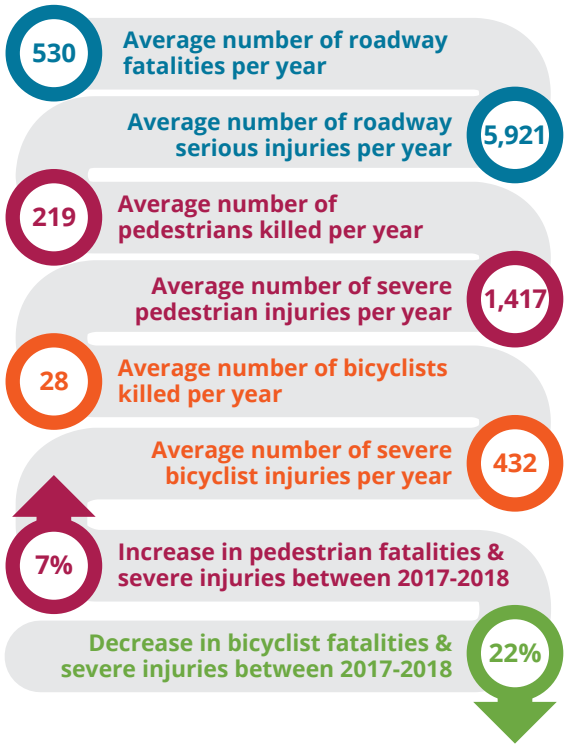
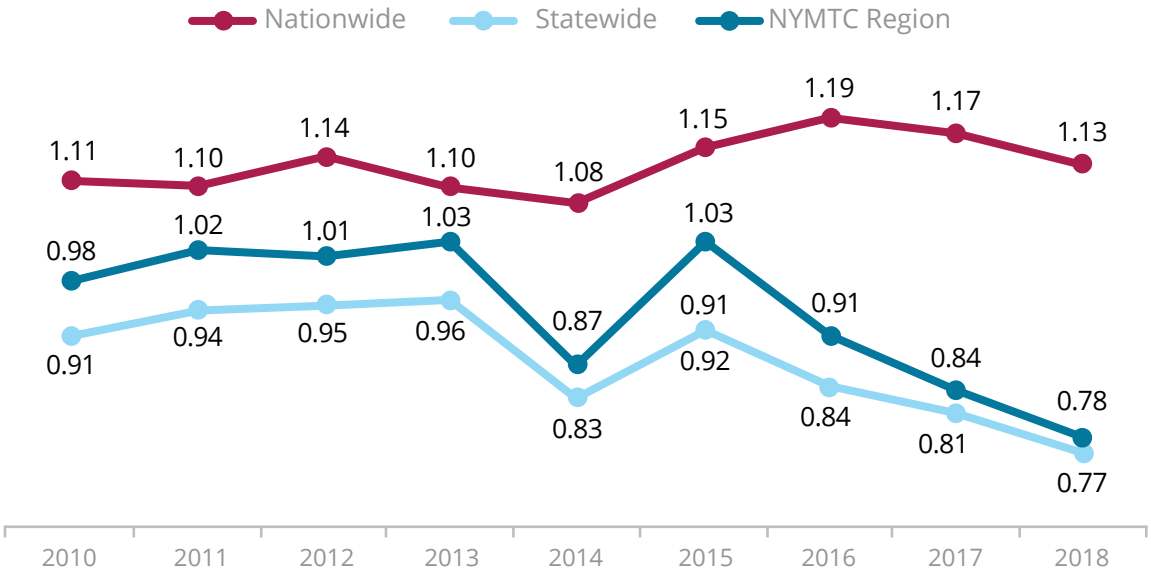


Figure 4-2

Motor Vehicle Fatalities (per 100 Million VMT)

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



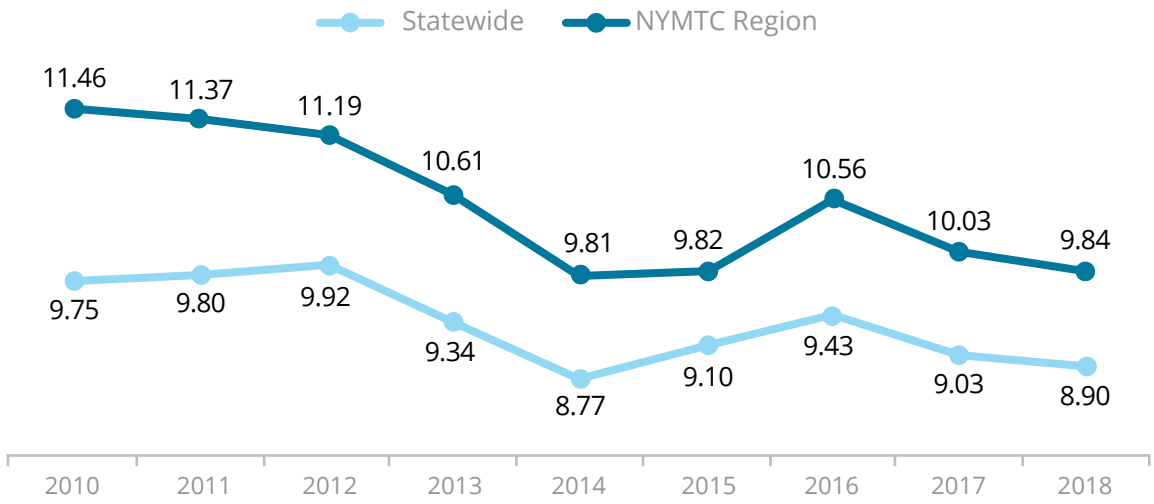
In New York City, there was a 1.2 percent decrease in serious injuries between 2017 and 2018, while Long Island saw a 2.7 percent decrease, and the Lower Hudson Valley saw a 1.8 percent increase. Overall, in the NYMTC planning, serious injuries from motor vehicle crashes decreased by 1.2 percent from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

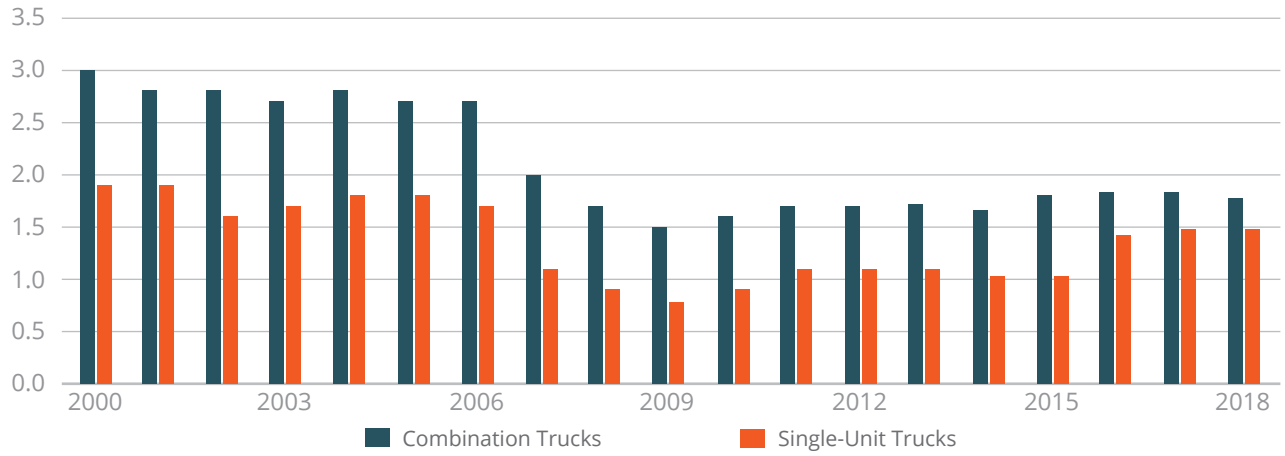
Chapter 4 of Appendix H, the Regional Freight Element, provides a detailed description of goods movement infrastructure in the NYMTC planning area. A subset of the NYMTC planning area's roadway network, identified as "strategic freight highways," is of particular importance to freight movement. Strategic 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.

4.2.4 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.

4.2.5 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 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).

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.

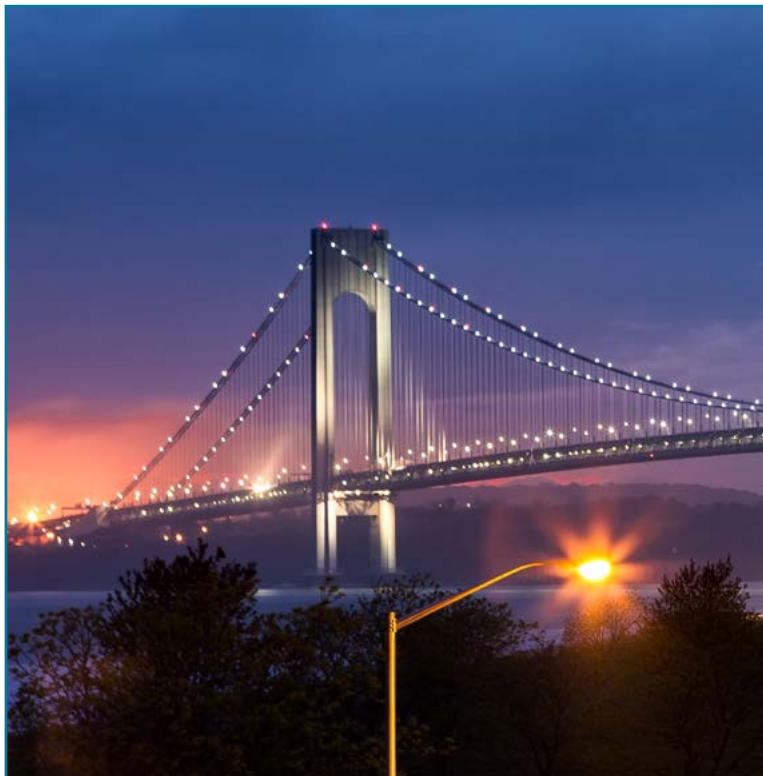
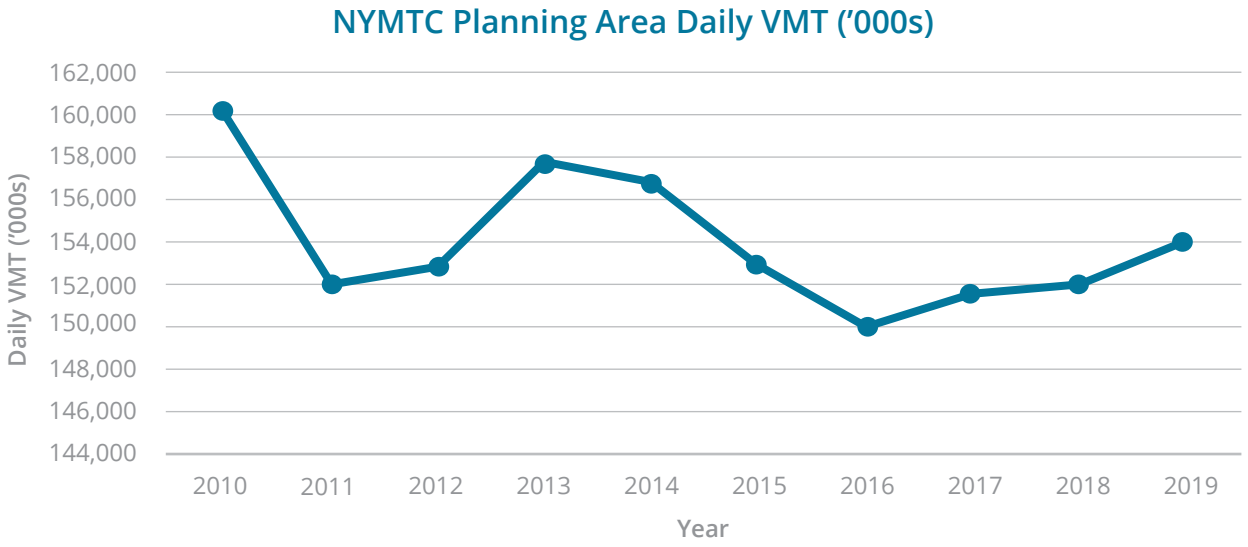


Figure 4-5

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* report[6] 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

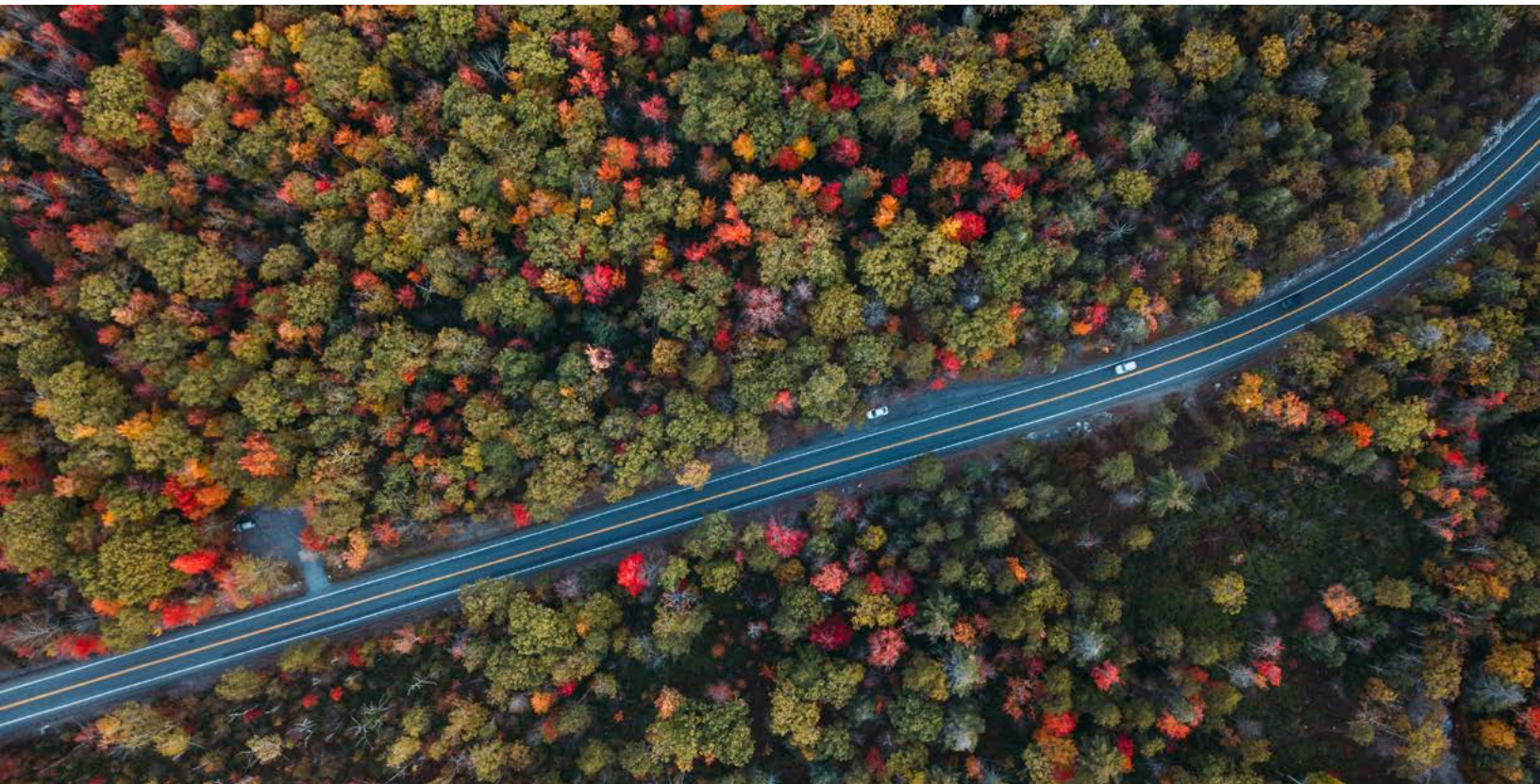
Like other metropolitan areas, public transportation access for all populations is also a challenge in the NYMTC planning area. In some areas, gaps in services may affect minority and low-income populations; in other cases, options for people with disabilities may be limited. These issues are further 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."[7]



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.

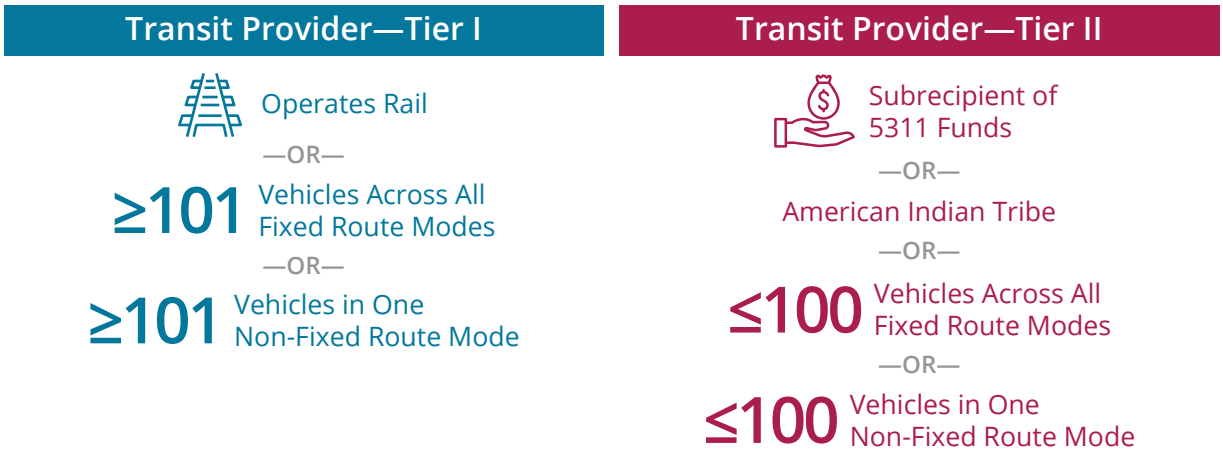
ASSET MANAGEMENT PLANS

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.

TRANSPORTATION SYSTEM MANAGEMENT AND OPERATIONS

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

Transit Strategies

- Fixed Route Bus Transit Improvements
- On-Demand Transit
- Bus Rapid Transit
- Transit Signal Priority
- Transit Vehicle Tracking
- Park & Ride

Roadway Strategies

- Traffic Signal Coordination
- Adaptive Signal Control
- Access Management
- Arterial Geometric Modifications
- Traffic Signal Retiming
- Traffic Management Centers
- Ramp Metering
- Work Zone Management
- Electronic Toll Collection
- Reversible Lanes
- Roadway Incident & Emergency Management Operations

Transportation Demand Management

- Traveler Information
- Carpooling & Vanpooling
- Telecommuting
- Flexible Work Schedules
- Carsharing
- Transportation Network Companies
- Parking Pricing
- Transit-Oriented Development
- Guaranteed Ride Home

Bicycle & Pedestrian Strategies

- Bicycle & Pedestrian Facility Improvements
- Bicycle Parking Facilities
- Bike Sharing
- Crosswalks with Crossing Islands

Transportation Demand Management Strategies

- Traveler Information
- Carpooling & Vanpooling
- Telecommuting
- Flexible Work Schedules
- Carsharing
- Transportation Network Companies
- Parking Pricing
- Transit-Oriented Development
- Guaranteed Ride Home

Freight Strategies

- Truck Lane Restrictions
- Grade Crossing

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.** TTTR 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 GASES[17]

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.

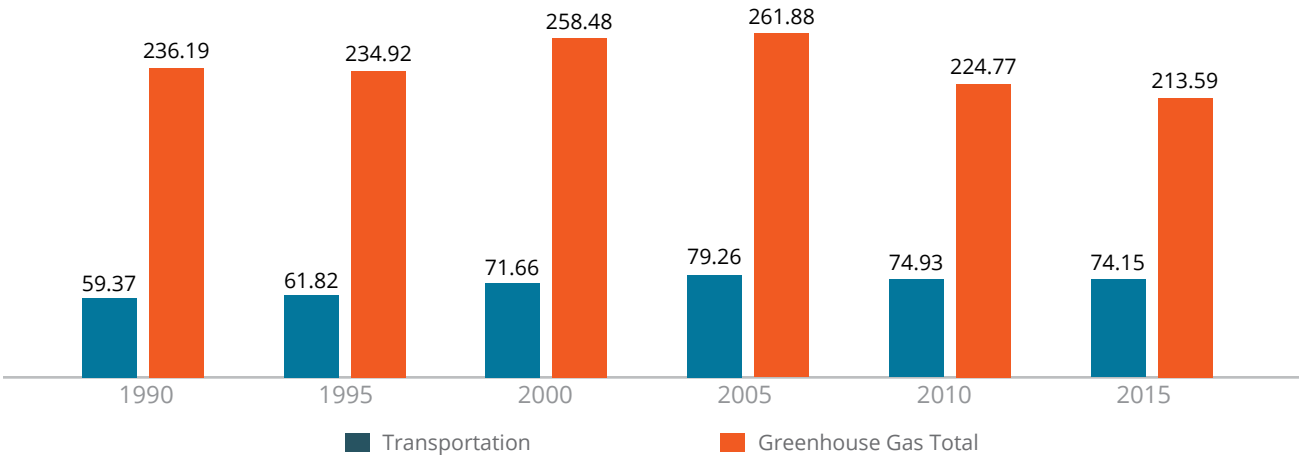
The largest contributor of all greenhouse gas emissions in New York State is vehicle fuel combustion in the transportation sector (36 percent) followed closely by on-site combustion in the residential, commercial, and industrial sectors (30 percent). Fuel combustion for electricity generation (including 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

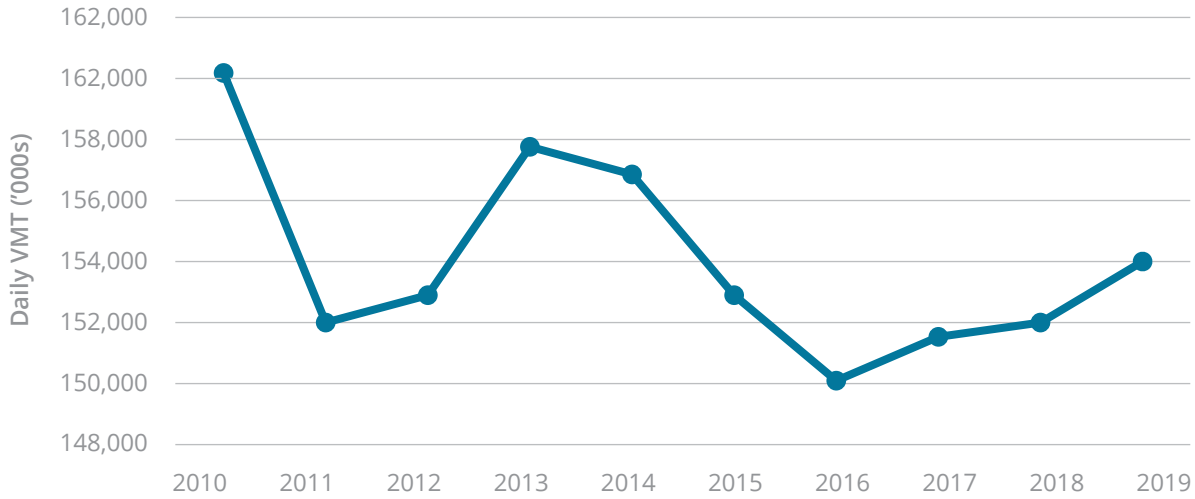
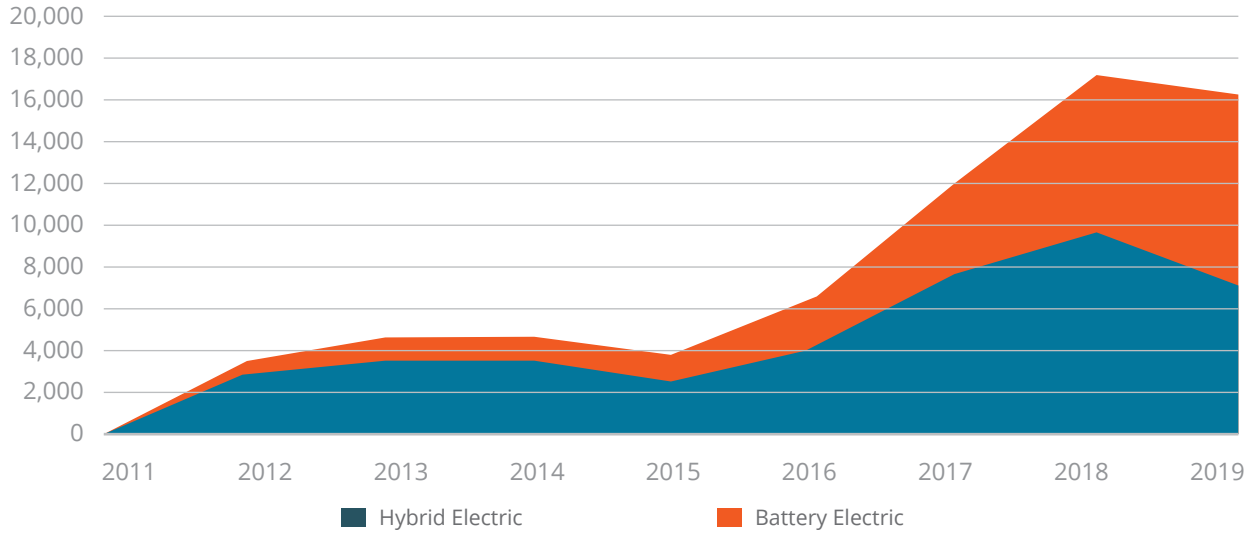


Figure 4-10

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

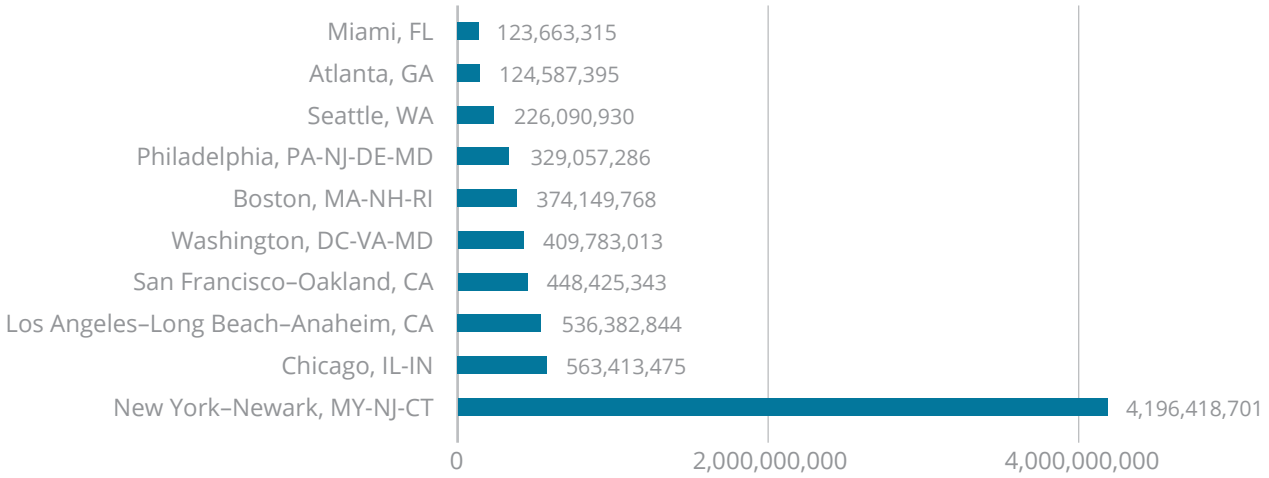
NYMTC's planning area features an extensive system of rapid transit, commuter rail transit, and bus transit provided by MTA, PATH, NJ Transit, Connecticut Transit, NYSDOT, and five suburban counties. These transit services increase the efficiency of the transportation system by providing an effective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



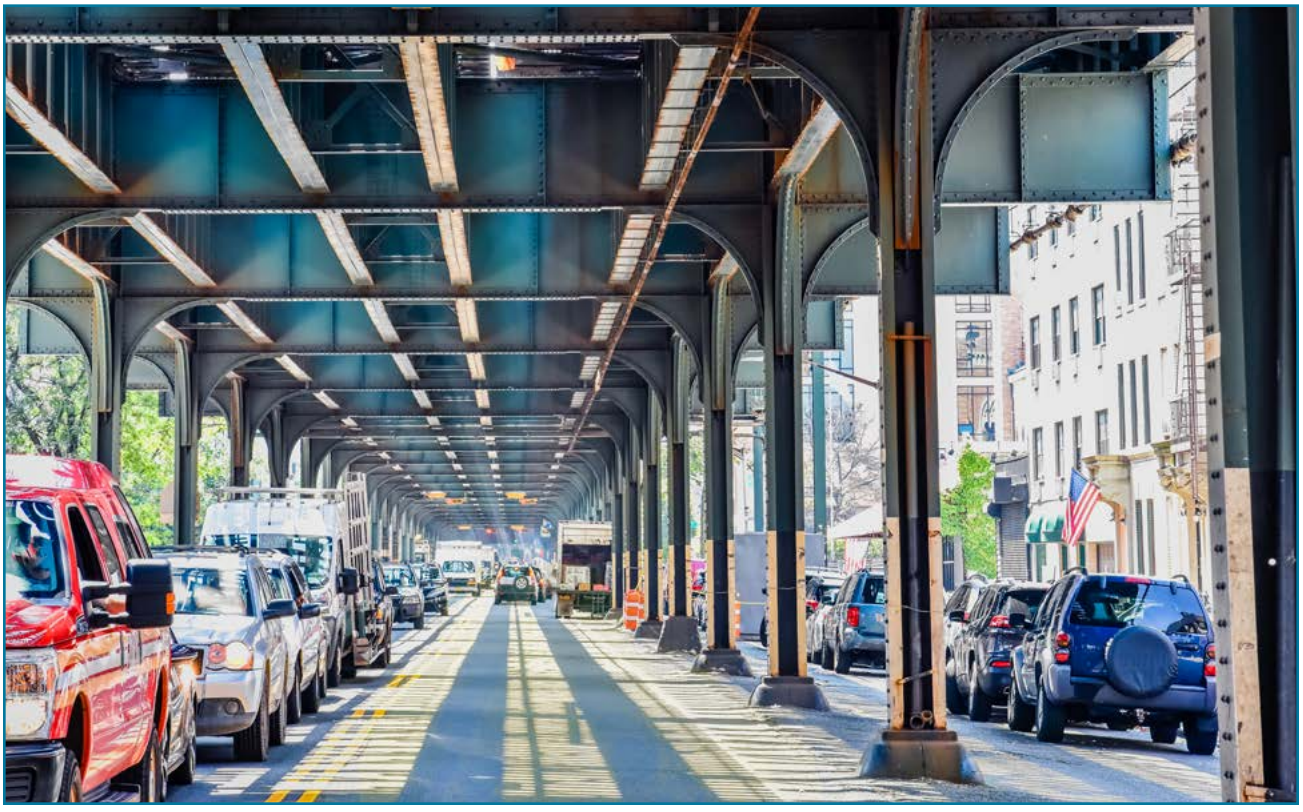
THE EMERGENCE OF SHARED MOBILITY AND MICROMOBILITY

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 scrappage 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 OPTIONS[27]

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 STRESSORS[28]

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.

ENDNOTES

1 Ghosh, S. February 2009. Scooters for Sustainable Suburbs. Medium Transportation.

2 NYSDOT. 2010. *New York State Strategic Highway Safety Plan*. ***https://www.dot.ny.gov/divisions/operating/osss/highway-repository/SHSP%202010%20Final.pdf.***

3 New York City Vision Zero website.

4 NYSDOT website.

5 Booz & Company. December 6, 2013. "The Benefits of Simplified and Integrated Ticketing in Public Transport" and Nir Sharaby and Yoram Shiftan. "The Impact of Fare Integration on Travel Behavior and Transit Ridership." *Transport Policy* Vol. 21, pp. 63–70.

6 City of New York. 2020. Where We Live NYC: Fair Housing Together. ***https://www1.nyc.gov/assets/hpd/downloads/pdfs/wwl-plan.pdf.***

7 NYMTC. February 2018. Westchester County BEE-Line System First and Last Mile Connections Mobility Study. ***https://transportation.westchestergov.com/images/stories/pdfs/FirstLastMileFinalRptRev.pdf.***

8 USDOT FHWA. "Transit Asset Management: Top 12 Frequently Asked Questions." ***https://www.transit.dot.gov/TAM/gettingstarted/htmlFAQs.***

9 MTA. Fast Forward: The Plan to Modernize New York City Transit. ***https://fastforward.mta.info/.***

10 INRIX. 2019. *Traffic Scorecard Report for New York City*. ***https://inrix.com/scorecard-city/?city=New%20York%20City%2C%20NY&index=14.***

11 U.S. Census Bureau. American Community Survey. Five-Year Estimates Subject Tables. ***https://data.census.gov/cedsci/table?q=S0802&t=Commuting&tid=ACSST5Y2018.S0801&hidePreview=false.***

12 NYMTC SED Forecasts.

13 Mobility Performance Metrics (MPM) for Integrated Mobility and Beyond; Federal Transit Administration Research; February 2020.

14 USEPA. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2018. ***https://www.epa.gov/sites/production/files/2020-04/documents/us-ghg-inventory-1990-2018-data-highlights.pdf.***

15 USEPA website.

16 NYSDEC website.

17 NYSERDA. July 2019. New York State Greenhouse Gas Inventory: 1990–2016. Final Report.

18 New York State website.

19 U.S. Department of Energy Clean Cities website.

20 Greater Long Island Clean Cities Coalition website.

21 Empire Clean Cities website.

22 New York State Energy Research and Development Authority website.

23 New York State Energy Research and Development Authority website.

24 NYCDOT website.

25 Port Authority fact sheet.

26 Northeast Diesel Collaborative website.

27 FHWA. October 2017. Post-Hurricane Sandy Transportation Resilience Study of New York, New Jersey and Connecticut, Federal Highway Administration.

28 FHWA. October 2017. Post-Hurricane Sandy Transportation Resilience Study of New York, New Jersey and Connecticut, Federal Highway Administration.

29 USDOT fact sheet.

30 Homeland Security News Wire. March 25, 2016.

31 American Journal of Managed Care website.

32 Bushman D, Alroy KA, Greene SK, et al. Detection and Genetic Characterization of Community-Based SARS-CoV-2 Infections — New York City, March 2020. MMWR Morb Mortal Wkly Rep 2020;69:918–922. DOI: ***http://dx.doi.org/10.15585/mmwr.mm6928a5***.

33 New York State website.

34 NYC Special Initiative for Rebuilding and Resiliency. June 2013. "A Stronger, More Resilient New York." Chapter 10, Transportation.

35 Mineta Transportation Institute. September 2001. Protecting Public Surface Transportation Against Terrorism and Serious Crime: Continuing Research on Best Security Practices.

36 Holland & Knight LLP, JD Supra website, June 3, 2019.

37 Centers for Disease Control and Prevention. October 2018. Public Health Emergency Preparedness and Response Capabilities: National Standards for State, Local, Tribal, and Territorial Public Health.

38 USDOT website.

39 NYSDOH website.

5 OUR PLAN TO PAY FOR THE PLAN

5.1 INTRODUCTION

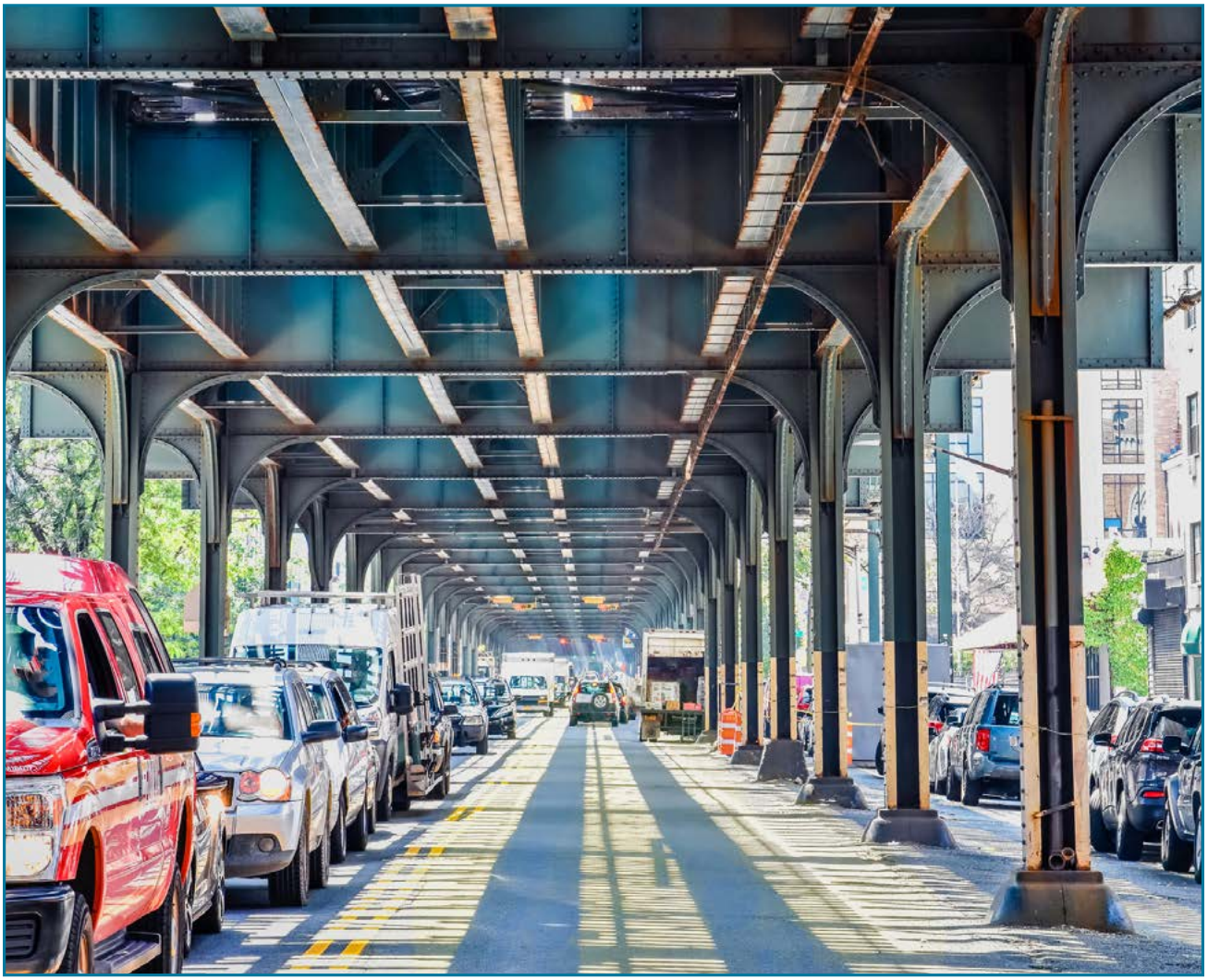
*The purpose of this chapter is to demonstrate how the federal requirements for fiscal constraint are met and how **Moving Forward** can be implemented. Federal regulations require that the financial plan include the following:*

- System-level estimates of the costs and revenues reasonably expected to be available to adequately operate and maintain federal-aid highways and public transportation;
- Estimates of funds that will be available for the implementation of the Plan; and
- Additional financing strategies for the implementation of the Plan.

5.1.1 FINANCIAL PLANNING REQUIREMENTS

At the time of this writing, the current federal legislation that authorizes federal aid to highway and transit programs through September 2021 maintains the pre-existing financial planning requirements, which apply to *Moving Forward*. According to 23 CFR 450.324, *Moving Forward* is required to contain the following:

> *(11) A financial plan that demonstrates how the adopted transportation plan can be implemented.*
>
> *(i) For purposes of transportation system operations and maintenance, the financial plan shall contain system-level estimates of costs and revenue sources that are reasonably expected to be available to adequately operate and maintain the Federal-aid highways (as defined by 23 U.S.C. 101(a)(5)) and public transportation (as defined by title 49 U.S.C. Chapter 53).*
>
> *(ii) For the purpose of developing the metropolitan transportation plan, the MPO(s), public transportation operator(s), and State shall cooperatively develop estimates of funds that will be available to support metropolitan transportation plan implementation, as required under §450.314(a). All necessary financial resources from public and private sources that are reasonably expected to be made available to carry out the transportation plan shall be identified.*
>
> *(iii) The financial plan shall include recommendations on any additional financing strategies to fund projects and programs included in the metropolitan transportation plan. In the case of new funding sources, strategies for ensuring their availability shall be identified. The financial plan may include an assessment of the appropriateness of innovative finance techniques (for example, tolling, pricing, bonding, public private partnerships, or other strategies) as revenue sources for projects in the plan.*
>
> *(iv) In developing the financial plan, the MPO shall take into account all projects and strategies proposed for funding under title 23 U.S.C., title 49 U.S.C. Chapter 53 or with other Federal funds; State assistance; local sources; and private participation. Revenue and cost estimates that support the metropolitan transportation plan must use an inflation rate(s) to reflect "year of expenditure dollars," based on reasonable financial principles and information, developed cooperatively by the MPO, State(s), and public transportation operator(s).*
>
> *(v) For the outer years of the metropolitan transportation plan (i.e., beyond the first 10 years), the financial plan may reflect aggregate cost ranges/cost bands, as long as the future funding source(s) is reasonably expected to be available to support the projected cost ranges/cost bands.*
>
> *(vi) For nonattainment and maintenance areas, the financial plan shall address the specific financial strategies required to ensure the implementation of TCMs in the applicable SIP.*
>
> *(vii) For illustrative purposes, the financial plan may include additional projects that would be included in the adopted transportation plan if additional resources beyond those identified in the financial plan were to become available.*
>
> *(viii) In cases that the FHWA and the FTA find a metropolitan transportation plan to be fiscally constrained and a revenue source is subsequently removed or substantially reduced (i.e., by legislative or administrative actions), the FHWA and the FTA will not withdraw the original determination of fiscal constraint; however, in such cases, the FHWA and the FTA will not act on an updated or amended metropolitan transportation plan that does not reflect the changed revenue situation.*



5.1.2 COST AND REVENUE CATEGORIES

In keeping with the federal financial planning requirements, *Moving Forward's* financial chapter is built around the following activity categories:

1. **Operations and Maintenance (O&M).** This chapter contains current systems-level estimates of costs and revenues for O&M that are reasonably expected to be available to operate and maintain the federally supported transportation system as defined by federal legislation [23 U.S.C. 101 (a)(6) and 49 U.S.C. Chapter 53].
2. **System Preservation** is broadly defined as costs related to the life-cycle replacement, refurbishment, rehabilitation, reconditioning, or reconstruction of components of the federally supported transportation system (i.e., equipment and facilities).
3. **System Enhancement** refers to extensions and/or improvements to the existing transportation system or new segments or services added to the transportation system to improve capacity and/or throughput.

5.1.3 KEY STEPS IN THE DEVELOPMENT OF FINANCIAL FORECASTS

The costs and revenue forecasts associated with transportation-related projects in *Moving Forward* have been developed using the multi-step process outlined below:

1. **Defining the Federally Supported Transportation System.** The transportation system that moves people and goods in the NYMTC planning area is a complex network of services and facilities under a variety of jurisdictions. Some of these facilities are operated and maintained by fiscally self-supporting public authorities that generally do not access federal transportation funding. Others are owned and operated by local municipalities and not federal-aid eligible.

   Given these distinctions, this chapter first defines the federal-aid eligible (i.e., federally supported) portions of the transportation system as a basis for forecasting the long-range costs and resources. The federally supported component is a subset of the overall transportation network in NYMTC's planning area. This chapter assumes that the fiscal needs of those system components owned, operated, and maintained by self-financed public authorities (described below) and local municipalities are met by those authorities and municipalities as demonstrated in their board/council-approved capital and operating budgets, plans, and programs.

2. **Inventorying System Components.** The condition of the facilities and equipment that are determined to be part of the federally supported transportation system have been inventoried as a step toward defining long-term system preservation needs. Note that this includes existing system components and any planned future components that appear in the fiscally constrained element of the Plan.

3. **Forecasting Costs.** Based on the inventory of the federally supported transportation system components, forecasts of O&M, system preservation, and system enhancements costs were developed through the Plan's horizon year. The forecasts are aggregated modally for roadways (including pavements, bridges, and non-motorized facilities) and transit (including facilities and equipment).

4. **Forecasting Revenues.** Resources that are reasonably expected to be available from all sources to support the Plan's implementation are forecasted through the Plan's horizon year.

5.1.4 CAUTIONS IN FORECASTING LONG-RANGE COSTS AND REVENUES

Forecasting costs and revenues over such a long period presents risks and significant challenges for New York State and for NYMTC. For example, forecasting federal resources is complicated by the perennial threat to the financial solvency of the Highway Trust Fund, which partially supports federal highway and transit programs. Additionally, the COVID-19 pandemic has introduced unpredictable potential impacts during the initial years of the Plan. Taken together, these factors introduce a level of risk and uncertainty into long-range resource and cost forecasts.

5.2 SYSTEM-LEVEL ESTIMATES OF COSTS AND REVENUE SOURCES

Federal Regulatory Language: *For purposes of transportation system operations and maintenance, the financial plan shall contain system-level estimates of costs and revenue sources that are reasonably expected to be available to adequately operate and maintain the Federal-aid highways (as defined by 23 U.S.C. 101(a)(5)) and public transportation (as defined by title 49 U.S.C. Chapter 53).*

5.2.1 THE FEDERALLY SUPPORTED TRANSPORTATION SYSTEM

In ***Chapter 2***, *Moving Forward* presents an inventory of the various components of the transportation system in NYMTC's planning area. As noted in Chapter 2, the multi-state metropolitan area has one of the oldest, most complex, and highly used transportation networks in the world. On a typical weekday in 2019, the region's multimodal transportation network handled more than five million passenger trips and thousands of tons of freight shipments. Notably, public transit mode share on this network is the highest in the United States, accounting for nearly 40 percent of all transit trips taken in the country, which is a testament to the scale of the public transit components of the network.

The federally supported transportation system is a subset of this overall transportation network that is defined through federal-aid eligibility.

Transportation system components that fall within this threshold are eligible for federal funding and/or require a federal action to proceed. ***Table 5-1*** provides details of the general parameters of the federally supported transportation system.

Local roadways that are not part of the federal-aid highway system and whose costs are borne by the locality, regardless of ownership, are not included in the federally supported system. Similarly, any transportation system components that are financed exclusively with non-federal funds through state, local, or private means are not included in the federally supported system, regardless of eligibility.

In the NYMTC planning area, five self-financed public authorities have jurisdiction over significant system components that are not considered part of the federally supported system. Brief descriptions of these five authorities and the system components that are under their jurisdictions are provided below.

Table 5-1

Major Parameters of the Federally Supported Transportation System

More than 19,000 lane miles of interstates, freeways, parkways, expressways, arterial and collector roadways.
More than 2,400 roadway bridges of all types under the ownership of the state, counties and local municipalities.
Nearly 1,300 track miles of commuter rail and 665 mainline track miles of subway tracks in passenger service, plus hundreds of miles of local, express, commuter, and intercity bus routes and an aerial tramway.
An extensive network of passenger hubs, transit stations and stops, bus terminals and subway transfer facilities, ferry landings, and bus stops.
More than 1,300 miles of bicycle facilities, ranging from shared-use bike trails to on-road bike lanes, in addition to pedestrian sidewalks, trails, and paths.
Supporting infrastructure such as rail yards and highway maintenance facilities, highway rest areas, parking lots and garages, bus depots and transit storage yards, bicycle parking areas, toll plazas, signage, signals, electronics, and other equipment.

- **Port Authority** infrastructure assets include the George Washington Bridge and Bus Station; the Lincoln and Holland tunnels; the Bayonne Bridge, Goethals Bridge and Outerbridge Crossing; the Port Authority Bus Terminal in midtown Manhattan; the PATH rapid-transit system and World Trade Center transportation hub; rail freight and car float operations, and the World Financial Center Ferry Terminal. In addition, the Port Authority has taken the lead in financing infrastructure at its airports (JFK, LaGuardia, Newark-Liberty, and Stewart) and marine terminals, including on-dock rail freight service at the container terminals and the Air-Train-JFK and AirTrain-Newark transit links.
- **MTA Bridges and Tunnels** (legally, the Triborough Bridge and Tunnel Authority) is one of the component operating authorities of the MTA. MTA Bridges and Tunnels operates seven bridges (the Robert F. Kennedy, Throgs Neck, Verrazzano-Narrows, Bronx-Whitestone, Henry Hudson, Marine Parkway-Gil Hodges Memorial, and Cross Bay Veterans Memorial) and two tunnels (Hugh L. Carey Tunnel and the Queens-Midtown Tunnel) that connect the five boroughs of New York City over and under various waterbodies. The other operating authorities that compose MTA (i.e., MTA NYCT, MTA MNR, MTA LIRR, MTA Staten Island Railway, and MTA Bus) operate facilities and services that are defined as part of the federally supported transportation system. In addition to funding the operating and capital budgets of MTA Bridges and Tunnels, toll revenue from MTA Bridges and Tunnels helps support other MTA-operated transit services.
- The **New York State Thruway Authority** operates the New York State Thruway (I-87), the New England Thruway (I-95), and the Cross Westchester Expressway (I-287) within the NYMTC planning area; it also operates the Governor Mario M. Cuomo Bridge, which carries the New York State Thruway over the Hudson River between Westchester and Rockland counties.
- The **New York State Bridge Authority** operates the Bear Mountain Bridge that carries U.S. 202 and U.S. 6 over the Hudson River between the northern portions of Westchester and Rockland counties.
- The **Nassau County Bridge Authority** operates the Atlantic Beach Bridge that connects the Nassau Expressway with Atlantic Beach across the Reynolds Channel.

Other transportation facility owners and services that are not included in the financial forecasts for the federally supported transportation system are described below.

- The **National Railroad Passenger Corporation**, otherwise known as Amtrak, provides intercity rail services in the NYMTC planning area but does not program its federally funded projects through NYMTC's metropolitan transportation planning process. Amtrak owns Penn Station and the newly opened Moynihan Train Hall, as well as the trans-Hudson rail tunnels accessing Penn Station.

- **NJ Transit** and **Connecticut Transit** are public benefit corporations operating transit services in the states of New Jersey and Connecticut; they provide services that terminate in Manhattan and in the City of White Plains in Westchester County. Although these carriers are eligible for and make use of federal transportation funding through other MPOs, they do not program federally funded projects through NYMTC's metropolitan transportation planning process.
- Privately owned and operated ferry systems, rail freight systems, and intercity and interstate bus systems that provide services in the NYMTC planning area.
- Suburban municipalities that have jurisdiction over roadways and/or bridges within their jurisdictions.

5.2.2 COST AND RESOURCE FORECASTS

System-level forecasts of costs to operate and maintain infrastructure and services are based on the current operating budgets of NYMTC's member agencies, as well as any longer-range operational plans they maintain. Entities generally have annual operating budgets approved by their respective legislatures or boards, while a capital program may have a longer term. New York State and local municipal sponsors have historically demonstrated both a commitment and track record to match federal capital funding and provide enough funds to balance operating budgets. The O&M costs of system enhancements are included in these estimates in cases where planned enhancements add new components to the system. System enhancements that are included in the fiscally constrained element of the Plan are described in detail in subsequent sections of this chapter.

O&M COST FORECAST

More than $906 billion in year of expenditure (YOE) dollars (an average of $31 billion per year) will likely be needed through the 2050 horizon year to operate and maintain the federally supported transportation system. These O&M cost forecasts are detailed in ***Table 5-2***. ***Figures 5-1*** and ***5-2*** provide a modal and agency breakdown of these projected O&M costs for the federally supported transportation system. Roughly 95 percent of the NYMTC planning area's forecasted O&M costs are related to the operation of transit services.

Table 5-2

Projected O&M Costs
(in millions of YOE dollars)

Owner	Category	Forecast	Inflation Factor
MTA	Transit	$ 837,252.92	2.15%-2.25%
	Roadways	N/A	N/A
	Non-Motorized	N/A	N/A
MTA Total		**$ 837,252.92**	
Westchester	Transit	$ 7,144.75	2.5%
	Roadways	$ 232.39	2.2%
	Non-Motorized	In Roadways	
Rockland	Transit	$ 1,636.61	0.5%
	Roadways	$ 376.70	2.2%
	Non-Motorized	In Roadways	
Putnam	Transit	$ 76.98	2.2%
	Roadways	$ 245.51	2.2%
	Non-Motorized	$ 15.44	2.2%
Lower Hudson Valley Total		**$ 9,728.38**	
Nassau	Transit	$ 5,834.32	2.5%
	Roadways	$ 267.28	2.2%
	Non-Motorized	In Roadways	
Suffolk	Transit	$ 3,800.56	2.4%
	Roadways	$ 1,033.39	2.2%
	Non-Motorized	In Roadways	
Long Beach	Transit	$ 112.76	2.2%
	Roadways	In Nassau	
	Non-Motorized	In Nassau	
Long Island Total		**$ 11,048.31**	
New York City	Transit - NYC Ferries	$ 115.20	1.0% - 2.0%
	Transit - Staten Island Ferry	$ 4,952.75	1.1%
	Roadways	$ 24,425.60	2.0%
	Non-Motorized	In Roadways	
New York City Total		**$ 29,493.55**	
New York State	Transit	$ 483.73	2.5%
	Roadways	$ 18,037.12	2.2%
	Non-Motorized	In Roadways	
New York State Total		**$ 18,520.85**	
Total	Other Transit	$ 24,157.65	
	Transit Total	$ 861,410.58	
	Roadways	$ 44,617.99	
	Non-Motorized	$ 15.44	
	Roadways/Non-Motorized Total	$ 44,633.43	
	Grand Total	$ 906,044.01	

Figure 5-1

O&M Costs by Mode
Federally Supported Transportation System
(in millions of YOE dollars)

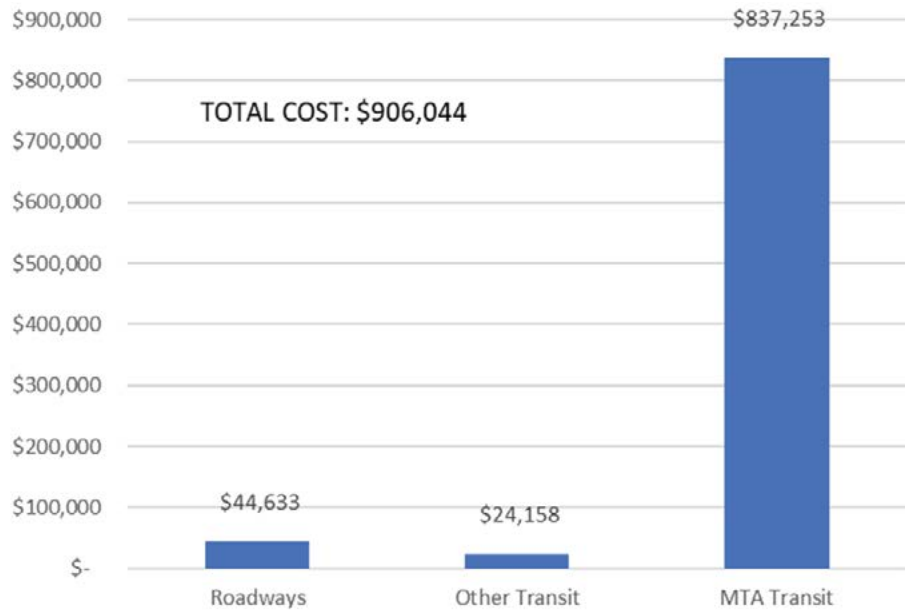
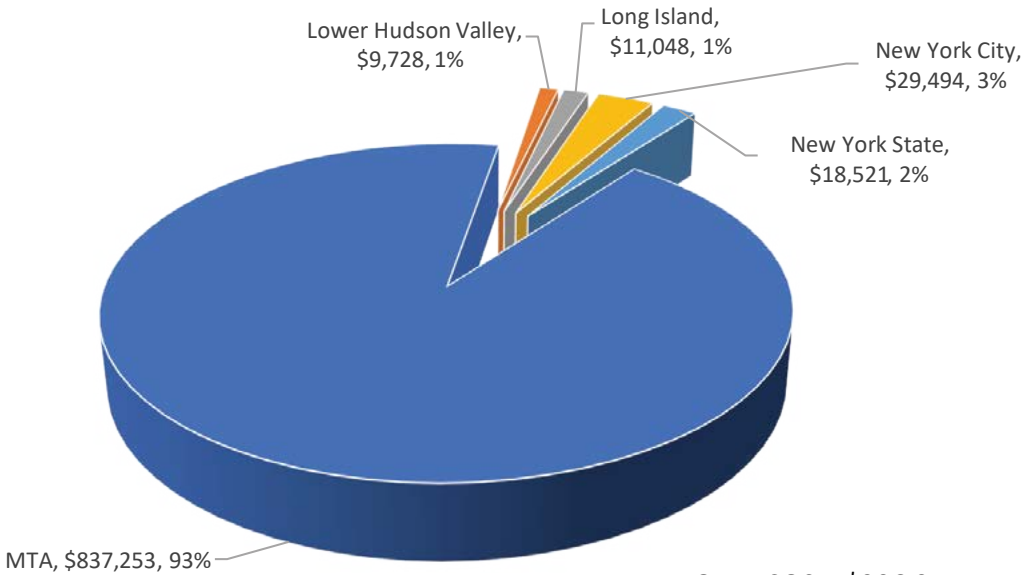


Figure 5-2

O&M Cost by Agency
Federally Supported Transportation System
(in millions of YOE dollars)



O&M REVENUE FORECAST

Forecasts of revenue sources that will be available to adequately operate and maintain the federally supported transportation system are based on revenues reasonably expected to be available from all sources. These funding sources were projected into the future using the assumptions of local tax receipts, user fees, and/or budget allocations that underlie the individual agency operating budgets. *Table 5-3* identifies the escalation rates that were employed, compounded annually.

Table 5-3

Projected O&M Revenues
(in millions of YOE dollars)

Owner	Category	Source	Forecast	Escalation Factor
MTA	Transit	Operating Revenue	$ 224,653.73	Average 0.360%
		Federal Formula	–	N/A
		Federal Discretionary/Other	–	N/A
		State/Local	$ 612,670.61	Varies
	Roadways	State/Local	–	N/A
Westchester	Transit	Operating Revenue	$ 1,431.05	0.0%
		Federal Formula	$ 757.57	See note
		Federal Discretionary/Other	$ 38.80	See note
		State/Local	$ 3,991.11	2.2%
	Roadways	State/Local	$ 216.76	2.0%
Rockland	Transit	Operating Revenue	$ 851.41	0.0%
		Federal Formula	$ 192.04	See note
		Federal Discretionary/Other	$ 6.28	See note
		State/Local	$ 764.81	2.2%
	Roadways	State/Local	$ 353.52	2.0%
Putnam	Transit	Operating Revenue	$ 2.65	0.0%
		Federal Formula	$ 13.88	See note
		Federal Discretionary/Other	$ 8.45	See note
		State/Local	$ 45.37	2.0%
	Roadways	State/Local	$ 188.14	2.2%
Nassau	Transit	Operating Revenue	$ 1,070.74	1.5% every 2 years
		Federal Formula	$ 370.06	See note
		Federal Discretionary/Other	–	N/A
		State/Local	$ 4,433.64	3.0%
	Roadways	State/Local	$ 228.67	2.2%
Suffolk	Transit	Operating Revenue	$ 238.63	0.0%
		Federal Formula	$ 95.36	See note
		Federal Discretionary/Other	$ 128.80	See note
		State/Local	$ 3,152.55	2.0%
	Roadways	State/Local	$ 512.88	2.2%
Long Beach	Transit	Operating Revenue	$ 10.84	0.0%
		Federal Formula	$ 6.61	See note
		Federal Discretionary/Other	–	N/A
		State/Local	$ 88.34	2.0%
	Roadways	State/Local	in Nassau	
New York City	Transit	Operating Revenue	$ 105.49	0.0%
		Federal Formula	$ 514.75	See note
		Federal Discretionary/Other	–	N/A
		State/Local	$ 5,147.12	2.0%
	Roadways	Federal Formula	$ 2,168.73	2.0%
		State/Local	$ 22,772.60	2.2%
New York State	Transit	State/Local	$ 483.73	2.5%
	Roadways	State/Local	$ 18,037.12	2.2%
Total	Transit Total	State/Local	$ 861,274.45	
	Roadways Total		$ 44,478.42	
	Grand Total		$ 905,752.87	

Note: Federal funds are forecast to increase 24.78% with each new authorization act every 6th years while remaining constant during each 5-year period.

State and Local Revenue Sources. Public authority and municipal operating budgets are assumed to address most of the O&M costs. *Figure 5-3* presents the forecasted O&M revenue that is detailed in *Table 5-3*.

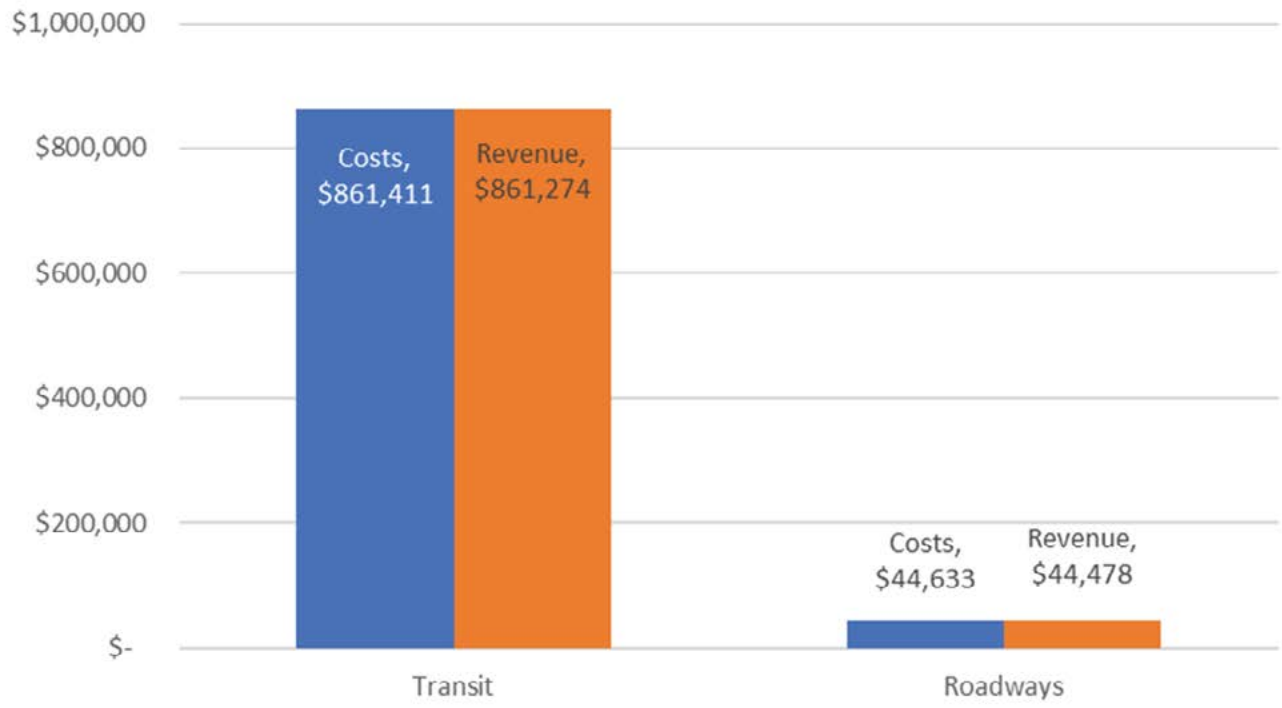
A forecast of roughly $906 billion in YOE dollars will be reasonably available through the 2050 horizon year for operating and maintaining the federally supported transportation system. Similar to O&M costs, more than 95 percent of the revenues are related to the operation and maintenance of transit services.

The projected revenue sources that can be reasonably expected to be available to NYMTC's members from all sources to address the forecasted O&M costs are within 0.3 percent the forecasted costs. This slight difference is due mainly to the budgeting practices and forecasting assumptions of the larger members, such as MTA and NYC DOT.

Through these forecasts, *Moving Forward* meets the federal regulatory requirement for a financial plan that contains system-level estimates of costs and revenue sources that are reasonably expected to be available to operate and maintain federal-aid highways (as defined by 23 U.S.C. 101(a)(6)) and public transportation (as defined by title 49 U.S.C. Chapter 53).

Figure 5-3

O&M Revenue Sources
Federally Supported Transportation System
(in millions of YOE dollars)



5.3 PROJECTS AND STRATEGIES PROPOSED FOR FUNDING

Federal Regulatory Language: *In developing the financial plan, the MPO shall take into account all projects and strategies proposed for funding under title 23 U.S.C., title 49 U.S.C. Chapter 53 or with other Federal funds; State assistance; local sources; and private participation. Revenue and cost estimates that support the metropolitan transportation plan must use an inflation rate(s) to reflect "year of expenditure dollars," based on reasonable financial principles and information, developed cooperatively by the MPO, State(s), and public transportation operator(s).*

The projects and strategies proposed for funding through *Moving Forward* fall into two broad categories:

- **System Preservation** includes project and program costs related to the life-cycle replacement, refurbishment, rehabilitation, reconditioning, or reconstruction of the components (i.e., equipment and facilities) of the federally supported transportation system under the jurisdiction of NYMTC's member agencies.
- **System Enhancements** include project and program costs related to the expansion of the federally supported system's capacity through the addition of new components or the significant expansion of the capacity of existing components to move, people, vehicles, and/or goods.

5.3.1 SYSTEM PRESERVATION

System preservation forecasts incorporate several regional and local assumptions and policies, such as pavement treatment costs and strategies as well as transit fleet life-cycle replacement cycles. The unit costs for the preservation of individual system components, such as lane miles of roadway or track miles of rail, are assumed to include costs of peripheral infrastructure, such as signage, lighting, and fencing.

Inflation rates are applied to unit cost estimates to represent YOE dollars, using either local inflation data for planning and programming estimates, or, in the absence of such data, applying a default inflation rates of 2.2 percent, compounded annually, to their cost estimates. These inflation rates were arrived at through a trend analysis of the Consumer Price Index.

Based on the forecasts of the member agencies' costs to preserve the various components of the federally supported transportation system under their jurisdiction (see ***Table 5-4*** for details), approximately $750 billion in YOE dollars ($26 billion annual average) in system preservation projects and strategies may need to be funded through the 2050 horizon year for this purpose. ***Figure 5-4*** provides a modal breakdown of these projected system preservation costs for the federally supported transportation system.

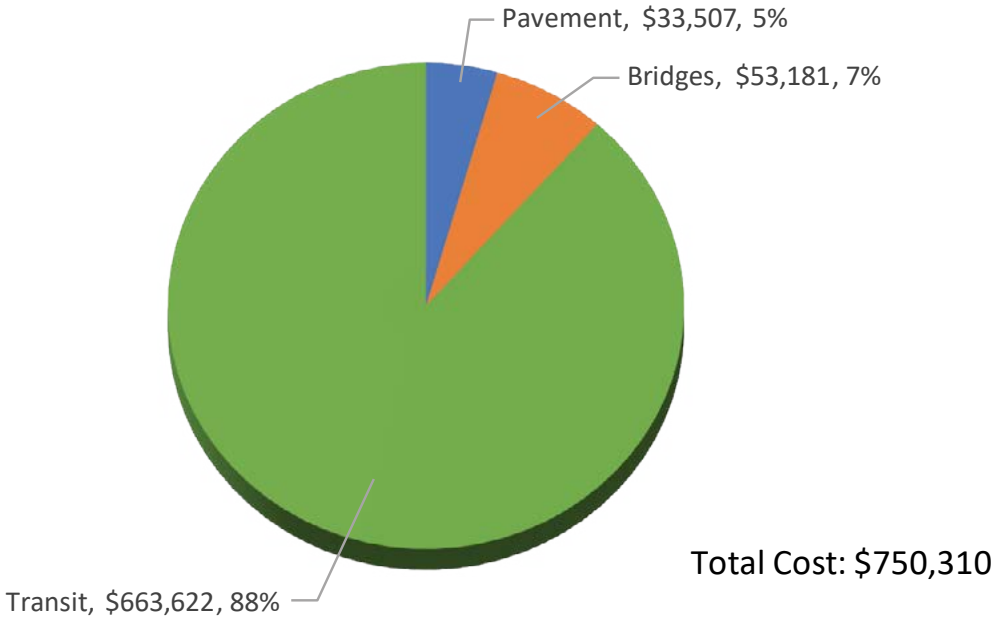
Table 5-4

Projected System Preservation Costs
(in millions of YOE dollars)

Category	Owner	System	2022-2026	2027-2031	2032-2036	2037-2041	2042-2046	2047-2050	TOTAL
Transit	MTA	MTA New York City Transit, MTA Bus Company, MTA LIRR, MTA MNR	$53,496.11	$75,481.35	$95,507.54	$123,598.36	$158,358.44	$147,781.77	$654,223.57
	New York City	NYC Ferry, Staten Island Ferry	$182.49	$446.98	$782.40	$1,116.63	$1,757.25	$1,743.58	$6,029.33
	Putnam	PART	$2.53	$3.03	$1.91	$3.47	$4.49	$1.45	$16.87
	Rockland	TOR, Clarkstown Mini-Trans, Rockland Coaches (Red & Tan), TRIPS Paratransit, Monsey Trails, Hudson Transit	$15.38	$37.92	$70.63	$9.44	$100.58	$17.64	$251.59
	Westchester	Bee-Line System	$351.61	$151.24	$402.89	$28.85	$739.33	$250.18	$1,924.10
	Nassau	NICE Bus	$72.77	$71.70	$182.57	$121.32	$175.88	$66.64	$690.88
	Long Beach	Long Beach Bus	$4.95	$1.65	$4.23	$4.59	$4.70	$4.79	$24.89
	Suffolk	Suffolk County Transit (SCT)	$45.16	$100.45	$66.20	$103.23	$103.92	$15.08	$434.03
	Huntington	HART	$2.05	$6.46	$5.05	$6.68	$4.49	$2.20	$26.94
Pavement			$4,378.57	$4,881.87	$5,443.03	$6,068.70	$6,766.28	$5,968.87	$33,507.32
Bridges			$6,949.41	$7,748.23	$8,638.87	$9,631.89	$10,739.06	$9,473.45	$53,180.91
Total		**Transit**	**$54,173.06**	**$76,300.77**	**$97,023.41**	**$124,992.56**	**$161,249.07**	**$149,883.32**	**$663,622.20**
		Roadways	**$11,327.98**	**$12,630.11**	**$14,081.91**	**$15,700.59**	**$17,505.34**	**$15,442.31**	**$86,688.24**
		Grand Total	**$65,501.04**	**$88,930.88**	**$111,105.32**	**$140,693.15**	**$178,754.41**	**$165,325.63**	**$750,310.44**

Figure 5-4

System Preservation Costs by Mode
Federally Supported Transportation System
(in millions of YOE dollars)



5.3.2 SYSTEM ENHANCEMENT

System enhancement includes forecasted costs related to projects and strategies proposed to be funded to expand the federally supported transportation system's capacity through the addition of new components or by significantly expanding the capacity of existing components. These include both major system enhancement projects—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. Generally, major system enhancement projects included in the fiscally constrained Plan and/or FFYs 2020–2024 TIP are derived from the Shared Vision described in ***Chapter 1***.

The system enhancement projects and strategies proposed for funding as part of the fiscally constrained Plan and FFYs 2020–2024 TIP are itemized in ***Table 5-5*** and total $49.6 billion in YOE dollars through the 2050 horizon year.

Table 5-5

Major System Enhancement Projects and Programs

No.	Plan ID#/PIN #	Category/Item	Funding category	TIP		PLAN						Total $$ programmed (in billions)
				Pre-2022	2022-2024	2025-2026	2027-2031	2032-2036	2037-2041	2042-2046	2047-2050	
Minor Projects (from TIP & Plan)												
FFYs 2020-24 TIP			Formula federal	$ 0.315	$ 0.254							$ 0.254
			Project-specific: federal	$ 0.005	$ 0.024							$ 0.024
			Project-specific: state/local	$ 0.505	$ 0.230							$ 0.230
FFYs 2022-2050 Plan			Formula federal	N/A		$ 0.247	$ 0.150	$ 0.059	$ 0.059	$ 0.059	$ 0.047	$ 0.622
			Project-specific: federal	N/A								$ -
			Project-specific: state/local	N/A		$ 0.062	$ 0.038	$ 0.015	$ 0.015	$ 0.015	$ 0.012	$ 0.155
Major Projects (Itemized)												
1	PLAN ID: NSSC650C	NY Route 347 Safety, Mobility and Environmental Improvements	Formula federal	$ 0.080		$ 0.009	$ 0.369	$ 0.071				$ 0.449
			Project-specific: federal									$ -
			Project-specific: state/local	$ 0.064	$ 0.019	$ 0.024	$ 0.070	$ 0.018				$ 0.130
2	PLAN ID: NYCM2663C	MTA NYCT Second Avenue Subway Phase 2	Formula federal									$ -
			Project-specific: federal	$ 1.000			$ 0.435					$ 0.435
			Project-specific: state/local	$ 0.540			$ 2.575					$ 2.575
3	PLAN ID: NYCM2664C	MTA NYCT Second Avenue Subway Phase 3-4	Formula federal									$ -
			Project-specific: federal					$2.895	$7.380	$4.689		$ 14.964
			Project-specific: state/local					$2.895	$7.380	$4.689		$ 14.964
4	PLAN IDs: MHSDM708C, NYCDM2304C, NSDM2305C	Transportation Systems Management & Operations Programs	Formula federal		$ 0.482	$ 0.337	$ 0.909	$ 1.014	$ 0.894	$ 1.260	$ 1.118	$ 6.015
			Project-specific: federal		$ -		$ -	$ -	$ -	$ -	$ -	$ -
			Project-specific: state/local		$ 0.121	$ 0.084	$ 0.227	$ 0.253	$ 0.224	$ 0.315	$ 0.278	$ 1.502
5	PIN: X77338 PLAN ID: NYCQ2361C	Great Streets Vision Zero – Queens Boulevard	Formula federal	$ 0.002	$ 0.020	$ 0.022						$ 0.042
			Project-specific: federal									
			Project-specific: state/local	$ 0.046	$ 0.140	$ 0.090						$ 0.230
6	PLAN ID: MHSMC767C	Penn Station Access: New Haven Line via Amtrak's Hell Gate Line	Formula federal	$ 0.065	$ -							
			Project-specific: federal									$ -
			Project-specific: state/local	$ 1.575	$ 0.186							$ 0.186
8	PLAN ID: NYCBX2162C	Hunts Point Interstate Access Improvement	Formula federal	$ 0.329								
			Project-specific: federal									
			Project-specific: state/local	$ 0.946	$ 0.486							$ 0.486
9	PLAN ID: NYCQ386C	Woodhaven Boulevard Select Bus Service - Capital Improvements	Formula federal									
			Project-specific: federal									
			Project-specific: state/local				$ 0.236					$ 0.236
11	PLAN ID: NYCMB5413C	Central Business District Tolling Program	Formula federal									
			Project-specific: federal									
			Project-specific: state/local		$ 0.503							$ 0.503
12	PIN: 082498; PLAN ID: N5NC1787C	Nassau Hub Transit Initiative	Formula federal									$ -
			Project-specific: federal				$ 0.016	$ 0.164				$ 0.180
			Project-specific: state/local				$ 0.079	$ 0.141				$ 0.220
13	PIN: G609/01/AA 09; PLAN ID: NYCMB2411C	Jamaica Capacity Improvements - Phase 2	Formula federal									
			Project-specific: federal									
			Project-specific: state/local						$ 0.140			$ 0.140
14	PLAN ID: NYCMB5127C	ADA Accessibility at Subway Stations	Formula federal									
			Project-specific: federal		$ 0.450							$ 0.450
			Project-specific: state/local		$ 1.165	$ 3.490						$ 4.655
15	PIN: G609/01/AA 09; PLAN ID: NYCMB2411C	MTA LIRR East Side Access Project	Formula federal									
			Project-specific: federal									
			Project-specific: state/local	$ 0.330								
16	PLAN ID: NYCQ2707C	Van Wyck Expressway (Interstate 678) Capacity and Access Improvement to JFK Airport	Formula federal									
			Project-specific: federal									
			Project-specific: state/local	$ 1.293								
17	PLAN ID: NYCQ388C	AirTrain LaGuardia Project	Formula federal									
			Project-specific: federal									
			Project-specific: state/local	$ 2.050								
Subtotals			**Formula federal**	$ 0.791	$ 0.756	$ 0.615	$ 1.429	$ 1.144	$ 0.953	$ 1.319	$ 1.165	**$ 7.381**
			Project-specific: federal	$ 1.005	$ 0.474	$ -	$ 0.451	$ 3.059	$ 7.380	$ 4.689	$ -	**$ 16.053**
			Project-specific: state/local	$ 7.349	$ 2.849	$ 3.750	$ 3.225	$ 3.322	$ 7.759	$ 5.019	$ 0.290	**$ 26.213**
			TOTALS	**$ 9.145**	**$ 4.080**	**$ 4.365**	**$ 5.104**	**$ 7.525**	**$ 16.092**	**$ 11.027**	**$ 1.455**	**$ 49.648**

5.3.3 TOTAL SYSTEM COSTS

In total, the projects and strategies proposed for funding in the fiscally constrained Plan and the FFYs 2020–2024 TIP are forecast to cost $800 billion in YOE dollars ($27.5 billion annual average) to preserve and enhance the federally supported transportation system through the planning period.

5.4 ESTIMATES OF AVAILABLE FUNDS

Federal Regulatory Language: *For the purpose of developing the metropolitan transportation plan, the MPO(s), public transportation operator(s), and State shall cooperatively develop estimates of funds that will be available to support metropolitan transportation plan implementation, as required under §450.314(a). All necessary financial resources from public and private sources that are reasonably expected to be made available to carry out the transportation plan shall be identified.*

5.4.1 FEDERAL FUNDING FORECASTS

The strong federal partnership that has characterized transportation funding in the NYMTC planning area is assumed to continue during the planning period and to play a significant role in the preservation and enhancement of the federally supported transportation system. As of this writing, the FAST Act has been extended through FFY 2021, and the detailed discussions in Congress on replacing the FAST Act are expected to occur prior to the end of the FAST Act extension on September 30, 2021.

The COVID-19 pandemic has resulted in Congressional action on four emergency relief acts and three supplemental appropriations since the declaration of a national public health emergency in March 2020. Through these legislative actions, emergency operating assistance has been provided to transportation agencies and transit providers to avoid employee layoffs and furloughs, and reductions in transit service. Of these, the Coronavirus Aid, Relief, and Economic Security (CARES) Act provided $25 billion to transit agencies in FFY 2020 to help to offset costs related to the pandemic. As of this writing, the Coronavirus Response and Relief Supplemental Appropriations Act (CRRSAA) is providing an additional $13.2 billion in UZA formula funding for transit providers in FFY 2021 and $10 billion in Surface Transportation Block Grant program funding. Additionally, the American Rescue Plan Act is providing an additional $30.5 billion in UZA formula funding for transit providers.

Using historical federal funding trends dating from the Intermodal Surface Transportation Efficiency Act of 1991, six successor authorization acts to the FAST Act are assumed beginning in FFY 2022. Each successor act is assumed to be five years in duration, with federal funding authorizations in each act escalating per the historical trend (see ***Figure 5-5*** and ***Table 5-6***). State and local funds are assumed to escalate at the same rate as the authorized federal funding.

Figure 5-5

Average Annual Federal Authorization (National) (in millions of YOE dollars)

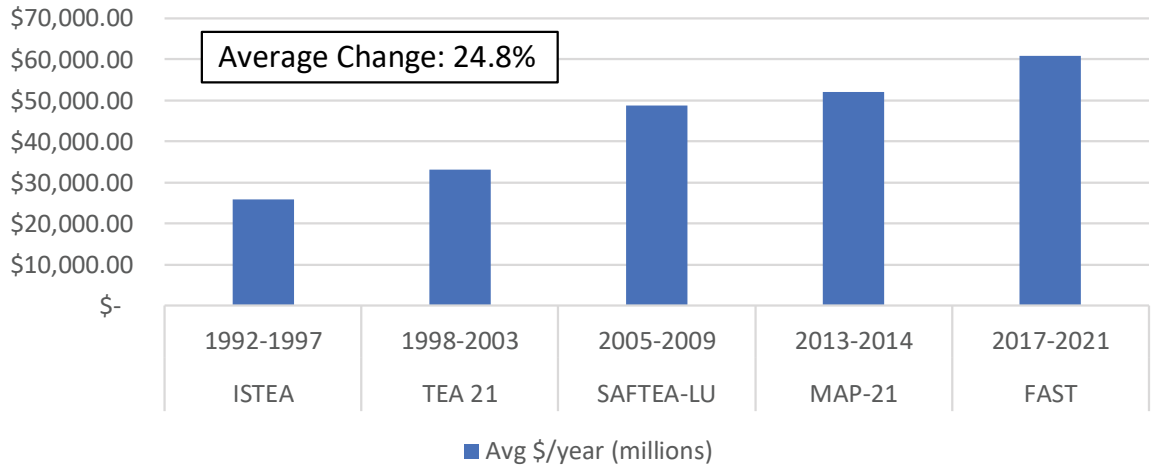
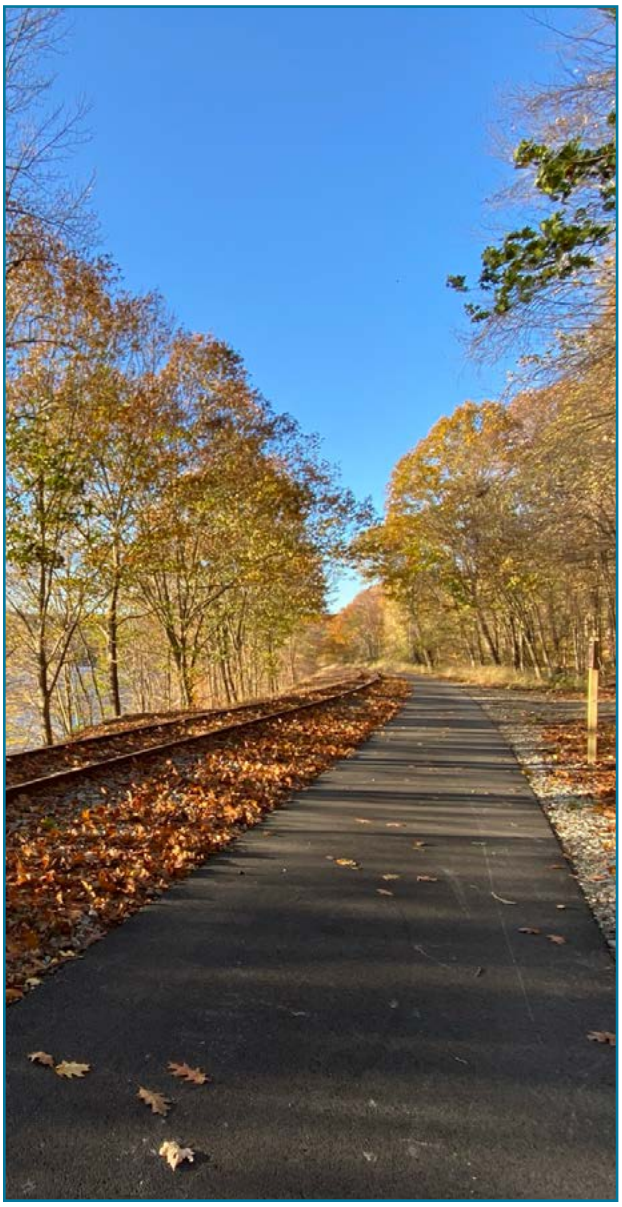


Table 5-6

Assumed Future Federal Authorization Acts
(in millions of YOE dollars, historical escalation rate: 1.2478)

Federal Act	Federal Fiscal Years	Total Authorized (National)	Average Annual NYMTC Formula Federal Planning Target	Total NYMTC Formula Federal Planning Target
Successor 1	2022-2026	$ 380,173.47	$ 2,417.84	$ 12,089.21
Successor 2	2027-2031	$ 474,380.45	$ 2,975.51	$ 14,877.55
Successor 3	2032-2036	$ 591,931.93	$ 3,708.38	$ 18,541.92
Successor 4	2037-2041	$ 738,612.66	$ 4,689.35	$ 23,446.76
Successor 5	2042-2046	$ 921,640.87	$ 5,919.47	$ 29,597.36
Successor 6	2047-2050	$ 1,150,023.48	$ 7,507.50	$ 30,030.00
Totals		**$ 4,256,762.85**		**$ 128,582.78**



5.4.2 STATE AND LOCAL FUNDING FORECASTS

New York State-authorized revenues for transportation purposes were projected from base year funding levels and generally follow a 2 percent annual growth rate. Additional state and local revenues are assumed to be available, as necessary, to address the forecasted non-federal share. NYMTC's members have a long-standing and demonstrated history of providing the non-federal share necessary to leverage any additional funds that are apportioned/allocated to the region.

5.4.3 ESTIMATED FUNDS FOR PLAN IMPLEMENTATION

Funds reasonably expected to be available for the implementation of the fiscally constrained Plan are $805 billion in YOE dollars from all sources, an annual average of $27.8 billion. ***Table 5-7*** and ***Figure 5-6*** detail reasonably expected revenues during the planning period.

Table 5-7

Resource Forecasts (in millions of YOE dollars)

	2022-2026	2027-2031	2032-2036	2037-2041	2042-2046	2047-2050	TOTAL
CMAQ	$ 473.833	$ 591.249	$ 737.761	$ 920.578	$ 1,148.697	$ 1,146.675	**$ 5,018.794**
NHPP	$ 1,759.317	$ 2,195.276	$ 2,739.265	$ 3,418.055	$ 4,265.049	$ 4,257.542	**$ 18,634.503**
STBG FLEX	$ 159.463	$ 198.977	$ 248.284	$ 309.809	$ 386.579	$ 385.899	**$ 1,689.011**
STBG LG URBAN	$ 862.523	$ 1,076.256	$ 1,342.953	$ 1,675.736	$ 2,090.984	$ 2,087.303	**$ 9,135.755**
STBG-OFF	$ 88.151	$ 109.995	$ 137.251	$ 171.262	$ 213.701	$ 213.325	**$ 933.685**
Total Title 23 Formula Funds	**$ 3,343.287**	**$ 4,171.753**	**$ 5,205.514**	**$ 6,495.440**	**$ 8,105.010**	**$ 8,090.745**	**$ 35,411.748**
Title 23 Formula Funds Used for O&M	$ 296.560	$ 328.234	$ 363.405	$ 402.486	$ 445.947	$ 391.638	**$ 2,228.269**
Title 23 Formula Funds Available for System Preservation/Enhancement	**$ 3,046.727**	**$ 3,843.519**	**$ 4,842.109**	**$ 6,092.954**	**$ 7,659.063**	**$ 7,699.107**	**$ 33,183.479**
Title 49 Formula Funds	$ 8,745.919	$ 10,705.792	$ 13,336.404	$ 16,951.316	$ 21,492.347	$ 21,939.252	**$ 93,171.030**
Title 49 Formula Funds Used for O&M	$ 178.508	$ 222.742	$ 277.937	$ 346.810	$ 432.750	$ 431.988	**$ 1,890.735**
Title 49 Formula Funds Available for System Preservation/Enhancement	**$ 8,567.411**	**$ 10,483.050**	**$ 13,058.467**	**$ 16,604.506**	**$ 21,059.598**	**$ 21,507.264**	**$ 91,280.295**
Total Federal Formula	$ 12,089.206	$ 14,877.545	$ 18,541.918	$ 23,446.756	$ 29,597.357	$ 30,029.997	**$ 128,582.778**
Total Federal Formula Available for System Preservation/Enhancement	**$ 11,614.138**	**$ 14,326.570**	**$ 17,900.576**	**$ 22,697.460**	**$ 28,718.661**	**$ 29,206.370**	**$ 124,463.774**
HSIP	$ 168.023	$ 209.658	$ 261.612	$ 326.439	$ 407.331	$ 406.614	**$ 1,779.677**
HPP	$ 8.082	$ -	$ -	$ -	$ -	$ -	**$ 8.082**
Title 23 Discretionary Funds	$ 176.105	$ 209.658	$ 261.612	$ 326.439	$ 407.331	$ 406.614	**$ 1,787.759**
Title 49 Discretionary Funds	$ 2,124.231	$ 2,523.870	$ 4,050.744	$ 2,240.546	$ 2,290.053	$ 3,827.386	**$ 17,056.829**
Project-Specific Federal Discretionary Funds	$ 474.210	$ 450.600	$ 3,059.070	$ 7,380.235	$ 4,689.099	$ -	**$ 16,053.214**
Total Federal Discretionary	**$ 2,774.545**	**$ 3,184.128**	**$ 7,371.426**	**$ 9,947.220**	**$ 7,386.482**	**$ 4,234.000**	**$ 34,897.803**
Total Federal Available for System Preservation / Enhancement	**$ 14,388.683**	**$ 17,510.698**	**$ 25,272.002**	**$ 32,644.680**	**$ 36,105.143**	**$ 33,440.371**	**$ 159,361.577**
State/Local - Formula Match for MTA	$ 2,086.912	$ 2,535.172	$ 3,140.780	$ 3,979.567	$ 5,033.791	$ 5,132.485	**$ 21,908.708**
State/Local - Discretionary / Other Match for MTA	$ 508.472	$ 602.786	$ 977.521	$ 516.257	$ 517.761	$ 902.191	**$ 4,024.987**
State/Local - Overmatch for MTA	$ 39,134.771	$ 58,569.470	$ 78,055.070	$ 98,960.205	$ 127,129.356	$ 118,139.295	**$ 519,988.167**
Total State/Local for MTA	**$ 41,730.156**	**$ 61,707.428**	**$ 82,173.371**	**$ 103,456.029**	**$ 132,680.908**	**$ 124,173.971**	**$ 545,921.862**
Other State/Local - Formula Match	$ 473.853	$ 689.193	$ 1,048.482	$ 1,456.452	$ 1,816.038	$ 1,879.361	**$ 7,363.380**
Other State/Local - Discretionary/Other Match	$ 66.611	$ 80.596	$ 100.568	$ 125.489	$ 156.585	$ 156.310	**$ 686.160**
Other State/Local - Overmatch	$ 8,475.464	$ 10,149.760	$ 10,927.774	$ 11,973.559	$ 12,913.017	$ 10,964.415	**$ 65,403.989**
Total Other State/Local	**$ 9,015.929**	**$ 10,919.549**	**$ 12,076.824**	**$ 13,555.501**	**$ 14,885.641**	**$ 13,000.085**	**$ 73,453.529**
Project-Specific Formula Match	$ 342.769	$ 357.278	$ 285.881	$ 238.346	$ 329.836	$ 289.746	**$ 1,843.855**
Project-Specific Discretionary Match	$ 118.553	$ 112.650	$ 764.768	$ 1,845.059	$ 1,172.275	$ -	**$ 4,013.304**
Project-Specific State/Local Overmatch	$ 6,137.799	$ 2,754.687	$ 2,271.305	$ 5,675.179	$ 3,516.827	$ -	**$ 20,355.796**
Total Project-Specific State/Local	**$ 6,599.120**	**$ 3,224.614**	**$ 3,321.954**	**$ 7,758.584**	**$ 5,018.937**	**$ 289.746**	**$ 26,212.955**
Total Non-Federal	**$ 57,345.205**	**$ 75,851.591**	**$ 97,572.149**	**$ 124,770.113**	**$ 152,585.486**	**$ 137,463.802**	**$ 645,588.346**
Formula Revenue	**$ 14,517.673**	**$ 17,908.212**	**$ 22,375.719**	**$ 28,371.825**	**$ 35,898.326**	**$ 36,507.963**	**$ 155,579.718**
Discretionary/Other Revenue	**$ 57,216.215**	**$ 75,454.077**	**$ 100,468.431**	**$ 129,042.969**	**$ 152,792.303**	**$ 134,396.210**	**$ 649,370.205**
Grand Total	**$ 71,733.888**	**$ 93,362.289**	**$ 122,844.151**	**$ 157,414.793**	**$ 188,690.629**	**$ 170,904.173**	**$ 804,949.923**

Figure 5-6

Estimated Funds for Plan Implementation
Federally Supported Transportation System
(in millions of YOE dollars)

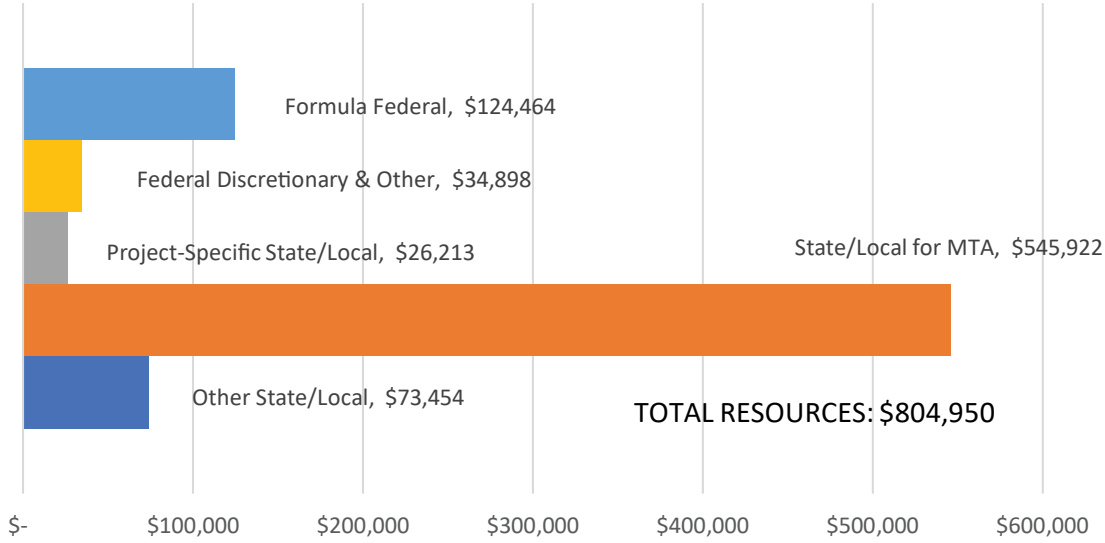
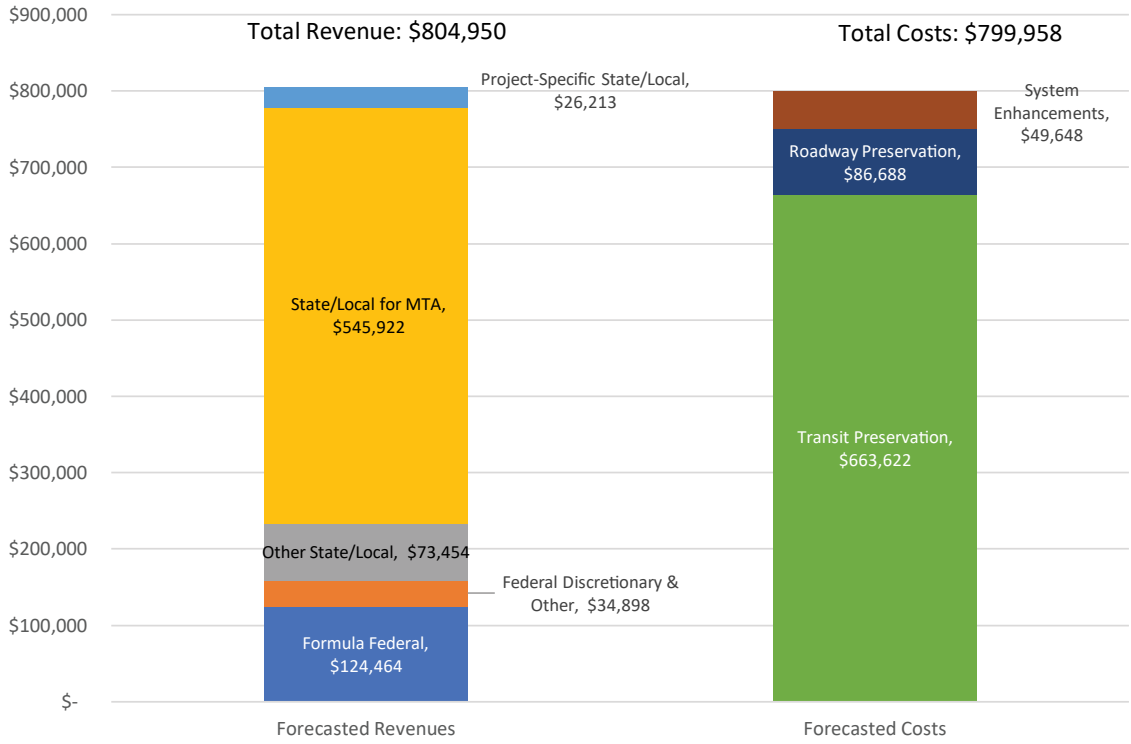


Figure 5-7 compares the forecasts of reasonably expected revenues to the forecasts of the estimated costs to implement the projects and strategies proposed for funding in the fiscally constrained Plan and FFYs 2020–2024 TIP. Broadly speaking, the reasonably expected revenues will address the projected costs of Plan implementation.

Figure 5-7

Revenues vs. Costs
Federally Supported Transportation System
(in millions of YOE dollars)



5.5 ADDITIONAL FINANCING STRATEGIES

Federal Regulatory Language: *The financial plan shall include recommendations on any additional financing strategies to fund projects and programs included in the metropolitan transportation plan. In the case of new funding sources, strategies for ensuring their availability shall be identified. The financial plan may include an assessment of the appropriateness of innovative finance techniques (for example, tolling, pricing, bonding, public private partnerships, or other strategies) as revenue sources for projects in the plan.*

Moving Forward identifies a number of project-specific federal, state, and local funding sources among its estimates of available funding.

The availability, adoption, and implementation of these additional funding opportunities are subject to legislative actions at various levels of government, as well as budgeting and policy decisions. As an organization, NYMTC does not have the statutory authority to adopt or implement these additional funding opportunities because they fall outside the metropolitan transportation planning process.

5.5.1 PROJECT-SPECIFIC FUNDING STRATEGIES

This section outlines various project-specific funding opportunities that are expected to be plausibly available for *Moving Forward* projects. This judgement is based on a study of feasibility, merit, and precedents in the New York area and elsewhere, as well as the recent financing plans developed for large projects in the NYMTC planning area.

PUBLIC-PRIVATE PARTNERSHIPS

Public-private partnerships (P3s) are contracts between a governmental entity or public authority and a private company, either for the purpose of funding, constructing, operating, or maintaining a piece of infrastructure or program. Transportation projects or programs can be financed through these contractual arrangements, especially if they can generate user fees to compensate the private entity. A P3 arrangement can be undertaken for newly built infrastructure, replacement projects, the privatization of existing infrastructure, or for the privatization of government programs.

In a Design-Build P3, the public partner finances the project while the private partner designs and builds the project. Under the Design-Build-Finance-Operate-Maintain Concessions approach, the responsibilities for designing, building, financing, and operating are bundled together and transferred to private sector partners. In Design-Build-Operate-Maintain P3s, the private partner assumes responsibility for design, construction, and long-term operation, and/or maintenance services. The public sector is responsible for securing the project's financing independently and retains the operating revenue risk. In a Design-Build-Finance-Maintain partnership, the private sector is responsible for designing, building, financing, and maintaining the facility or project.

Finally, brownfield projects for existing infrastructure facilities can generate private investment through O&M concessions, such as those employed at the Port Newark Container Terminal. In these instances, private operating entities can receive revenues or more beneficial lease agreements in exchange for private investment in infrastructure investment.

According to FHWA, 37 states have enacted legislation authorizing P3 agreements for the development of transportation infrastructure.[1] New York is not currently one of these states, but several entities within the state have the ability in certain circumstances to engage in P3 agreements, including MTA and the Port Authority (*Table 5-8*). P3 agreements are slowed by the absence of legal provisions at the state level in New York. Once an entity is legally allowed to enter into a P3 agreement, it often takes years to complete the contract and bid negotiations required to select and onboard a private entity, and as such, this approach requires a substantial amount of lead planning time to implement.

Crucially, it is through these contracts and bid negotiations that the governmental entity or public authority has the chance to lay out the payment incentives the private entity will have to match to meet the governmental entity's project goals. This is a key step in the process that can have significant ramifications after project implementation.

Table 5-8

Examples of Current P3s[2]

Project	Description	P3 Type	Public Partner(s)
LaGuardia Airport Terminal B	The project involves building the new 840,000-square-foot Terminal B at LaGuardia Airport. The project is being developed in partnership with LaGuardia Gateway Partners LLC, which is entitled to develop, design, construct, operate, and maintain new Terminal B facilities and to charge, collect, and retain revenues from the operation of such facilities through a 35-year lease that will expire in December 2050.	Design-Build-Finance-Operate-Maintain	Port Authority
TWA Hotel at JFK Airport	The project involved redeveloping the TWA Flight Center at JFK Airport into a hotel.	Design-Build-Finance-Operate-Maintain	Port Authority
Hudson-Bergen Light Rail	The Hudson-Bergen Light Rail is a light rail system connecting the communities of Bayonne, Jersey City, Hoboken, Weehawken, Union City, and North Bergen.	Design-Build-Operate-Maintain	NJ Transit, NJ DOT, USDOT FTA
Goethals Bridge Replacement	This project consists of demolishing and replacing the 85-year old Goethals Bridge. The Port Authority operates the facility and collects tolls. It makes annual availability payments of $56.5 million to the concessionaire from pooled Port Authority revenues not tied to usage of the bridge.	Design-Build-Finance-Maintain	Port Authority
Port Newark Container Terminal	The container operations at Port Newark Container Terminal, owned by the Port Authority, operates on a concessions-based model for the lease of Ports America's operations at the Port. In exchange for over $500 million in investment of Port infrastructure, the Port Authority and Ports America agreed to a long-term, 50-year lease. This agreement has spurred investment in port rail infrastructure and a revamp of other facilities at the terminal since 2011.	O&M	Port Authority

VALUE CAPTURE

Value capture is a funding mechanism that uses the increase in property values that would result from infrastructure improvements to fund the improvements. One form of value capture is tax increment financing (TIF), which uses projected increases in tax revenues resulting from increases in property values associated with infrastructure improvements to fund the improvements. Although TIF can take various forms, a development entity is usually created to manage TIF-financed projects. Such an entity can often issue bonds to fund the infrastructure improvements, with the bonds being repaid through the TIF revenues. Often, all tax amounts in excess of the original tax amount in the investment zone flow into a fund used to make payments for the issued bonds. Since TIF generates revenues from the increase on the original tax amount, it is most appropriate for investment in undeveloped or under-developed land.

The extension of MTA NYCT's No. 7 subway line to Hudson Yards on the far west side of Manhattan was financed through PILOTs (i.e., payments in lieu of taxes, a variant of TIF) as well as through additional density bonuses. PILOTs are payments made to the government to offset losses from property tax revenues due to the existence of tax-exempt properties. In this case, developers building new commercial buildings in Hudson Yards were given tax breaks through PILOTs, which are discounted by 40 percent for 19 years. In addition, the right to build taller buildings than otherwise allowed by the zoning code was awarded to real estate developers who made financial contributions to a fund that paid for infrastructure improvements. Using a TIF financing structure, New York City issued bonds to finance the No. 7 subway line extension. These bonds will be repaid through a set of revenue streams created by New York City, including PILOTs. Notably, this approach has been taken the furthest in Hong Kong, where a significant share of the city's transit system is funded by real estate development orchestrated by the local transit agency. New York State explicitly authorizes the use of PILOTs but not other kinds of TIF.

Tax assessment districts are another way that municipalities in New York have used value capture to finance transportation improvements. This approach allows the municipality to charge a tax or surcharge in a specific geographic area to pay for infrastructure improvements that enable new development in the area. In the 1980s, the Town of Greenburgh in Westchester County established a structure like this to fund roadway improvements on Route 119 in anticipation of several large nearby development projects.

Value capture programs have a wide range of implementation timeframes. Some mechanisms, such as assessment districts, are less complex than TIF- or PILOT-based projects, which require land acquisition, rezonings, and the creation of specialized legal entities. Furthermore, properties subject to value capture can take a significant amount of time to generate the surplus revenues needed for the financing if the development is long-term, phased, or dependent on growing market demand.

Notably, density bonuses require market conditions that would support construction in excess of what it currently permitted under the zoning code—these conditions exist in multiple areas in the New York City region, including in both New York City's boroughs and some suburban municipalities, particularly near transit.

DEBT FINANCING

In debt financing, the funding capital is loaned for construction or equipment purchase and then repaid over time with any interest accrued. Debt financing can occur through the sale of bonds, federal credit programs (such as Transportation Infrastructure Finance and Innovation Act, or TIFIA, loans), and government infrastructure banks.

Debt financing is primarily used for infrastructure improvements that can generate a revenue stream. Local examples include the currently under-construction MTA LIRR East Side Access project. Funding for this project was included in the Rebuild and Renew Transportation Bond Act of 2005. In accordance with the act, the state would take on $2.9 billion in debt to issue bonds to fund transportation projects, $450 million of which was dedicated to the East Side Access project.[3]

TIFIA financing was used for the construction of the Governor Mario M. Cuomo Bridge, the Goethals Bridge replacement project and the reconstruction of the Staten Island Ferry terminals and acquisition of three new ferry boats.

Debt financing is a common funding approach for infrastructure improvements around the country. A project that generates user fees is a prime candidate for debt financing, including managed lanes toll conversions, as well as future cordon pricing projects. Bond issuance is generally a quick process and can be structured to be repaid over various timeframes depending on repayment revenue projections, but it does require various agency and governmental approvals, as well as ratings agency assessments.

TIFIA financing is available from the federal government on a competitive basis. TIFIA provides low-cost loans for transportation infrastructure projects. TIFIA loans can be used to cover up to 33 percent of a project's cost (or up to 49 percent under compelling circumstances).[4] The program requires an identified repayment source, such as tolls or taxes. The main benefit of TIFIA over other bond sales is lower interest rates that can translate to major project cost savings over time.

There is currently no federal infrastructure bank. Loans made by governmental infrastructure banks are generally offered interest-free or at lower rates than would otherwise be available through the private market.

DISCRETIONARY FEDERAL FUNDING

Additional project-specific funding may also be available through competitive discretionary federal funding programs authorized and appropriated by Congress. These competitive funding programs are offered at the discretion of the U.S. Secretary of Transportation for projects of various sizes, innovative practices, and other selected opportunities to improve mobility and infrastructure. At this writing, major discretionary funding programs identified in federal transportation legislation include the Rebuilding American Infrastructure with Sustainability and Equity (RAISE) program (formerly the Better Utilizing Investments to Leverage Development program), Infrastructure for Rebuilding America (INFRA) program, Capital Investments Grant program (including New Starts discretionary funding), and Consolidated Rail Infrastructure and Safety Improvement Grants.

To date, various projects in the NYMTC planning area have benefited from many of the discretionary federal funding programs. Examples include:

- Sections 5309 (Capital Investment Grants) and 5339 (Buses and Bus Facilities) funding has been employed in Phase I of the Second Avenue Subway project on the East Side of Manhattan and will be sought for Phase II of this project, as well as in the MTA LIRR's East Side Access project. It has also been used for SBS projects in New York City. Other discretionary programs have been applied in the region on a smaller scale, including:
  - Nassau County Hempstead Intermodal Facility
  - Westchester County's Electric Bus Purchase Program
- RAISE and INFRA discretionary funding sources were used for the Brooklyn Bridge Approach Arches and Towers Rehabilitation program, Phase I of the Moynihan Station project adjacent to Penn Station in midtown Manhattan, Vision Zero safety improvements, Fordham Plaza in the Bronx, Hunts Point freight improvements in the Bronx, greenway improvements, and the Cross-Harbor Freight Program.

Given NYMTC's varied use of discretionary funds, continued pursuit of these funding opportunities for a wide variety of potential needs should continue. However, it is important to note that the scope, availability of funds, and their eligibility criteria are subject to change over time.

CORDON PRICING

Cordon pricing introduces a surcharge for entering a certain geographical area, usually the dense core of a city. Tolls can be flat-fee or variable based on time of day, vehicle type, and other parameters. Cordon pricing has been implemented in a significant number of cities around the world, most prominently in London, Stockholm, and Milan, and has been shown to lower congestion and pollution, while raising transit travel speeds and a significant amount of revenue. While it has not been implemented in any cities in the United States, multiple cities, including New York City, Seattle, Los Angeles, and Chicago, are studying or actively developing cordon pricing.

In March 2019, New York State passed legislation authorizing the state to seek federal approval to implement cordon pricing in the Manhattan central business district. Manhattan's central business district tolling program is expected to generate an estimated $15 billion of funding for MTA's capital needs.[5] As of this writing, the program is proceeding with a National Environmental Policy Act environmental assessment.

5.5.2 STRATEGIES FOR ENSURING THE AVAILABILITY OF ADDITIONAL FINANCING

Moving Forward assumes the availability of a certain amount of reasonably expected local, state, and federal funding for the duration of the planning period. The alternative funding strategies detailed above present project-based and regionwide opportunities to fund the future of transportation initiatives in the region beyond typical reliance on property, sales, or gas taxes. These strategies, both proven and unproven in the New York region, have the potential to expand the potential revenue base from which to meet future transportation demand through 2050.

The strategic basis for the additional funding sources identified above is found in *Moving Forward's* Shared Vision for Regional Mobility as stated in ***Chapter 1***. Specifically, the guiding principles identified by NYMTC's members as

part of their approach to the shared vision include the following:

We will make the best use of federal resources for the regional transportation system and increase them where practical, while leveraging local resources as efficiently and effectively as possible.

NYMTC's members and the region's other elected officials must think regionally about transportation needs, solutions, strategies, and investment priorities. In developing a Shared Vision for Regional Mobility, NYMTC's members support the position that these investments and actions are a shared priority and are of strategic importance to this region and to the nation.

Increasing the availability of federal resources and leveraging local resources as efficiently and effectively as possible will require collaborative work to ensure reasonably expected revenues and to increase the use of alternative methods of financing transportation investments, as necessary, to supplement these existing sources. Thus, *Moving Forward's* exploration of additional funding opportunities is drawn from within its strategic planning framework. Evidence of the current implementation of several of these additional funding sources can be found in the fiscally constrained components of the planning process—the TIP and the constrained element of the Plan—which demonstrate that NYMTC and its members are already using some of these sources to advance system enhancement projects.

ENDNOTES

1 USDOT FHWA. State P3 Legislation. ***https://www.fhwa.dot.gov/ipd/p3/legislation/.***

2 Dentons. "US Infrastructure: Maximizing the benefits of private participation." ***https://impactnyc.org/wp-content/uploads/2019/08/PPP-Infrastructure-whitepaper.pdf.;*** USDOT FHWA. Project Profile: Hudson-Bergen Light Rail. ***https://www.fhwa.dot.gov/ipd/project_profiles/nj_hudson_bergen.aspx.;*** USDOT FHWA. Project Profile: Goethals Bridge Replacement. ***https://www.fhwa.dot.gov/ipd/project_profiles/ny_goethals.aspx.***

3 MTA. Transportation Bond Act. ***http://web.mta.info/mta/bondact.htm.***

4 USDOT. 2021. Build America Bureau. TIFIA Credit Program Overview. ***https://www.transportation.gov/buildamerica/financing/tifia/tifia-credit-program-overview.***

5 New York State website. April 1, 2019. "Governor Cuomo announces highlights of FY 2020 budget." ***https://www.governor.ny.gov/news/governor-cuomo-announces-highlights-fy-2020-budget.***