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A CONTEXT FOR OUR PLANNING—TRENDS AND CHANGE

3.1 OVERVIEW

Moving Forward 2055 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 multistate metropolitan region. Chapter 3 describes this related performance and anticipated future conditions to provide context for *Moving Forward 2055*'s recommended actions and investments.

3.2 STATE OF THE SYSTEM

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.

This System Performance Report, required by Federal regulation through [23 CFR 450.324](#), is an element of *Moving Forward 2055* that describes the condition and performance of the transportation system, identifies relevant performance targets, and reports on current progress in meeting the targets. It addresses the federally required performance measures and targets for highway safety, bridge condition, pavement condition, highway system performance, freight reliability, congestion, transit asset management, and transit safety.

3.2.1 HIGHWAY SAFETY PERFORMANCE

FHWA's Highway Safety Performance Management rule established five performance measures for safety on all public roads:

1. Number of Fatalities.
2. Rate of Fatalities per 100 million Vehicle Miles Traveled (VMT).
3. Number of Serious Injuries.
4. Rate of Serious Injuries per 100 million VMT.
5. Number of Nonmotorized Fatalities and Serious Injuries.

NYSDOT set 2025 statewide highway safety targets in August 2024. The following steps were used in setting the 2025 targets:

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.

Table 3.1 presents the 2025 targets, as well as the last five years for which final performance data is available. To be consistent with the performance measures, all data shown below is a five-year rolling average. NYMTC has agreed to support the NYSDOT statewide 2025 targets.¹

**Table 3.1 Statewide Safety Performance and 2025 Targets
(5-Year Rolling Average)**

Performance Measure	2018	2019	2020	2021	2022*	2025 Target
Number of Fatalities	1,038	1,016	998.0	1,021	1,054.8	1,011.0
Rate of Fatalities per 100 Million VMT	0.844	0.827	0.842	0.888	0.930	0.881
Number of Serious Injuries	11,119	11,287	11,198.2	11,145.6	11,056.6	11,034.1
Rate of Serious Injuries per 100 Million VMT	9.041	9.176	9.432	9.656	9.706	9.557
Number of Combined Non-Motorized Fatalities and Non-Motorized Serious Injuries	2,638	2,672	2,666.4	2,645.8	2,664.8	2,615.2

Source: NYSDOT.

ASSESSMENT OF PROGRESS IN ACHIEVING TARGETS

New York State's 2023–2027 Strategic Highway Safety Plan (SHSP) uses data-driven analysis to identify the state's safety needs, set goals for reducing fatal and serious injury crashes, and allocate investments in safety projects and programs. The SHSP guides statewide efforts to address safety and defines a framework for implementation activities. NYSDOT's Highway Safety Improvement Program (HSIP) 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 highway safety 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 HSIP, New York City's Vision Zero, and the NYSDOT Pedestrian Safety Action Plan. *Moving Forward 2055's* shared vision includes a Vision Goal that safety and security are maximized for people and goods across all uses and modes.

As shown in Table 3.1, the five-year rolling average for number of fatalities in 2022 surpassed the 2018 figure, after three consecutive years with lower fatalities than 2018. As VMT declined during the pandemic, and the total number of fatalities and serious injuries remained constant or increased, the rate of fatalities and rate of serious injuries notably increased. The five-year average for non-motorized fatalities and serious injuries has gradually increased since 2018. FHWA annually completes an assessment of progress toward achieving safety targets for each state.

A state makes significant progress toward its safety targets when at least four of the five targets have been met, or the actual outcome was better than the baseline performance.

If a state has not met or made significant progress toward meeting performance targets, the State DOT must comply with additional deferral requirements for minimum investments in highway safety projects through the HSIP and submission of an HSIP Implementation Report. For the most recent assessment of progress, New York State did not make significant progress towards meeting the safety targets. The [2023–2027 SHSP](#) highlighted several thematic areas where the state feels it can make improvements to the number and rate of fatalities and serious injuries. This includes strategies for improving intersections, improving safety for vulnerable road users, safety enforcement, vehicle design, and post-crash care, across the entire state. Implementation of these strategies through the HSIP and other state and regional programs will help the region make progress toward the *Moving Forward 2055* goal of a “transportation system for which safety and security are maximized for people and goods across all uses and modes.”

PAVEMENT AND BRIDGE CONDITION

FHWA established the following six performance measures for pavement and bridge condition on National Highway System (NHS) roads:

1. Percent of Interstate pavements in good condition.
2. Percent of Interstate pavements in poor condition.
3. Percent of non-Interstate NHS pavements in good condition.
4. Percent of non-Interstate NHS pavements in poor condition.
5. Percent of NHS bridges (by deck area) classified as in good condition.
6. Percent of NHS bridges (by deck area) classified as in poor condition.

NYSDOT and other State or local agencies are required to measure pavement and bridge condition on an ongoing basis to assess their condition and report the data to FHWA. The agencies use this data to determine when the pavement and bridges need repair or replacement. Pavement and bridges in good condition suggests that no significant investment is needed in the near term. Pavement or 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

NYSDOT established statewide pavement and bridge condition targets for 2023 and 2025. NYMTC has agreed to support the statewide targets. By doing so, NYMTC plans and programs Federal transportation funding for projects and activities that help to achieve these targets. Table 3.2 presents statewide performance for the measures from 2018 through 2023 as well as the 2023 and 2025 statewide targets established by NYSDOT and supported by NYMTC.¹

Table 3.2 Pavement and Bridge Condition Statewide Performance and Targets

Performance Measure	2018	2019	2020	2021	2022	2023	2023 Target	2025 Target
Percent of Interstate pavements in good condition	53.0%	51.1%	45.5%	45.3%	36.9%	50.7%	53.2%	48.2%
Percent of Interstate pavements in poor condition	1.2%	1.1%	0.7%	1.1%	1.8%	1.0%	1.4%	1.6%
Percent of non-Interstate NHS pavements in good condition	N/A	13.4%	18.3%	18.9%	16.3%	20.3%	22.3%	18.6%
Percent of non-Interstate NHS pavements in poor condition	N/A	7.5%	7.3%	7.6%	7.5%	7.1%	9.3%	8.4%
Percent of NHS bridges (by deck area) in good condition	24.4%	26.0%	25.3%	25.3%	24.7%	24.1%	24.1%	21.1%
Percent of NHS bridges (by deck area) in poor condition	10.2%	9.6%	10.9%	11.3%	11.2%	13.0%	12.5%	12.8%

Source: NYSDOT.

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On the NY Interstate system, the percentage of pavement in good condition decreased from 2018 to 2022 and then increased in 2023. The percentage in poor condition has fluctuated slightly over this time period but remains low. On the non-Interstate NHS system, the percentage of pavement in good condition has increased from 2019 to 2023, while pavement in poor condition has decreased by a slight amount. For bridges on the NHS, the percentage of deck area in good condition decreased by a small amount from 2018 to 2023, while the percentage in poor condition increased.

System preservation is a major focus of both *Moving Forward 2055* 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 the pavement and bridge targets, *Moving Forward 2055* forecasts a total of \$685 billion to address system preservation during the planning period, an average of approximately \$22.8 billion per year in year-of-expenditure dollars (refer to *Moving Forward 2055*, Chapter 5 for more detail).

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

FHWA established the following performance measures to assess system performance, freight reliability, and Congestion Mitigation and Air Quality Improvement Program (CMAQ) projects. The performance measures include:

1. Percent of person-miles on the Interstate system that are reliable.¹
2. Percent of person-miles on the non-Interstate NHS that are reliable.
3. Truck Travel Time Reliability (TTTR) Index.
4. Annual hours of peak-hour excessive delay (PHED) per capita.
5. Percent of non-single-occupant vehicle (Non-SOV) travel.
6. Cumulative two-year (2019 and 2023) and four-year (2021 and 2025) reduction of on-road mobile source emissions for CMAQ funded projects (CMAQ Emission Reduction).

ASSESSMENT OF PROGRESS IN ACHIEVING TARGETS

NYSDOT established statewide system performance, freight reliability, and CMAQ performance targets for 2023 and 2025. NYMTC has formally agreed to support the statewide targets. By doing so, NYMTC plans and programs Federal transportation funding for projects and activities that help to achieve these targets.

Table 3.3 presents annual performance for each measure from 2018 through 2023, as well as the 2023 and 2025 targets established by NYSDOT and supported by NYMTC. The figures represent statewide performance, except for the Peak Hour Excessive Delay Measure (PHED) per capita and the non-SOV travel measures, which represent performance only in the full New York-Newark, NY-NJ-CT Urbanized Area (UZA). NYMTC worked with agencies located in the vicinity of the UZA, including NYSDOT, New Jersey DOT, and Connecticut DOT, to establish the PHED and non-SOV travel targets.

¹ Reliability is defined as the ratio of longer travel times (80th percentile) to a normal travel time (50th percentile) over all applicable roads. Travel times are analyzed for each highway segment. A level of travel time reliability (LOTR) is calculated for each segment for four time periods that cover the hours of 6:00 a.m. to 8:00 p.m. each day:

- » AM Peak 6:00 a.m.–10:00 a.m. Monday through Friday
- » Mid-day 10:00 a.m.–4:00 p.m. Monday through Friday
- » PM Peak 4:00 p.m.–8:00 p.m. Monday through Friday
- » Weekends 6:00 a.m.–8:00 p.m. Saturday and Sunday

A segment is reliable if its LOTTR is less than 1.5 during all four time periods. If one or more time periods has a LOTTR of 1.5 or above, that segment is unreliable. The two measures are expressed as the percent of person-miles traveled on that are reliable. Person-miles consider the number of people traveling in buses, cars, and trucks over these roadway segments. The length of each segment is multiplied by its AADT and average occupancy factor for all vehicles, which results in person-miles. This calculation is done for reliable segments and for all segments. The sum of reliable segment person-miles is divided by the sum of all segment person-miles to calculate the measure.

Table 3.3 System Performance, Freight, and CMAQ Performance and Targets

Performance Measure	2018	2019	2020	2021	2022	2023	2023 Target	2025 Target
Percent of person-miles on the Interstate system that are reliable	80.7%	78.8%	86.9%	81.6%	80.1%	79.0%	75.0%	75.0%
Percent of person-miles on the non-Interstate NHS that are reliable	N/A	80.3%	86.8%	85.7%	85.4%	84.0%	70.0%	70.0%
Truck Travel Time Reliability index	1.43	1.47	1.33	1.39	1.41	1.40	2.00	2.00
Total on-road emission reductions, PM2.5 (kg/day)	5.480	89.576	N/A	96.148	N/A	2.181	2.015	2.643
Total on-road emission reductions, PM10 (kg/day)	12.885	179.441	N/A	N/A	N/A	N/A	3.097	5.395
Total on-road emission reductions, VOC (kg/day)	32.452	602.290 ¹	N/A	636.770 ¹	N/A	12.605 ¹	12.605	23.165
Total on-road emission reductions, NOx (kg/day)	83.606	925.308 ¹	N/A	1,015.504 ¹	N/A	52.664 ¹	40.295	72.603
Total on-road emission reductions, CO (kg/day)	611.939	15,117.4 ¹	N/A	16,141.420 ¹	N/A		258.263	484.920
Peak Hours of Excessive Delay per Capita (New York-Newark UZA only)	N/A	22.3	14.0	20.9	20.9	19.8	22.0	22.0
Percent Non-SOV Travel, (New York-Newark UZA only)	51.7%	51.6%	51.7%	52.4%	53.4%	53.4%	52.4%	52.4%

Source: NYSDOT.

¹ 2019 and 2023 represent two-year cumulative statewide emission reductions. 2021 represents four-year cumulative statewide emission reductions (as will 2025 data).

As shown in Table 3.3, the percentage of person-miles on the Interstate system that are reliable decreased slightly from the 2018 baseline to 2023. For the non-Interstate NHS, reliability increased notably from 2019 to 2023. TTTR performance improved slightly from 2019 to 2023. Total on-road emission reductions from CMAQ projects for applicable criteria pollutants fluctuated from year to year, which is to be expected as the mix of CMAQ-funded projects change annually.

Performance for the PHED measure improved from 2019 to 2023, decreasing from 22.3 to 19.8 hours. Performance for the percent of non-SOV travel measure increased from 51.7 percent in 2018 to 53.4 percent in 2023.

Moving Forward 2055 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 third performance management rule (PM3) targets and will continue to monitor and track the current performance of the roadway network.

3.2.3 TRANSIT ASSET MANAGEMENT

FTA's Transit Asset Management (TAM) regulations apply to recipients and subrecipients of Federal transit funding that own, operate, or manage public transportation capital assets. The regulations require that public transportation providers develop and implement TAM plans and establish state of good repair standards and performance targets for the performance measures presented in Table 3.4.

Table 3.4 FTA TAM Performance Measures

Asset Category	Performance Measure and Asset Class
Rolling Stock	Percentage of revenue vehicles within a particular asset class that have either met or exceeded their Useful Life Benchmark (ULB)
Equipment	Percentage of non-revenue, support-service and maintenance vehicles within a particular asset class that have met or exceeded their ULB
Infrastructure	Percentage of track segments with performance restrictions
Facilities	Percentage of facilities within an asset class rated below condition 3.0 on the Transit Economic Requirements Model (TERM) scale

Source: FTA, TAM Final Rule, 49 CFR Parts 625 and 630.

Transit agency assets used by these providers for public transit services are expected to be included in the TAM plan asset inventory. Agencies need to include condition assessments and targets only for assets for which they have direct capital responsibility.

Under the TAM requirements, FTA defines two tiers of public transportation providers based on number of vehicles and operating mode parameters. Tier I transit agencies, which are generally larger providers, establish their own TAM targets, while Tier II providers, generally smaller agencies, may establish their own targets or participate in a group plan where targets are established by a plan sponsor (NYSDOT) for those agencies in this group. NYSDOT's 2023 Group TAM Plan is available [online](#).

A variety of transit service providers receiving FTA funding serve the NYMTC planning area. These include:

- » Metropolitan Transportation Authority (MTA), including New York City Transit, Staten Island Railway, MTA Bus, MTA-Long Island Rail Road (LIRR), and MTA Metro-North Railroad (MNR).
- » Nassau Inter-County Express (NICE)
- » Suffolk County Transit (SCT)
- » Westchester County Bee-Line System
- » Staten Island Ferry, New York City Department of Transportation (NYC DOT)
- » City of Long Beach Transit (LBT)
- » Huntington Area Rapid Transit (HART)
- » Putnam Area Rapid Transit (PART)
- » Transport of Rockland (TOR)

LBT, HART, PART, and TOR are Tier II providers and are included in NYSDOT's group TAM plan. The other providers listed above are Tier I providers.

Each provider and group TAM plan sponsor is required to establish and report TAM targets annually for the following fiscal year and must share its targets and asset condition information with NYMTC. In turn, NYMTC is required to establish TAM targets within 180 days after the providers established their first targets and must update its targets when it adopts a new regional transportation plan. 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.

ASSESSMENT OF PROGRESS IN ACHIEVING TARGETS

The public transportation providers in the NYMTC planning area have established the TAM targets listed in the following Table 3.5 through Table 3.12. NYMTC is supporting the providers' individual TAM targets for each of the transit providers in the NYMTC planning area.

Table 3.5 MTA Selected Systems

Performance Measure	Asset Class	NYCT		Staten Island Railway		MTA Bus	
		ULB (years)	2024 Target	ULB (years)	2024 Target	ULB (years)	2024 Target
Rolling Stock	Articulated Bus	12	31.23%	N/A	N/A	12	0%
Age - % of revenue vehicles that have met or exceeded their Useful Life Benchmark (ULB)	Over-the-road Bus	12	17.48%	N/A	N/A	12	49.9%
	Bus	12	17.63%	N/A	N/A	12	28.45%
	Cutaway	10	13.2%	N/A	N/A	N/A	N/A
	Heavy Rail Passenger Cars	40	15.52%	40	33.63%	N/A	N/A
	Sports Utility Vehicle	8	100%	N/A	N/A	N/A	N/A
	Van	10-13	25%	N/A	N/A	N/A	N/A
Equipment	Trucks and other Rubber Tire Vehicles	7-11	29.72%	7-11	68.75%	7-11	58.68%
Age - % of non-revenue vehicles that have met or exceeded their ULB	Steel Wheel Vehicles	Various	65.45%	15-35	55.56%	N/A	N/A
	Automobiles	7-11	50.89%	7-11	100%	7-11	76.19%
Infrastructure	HR—Heavy Rail	N/A	0.63%	N/A	0%	N/A	N/A
% of track segments with performance restrictions							
Facilities	Administrative/Maintenance Facilities	N/A	66.98%	N/A	62.5%	N/A	37.5%
Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	Passenger/Parking Facilities	N/A	34.81%	N/A	76%	N/A	N/A

Source: FTA National Transit Database, 2023 Annual Database Performance Measure Targets.

Table 3.6 MTA Long Island Railroad

Performance Measure	Asset Class	ULB (years)	2024 Target
Rolling Stock	RL—Commuter Rail Locomotive	39	0%
Age - % of revenue vehicles that have met or exceeded their Useful Life Benchmark (ULB)	RP—Commuter Rail Passenger Coach	39	0%
	RS—Commuter Rail Self-Propelled Passenger Car	39	7.9%
Equipment	Automobiles	8	100%
Age - % of non-revenue vehicles that have met or exceeded their ULB	Steel Wheel Vehicles	25	68.8%
	Trucks and other Rubber Tire Vehicles	14	14.4%
Infrastructure	CR—Commuter Rail	N/A	6.16%
% of track segments with performance restrictions			
Facilities	Administrative/Maintenance Facilities	N/A	28.85%
Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	Passenger/Parking Facilities	N/A	15.3%

Source: FTA National Transit Database, 2023 Annual Database Performance Measure Targets.

Table 3.7 MTA Metro-North Railroad

Performance Measure	Asset Class	ULB (years)	2024 Target
Rolling Stock	BU—Bus	12	36.25%
Age - % of revenue vehicles that have met or exceeded their Useful Life Benchmark (ULB)	RL—Commuter Rail Locomotive	35	67.35%
	RP—Commuter Rail Passenger Coach	35	27.23%
	RS—Commuter Rail Self-Propelled Passenger Car	35	21.9%
Equipment	Automobiles	8	100%
Age - % of non-revenue vehicles that have met or exceeded their ULB	Steel Wheel Vehicles	35	61.87%
	Trucks and other Rubber Tire Vehicles	14-18	29.13%
Infrastructure	CR—Commuter Rail	N/A	2.96%
% of track segments with performance restrictions			
Facilities	Administrative/Maintenance Facilities	N/A	38.1%
Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	Passenger/Parking Facilities	N/A	28.57%

Source: FTA National Transit Database 2023, Annual Database Performance Measure Targets.

Table 3.8 NICE Bus

Performance Measure	Asset Class	ULB (years)	2024 Target
Rolling Stock	AB—Articulated Bus	14	0%
Age - % of revenue vehicles that have met or exceeded their Useful Life Benchmark (ULB)	AO—Automobile	8	0%
	BU—Bus	14	5%
	CU—Cutaway	10	5%
Equipment	Automobiles	6-8	13%
Age - % of non-revenue vehicles that have met or exceeded their ULB	Trucks and other Rubber Tire Vehicles	10-13	15%
Facilities	Administrative/Maintenance Facilities	N/A	15%
Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	Passenger/Parking Facilities	N/A	50%

Source: FTA National Transit Database, 2023 Annual Database Performance Measure Targets.

Table 3.9 Suffolk County Transit

Performance Measure	Asset Class	ULB (years)	2024 Target
Rolling Stock	BU—Bus	14	10%
Age - % of revenue vehicles that have met or exceeded their Useful Life Benchmark (ULB)	CU—Cutaway	10	10%
Equipment	Trucks and other Rubber Tire Vehicles	10–13	0%
Age - % of non-revenue vehicles that have met or exceeded their ULB			

Source: FTA National Transit Database, 2023 Annual Database Performance Measure Targets.

Table 3.10 Westchester County Bee-Line System

Performance Measure	Asset Class	ULB (years)	2024 Target
Rolling Stock	AB—Articulated Bus	14	0%
Age - % of revenue vehicles that have met or exceeded their Useful Life Benchmark (ULB)	AO—Automobile	8	100%
	BU—Bus	14	37%
	CU—Cutaway	10	42%
	MV—Minivan	8	0%
	SV—Sports Utility Vehicle	8	20%
Equipment	Trucks and other Rubber Tire Vehicles	8–10	32%
Age - % of non-revenue vehicles that have met or exceeded their ULB			
Facilities	Administrative/Maintenance Facilities	N/A	0%
Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	Passenger/Parking Facilities	N/A	0%

Source: FTA National Transit Database, 2023 Annual Database Performance Measure Targets.

Table 3.11 New York City Department of Transportation Ferry

Performance Measure	Asset Class	ULB (years)	2024 Target
Rolling Stock Age - % of revenue vehicles that have met or exceeded their Useful Life Benchmark (ULB)	FB—Ferry Boat	42	33%
Equipment Age - % of non-revenue vehicles that have met or exceeded their ULB	Trucks and other Rubber Tire Vehicles	8–10	65%
	Automobiles	8–10	85%
Facilities Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	Administrative/Maintenance Facilities	N/A	0%
	Passenger/Parking Facilities	N/A	0%

Source: FTA National Transit Database 2023, Annual Database Performance Measure Targets.

Table 3.12 NYSDOT Group TAM Plan Providers (Includes PART, TOR, HART, and LBT)

Performance Measure	Asset Class	ULB (years)	2024 Target
Rolling Stock Age - % of revenue vehicles that have met or exceeded their Useful Life Benchmark (ULB)	Bus-Heavy Duty Large/Trolley	12	10%
	Bus-Heavy Duty Small	10	25%
	Bus-Medium Duty	7	55%
	Small Passenger Vehicle	5	65%
Equipment Age - % of non-revenue vehicles that have met or exceeded their ULB	All Equipment (Section 5311)	Varies	20%
	All Equipment (Section 5307)	Varies	60%
Facilities Condition - % of facilities with a condition rating below 3.0 on the FTA TERM Scale	Admin & Maintenance (Section 5307)	N/A	20%
	Admin & Maintenance (Section 5310)	N/A	50%
	Admin & Maintenance (Section 5311)	N/A	0%
	General Purpose (Section 5310)	N/A	0%
	General Purpose (Section 5311)	N/A	0%
	Maintenance (Section 5307)	N/A	25%
	Maintenance (Section 5311)	N/A	0%

Source: NYSDOT, Group TAM Plan for FTA Grantees, August 2023 Update.

Moving Forward 2055's vision includes a goal that infrastructure is maintained and improved in a sustainable and fair manner, with an accompanying objective to rebuild, replace and/or modernize needed transportation assets for passengers and freight. 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 2055 forecasts the cost of transit system preservation over the life of the Plan at approximately \$525 billion, or roughly 77 percent of the Plan's total projected system preservation costs for the entire transportation system in the NYMTC planning area (refer to *Moving Forward 2055*, Chapter 5 for more detail). The Plan estimates that most of these costs will be met through a combination of Federal, state, and local resources.

3.2.4 TRANSIT SAFETY

FTA's Public Transportation Agency Safety Plan (PTASP) regulation requires public transportation system operators that receive Federal financial assistance under 49 U.S.C. Chapter 53 to develop and implement a PTASP based on a Safety Management Systems approach. The PTASP must include performance targets for the following performance measures:

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

When a public transportation provider establishes targets, it must make the targets available to NYMTC. In turn, NYMTC is required to establish PTASP targets within 180 days after the providers established their first targets and must update its targets when it adopts a new regional transportation plan. When establishing PTASP targets, NYMTC can either agree to program projects that will support the transit provider targets or establish separate regional targets for its planning area.

The targets set by transit operators in the NYMTC planning area are displayed in Table 3.13 through Table 3.15. It should be noted that the PTASP Rule states that agencies that operate passenger ferries regulated by United States Coast Guard, 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 3.13 MTA Bus Systems Targets

Provider	Fatalities (total)	Customer Accident Injury Rate (per million customers)	Collisions with Injury Rate (per million vehicle miles)	System Reliability: Mean Distance Between Failures (miles)	System Reliability (% of trips completed)
MTA NYC Transit	0.00	1.19	6.47	6,413.0	99%
MTA Bus Company	0.00	1.06	5.51	6,880.0	99%

Source: NYMTC.

Table 3.14 MTA Subway Targets

Category	Fatalities	Injuries	Safety Events	System Reliability (Average Miles Between Failure)
Employee Safety	Reduction by 5%	Reduction by 5%	Reduction by 5%	146,681
Customer Safety	Reduction by 3%	Reduction by 3%	Reduction by 3%	N/A

Source: NYMTC.

Table 3.15 Remaining Transit System Targets

Mode	Fatalities (total)	Fatalities (rate)	Injuries (total)	Injuries (rate)	Safety Events (total)	Safety Events (rate)	System Reliability (miles between major failures)
Westchester County Bee-Line System Fixed Route Bus	0	0	63	8.2	48	6.2	3,600
Westchester County Bee-Line System Paratransit	0	0	4	1.15	4	1.15	40,000
City of Long Beach/ Long Beach Bus Fixed Route Bus	0	0	0	0	0	0	0 failures
City of Long Beach/ Long Beach Bus Paratransit	0	0	0	0	0	0	0 failures
Nassau Inter-County Express Fixed Route Bus	1	0.01	61	0.62	41	0.42	6,902
Nassau Inter-County Express Paratransit	0	0	7	0.34	6	0.29	29,480
Huntington Area Rapid Transit Fixed Route Bus	0	0	0	0	1	0.264	0 failures
Huntington Area Rapid Transit Paratransit	0	0	0	0	0	0	0 failures
Transport of Rockland Fixed Route Bus	0	0	7	0.35	3	0.15	12,396
Transport of Rockland Paratransit	0	0	0	0	0	0	16,117
Putnam Area Rapid Transit Fixed Route Bus	0	0	0	0	0	0	27,820
Putnam Area Rapid Transit Paratransit	0	0	0	0	0	0	99,805
Suffolk County Transit Fixed Route Bus	0	0	14.6	20.6	9.9	14	9,052
Suffolk County Transit Paratransit	0	0	8.6	10.5	7	8.7	133,900.6

Source: NYMTC.

Moving Forward 2055's vision includes maximizing safety and security for people and goods across all uses and modes. As part of the ongoing coordination efforts to fulfill the PTASP requirements, the progress of the transit providers toward achieving their safety targets will be monitored and reported. Additionally, Federal funding will be programmed toward achieving the safety targets of the transit providers.

3.3 FORECASTS THROUGH 2055

3.3.1 FORECASTING OVERVIEW AND ASSUMPTIONS

NYMTC's socioeconomic and demographic (SED) forecasts establish the likelihood that the multistate metropolitan region will experience growth in population, jobs, and economic activity 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. As applicable, these forecasts contextualize the data within a broader 31-county forecasting region drawn from New York City's multistate metropolitan area. Typically, NYMTC uses U.S. Census data to describe historical trends and forecast them through the Plan's horizon year. Additional technical detail on the forecasting process is provided in Appendix B.

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 forecasting region comprises 31 counties in the multistate metropolitan region, consisting of the subregions and their respective counties shown in Table 3.16. Although the SED forecast produces data for the entire forecasting region, much of this chapter focuses on the 10-county NYMTC planning area, which is disaggregated into the New York City, Long Island, and Lower Hudson Valley subregions. A map of the 31-county forecasting region and the NYMTC planning area is also shown in Figure 3.1. NYMTC's [Moving Forward 2055 Interactive Map](#) visualizes the results of the SED forecasting.

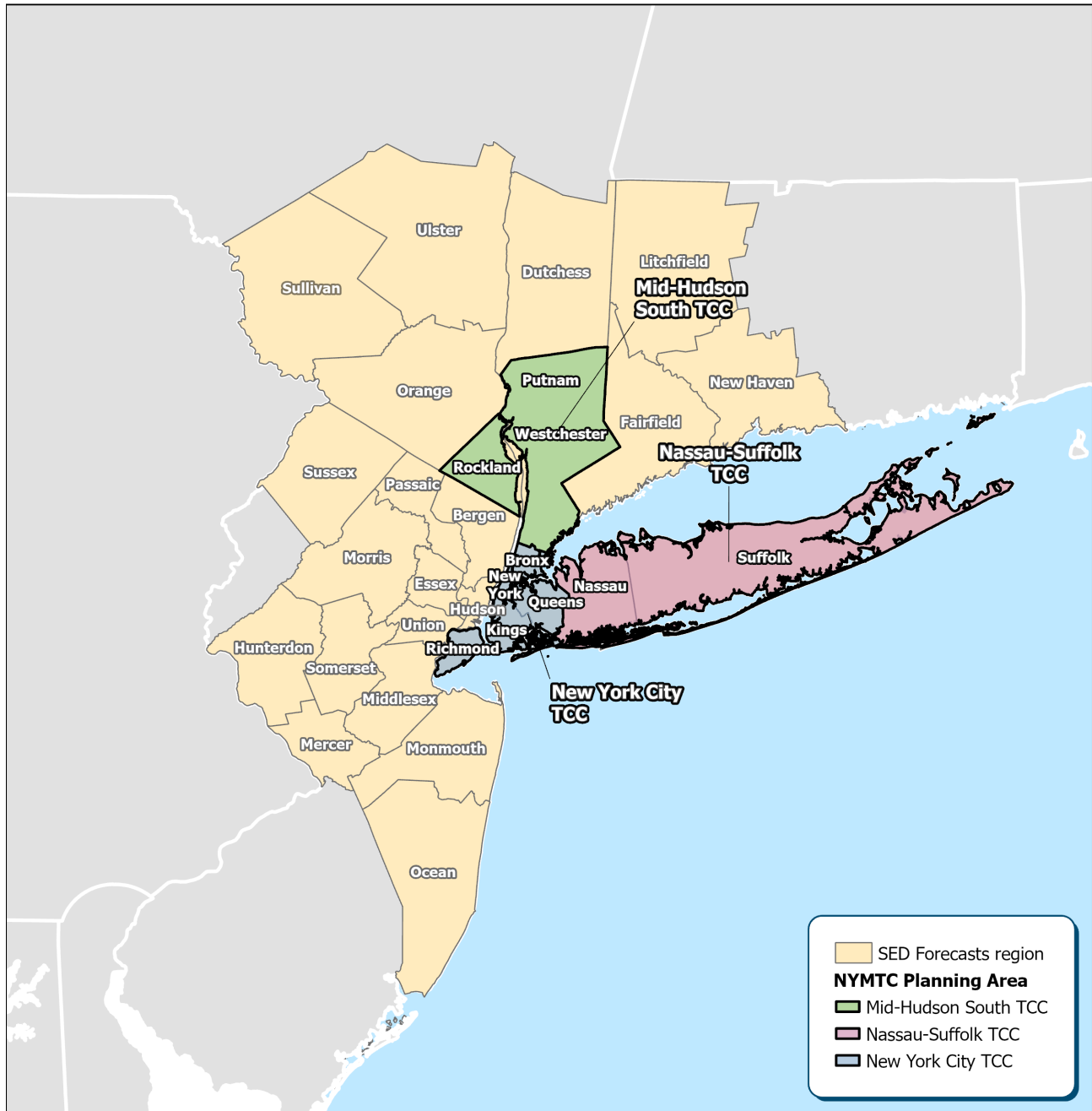
Table 3.16 Subregions of the 31-County Forecasting Region

Larger Subregion	Smaller Subregion	Counties
New York City	New York City ¹	Bronx, Kings (Brooklyn), New York (Manhattan), Queens, Richmond (Staten Island)
Long Island	Long Island ¹	Nassau, Suffolk
Hudson Valley	Lower Hudson Valley ¹	Putnam, Rockland, Westchester
	Mid-Hudson Valley	Dutchess, Orange, Sullivan, Ulster
Northern New Jersey	Northern New Jersey	Bergen, Essex, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union, Warren
Southwestern Connecticut	Southwestern Connecticut	Fairfield, Litchfield, New Haven

Source: NYMTC.

¹ Included in the NYMTC Planning Area.

Figure 3.1 31-County Forecasting Region and NYMTC Planning Area



Source: NYMTC.

Because of the interdependencies between the NYMTC planning area and the larger multistate metropolitan region, forecasting for a broader 31-county region is important for understanding the NYMTC planning area's prospective SED trends and future transportation needs. In addition, understanding potential regional growth patterns can strengthen integrated transportation and development planning and provide opportunities for more balanced growth. Housing production and capacity play a critical role in these forecasts, as they influence where and how population growth can occur. Limitations in housing supply can constrain projected growth in certain areas, while increases in housing capacity—through zoning changes

or new development—can shift future demographic and transportation patterns. Forecasts in this plan are disaggregated by subregion and county as needed to describe these trends and patterns.

At the time of the development and adoption of NYMTC's previous long-range Plan, *Moving Forward*, in 2020 and 2021, the direct effects of the COVID-19 pandemic were still being felt. The NYMTC planning area, like the rest of the United States, was emerging from stringent lockdowns, mandates, and business capacity restrictions. However, there were still concerns over new and emerging COVID variants, in addition to supply chain disruptions. Especially significant as a result of these events were major shifts in work patterns, such as the widespread adoption of remote work and hybrid work schedules and shifts in housing demand and preferences. These changes at that time signaled a possible trend for living in lower density areas and increased migration outside of the metropolitan cores.

Taken together, these broad impacts, along with restrictions on immigration during the COVID-19 pandemic, contributed to a slight decline in population for the NYMTC region, compared to 2019 pre-pandemic figures. Despite this drop in population, much of the forecasting through 2055 assumes that each subregion will recover to its 2019 levels of population and resume some degree of pre-pandemic growth trend established in the late 2010s. Since 2022, population, employment, and overall traffic levels have rebounded. Depending on the metric and location, certain figures have neared, matched, or surpassed 2019 figures, indicating an overall recovery in relation to key transportation planning metrics discussed in this chapter.

By 2055, the region is expected to be home to a population of 26.1 million people, representing a population gain of 3.1 million over the 2022 base year, and 14.2 million jobs, an increase of 1.8 million from 2022.

3-17

HOUSING DEVELOPMENT AND CAPACITY

The Plan's forecasts were developed in the context of new Federal requirements included in the Infrastructure Investment and Jobs Act (IIJA) for MPOs to include housing development and capacity in population and employment projections. To comply, NYMTC staff and stakeholders cross-checked population and employment projections with estimates of required housing units for forecasted households and—forecasts of annual residential building permits.

This analysis found that the number of new housing units needed was greater than the average annual number of residential building permits issued in the last 10 years in four counties within the NYMTC forecasting region. These include Nassau and Suffolk Counties on Long Island; Rockland County, NY; and Passaic County, NJ. In the case of Rockland and Passaic, the number of permitted housing units is much higher than the estimated future local demand. This surplus could help offset housing shortages elsewhere in the region. The Long Island subregion shows an overall deficit of more than 1,300 units per year. Discussions with regional stakeholders in Nassau and Suffolk counties determined that future development should still keep up with the forecasted growth given current information.

This data informed a consensus on the 2055 projections based on comparisons of housing unit development trends, local permitting data, and future housing demand. This approach is in line with the regulations and helps to further ensure the reasonableness of future population and employment forecasts. More information is included in Table 3.17 and Appendix B.

Table 3.17 Comparison of Housing Forecasts, Trends, and Demand

Subregion/County	Adjusted SED Households		New Housing Units Needed			
	2022	2055	Net 2022–2055	Annual Demand	Annual Building Permits Issued (10-Year Average U.S. Census Building Permit Data)	Difference Between New Housing Units Needed and Building Permit Survey (New Units)
Non-NYC Region Total¹	5,400,584	6,057,044	+656,460		36,183	+15,829
Nassau County	456,149	510,927	+54,778	+1,660	1,103	-557
Suffolk County	511,964	574,537	+62,573	+1,896	1,133	-763
Long Island Total	968,113	1,085,464	+117,351	+3,556	2,236	-1,320
Dutchess County	117,028	121,975	+4,947	+150	460	+310
Orange County	139,757	176,538	+36,781	+1,115	1,144	+29
Putnam County	36,104	38,515	+2,411	+73	79	+6
Rockland County	104,003	130,448	+26,445	+801	431	-370
Sullivan County	32,758	36,029	+3,271	+99	335	+236
Ulster County	75,187	75,065	-122	N/A	303	N/A
Westchester County	373,505	387,742	+14,237	+431	1,757	+1,326
Mid-Hudson Total	878,342	966,312	+87,970	+2,669	4,509	+1,840
New Jersey Total	2,789,616	3,182,046	+392,430	+11,892	26,281	+14,389
Connecticut Total	764,513	823,222	+58,709	+2,237	3,157	+920

Source: NYMTC.

¹ The Non-New York City region total includes Long Island, Mid-Hudson, New Jersey, and Connecticut subregion totals within the 31-county forecasting region.

REGIONAL GROWTH

In line with key assumptions from *Moving Forward*, the forecasts show 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 such as Nassau, Westchester, Bergen, and Essex Counties in New York and New Jersey. A combination of housing and transportation constraints in the urban 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.

With the COVID-19 pandemic in the past, the NYMTC planning area and forecasting region will continue to experience population and employment growth through the planning period, a key indication of the region's overall resilience. However, the rate of growth is expected to slow slightly over time, as a result of various growth constraints, including an aging population. As a mature region, new population and jobs will be absorbed into built out areas, slowing their rates of growth, particularly in the later years of the forecasting period. Despite slowing growth rates, there are still large absolute gains, indicating the continued importance of proactive and informed transportation planning. Key figures associated with these forecasts and takeaways are described in the following subsections.

3.3.2 AGGREGATE FORECASTS FOR THE REGION

Within the 10-county NYMTC planning area, total population is expected to grow by approximately 13 percent between the 2022 base year and 2055, representing an additional 1.7 million residents. Growth rates for employment, referring to the number of jobs, is expected to be approximately 15 percent. Growth in the civilian labor force, referring to the number of people who are 16 or older, not in the military, and either employed or actively looking for work, is expected to be approximately 11 percent. The breakdown of these metrics for the NYMTC planning area and their forecasts for 2022 through 2055 is shown in Table 3.18.

Table 3.18 Aggregate SED Forecasts for the NYMTC Planning Area

Statistic	2022 Value	2055 Value	Absolute Change	Percent Change from 2022–2055
Population	12.67 million	14.33 million	1.66 million	+13.1%
Employment	7.22 million	8.32 million	1.10 million	+15.2%
Civilian Labor Force	6.63 million	7.39 million	0.76 million	+11.4%
Average Household Size	2.52	2.52	No change	0.0%

Source: NYMTC.

Among the NYMTC subregions, as shown in Table 3.19, New York City is expected to have the highest population growth rate, at just under 14 percent. Through 2055, New York City's population is expected to reach nearly 9.5 million, comprising two-thirds of the NYMTC planning area total population, in line with current trends. Long Island's population growth rate is expected to reach 13 percent, with a total population of just under 3.3 million through 2055. The Lower Hudson Valley's population is expected to grow the slowest at approximately 10 percent. The Lower Hudson Valley is also the smallest subregion by measure of population, with an expected 2055 value of slightly below 1.6 million.

By measure of employment, New York City is also expected to have the highest growth rate at nearly 17 percent, exceeding the subregion's population growth rate. In comparison, the growth rate of employment for Long Island and the Lower Hudson Valley subregions is expected to amount to just over

11 percent. At a total figure of 5.9 million, New York City's employment comprises over 70 percent of the entire NYMTC planning area's employment.

The growth rates of the civilian labor force for each subregion are expected to range from 10.7 percent (Long Island) to 11.9 percent (Lower Hudson Valley). Through 2055, New York City's civilian labor force is expected to rise to just over 4.8 million, at a growth rate of just under 12 percent. Overall, the New York City subregion's civilian labor force comprises approximately 65 percent of the entire NYMTC planning area's civilian labor force.

Average household sizes are expected to grow very slightly in the Long Island (an increase of 0.3 percent) and Lower Hudson Valley (an increase of 1.1 percent) subregions and held constant in New York City. The largest average household sizes are expected in Long Island at 2.97, compared to 2.74 for the Lower Hudson Valley. By comparison, New York City's average household size is held constant at 2.37 for the forecast period.

Table 3.19 SED Forecast for the NYMTC Planning Area by Subregion

Statistic	NYMTC Subregion	2022 Value	2055 Value	Absolute Change	Percent Change from 2022–2055
Population (millions)	New York City	8.336	9.471	1.135	+13.6%
	Long Island	2.909	3.286	0.377	+13.0%
	Lower Hudson Valley	1.427	1.570	0.143	+10.1%
Employment (millions)	New York City	5.056	5.903	0.847	+16.8%
	Long Island	1.479	1.651	0.172	+11.6%
	Lower Hudson Valley	0.685	0.764	0.079	+11.5%
Civilian Labor Force (millions)	New York City	4.327	4.831	0.504	+11.6%
	Long Island	1.568	1.735	0.167	+10.7%
	Lower Hudson Valley	0.733	0.820	0.087	+11.9%
Average Household Size	New York City	2.37	2.37	0	0.0%
	Long Island	2.96	2.97	0.01	+0.3%
	Lower Hudson Valley	2.71	2.74	0.03	+1.1%

Source: NYMTC.

When considering the broader 31-county forecasting region, growth rates in northern New Jersey are expected to be the most robust, particularly by measure of population and civilian labor force. From 2022 to 2055, northern New Jersey population is forecasted to grow by 15 percent, labor force by 12 percent, and employment by 14 percent. Southwestern Connecticut's population is expected to grow more slowly, with the region's population increasing by 8 percent, labor force increasing by 10 percent, and employment increasing by 13 percent over the planning period.

3.3.3 POPULATION AND EMPLOYMENT TRENDS AND FORECASTS

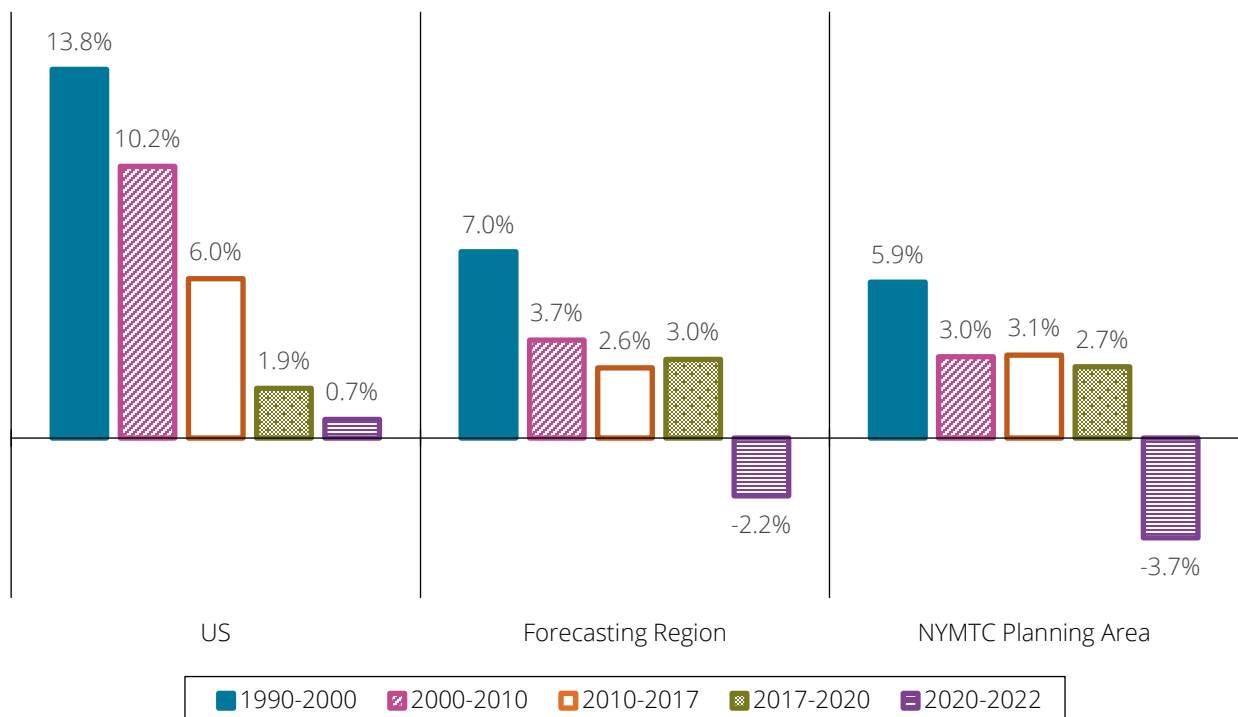
Historical trends provide a context and a basis for the SED forecasts. Trends in population and employment are assessed through the 2022 base year of the forecasts and projected to the Plan's horizon year of 2055. Most of this section focuses on historical trends and forecasts for the NYMTC planning area, with reference to larger patterns within the 31-county region, as necessary.

POPULATION

Between 1990 and 2022, the NYMTC planning area population grew approximately 0.6 percent annually. As shown in Figure 3.2, for the NYMTC planning area, this included an overall trend of slowing growth across much of this period. The NYMTC planning area observed the largest increase in growth between 1990 and 2000, at nearly 6 percent. The rate of growth decreased to approximately 3 percent over each trend period through 2020. From 2020 through 2022, the NYMTC planning area's population declined by nearly 4 percent.

In comparison to the NYMTC planning area, the 31-county forecasting region experienced a slightly greater increase in population between 1990 and 2020. The entire forecasting region also saw a more subdued population decline between 2020 and 2022. Both the core NYMTC planning area, as well as the 31-county forecasting region grew at a slower rate compared to the entire United States. While the United States has followed a similar trend of decreasing rate of growth, the population of the entire United States still managed to grow between 2020 and 2022.

Figure 3.2 Relative Growth in Total Population, 1990–2022



Source: NYMTC.

The disparities in growth in the NYMTC planning area compared to the 31-county forecasting region and the United States can be attributed to multiple factors. One of the most impactful factors is that the NYMTC planning area functions as a mature and nearly built-out region. As indicated by the dense street grid that characterizes much of the NYMTC planning area geography, there are relatively few undeveloped tracts of land where new population growth could occur. Many of those lower density portions of the NYMTC planning area, such as Putnam County, northern Westchester County, and western Rockland County are also characterized by challenging topographies or are already protected as state parks and nature preserves.

Furthermore, while the region has sufficient housing capacity to accommodate projected growth, zoning ordinances—governed at the municipal level— still pose challenges to new residential development. Concerns over aging infrastructure, vehicular traffic levels, and impacts on schools may lead local governments to impose limits on building heights and the ratio of total building floor area to the size of each lot, as well as minimum parking requirements. Although efforts to loosen these restrictions are underway in New York City and other parts of the region, the extent to which these changes will facilitate housing production remains uncertain.

Although these trends can also be found across the larger 31-county forecasting region, the availability of larger areas of undeveloped and underdeveloped land has provided increased opportunities for residential growth. Examples of this can be found in Orange County in New York, as well as Ocean County in New Jersey, which have experienced increases in population—on the magnitude of over 50 percent growth—over the span of recent decades.²

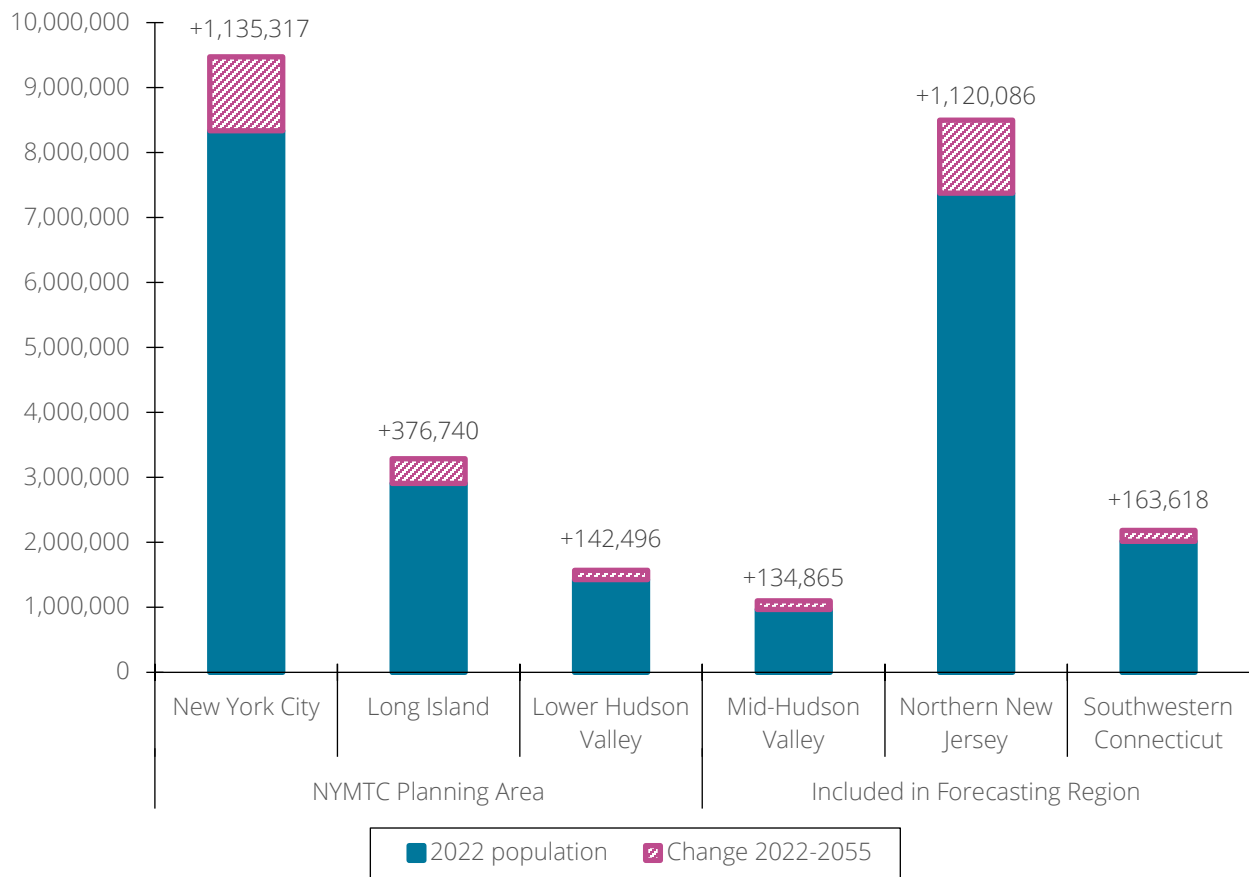
Despite factors which have restricted population growth, the NYMTC planning area has seen increases in population across multiple geographies. Trends of increased development in and around central business districts and train stations have continued, providing opportunities for new multifamily housing developments. For example, high-density development has continued to occur in locations such as New Rochelle, White Plains, and Yonkers in addition to multiple locations across New York City. Additional recent examples of increased residential development in the form of mid-to-high density housing units can be found across the NYMTC planning area in locations such as Tarrytown, Patchogue, Wyandanch, Riverhead, and other locations.

As expected, the COVID-19 pandemic greatly impacted population in the planning area, forecasting region, as well across the entire United States at a scale that could not be fully illustrated in the previous Plan. New York City and surrounding areas were some of the first and hardest hit from the surge of COVID-19. In New York City alone, nearly 36,000 people died of COVID-19 from 2020 through 2021, resulting in a directly related population loss of 0.2 percent per year.³ Concerns over the contagious nature of the virus, and social distance requirements contributed to domestic migration trends favoring lower density communities. For example, 8 out of 10 counties within the NYMTC planning area and all five boroughs of New York City lost population from 2020 through 2021 due to domestic migration. By comparison, Dutchess County, to the north of the NYMTC planning area, gained approximately 4,000 residents during this timeline.

The COVID-19 pandemic also contributed to a rise in remote work (see more details in Section 3.4.1), allowing many white-collar employees to work in locations away from their anchor office. This contributed to significant growth in traditionally lower cost states and regions, especially in the Sun Belt, and away from larger traditionally higher cost locations, including New York City, and other Northeast and Midwest cities such as Boston, Philadelphia, Chicago, and Washington, D.C.

The forecasting of future population totals must be considered against the backdrop of population losses from the COVID-19 pandemic, but also those trends which have followed. Through 2025, initial estimates indicate that migrations away from the region's most UZAs within New York City have largely dissipated and even reversed, indicating that the NYMTC planning area will resume growth in the upcoming decades. As shown in Figure 3.3, the NYMTC planning area's population is projected to increase by 13 percent, or by almost 1.65 million people from 2022 to 2055. Within this area, the New York City subregion is expected to grow by just over 13 percent, adding 1,135,000 people in the next three decades. The population on Long Island is expected to grow by 13 percent, or by about 377,000 people. The Lower Hudson Valley subregion is expected to grow by 10 percent, or by almost 143,000 people. By comparison, the entire forecast region is expected to grow at a similar pace, with northern New Jersey adding the newest residents, at an increase of approximately 16 percent through 2055.

Figure 3.3 Population Growth by Subregion, 2022–2055



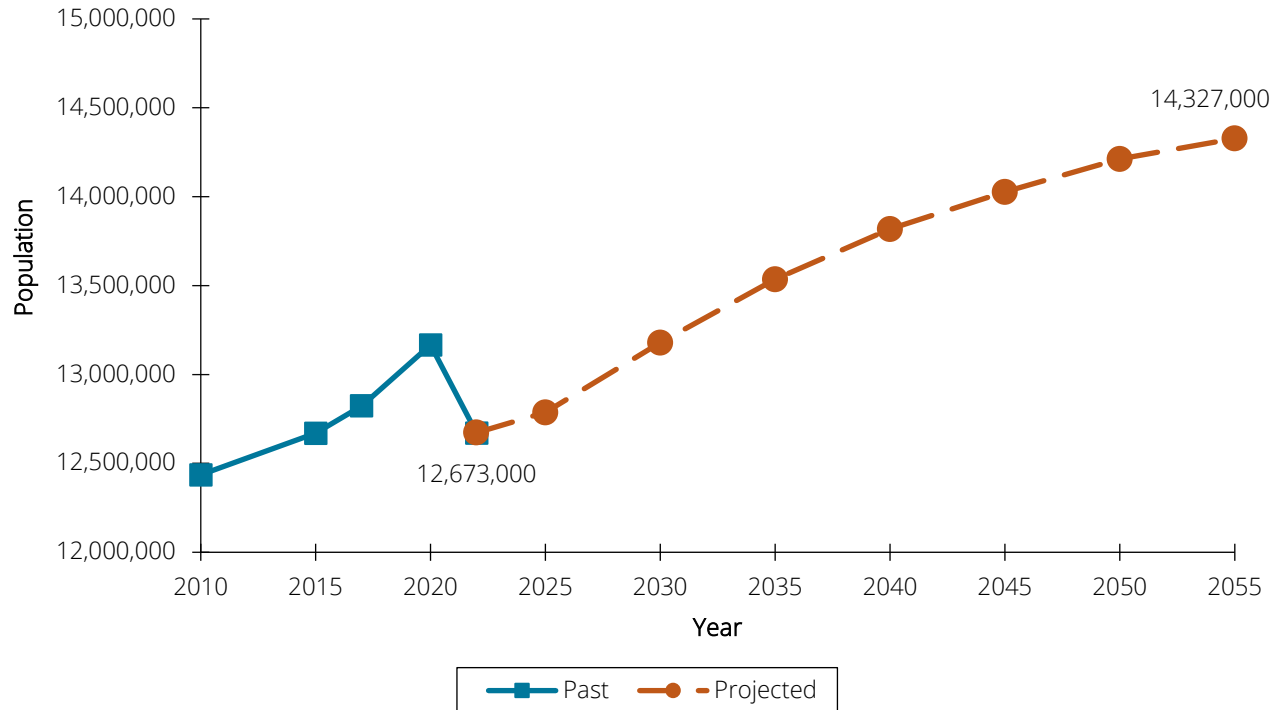
Source: NYMTC.

As shown in Table 3.20, projected population growth rates in Long Island and the Lower Hudson Valley are expected to exceed recent historical averages. New York City's population, however, is expected to grow at a decreasing rate, especially through the latter portion of the forecasted time period. As further illustrated in Figure 3.4, the NYMTC planning area as a whole is expected to grow at a decreasing rate, reflecting the trends of New York City, which comprises the majority of the NYMTC planning area's population. As a whole, the NYMTC planning area is expected to exceed its pre-pandemic population by around 2030 according to forecasts. As noted earlier in this section and presented in Table 3.17 NYMTC staff and stakeholders cross-checked population forecasts with estimates of required housing units for forecasted households and forecasts of annual residential building permits.

Table 3.20 Population Trends and Forecasts by County/Borough and Subregion (Thousands)

Area	2010	2015	2020	2022	2025	2030	2035	2040	2045	2050	2055
New York City Total	8,243	8,426	8,804	8,336	8,429	8,763	8,964	9,136	9,295	9,418	9,471
Bronx County	1,385	1,423	1,473	1,380	1,430	1,495	1,536	1,574	1,608	1,634	1,647
Kings County	2,553	2,594	2,736	2,591	2,612	2,723	2,792	2,853	2,910	2,957	2,980
New York County	1,586	1,637	1,694	1,596	1,604	1,674	1,714	1,745	1,772	1,791	1,797
Queens County	2,250	2,295	2,405	2,278	2,291	2,376	2,423	2,462	2,499	2,529	2,537
Richmond County	469	478	496	491	491	495	499	502	505	508	510
Long Island Total	2,833	2,856	2,922	2,909	2,923	2,963	3,079	3,157	3,191	3,238	3,286
Nassau County	1,340	1,355	1,396	1,384	1,389	1,409	1,466	1,505	1,518	1,546	1,573
Suffolk County	1,493	1,501	1,526	1,525	1,534	1,554	1,613	1,652	1,673	1,693	1,713
Lower Hudson Valley Total	1,361	1,387	1,440	1,427	1,434	1,454	1,494	1,525	1,542	1,556	1,570
Putnam County	100	99	98	98	98	100	103	106	107	107	108
Rockland County	312	321	338	339	345	357	374	390	404	419	435
Westchester County	949	967	1,004	990	991	997	1,017	1,030	1,031	1,029	1,028
NYMTC Planning Area Total	12,436	12,669	13,166	12,673	12,786	13,180	13,536	13,818	14,027	14,213	14,327

Source: NYMTC.

Figure 3.4 Population Forecast for the NYMTC Planning Area

Source: NYMTC.

HOUSEHOLDS

3-25

The number of households in the NYMTC planning area is projected to increase by approximately 13 percent between 2022 and 2055, resulting in approximately 641,000 new households. Household growth in New York City is anticipated to be the strongest, at 14 percent, compared to Long Island and the Lower Hudson Valley projected growths of approximately 12 percent and just over 8 percent, respectively. In absolute terms, New York City is expected to add approximately 481,000 households (Table 3.21), comprising the majority of new households across the NYMTC planning area.

Table 3.21 Total Number of Households by County/Borough and Subregion (In Thousands)

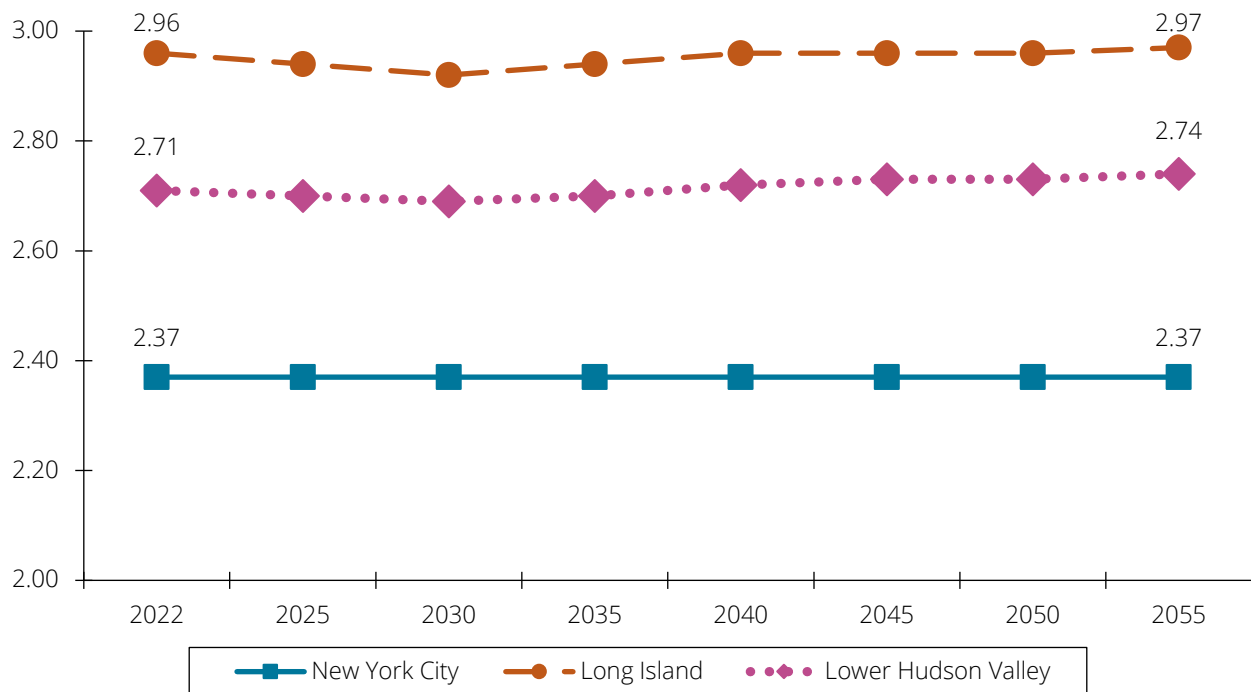
County & Subregion	2022	2025	2030	2035	2040	2045	2050	2055
New York City Total	3,427	3,465	3,608	3,694	3,767	3,834	3,886	3,908
Bronx	533	553	579	596	611	625	635	640
Kings	1,032	1,041	1,085	1,114	1,138	1,162	1,181	1,190
New York	826	830	869	890	907	922	932	935
Queens	862	867	899	918	933	947	958	961
Richmond	174	174	175	177	178	179	180	181

County & Subregion	2022	2025	2030	2035	2040	2045	2050	2055
Long Island Total	968	976	995	1,026	1,047	1,055	1,070	1,085
Nassau	456	459	466	480	489	492	502	511
Suffolk	512	517	528	546	558	563	569	575
Lower Hudson Valley Total	514	517	524	536	544	548	552	557
Putnam	36	36	37	38	38	39	39	39
Rockland	104	105	108	113	118	121	126	130
Westchester	374	375	379	385	388	388	388	388
NYMTC Planning Area	4,909	4,958	5,127	5,256	5,357	5,437	5,508	5,550

Source: NYMTC.

NYMTC's previous long-range plan (*Moving Forward*), projected a greater average household size for 2022 than what actually occurred. This discrepancy is particularly evident in New York City, where household size was previously projected at 2.58 persons but is currently at 2.37 persons per household, due to the post-2020 decline. This represents a notable decrease of 8 percent in household size between 2017 (the *Moving Forward* base year) and 2022 (*Moving Forward* 2055's base year). Given the uncertainty in the trajectory, average household size for the New York City subregion was held constant for the forecast period, with minor fluctuations anticipated in the other two subregions. By 2055, Long Island will continue to have the largest household size among the subregions, averaging 2.97 persons per household, as shown in Figure 3.5.

Figure 3.5 Average Household Size by Subregion

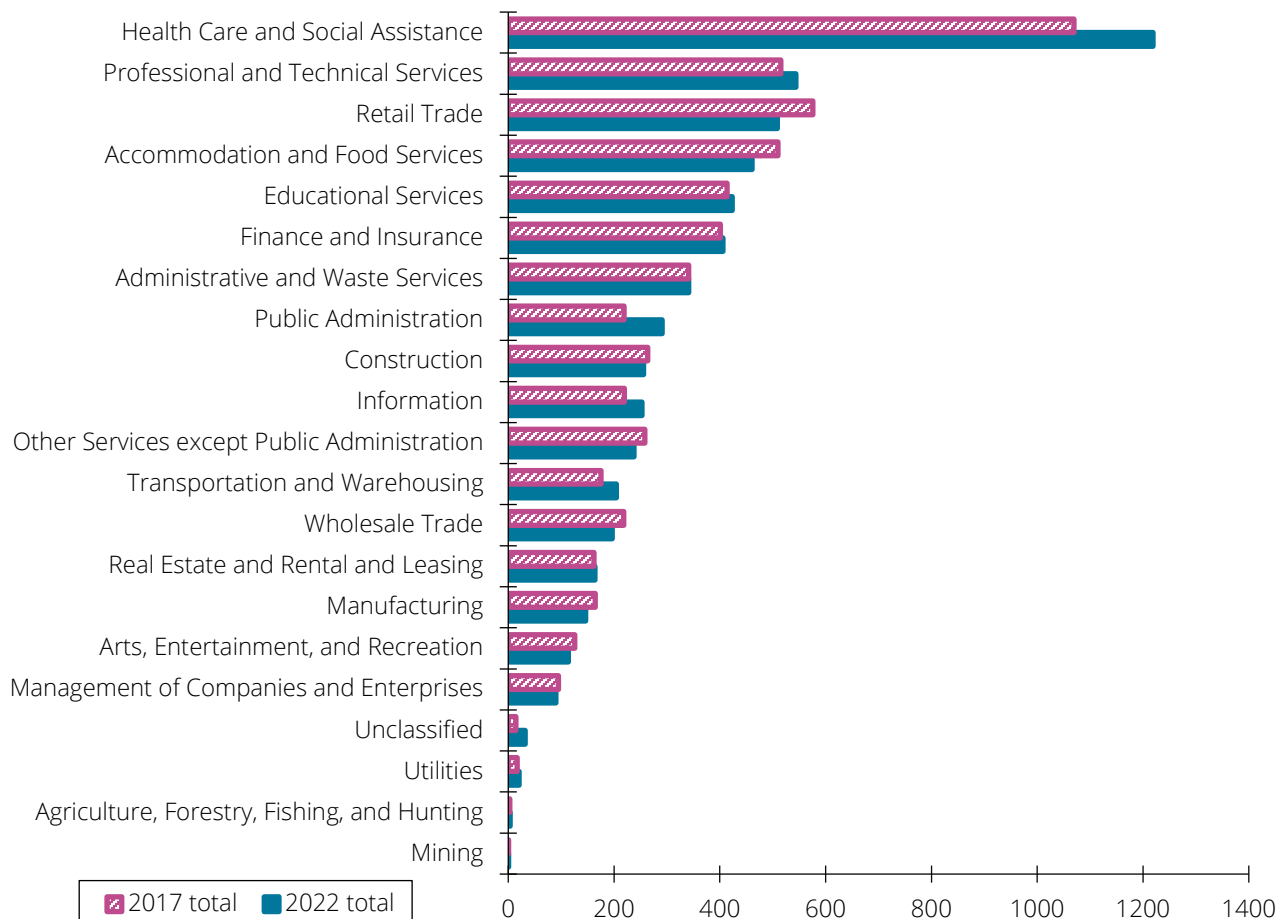


Source: NYMTC.

EMPLOYMENT

In 2022, approximately 7.2 million jobs were located within the NYMTC planning area, an increase of roughly 137,000 jobs, or just under 2 percent, compared to 2017 employment levels. As shown in Figure 3.6, the largest gains in employment across the NYMTC planning area occurred in the healthcare and social assistance sector, which already constituted the highest number of jobs. Between 2017 and 2022, healthcare and social assistance jobs increased by nearly 150,000 to just over 1.2 million. Notable increases in total jobs were also recorded across the public administration (increase of approximately 70,000 jobs), professional and technical services (increase of approximately 29,000 jobs), information (increase of approximately 33,000 jobs), transportation and warehousing (increase of approximately 29,000 jobs), educational services (increase of approximately 10,000 jobs), and finance and insurance (increase of approximately 5,000 jobs) sectors. By comparison, decreases in employment were observed in the retail trade (decrease of approximately 67,000 jobs), accommodation and food services (decrease of approximately 50,000 jobs), wholesale trade (decrease of approximately 22,000 jobs), other services except public administration (decrease of approximately 20,000 jobs), manufacturing (decrease of approximately 18,000 jobs) and construction (decrease of approximately 7,000 jobs) sectors.

Figure 3.6 Total Number of Jobs by Major Industry in the NYMTC Planning Area, 2017–2022 (Thousands)

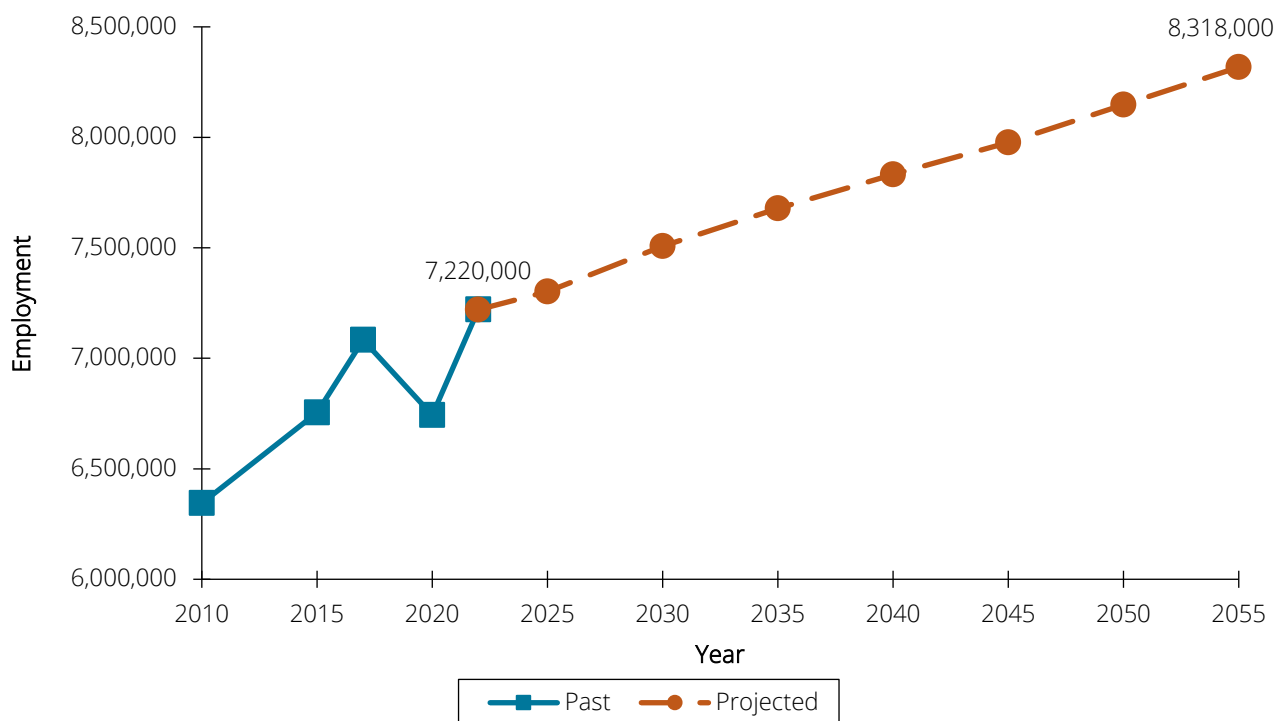


Source: U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages (2017–2022).

Over the six-year period, the fluctuations in employment by sector largely reflected the trends associated with the COVID-19 pandemic. This included widespread increases in demand for healthcare services, which contributed to the sector's pronounced growth, and such demand may grow further with the aging of the population in the NYMTC region. By comparison, the retail trade, as well as accommodation and food service sectors experienced drops in employment, reflecting reduced tourism and entertainment spending, as well as the challenging environment for restaurants and entertainment venues. At the same time, the professional and business services, as well as finance and insurance sectors both recorded slight increases, reflecting the overall economic resilience of the NYMTC planning area. Combined, both sectors constitute a substantial portion of the NYMTC planning area's white-collar employment, including within key financial hubs across NYMTC's urban and suburban areas.

Through 2055, employment growth is forecasted to continue over the planning period in a slower and more balanced pattern than seen in the past, as broadly shown in Figure 3.7. Overall, the forecasting region had a compound annual growth rate of 1 percent from 2010 through 2022 (1.6 percent from 2010 through 2017), although this is expected to moderate further over the planning period to 0.4 percent per year through 2055, factoring in assumptions of several economic cycles over the next three decades along with the recent effects of the COVID-19 pandemic. This annual growth results in a total increase of just over 14 percent, or 1.79 million jobs, over the time period of 2022 through 2055.

Figure 3.7 Employment Forecast for the NYMTC Planning Area



Source: NYMTC.

Detailed employment forecasts by geography shown in Table 3.22 and visualized in Figure 3.8. Employment in the New York City subregion is forecast to grow by 847,000 between 2022 and 2055, an increase of approximately 16 percent. This constitutes the majority of added jobs in the NYMTC planning area. Within

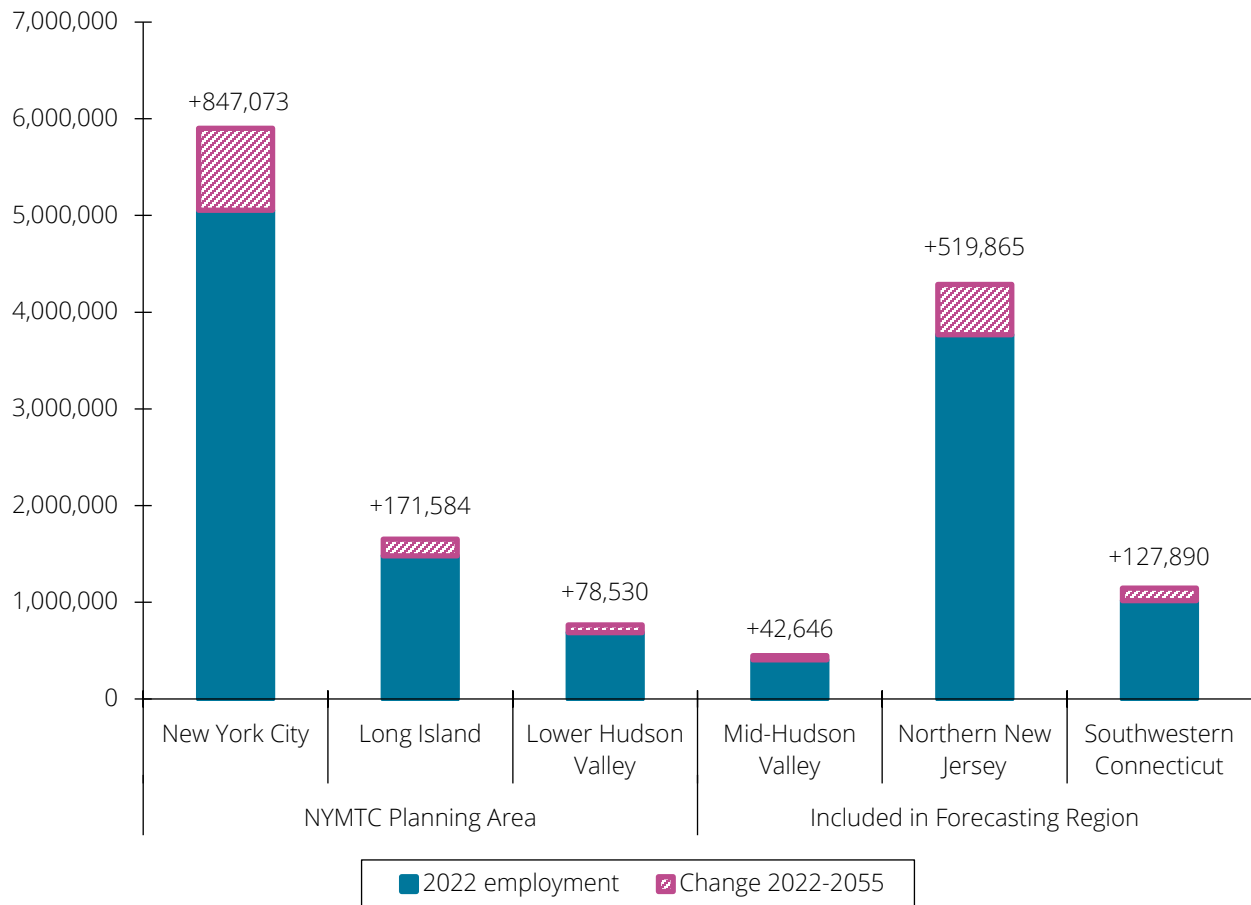
New York City, the centralization of job growth in the Manhattan core is anticipated to moderate, although Manhattan will continue to see the largest total increase in jobs. Employment growth in the outer boroughs is expected to continue as Brooklyn and Queens grow as regional job centers, outpacing Manhattan's growth. By 2045, employment in New York City's outer boroughs will be higher than those totals of Manhattan. Similarly, employment in those counties outside of New York City is expected to continue, with Nassau County expected to overtake Suffolk County as the largest employment hub. Both counties are expected to have over 800,000 jobs each, beginning in 2045. In the Lower Hudson Valley, Westchester County is expected to have approximately 557,000 jobs through 2055, an increase of approximately 53,000 over 2022, making it the largest employment hub in the subregion.

Table 3.22 Employment Trends and Forecasts by County/Borough and Subregion (Thousands)

Area	2010	2015	2017	2020	2022	2025	2030	2035	2040	2045	2050	2055
New York City Total	4,527	4,850	5,115	4,733	5,056	5,114	5,267	5,392	5,513	5,624	5,763	5,903
Bronx County	380	401	413	382	398	407	422	437	450	462	483	503
Kings County	823	903	941	922	1,021	1,040	1,080	1,115	1,151	1,182	1,215	1,248
New York County	2,489	2,654	2,832	2,497	2,626	2,644	2,696	2,737	2,765	2,793	2,821	2,849
Queens County	709	754	788	788	853	864	902	930	973	1,006	1,059	1,112
Richmond County	126	138	141	145	158	160	167	172	176	180	185	189
Long Island Total	1,227	1,285	1,324	1,368	1,479	1,494	1,534	1,566	1,586	1,607	1,629	1,651
Nassau County	591	613	631	666	728	737	762	781	794	807	821	835
Suffolk County	637	672	692	702	751	758	772	784	792	800	808	816
Lower Hudson Valley Total	590	619	645	641	685	693	707	721	732	746	755	764
Putnam County	28	29	30	31	34	34	35	35	36	36	36	36
Rockland County	117	122	129	136	148	150	154	158	161	164	167	170
Westchester County	445	467	486	473	504	509	518	527	536	546	552	557
NYMTC Planning Area Total	6,344	6,754	7,083	6,743	7,220	7,302	7,507	7,678	7,831	7,977	8,147	8,318

Source: NYMTC.

Figure 3.8 Employment Change by Subregion, 2022–2055



Source: NYMTC.

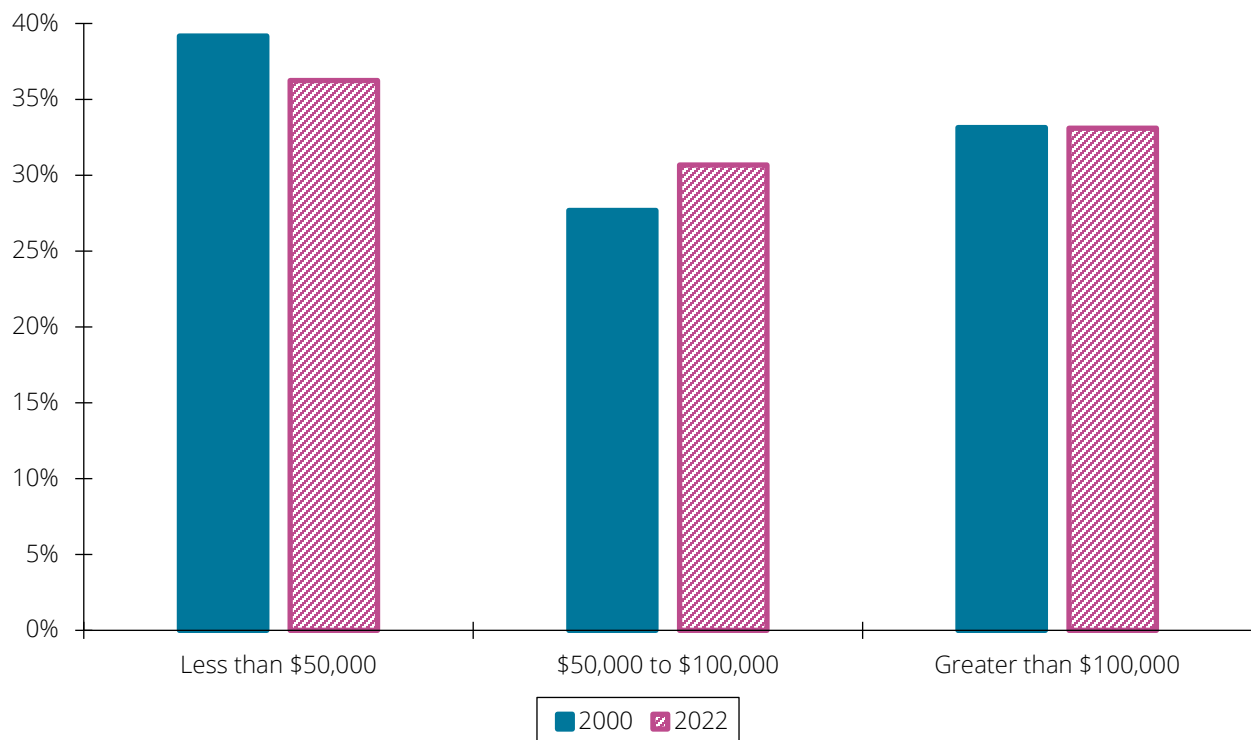
Outside of the NYMTC planning area, from 2022 to 2055, northern New Jersey's population is expected to grow as much as New York City's, although job growth will occur at a lower rate. This reflects a growing imbalance between residents and jobs within the subregions, with more residents in northern New Jersey and more jobs in New York City, potentially adding strain to the region's transportation system as more people need to commute longer distances.

In 2022, approximately 70 percent of all the jobs in the NYMTC planning area were in New York City. Roughly 2.6 million jobs were in Manhattan, constituting more than the rest of New York City combined, approximately 35 percent of jobs in the NYMTC planning area, and approximately 20 percent of jobs in the broader forecasting region. The employment forecast anticipates a rebalancing of growth throughout the NYMTC planning area with continued strong employment growth outside of New York City. From 2022 through 2055, employment is expected to grow in suburban Long Island and the Lower Hudson Valley by approximately 11.5 percent in each of those subregions, in the Mid-Hudson Valley by 10.5 percent, and in Southwestern Connecticut by 12.5 percent. Among subregions outside of New York City, northern New Jersey is expected to see the largest numerical and proportional increase in jobs, with nearly 14 percent growth between 2022 and 2055.

INCOME

In 2022, the real median household income in the NYMTC planning area was approximately \$104,000, nearly 140 percent of the U.S. average of just below \$75,000. Consistent with national trends, the median household income for the NYMTC planning area has been on the rise since 2013. Among the three subregions, Long Island had the highest median household income in 2022 at approximately \$128,000, followed by the Lower Hudson Valley at approximately \$106,000, and New York City at nearly \$78,000. At the county level, Nassau County had the highest median household income at nearly \$137,000, while the Bronx had the lowest at just under \$46,000. It is notable that from 2017 to 2022, counties in Long Island experienced the most substantial income growth (approximately 30 percent), while counties in Lower Hudson Valley had the smallest increase, around 15 percent (note all income trend statistics are inflation-adjusted to 2022 dollars). Between 2000 to 2022, there has been a notable shift in the distribution of household income within the planning area. When looking at three income brackets—less than \$50,000; between \$50,000 and \$100,000; and greater than \$100,000—the data shows a 3 percent decrease in the share of lower-income households (earning less than \$50,000). Conversely, the share of middle-income households (earning between \$50,000 and \$100,000) grew by approximately the same margin (3 percent), indicating an upward shift of households into the middle-income bracket. The proportion of households earning more than \$100,000 has remained relatively stable over this period, suggesting limited but steady growth in the highest income category (Figure 3.9).

Figure 3.9 Percentage of Households in Each Income Bracket



Source: U.S. Census Bureau, 2000 Census; 2022 American Community Survey (ACS) 1-Year Estimates.

The New York City subregion continues to have the highest share of households with incomes of less than \$50,000. In 2022, Long Island became the subregion with the greatest share of households with incomes greater than \$100,000 at 46 percent (Table 3.23). The Long Island subregion is also home to the greatest share of households within the \$50,000 to \$100,000 income bracket. These variations suggest that the migratory and economic impacts of COVID-19 may have differentially influenced the growth and distribution of household income distribution across the subregions, although further analysis is required to examine the magnitude of each impact, and the degree to which this is the case.

Table 3.23 Percent Share of Household Income by Subregion

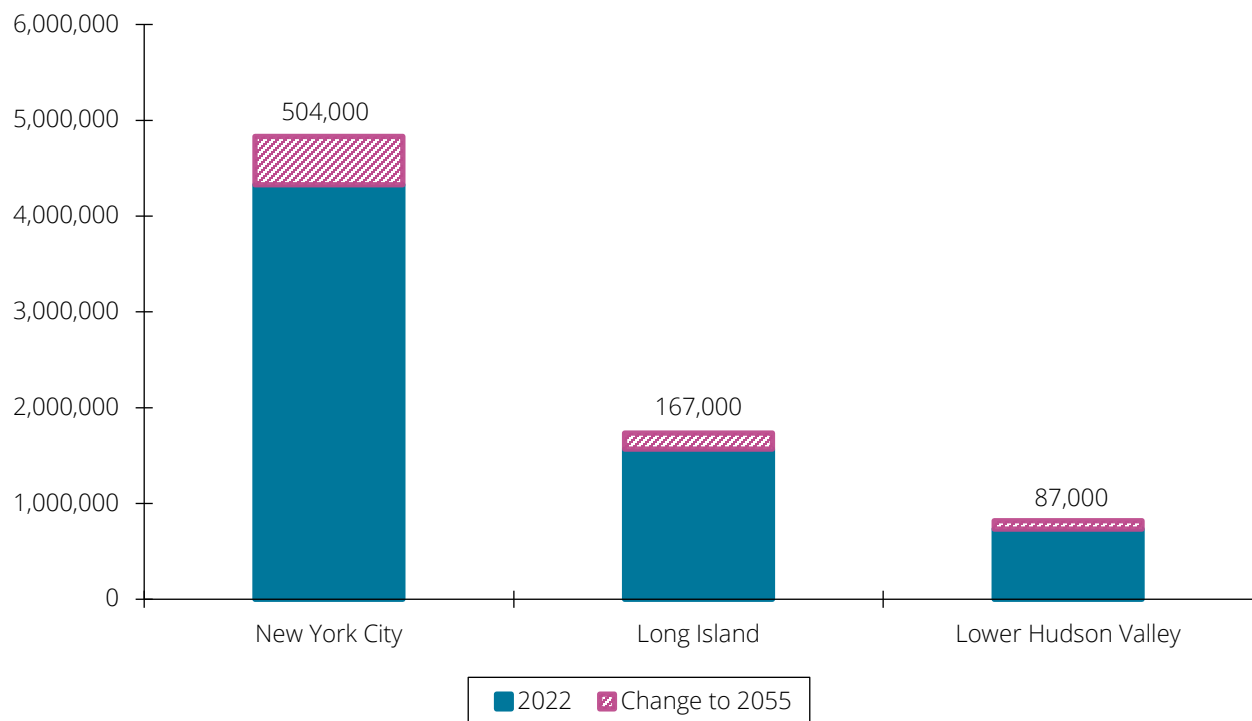
Year	Subregion	< \$50,000	\$50,000–\$100,000	> \$100,000
2000	New York City	38%	38%	24%
	Long Island	27%	39%	34%
	Lower Hudson Valley	21%	32%	48%
2022	New York City	42%	30%	28%
	Long Island	21%	33%	46%
	Lower Hudson Valley	28%	30%	41%

Source: U.S. Census Bureau, 2000 Census; 2022 ACS 1-Year Estimates.

LABOR FORCE

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Overall, the number of eligible workers in the NYMTC planning area is projected to grow to about 7.4 million by 2055, an approximately 11 percent increase from 2022, as seen in Figure 3.10 and Table 3.24 . From 2022 to 2055, the Lower Hudson Valley is projected to experience the highest growth rate at nearly 12 percent, while Long Island is expected to have the lowest at just under 11 percent. Although New York City's labor force growth rate at 11.6 percent is slightly lower than Lower Hudson Valley's, the City is expected to contribute about two-thirds of all labor force additions within the area, translating to approximately 504,000 additional eligible workers. Across the region, the growth of the labor force is also supported by an increase in the participation of older adults who may delay retirement or re-enter the workforce, due to rising costs of living and an increase in jobs more suitable for these demographics. Moreover, policies supporting flexible work arrangements and part-time opportunities for older adults may help sustain a larger labor force.

Figure 3.10 Labor Force Change by Subregion, 2022–2055

Source: NYMTC.

Table 3.24 Labor Force Trends and Forecasts by County/Borough and Subregion (Civilian Labor Force Size in Thousands)

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County & Subregion	2022	2025	2030	2035	2040	2045	2050	2055
New York City Total	4,327	4,338	4,472	4,573	4,676	4,759	4,805	4,831
Bronx	624	651	673	689	709	726	738	744
Kings	1,338	1,284	1,330	1,367	1,401	1,424	1,435	1,447
New York	925	969	1,003	1,028	1,054	1,074	1,082	1,085
Queens	1,198	1,202	1,236	1,258	1,280	1,298	1,311	1,315
Richmond	242	231	230	231	233	237	239	240
Long Island Total	1,568	1,517	1,516	1,587	1,637	1,668	1,710	1,735
Nassau	739	724	730	776	804	817	838	853
Suffolk	829	794	786	811	832	851	872	882
Lower Hudson Valley Total	733	738	747	765	783	798	814	820
Putnam	53	52	52	53	54	55	56	57
Rockland	158	169	175	184	193	202	211	219
Westchester	522	517	520	528	536	541	546	545
NYMTC Planning Area Total	6,628	6,593	6,735	6,925	7,096	7,225	7,328	7,386

Source: NYMTC.

3.3.4 WHERE GROWTH WILL LIKELY OCCUR

NYMTC uses the forecasting data to improve long-term transportation planning including which areas may grow by population or work force, increasing the need for further transportation investment. This effort is guided by the objective to produce fair, sustainable, and safe recommendations for meeting the region's evolving growth needs, which is found under *Moving Forward 2055's* Shared Vision Resiliency goal.

The NYMTC planning area is forecasted to continue to experience population and employment growth throughout the planning period. After a rapid post-pandemic recovery, the population in the NYMTC planning area is expected to slightly surpass 2020 levels by 2030. Afterwards, however, growth is expected to slow down over time. This longer-term deceleration in growth is in line with previous analyses and mainly comes from likely growth constraints across the planning area. The forecast also assumes more geographically balanced longer-term population and employment growth, compared to the last 10 years of more centralized growth in the core of the planning area, implying greater medium-term growth in the suburban subregions of the NYMTC planning area compensating for greater short-term growth in New York City.

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. All regions will see their respective job numbers increase by at least 10 percent from 2022 to 2055. Outside of New York City however, the largest relative growth in both population and employment—by measure of percentage increase, and absolute growth, will be in northern New Jersey.

COUNTY/BOROUGH GROWTH PATTERNS

At the county/borough level in New York City, Kings County (Brooklyn) is projected to lead all counties/boroughs in population growth, total household growth, and civilian labor force growth during the planning period, while Manhattan is projected to lead employment growth. Brooklyn and Queens County are projected to continue to grow as centers of regional employment, with each borough gaining more than 200,000 jobs through 2055. The Bronx (Bronx County) is projected to experience the highest proportional increases in population, total households, and civilian labor force in the New York City subregion through 2055.

Within the Long Island subregion, Nassau County will likely experience more absolute and relative (percentage) growth in population, employment, and the civilian labor force, while Suffolk County will experience more growth in total households. In the long term, Long Island counties will see steadily rising job growth through 2055. In the Lower Hudson Valley, Rockland County will experience the highest proportional increase in population, total households, and average household size through 2055. 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 forecasted to add the most jobs through 2055 in the Lower Hudson Valley.

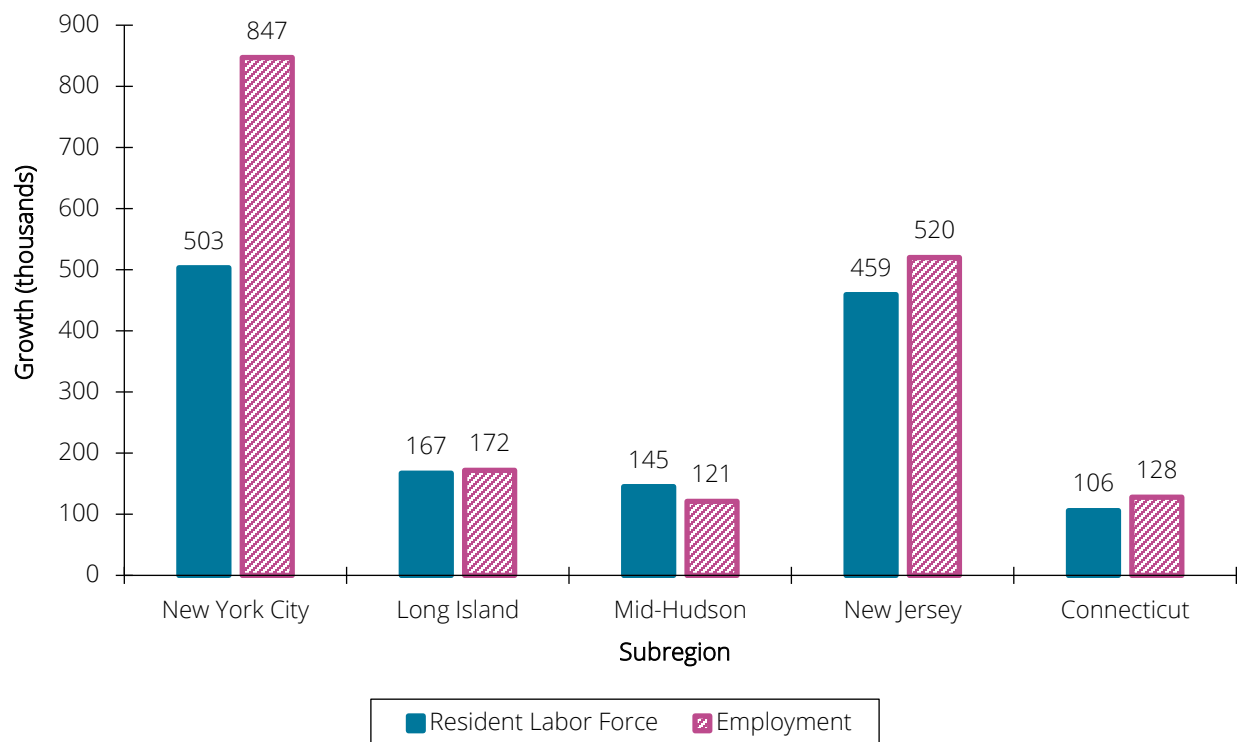
Outside the NYMTC planning area and considering the counties of the multistate metropolitan region, for northern New Jersey, Hudson County is expected to have the largest population and employment growth, both by numerical and percentage change. The county, adjacent to New York City, is expected to add over 200,000 people (29 percent growth), and nearly 80,000 jobs (24 percent growth). Among counties in southwestern Connecticut, Fairfield County is expected to have the largest absolute population growth, adding nearly 151,000 people (16 percent growth), while adding nearly 67,000 jobs. Both Fairfield and New Haven Counties will experience the largest relative employment growth among NYMTC counties in Connecticut at 13 percent.

EMPLOYMENT AND LABOR FORCE GROWTH BALANCE

Comparing the forecasted growth in employed residents (labor force) versus employment (number of jobs) can provide insights into how commuting patterns might change in the region (Figure 3.11). New York City job growth is expected to outpace the number of employed residents; Long Island and the Lower Hudson Valley are expected to see resident labor force growth nearly match or exceed that of employment through 2055 (see Appendix B).

In addition to changes in labor force and job growth, 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—will play a role in filling workforce demand.

Figure 3.11 Labor Force Growth vs. Employment Growth in the Forecasting Region, 2022–2055 (In Thousands)



Source: NYMTC.

3.4 TRAVEL DEMAND TRENDS AND FORECASTS

SED trends and forecasts are critical inputs for the modeling of travel demand in the NYMTC planning area. The SED projections described in Chapter 3.3 (and in more detail in Appendix B) are inputs into the New York Best Practice Model (NYBPM), the travel demand simulation model used to generate forecasts of travel demand. NYMTC uses the NYBPM to predict and simulate detailed travel patterns for every household in the 28-county study area, over a 24-hour weekday period, based on their travel behavior. NYMTC projects travel for people and goods in the multistate metropolitan region 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. Projections 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. NYMTC's [Moving Forward 2055 Interactive Map](#) also visualizes vehicular and truck traffic as a component of overall travel demand trends and forecasting.

3.4.1 IMPACTS OF THE COVID-19 PANDEMIC

The COVID-19 pandemic dynamically shifted travel patterns in 2020. While travel patterns have gradually trended toward pre-COVID conditions since 2021, significant differences still remain. Significant shares of the workforce continue to work remotely for some or all days of the week (also known as work from home, telecommute, or telework), decreasing travel demand to workplaces. As a result, transit ridership in the NYMTC region as a whole remains lower than pre-COVID levels, even as some transit agencies have actually started to see increases. Total vehicle travel, conversely, has recovered to pre-COVID levels and was not as affected by the increase in remote work. SED forecasts try to account for many of these changes by incorporating new employment and population data, as well as updated labor force projections, to better understand future travel demand. The SED forecasts do not directly incorporate the impacts of remote work trends on future locations of households and employment.

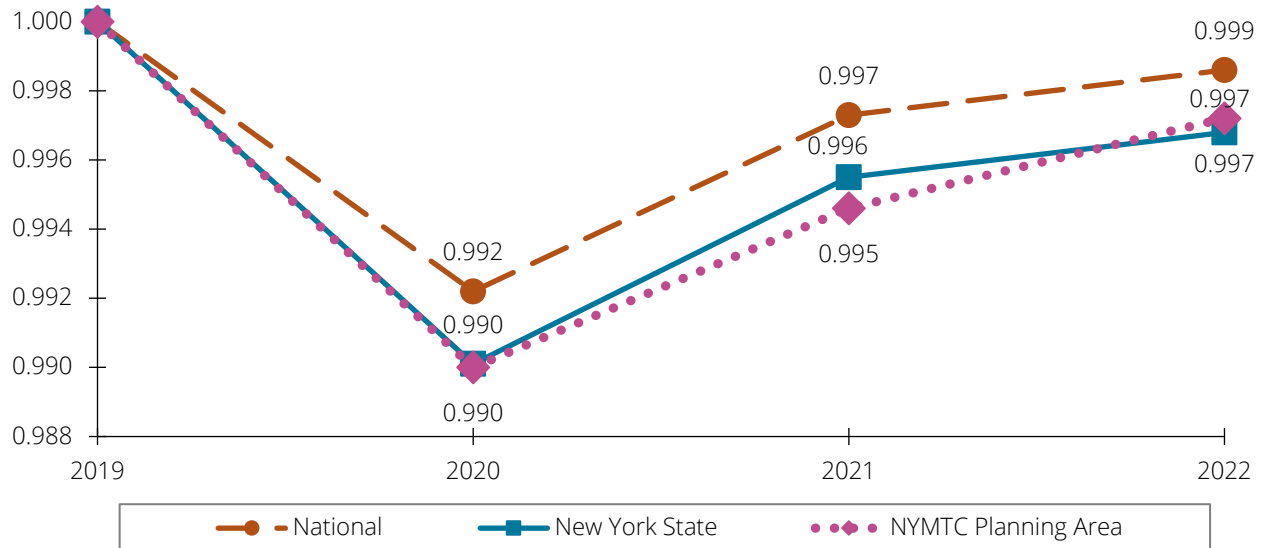
TRAVEL PATTERNS

Since the onset of the COVID-19 pandemic in 2020, travel patterns and trends have shifted throughout the NYMTC planning area and larger multistate New York metropolitan region. The pandemic impacted the level and type of travel in the NYMTC planning area. Available data indicates that a significant portion of the workforce continues to work remotely during a typical week, leading to a decrease in work-related travel. The pandemic outbreak resulted in comprehensive lockdowns that began in earnest in mid-March 2020 and lasted for several months. These were followed by expanded work from home policies and various social distancing measures that remained in effect at varying levels through 2022.

Pandemic impacts on short-term vehicular travel can be illustrated through trends in VMT at the national and state levels, as well as for NYMTC's planning area. Figure 3.12 presents those trends for 2019 through 2022. Although all three trends (national, state, region) show the same general pattern—VMT reduction in 2020 followed by gradual recovery in the subsequent years—the comparative trends shown in Figure 3.12

demonstrates that VMT in New York State and the NYMTC planning area saw a slightly greater relative reduction than was seen nationally and a slightly slower recovery. Logarithmic transformations of the data values are used in the figure, since logarithmic scaling provides a clearer view of data given the large variances in the scale of the VMT values at the national and state and regional levels.

Figure 3.12 Comparative VMT Trends (in Log Values)

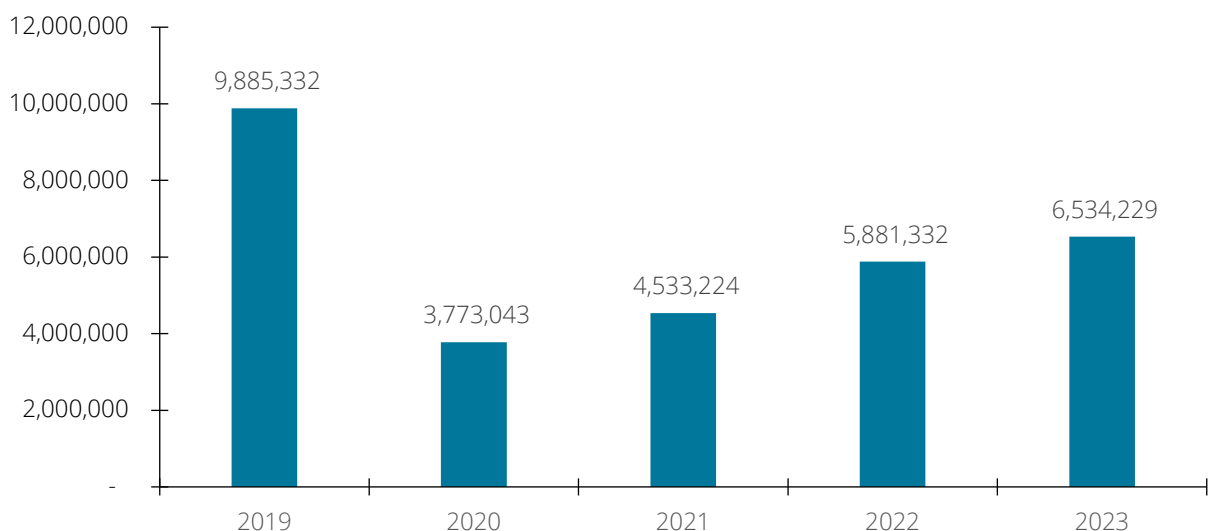


Source: FHWA; NYSDOT.

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The pandemic also resulted in a decline in transit ridership in the NYMTC planning area. Although ridership remains below pre-pandemic levels, it has increased gradually since 2020. Figure 3.13 presents average weekday transit ridership in the NYMTC planning area from 2019 through 2023. The transit ridership figures are a compilation of MTA rail and bus services, trans-Hudson rail via Port Authority Trans Hudson (PATH) and NJ TRANSIT, airport rail access and suburban bus systems.

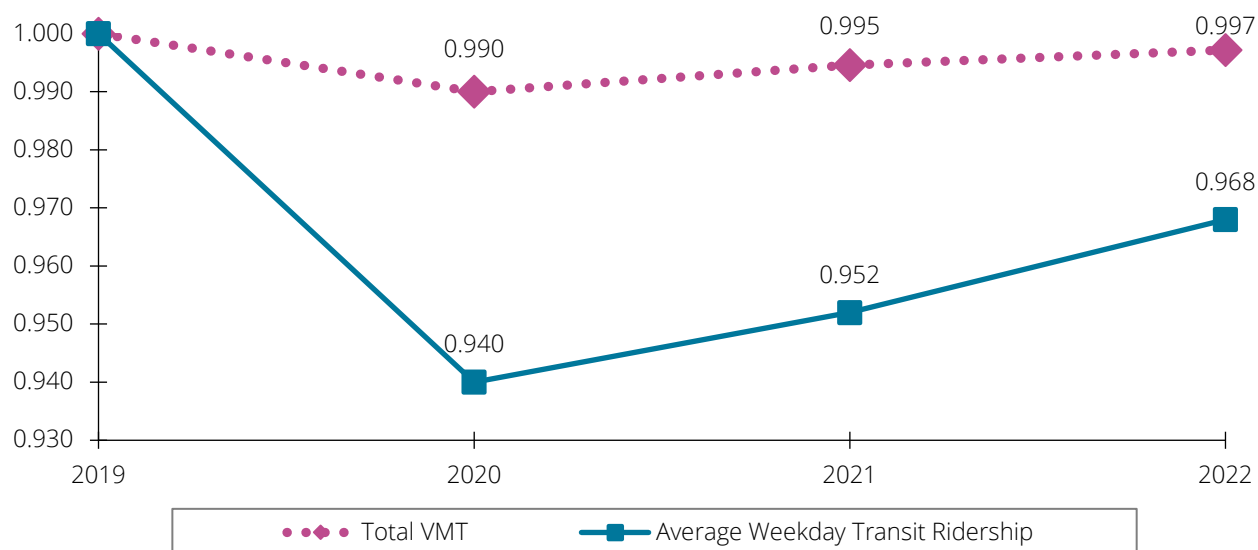
Figure 3.13 Average Weekday Transit Ridership in the NYMTC Planning Area



Source: NYMTC Travel Patterns.

As can be seen in Figure 3.14, although the transit ridership trend is similar to that for VMT in form, the transit ridership decrease in the pandemic year was significantly deeper than that for VMT and the recovery significantly slower. Logarithmic scaling is again used to provide a clearer view of data given the large variances in the scale of the VMT values and average transit ridership.

Figure 3.14 Comparative Trends—VMT and Transit Ridership (in Log Values)



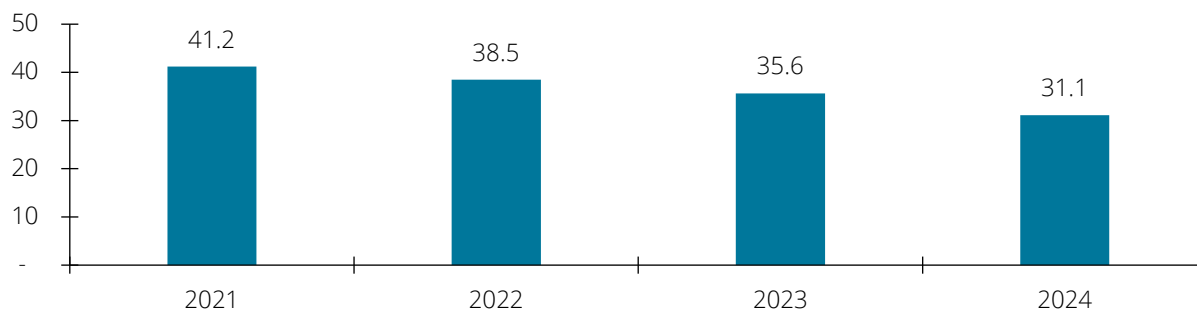
Source: NYMTC *Travel Patterns*; NYSDOT.

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WORK FROM HOME

Data on work from home is fragmented, with multiple sources and various methods of assessment. The Survey of Working Arrangements and Attitudes (SWAA), a monthly online survey run jointly by the University of Chicago, Autonomous Technological Institute of Mexico (ITAM), Massachusetts Institute of Technology (MIT), and Stanford University, began in May 2020 in response to the dramatic impact of COVID-19 on working arrangements. SWAA defines cities using Combined Statistical Areas (CSA) to delineate metropolitan regions. This survey produced time series data on the percentage of full paid work days that were work from home. Figure 3.15 presents average monthly work from home days as a percent of full paid days for the New York City CSA, demonstrating the downward trend of this percentage.

Figure 3.15 Average Monthly Work From Home Percentage by Year (New York CSA)

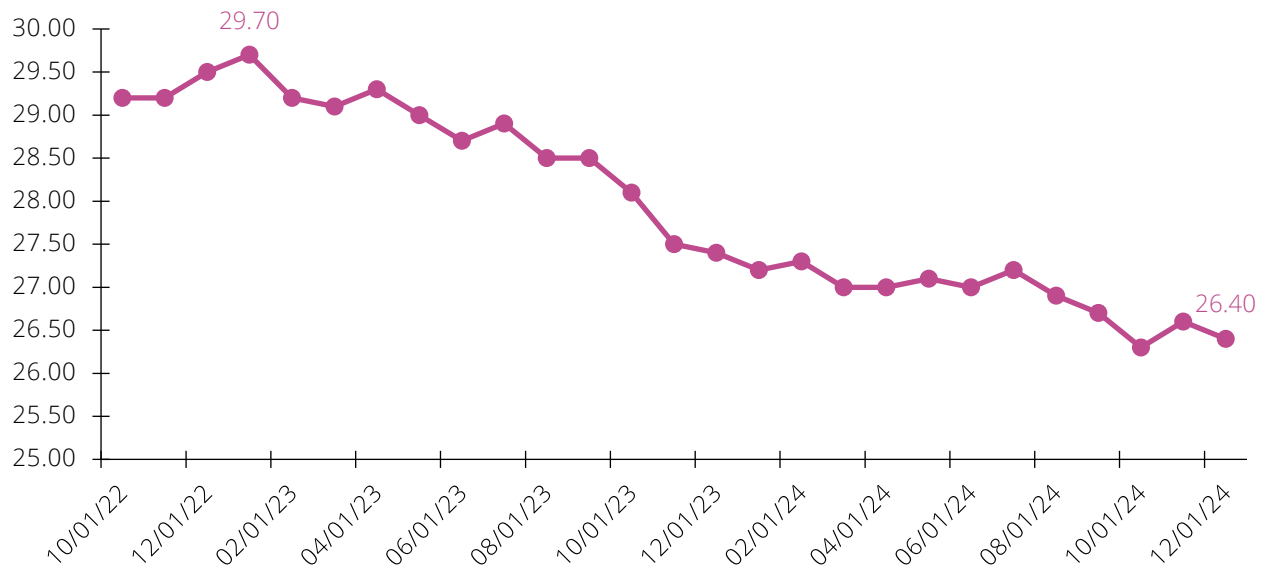


Source: Survey of Working Arrangements and Attitudes.⁴

The Current Population Survey (CPS) from the U.S. Bureau of Labor Statistics provides information on the nation's labor force, including data on the employed, unemployed, and those not in the labor force. The survey was redesigned for telework data collection in October 2022 with questions on whether people had teleworked or worked at home for pay in the survey reference week and the number of hours teleworked. In the resulting analyses, telework or work at home for pay is frequently referred to simply as "telework."

Figure 3.16 shows the national average of weekly telework hours beginning in October 2022. The trend presented in the figure shows a decreasing trend in the average hours teleworked, which is generally consistent with the SWAA results for the New York CSA. The CPS does not present data by city or region.

Figure 3.16 Average Weekly Hours Teleworked (Oct 2022–Dec 2024)



Source: U.S. Bureau of Labor Statistics—Current Population Survey⁵

The New York City Department of City Planning (DCP) used the 2023 American Community Survey (ACS) from the U.S. Census Bureau and determined that roughly 13 percent of the resident workforce in the NYMTC planning area worked from home at some level of frequency; this translates to roughly 855,000 workers. However, since these data did not distinguish between fully home-based workers or those who telecommute on various days, it is difficult to quantify the impacts on weekday travel demand.

Determining how the work from home estimates described above impact overall transportation demand is difficult to say for certain given the data limitations, different units of measure, and unknown factors. However, these trends are still critical for anticipating the longer-term impacts of remote work on travel demand, if any. While work from home is not new, the pandemic and technological advances expanded it on a larger scale, resulting in higher rates of remote work. Available data suggests those rates have not been stable in the short-term and are falling in the aftermath of the pandemic. Given that, forecasting impacts in the longer-term is difficult both from a technical perspective and because of uncertainties surrounding the reasons for current trends and future work rules and labor practices. Translating data into measurable impacts on travel and transportation demand is challenging due to these limitations and uncertainties. Continued monitoring will be required to establish any future projections.

3.4.2 HISTORICAL TRENDS

VEHICLE ACCESS

In 2022, almost 2.88 million households in the NYMTC planning area had regular access to a vehicle, which was about 59.3 percent of all households in the planning area (or an aggregate number of about 4.8 million vehicles accessible to households in the NYMTC planning area). Compared to 2010, the proportion of households with vehicle access has decreased from 60 percent of all households. The reason for this decrease is primarily driven by the decrease in the proportion of households in New York City that have access to a vehicle (see Table 3.25). On Long Island, alternatively, the percentage of households with vehicle access increased from 94.0 percent to 94.3 percent. The share of total vehicles available for each subregion has not changed substantially: 43 percent of vehicles are associated with households in New York City, 40 percent are in suburban Long Island, and the Lower Hudson Valley has 17 percent of all vehicles in the region. Additionally, automobiles are the predominant commuting mode choice for all counties in the NYMTC planning area except for Manhattan, the Bronx, Queens, and Brooklyn.

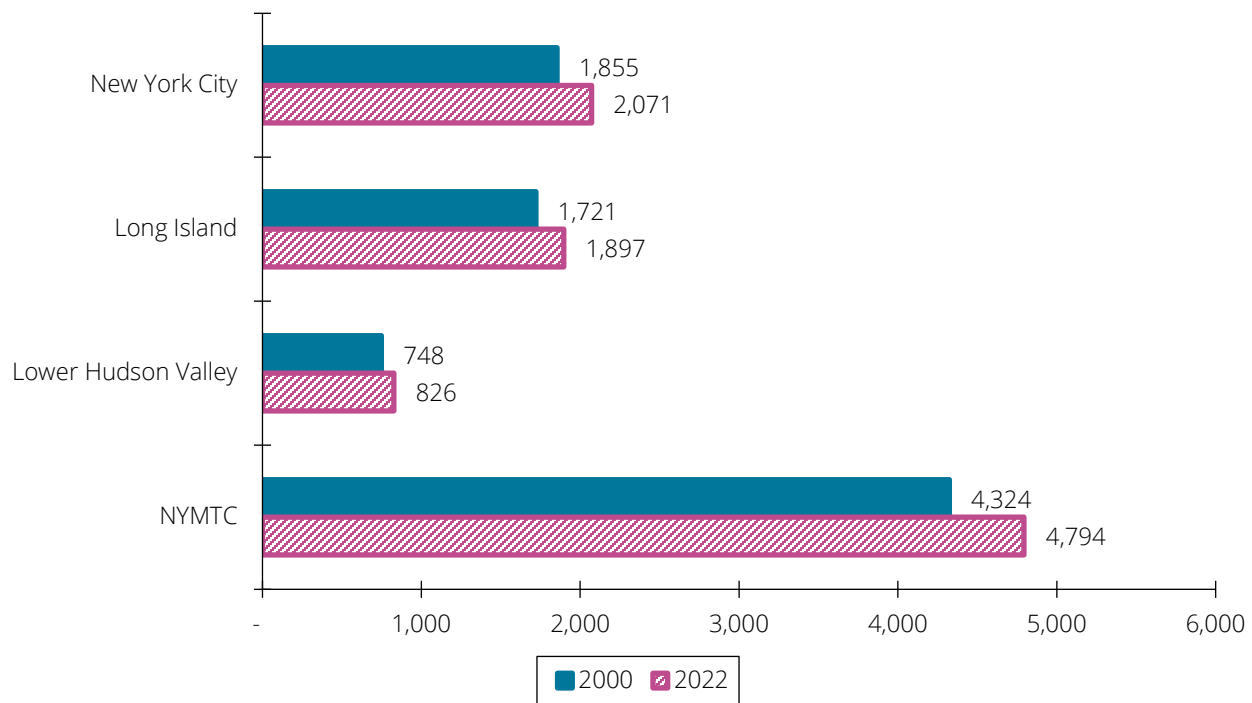
Table 3.25 Percent of Households with Vehicle Access by Subregion, 2000–2022

Subregion	2000	2010	2022
New York City	44.3%	45.4%	45.0%
Long Island	93.5%	94.0%	94.3%
Lower Hudson Valley	86.9%	87.5%	87.4%
NYMTC Planning Area	59.0%	60.1%	59.3%

Source: U.S. Census Bureau, 2000 Census, 2006–2010 ACS 5-year estimates, 2022 ACS 1-year estimates.

Despite the slight decrease regionwide in the proportion of households with vehicle access, the aggregate number of vehicles for all households has increased over the past two decades as the number of households and people has increased (see Figure 3.17). The number of households with vehicle access increased by 7 percent, or by an additional 195,000 households. The aggregate number of vehicles in the planning area increased by 6 percent, or an additional 257,700 vehicles.⁶ While the number of households with regular access to a vehicle have increased, there has been little change in the proportion of households with such access.

Figure 3.17 Aggregate Number of Vehicles in the NYMTC Planning Area by Subregion (Values in Thousands)



Source: U.S. Census Bureau, 2000 Census, 2022 ACS 1-year estimates.

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As described earlier, the NYMTC planning area is forecasted to have a modest increase in the total number of households and jobs, which will contribute to an increased number of vehicles being used in the region. This is especially true for the Lower Hudson Valley and Long Island subregions, which have a higher proportion of household vehicular access.

PUBLIC TRANSIT USAGE

Up until the onset of the COVID-19 pandemic, the NYMTC planning area had experienced a steady increase in public transit ridership. From 2010 to 2018, the number of people using public transit to commute to work increased by 11 percent or nearly 247,000 people according to U.S. Census figures. This is the largest increase for all travel modes used for work during this time period. In 2019, based on the five-year average (2015-2019) from the U.S. Census ACS, public transit reached a 42 percent commute mode share, nearly equaling commuting by private vehicle (see Table 3.26). New York City residents' accessibility to various job centers by public transit is a significant contributor to the continued growth in public transit usage in the NYMTC planning area.

Public transit ridership (rather for commute trips or non-commute trips) has not fully recovered to pre-pandemic levels. Nonetheless, public transportation does remain an important mode of transportation for residents and workers in the region. In 2023, ridership on New York City Transit's subways was more than 1.15 billion, reflecting how the subway system is still used by hundreds of thousands of riders daily.⁷ MTA bus ridership was more than 426 million in 2023. Long Island Rail Road and Metro-North Railroad also

continue to see increasing ridership year over year since 2020, with the former surpassing 65 million trips in 2023⁸ and the latter reaching over 60 million trips in the same year.⁹

Table 3.26 Means of Transportation to Work for the NYMTC Planning Area, 2010–2023

Year	Car, Truck, or Van	Public Transportation	Walked	Taxicab, Motorcycle, Bicycle, or other Means	Worked from Home
2010	46%	40%	7%	2%	4%
2019 ¹	44%	42%	7%	3%	4%
2022	42%	32%	6%	4%	16%
2023	41%	35%	7%	4%	13%

Source: U.S. Census Bureau: 2010 Census, 2015–2019 ACS 5-year estimate, 2022 and 2023 ACS 1-year estimates.

¹ The 2019 estimates are a 5-year estimate representing average commuting characteristics from 2015–2019.

COMMUTING PATTERNS

U.S. Census Bureau data provides a snapshot of commuting patterns (Table 3.27). In 2020, in the five boroughs of New York City, approximately 74 percent or more of workers commuted within their home county or to/from Manhattan (ranging from a low of 74 percent for Staten Island to a high of 90 percent for Manhattan). In Manhattan, approximately 86 percent of resident-workers commuted within the borough. Outside of the boroughs of New York City, the commute patterns are different. For example, in Long Island, 88 percent of resident-workers in Suffolk County commute within the county or to Nassau County. In Nassau County, 58 percent of resident-workers commute within the county and another 15 percent commute to Manhattan. In the Lower Hudson Valley, the pattern in each county is unique, for example in Putnam County only 39 percent of resident-workers commute within the county while in Westchester County, 63 percent of resident-workers commute within the county.

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 2020, approximately 9 percent of New Jersey workers and 8 percent of workers from the Western Connecticut Planning Region, were employed in New York City.¹⁰

Table 3.27 Top Work Location by Residence, 2020

Residence (County / Borough)	Work Location	Share of Total Workers
Bronx	Bronx	44%
	Manhattan	37%
Kings/Brooklyn	Brooklyn	51%
	Manhattan	38%
New York / Manhattan	Manhattan	86%
	Bronx	3%
Queens	Queens	45%
	Manhattan	34%
Richmond / Staten Island	Staten Island	51%
	Manhattan	23%
Nassau	Nassau	58%
	Manhattan	15%
Suffolk	Suffolk	77%
	Nassau	11%
Putnam	Westchester	33%
	Putnam	39%
Rockland	Rockland	62%
	Manhattan	10%
Westchester	Westchester	63%
	Manhattan	20%

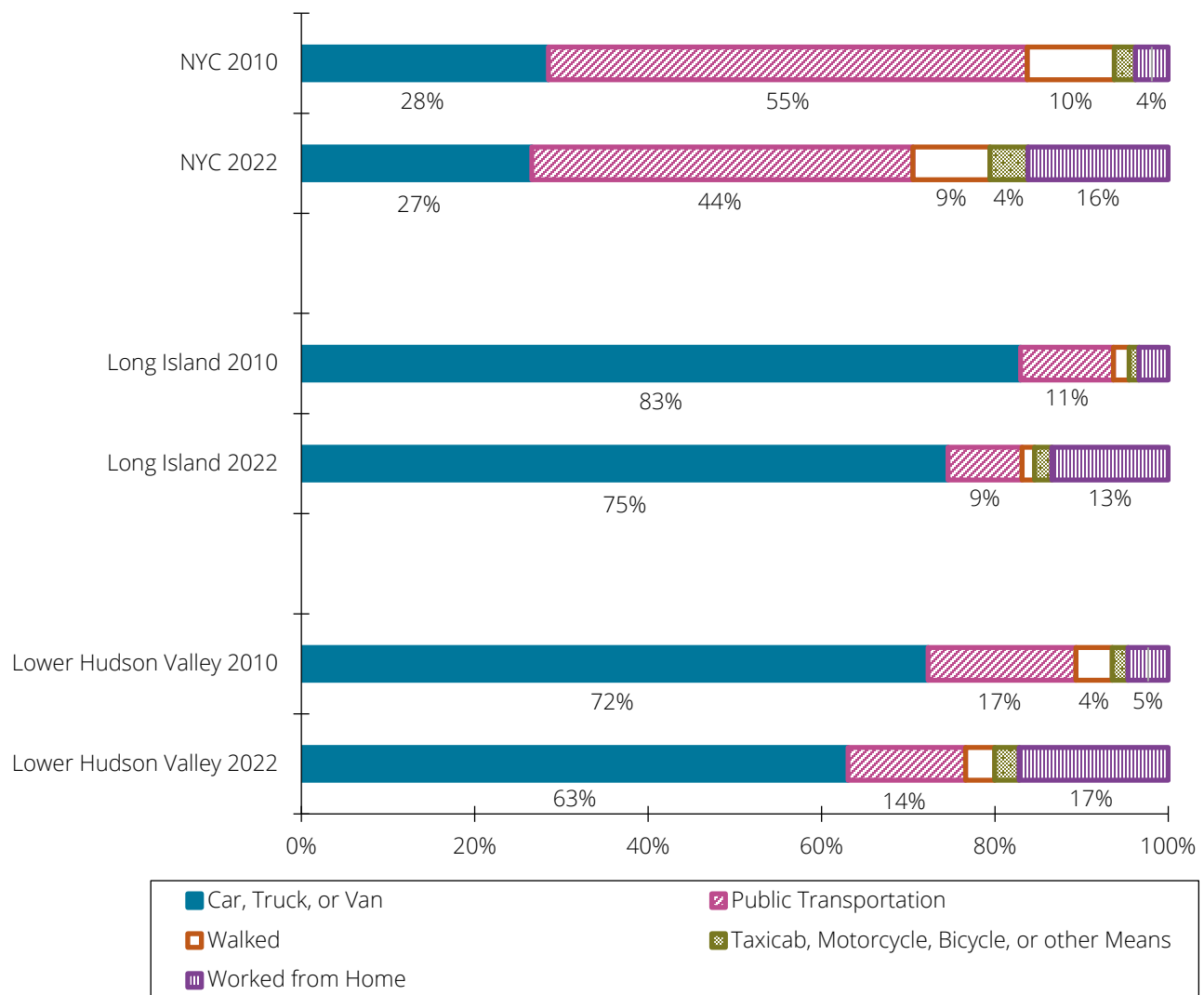
Source: U.S. Census Bureau, 2016–2020 ACS 5-year estimates.

A notable trend has been the increase in the number of people working from home. As described in Section 3.4.1, the COVID-19 pandemic dynamically shifted travel patterns in 2020. While those travel patterns have gradually trended toward pre-COVID conditions since 2021, substantial differences remain through 2025. Significant shares of the workforce continue to work remotely for some or all days of the week, decreasing travel demand to workplaces. As a result, transit ridership in the NYMTC region as a whole remains lower than pre-COVID levels, even as some transit agencies have started to see ridership increases. Total vehicle travel, conversely, has recovered to pre-COVID levels and was not as affected by the increase in remote work.

Between 2019 and 2022, the NYMTC planning area saw a fourfold increase (2015–2019 ACS 5-year estimates compared to the 2022 ACS 1-year estimates) in commuters working from home (see Table 3.26). With an increase in the proportion of remote workers, there has been a noticeable decrease in the number of workers who take public transit to work. Figure 3.18 compares mode choice for daily commuting by subregion between 2010 and 2022. In New York City, the increase in work from home is primarily offset by

a decline in transit commuting. In Long Island and the Lower Hudson Valley, the increase in work from home is primarily offset by a decline in commuting by private vehicle (car, truck, or van) and to a far lesser extent a decline in transit.

Figure 3.18 Transportation Mode Choice for Daily Commuting Trips by Subregion



Source: U.S. Census Bureau, 2006–2010 ACS 5-year estimates, 2022 ACS 1-year estimates.

Despite an increase in the number of workers who work from home, there is still a significant number of NYMTC planning area workers that travel long distances and/or face substantive congestion on a daily basis and thus have commutes greater than 60 minutes each way. In 2022, 32 percent of workers employed in New York City and 37 percent of Manhattan workers commuted longer than 60 minutes in each direction.¹¹ 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 3.27

Table 3.27). In turn, these imbalances further highlight regional transit infrastructure and housing needs.

As described in Section 3.4.1 and this section, available data suggests that work from home rates have not been stable in the short-term and are falling in the aftermath of the pandemic. Given that, forecasting impacts in the longer-term is difficult both from a technical perspective and because of uncertainties surrounding the reasons for current trends and future work rules and labor practices. Translating existing data into measurable impacts on travel and transportation demand is challenging due to these limitations and uncertainties.

3.4.3 TRAVEL FORECASTS

TRAVEL DEMAND

Table 3.28 displays NYBPM travel forecasts for the NYMTC planning area. Growth in travel is expected to occur in the NYMTC planning area and its subregions across the modes of auto travel and transit. Total daily trips are projected to reach approximately 30 million by 2050, an increase of 11 percent from 2019. Daily auto trips are expected to grow by 13 percent, while daily transit trips are forecast to grow by 7 percent. Similarly, 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. The increase in VMT of 12 percent is commensurate with the increase in daily auto trips of 13 percent, as more vehicles directly lead to higher VMT.

Table 3.28 Travel Forecasts for the NYMTC Planning Area

Travel Forecast	2019	2050	Percentage Change 2019–2050
Total Daily Trips	26,323,088	29,190,509	11%
Daily Auto Trips	17,741,882	20,027,492	13%
Daily Transit Trips	8,581,206	9,163,017	7%
Daily VMT	123,660,640	138,532,952	12%
Daily VHT	3,781,828	4,821,593	27%

Source: NYMTC.

Table 3.29 and Table 3.30 show the daily auto trip origins (columns) and destinations (rows) of the counties in the NYMTC planning area. As the tables demonstrate, most of the vehicle trips are taken within the counties of their origin. This indicates that most of the trips are for local purposes such as commuting to work or school or traveling for errands. This also means that the local road networks are heavily used and are mostly well-suited for short, intra-county trips.

Table 3.29 Daily Auto Trip Origins and Destinations (2019)

County	Manhattan	Queens	Bronx	Kings	Staten Island	Nassau	Suffolk	Westchester	Rockland	Putnam	Total
Manhattan	876,634	163,242	140,099	104,316	17,153	21,392	7,534	80,842	5,220	844	1,417,276
Queens	141,556	1,384,633	29,416	210,623	8,790	403,764	35,889	15,259	3,991	1,531	2,235,452
Bronx	131,447	28,698	701,304	18,354	4,100	11,199	2,858	124,851	4,214	1,352	1,028,377
Kings	86,245	211,855	18,817	1,911,609	23,985	80,968	16,554	3,997	2,886	690	2,357,606
Staten Island	16,052	12,152	4,620	26,031	373,002	5,152	2,339	1,979	643	160	442,130
Nassau	13,417	347,754	12,908	75,946	4,899	2,794,613	395,016	3,578	988	519	3,649,638
Suffolk	4,292	45,793	3,480	19,694	2,897	381,938	3,295,407	2,085	667	382	3,756,635
Westchester	63,538	16,803	112,170	5,369	2,146	3,862	2,226	1,904,231	48,282	15,588	2,174,215
Rockland	2,869	4,187	4,277	3,021	611	729	498	58,508	417,088	1,313	493,101
Putnam	455	1,715	1,310	794	171	403	348	16,056	1,579	164,619	187,450
Total	1,336,505	2,216,832	1,028,401	2,375,757	437,754	3,704,020	3,758,669	2,211,386	485,558	186,998	17,741,880

Source: NYMTC.

Table 3.30 Daily Auto Trip Origins and Destinations (2050)

County	Manhattan	Queens	Bronx	Kings	Staten Island	Nassau	Suffolk	Westchester	Rockland	Putnam	Total
Manhattan	982,001	165,534	160,400	105,123	15,147	21,217	10,274	83,595	4,985	836	1,549,112
Queens	138,954	1,559,372	32,238	259,883	9,729	415,905	40,180	16,800	3,085	1,494	2,477,640
Bronx	158,057	32,326	831,815	22,723	4,384	9,482	3,134	142,752	3,404	1,211	1,209,288
Kings	87,467	264,616	23,742	2,254,807	24,885	84,743	18,959	4,423	2,069	653	2,766,364
Staten Island	14,520	13,852	5,199	28,895	400,740	5,477	2,568	2,277	621	186	474,335
Nassau	12,569	358,036	10,480	80,140	4,720	3,240,543	437,533	4,343	781	486	4,149,631
Suffolk	5,257	49,888	3,522	21,904	3,118	425,533	3,796,911	2,466	736	364	4,309,699
Westchester	65,828	19,177	129,781	6,001	2,305	4,409	2,606	1,960,801	53,308	16,411	2,244,216
Rockland	2,712	3,098	3,003	2,009	566	674	555	62,784	553,283	1,456	630,140
Putnam	431	1,751	1,153	730	199	399	313	16,933	1,716	177,028	200,653
Total	1,467,796	2,467,650	1,201,333	2,782,215	465,793	4,208,382	4,313,033	2,297,174	623,988	183,714	20,011,078

Source: NYMTC.

VEHICULAR USAGE

Daily VMT in the NYMTC region is expected to rise by approximately 12 percent during the planning period (Table 3.31). At the subregional level, Long Island is projected to have the highest percentage growth in VMT at 14 percent, whereas the increase for New York City and Lower Hudson Valley are both 11 percent by 2050.

Table 3.31 Daily VMT by County/Borough and Subregion

County & Subregion	2019	2050	Change
New York City Total	46,139,383	51,073,290	11%
Bronx	6,920,705	7,810,373	13%
Brooklyn	11,893,196	13,522,297	14%
Manhattan	7,523,708	8,121,836	8%
Queens	16,309,627	17,723,477	9%
Staten Island	3,492,148	3,895,307	12%
Long Island Total	50,907,228	57,799,612	14%
Nassau	24,576,191	27,579,455	12%
Suffolk	26,331,037	30,220,157	15%
Lower Hudson Valley Total	26,614,029	29,660,049	11%
Putnam	2,516,629	2,695,225	7%
Rockland	5,625,222	6,763,655	20%
Westchester	18,472,178	20,201,169	9%

Source: NYMTC.

VHT reflects the congestion and reliability of vehicular travel, primarily in terms of travel speed. In the NYMTC planning area, VHT is projected to rise by 27 percent by 2050. Among the subregions, Long Island will experience the greatest percentage growth in VHT, increasing by nearly 20 percent by 2050, compared to 19 percent for the Lower Hudson Valley and 37 percent for New York City (Table 3.32).

Table 3.32 Daily VHT by County/Borough and Subregion

Subregion	2019	2050	Change
New York City Total	1,733,176	2,371,980	37%
Bronx	198,651	265,492	34%
Brooklyn	515,354	746,287	45%
Manhattan	389,716	568,043	46%
Queens	528,244	659,384	25%
Staten Island	101,210	132,773	31%
Long Island Total	1,437,951	1,724,660	20%
Nassau	750,948	898,330	20%
Suffolk	687,003	826,330	20%

Subregion	2019	2050	Change
Lower Hudson Valley Total	610,701	724,953	19%
Putnam	50,300	53,775	7%
Rockland	126,617	168,304	33%
Westchester	433,784	502,873	16%

Source: NYMTC.

COMMODITY FLOWS

The NYMTC planning area is a key region for goods movement. In 2021, approximately 438 million tons of goods valued at \$715 billion moved into, out of, and through the region by truck, rail, water, air, and pipeline (Table 3.33). Most of the goods—43 percent of the total tonnage—are traveling into the region, to residents and businesses within the planning area. Trucks are the primary transportation mode, accounting for 94 percent of regional volume and 96 percent of value. By 2055, the freight tonnage and value will increase marginally, 1.1 percent and 1.9 percent respectively (Table 3.34). While trucks will remain the predominant transportation mode, increases in tonnage of freight traveling by pipeline, air, water, and rail modes are also expected.²

Table 3.33 NYMTC Planning Area Freight Movement by Direction (2021)

Direction	Tons 2021 (Million)	Tons 2021 Percent	Value 2021 (\$Billion)	Value 2021 Percent
Inbound	188	43%	297	41%
Internal	57	13%	81	11%
Outbound	61	14%	89	12%
Through	133	30%	249	35%
Total	438	100%	715	100%

Source: Cambridge Systematics analysis of S&P Global Transearch, 2021.

² Commodity flow data is provided by S&P Global Transearch tool which tracks historic U.S. supply chain freight flows and provides forecasts out by origin, destination, commodity, and transportation mode.

Table 3.34 NYMTC Planning Area Forecast Freight Movement by Direction (2021–2055)

Direction	Tons 2055 (Million)	Tons Compound Annual Growth Rate (2021–2055)	Value 2055 (\$Billion)	CAGR 2021–2055)
Inbound	273	1.1%	548	1.8%
Internal	83	1.1%	140	1.6%
Outbound	86	1.0%	161	1.8%
Through	204	1.3%	504	2.1%
Total	646	1.1%	1,353	1.9%

Source: Cambridge Systematics analysis of S&P Global Transearch, 2021.

According to analysis of Transearch data, the primary commodities in the NYMTC planning area include chemicals and allied products, secondary traffic, and food and kindred products, all of which are expected to have continued growth through 2055. Electrical equipment is projected to grow the fastest, with tonnage increasing by 4 percent annually and value by 3.8 percent from 2021 to 2055.

By far the largest trading partners for inbound and outbound tonnage and value are the states of New York, New Jersey, and Pennsylvania, which is expected to remain true in 2055. By tonnage, inbound from Pennsylvania and outbound to the rest of the New York area are anticipated to grow faster. By value, freight inbound from New Jersey is estimated to be doubled in 2055 compared to 2021, at a 2 percent annual growth rate.

The Regional Freight Element of *Moving Forward 2055* is contained in Appendix D and contains a detailed discussion of recent trends and forecasts for commodity flows during the planning period.

TOURISM

Tourism plays a significant role in the regional and subregional economies by contributing tax revenues, driving purchases at businesses, and helping create or sustain jobs that support the tourism industry. It also significantly impacts mobility patterns such as trip generation, or the frequency and disbursement of transportation trips within a region. Tourism-related travel can lead to congestion, for both vehicles and pedestrians, near major attractions or as a result of events such as Fashion Week or the Thanksgiving Day Parade and is often influenced by peak season travel. Tourism also fuels the travel of workers in supporting industries such as hospitality and retail as well as regional ripple effects in neighboring areas such as New Jersey, Long Island, and the Hudson Valley.

In 2023, visitors to New York state spent \$88 billion, and generated a total economic impact of \$137 billion, the third consecutive year of double-digit percentage growth.¹² Visitor volumes appear to have fully recovered since pandemic-era declines; visitor volumes in 2023 increased 5 percent from the previous year, a total of 306.2 million visitors. The increasing number of tourists has many benefits, but it also places additional strain

on the transportation network as more people use the airways, roadways, and transit infrastructure to travel to and within the region.

SUBREGIONAL TRAVEL IMPACTS

The NYMTC planning area draws some of the largest tourist volumes in the world with implications for local transportation spending, seen in Table 3.35. Most of the region’s tourism and local transportation spending is concentrated in New York City. In fact, some of 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 join commuters on subway, buses, ferries, and commuter rail systems, in addition to taxis and ride-hailing services. Some international travelers to New York City take regional rail or bus service to attractions in other parts of the multistate metropolitan region.

Table 3.35 Visitors’ Local Transportation Spending by County

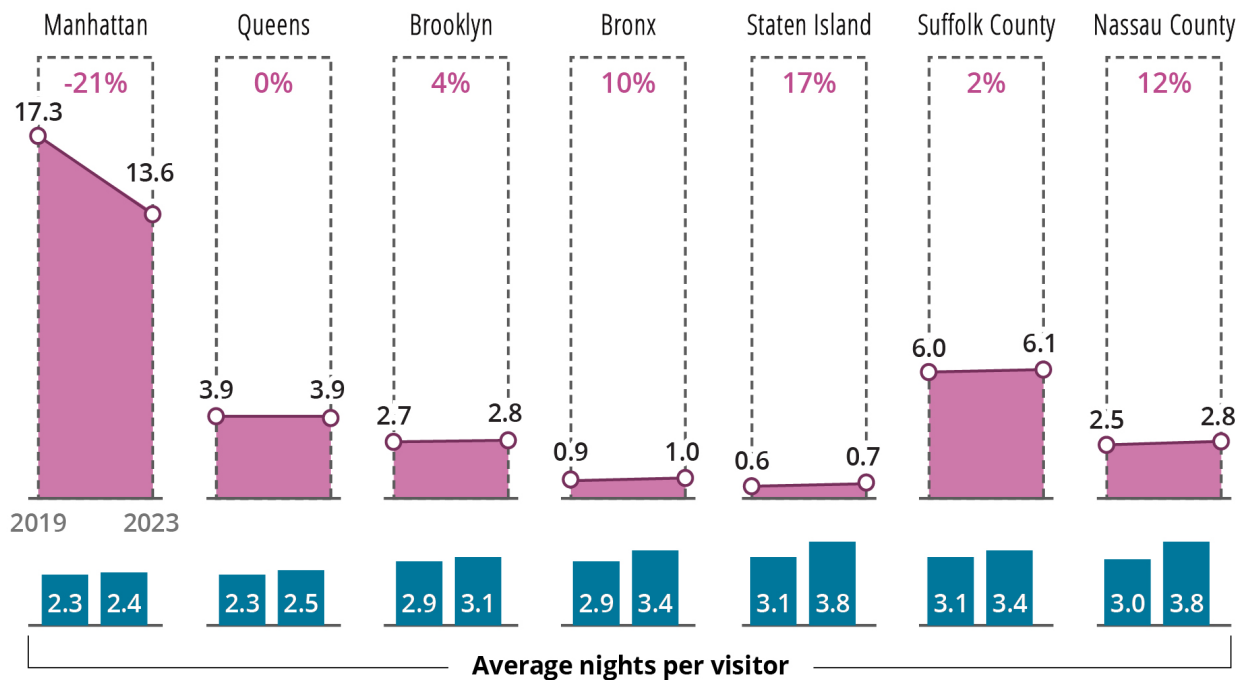
Counties	Local Transportation Spending by Visitors in 2023
New York City (encompassing the five boroughs)	\$10.1 billion
Nassau County	\$372 million
Putnam County	\$2 million
Rockland County	\$31 million
Suffolk County	\$607 million
Westchester County	\$223 million
Total	\$11.335 billion

Source: New York State Tourism Industry Association.

While New York City is a key draw for visitors, travel outside of Manhattan is growing with complementary impacts to transportation. From 2019 to 2023, annual visits to Manhattan declined by 21 percent (Figure 3.19). Conversely, visits to Staten Island, Nassau County, and the Bronx increased by 10 percent or more. Some of these may be day trips but average nights per visitor in these areas have also increased with the longest stays in Staten Island and Nassau County.

Figure 3.19 Annual Visits to the New York City Region, 2019–2023

Annual visits to New York City and Long Island, million visitors¹



Source: Placer Labs via McKinsey & Company.

¹ Visitors with a mobile “home” location >50 miles away.

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, LIRR and ferry services experience increased ridership for access to popular beaches and barrier islands. In 2023, visitors spent \$7.643 billion on Long Island, up from \$6 billion in 2018.¹³ 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, parks, wildlife, and a 300-year-old history of farming and fishing.

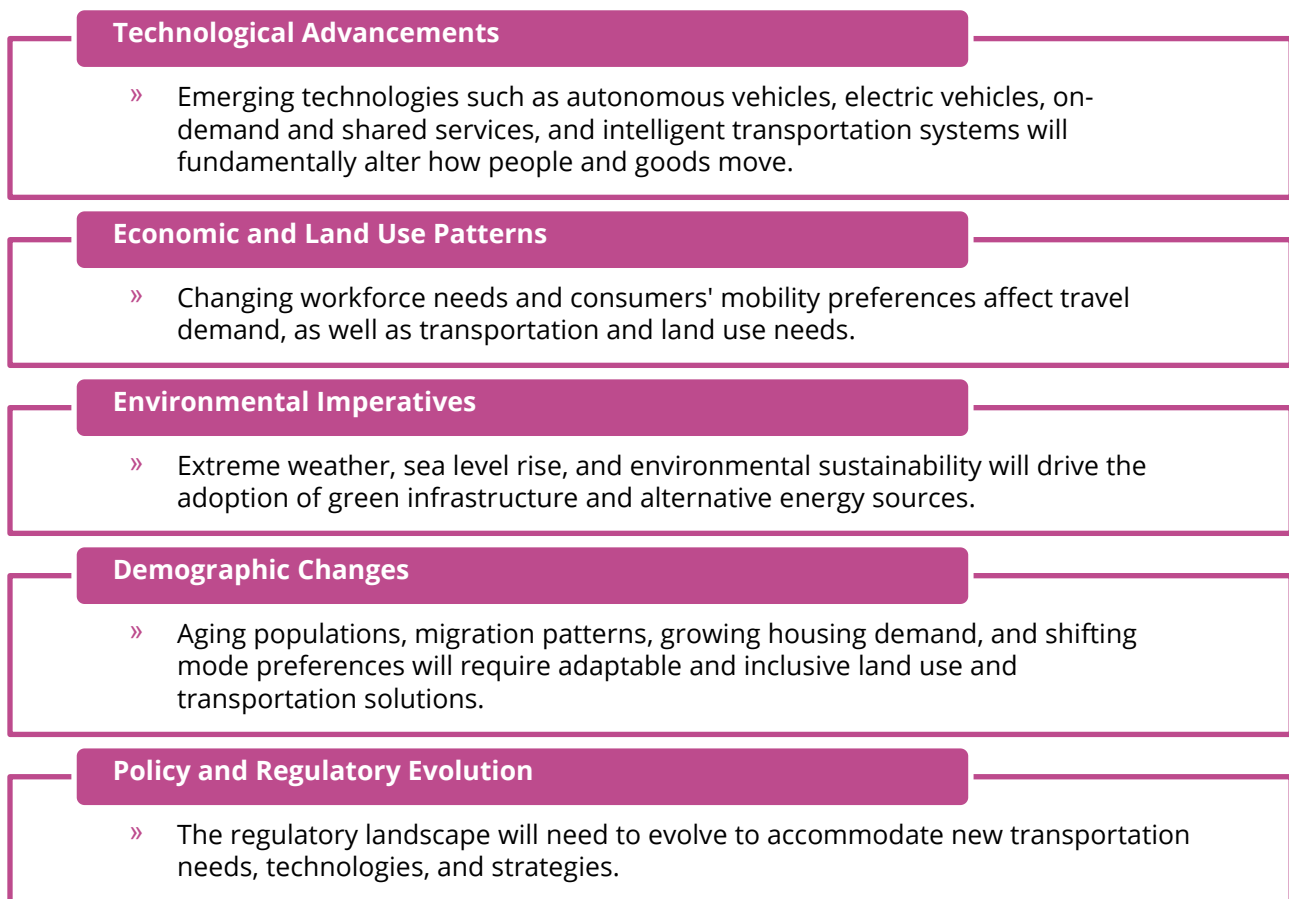
The Lower Hudson Valley continues to grow as a major tourist destination. According to Tourism Economics, traveler spending in 2023 for the Hudson Valley was \$5 billion, an increase of 8 percent compared to the previous year with the strongest growth in Putnam County. Westchester represents 43 percent of the Lower Hudson Valley’s tourism sales.¹⁴ The Lower Hudson Valley is well known for its hiking trails, historic estates and sites, State Parks, national historical sites, farms and farmers markets, and the fine arts. 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.

3.5 ASSUMPTIONS ON TRANSFORMATIVE CHANGE

Moving Forward 2055 seeks to highlight and navigate complexities and uncertainties that will affect transportation system planning and development and system utilization by people and goods over the long-term. This plan acknowledges that the transportation landscape is undergoing significant changes driven by technological advancements, evolving societal needs, and global trends. By assessing these transformative factors, *Moving Forward 2055* caveats its future forecasts to anticipate the possible impacts these factors may present.

The long-term impacts of these complexities and uncertainties are dependent on assumptions about global and regional changes over the next 30 years. These assumptions may enhance or diminish the scale and probability of the transformative changes identified in the plan. Figure 3.20 presents these assumptions.

Figure 3.20 *Moving Forward 2055* Assumptions on Transformative Change



Source: Cambridge Systematics.

It is important to note the 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. However, there is a significant degree of certainty that transformative changes will alter the demand for transportation and the way transportation services are provided during the planning period. This section will explore those potential impacts.

3.5.1 FUTURE TRENDS AND DISRUPTORS FRAMEWORK

Moving Forward 2055 identifies two types of transformative changes—Trends and Disruptors. Trends are predictable patterns in the development of these changes that will likely affect how the transportation system operates into the future. Conversely, Disruptors are sudden changes that impact how the transportation system operates, but their timing and impact can vary. In some cases, the Trends and Disruptors may become interconnected, and even overlap. For example, the COVID-19 pandemic was a Disruptor that affected how people work, travel, spend money, and interact in public spaces almost overnight. While the pandemic accelerated some habits, such as telecommuting, this mode of working has existed for decades, and researchers can predict how remote work will evolve based on historic and current demographic data, which makes it a Trend. *Moving Forward 2055* identifies several Trends and Disruptors that will shape transportation over the next several decades, as seen in Table 3.36 and Table 3.37.

Trends highlight the drivers of transformative change. These trends are more predictable, follow economic patterns, and impact mobility over longer timeframes.

Table 3.36 Summary of Long-Term Impacts of Trends

Virtual Economy	Shared Mobility	Technological Advancements	Distribution Innovations and Goods Movement
» Reduced VMT and emissions » Reduced transit ridership » Less predictable travel patterns » Changes in land use » Mixed effects on underserved groups » Increased congestion related to last-mile deliveries	» Mixed effect on emissions reductions » Increases transportation options » Increases transportation access for underserved groups » Opportunities to improve transit through on-demand service, and payment and scheduling	» Potential to reduce emissions and VMT » Mixed effect on safety and security » Concerns about fairness and bias » Changes in land use » Integration of ground and air travel modes » Lack of consistency in regionwide implementation of technological advancements	» Increase in last-mile deliveries and related congestion » Increase in industrial land uses in residential areas » Public health and fairness concerns » Increased demand for curb and parking management practices » Opportunities to integrate intermodal freight

Disruptors are less predictable both in timing and impact, vary in intensity, and can lead to sudden changes in mobility.

Table 3.37 Summary of Long-Term Impacts of Disruptors

Sea Level Rise, Extreme Heat, and Extreme Weather Events	Energy Transformation	Changing Demographics and Lifestyles	Changing Land Use Patterns	Cybersecurity
» Cost of damage to infrastructure	» Infrastructure Development	» Aging populations and reliance on transit	» Shifting land uses with warehousing boom and updated zoning policies	» Disruptions to travel
» Disruptions to movements of people and goods	» Impact of policies	» Accessibility/ knowledge gaps	» Adaptive reuse and shifting travel patterns	» ITS/CAV vulnerabilities
» Reduced life cycles for bridges and pavement	» Uncertainty of long-term financial planning and the Gas Tax replacement	» Rise in gig economy and shifting travel patterns	» Housing affordability and urban sprawl	» Workforce upskilling to meet cybersecurity needs
» Uncertainty in long-range financial planning	» Disruptions to utility grids	» Shifting mode preferences	» TODs as affordable housing solutions	» Safety concerns as barrier to technology adoption
» Policy impacts on long-term planning	» Safety concerns for new energy alternatives	» In-and-out migration shifting population and transit needs		

The Trends and Disruptors are analyzed using three overarching lenses, including:

- » **Feedback**—Incorporates public and stakeholder interpretations of priorities and potential impacts.
- » **Fairness**—Recognizes that not all the impacts will be felt equally and identifies opportunities to mitigate unique burdens when they exist.
- » **Uncertainty**—Acknowledges the inherent unpredictability in planning for the future.

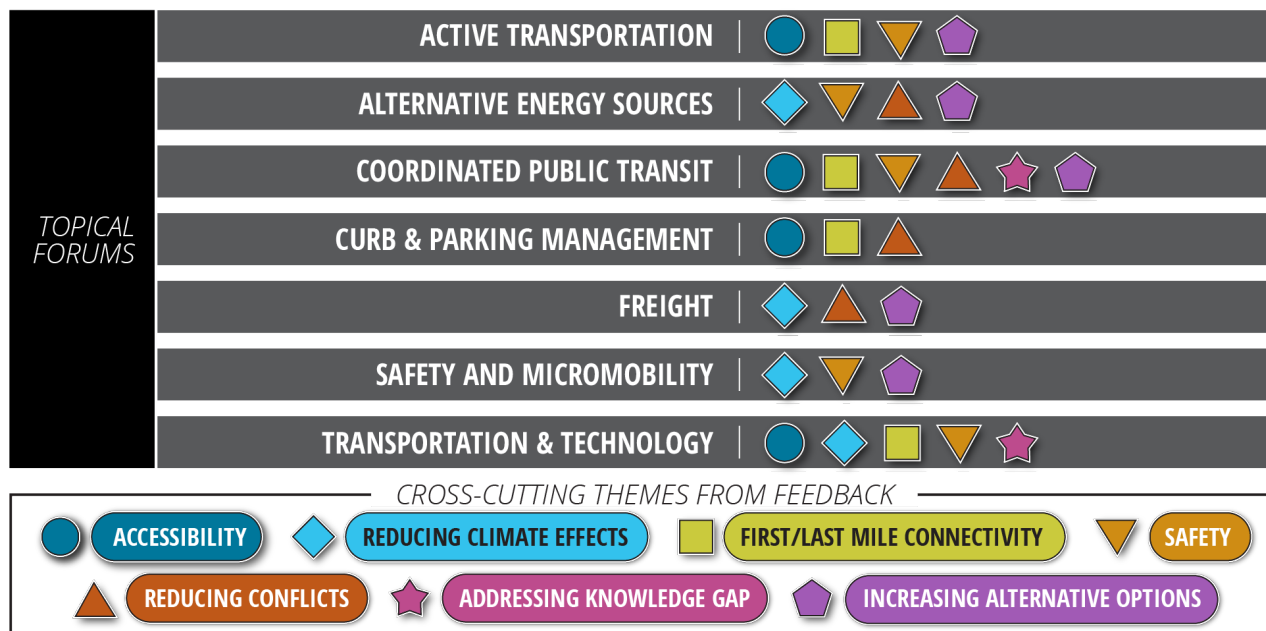
These lenses are applied throughout the Trends and Disruptors section and detailed below. The risks and opportunities of the Trends and Disruptors are also further explored to better understand how possible scenarios may impact the Region's ability to achieve its Vision and Goals.

3.5.2 FEEDBACK

During the development of *Moving Forward 2055*, NYMTC solicited public feedback to better understand the public's interest, concerns, and overall sentiment on a variety of transportation topics in the region. This was completed using (1) an online interactive survey tool, which received nearly 3,000 responses across the study area; (2) Focus Groups addressing Human Services Transportation and Environmental Justice, located in each of the three subareas within the NYMTC planning area); and (3) seven topical forums, as shown in Figure 3.21, covering a wide range of topics relevant to the Plan's development.

Across the topical forums, there were a few cross-cutting themes that continuously came up during discussions. *Moving Forward 2055* strives to incorporate that public feedback into the assessment of different Trends and Disruptors, recognizing there is a wide range of interest, enthusiasm, and concern for the future of transportation in the region. Feedback from stakeholders has been weaved throughout the chapter, including context about how it was received and where it came from in the region.

Figure 3.21 Summary of Cross-Cutting Themes from Topical Forums



Source: Cambridge Systematics.

3.5.3 FAIRNESS IN TRANSPORTATION DECISION MAKING

NYMTC endeavors to ensure that traditionally underserved groups, including socioeconomically vulnerable individuals and people of color, are not disproportionately burdened by mobility trends and disruptors, consistent with the agency's Title VI / Non-Discrimination Program. Accordingly, Fairness and Accessibility are integral to *Moving Forward 2055*'s vision and framework, aiming to establish and maintain a transportation system that advances fairness and improves access to opportunities for all communities. *Moving Forward 2055* identifies the risks and opportunities associated with how fairness among transportation system users is impacted by the Trends and Disruptors, as discussed above, and highlights variances in how the Trends and Disruptors impact different groups of people. For example, as innovations in transportation introduce more options, change costs, and potentially create knowledge gaps, uncertainties remain about who will benefit and how those benefits will be distributed.

3.5.4 UNCERTAINTY

Various efforts by public agencies, academic institutions, and private and non-profit organizations are predicting how transformative changes might influence future travel patterns and volumes. Even with this recent insight and research it remains difficult to fully assess how these changes will impact the SED

forecasts outlined in *Moving Forward 2055*, as well as the operation of the transportation system in the NYMTC planning area. Early predictions indicate that these transformations will likely alter both the demand for transportation and the methods by which transportation services are delivered.

The emerging futures brought about by these transformational changes will continue to shape the future of transportation globally, nationally, regionally, and within the NYMTC planning area. NYMTC and its members will continue to monitor these changes and respond as needed to make the regional transportation system safer, more sustainable, more fair, and more efficient as *Moving Forward 2055* and subsequent plans are developed and implemented. Transportation planning as practiced through the NYMTC process and individually by NYMTC's members will itself be transformed, as data, technical tools, and staff expertise are enhanced in response to changing technological and operational needs.

3.6 TRENDS SHAPING TRANSPORTATION

Transportation has been, and will continue to be, shaped by technological, behavioral, economic, and environmental trends that affect how people and goods move throughout the region. Anticipating the scale, probability, and timing of these changes is crucial to the NYMTC planning process and can pose opportunities or threats to achieving NYMTC members' goals of a safe, efficient, resilient, sustainable, and fair transportation system. *Moving Forward 2055* has identified several trends that may impact the region's long-term mobility.

3.6.1 VIRTUAL ECONOMY

3-57

The virtual economy, or economic activity that occurs primarily through digital platforms and remote technologies rather than a physical presence, exploded during the pandemic and continues to expand today. Although some of this was already happening before the pandemic, when the world shut down, many people's lives abruptly shifted from in-person to remote. There was an increase in jobs becoming remote and groceries ordered online as opposed to being shopped for in-person. Telehealth replaced many doctor's visits, and some residents moved away from cities into suburbs and rural areas. The virtual economy produced two key changes that impact long-term mobility in the region—work from home patterns and on-demand access to goods and services.

WORK FROM HOME

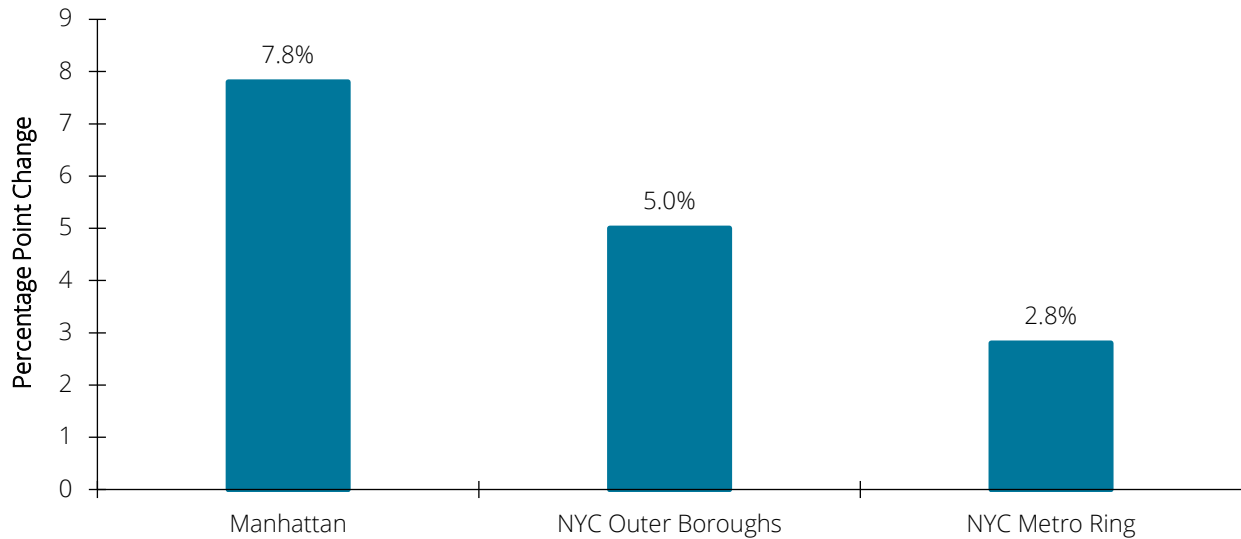
Work from home rates vary significantly by community, industry, and age group, leading to complex and often mixed effects on long-term mobility patterns. These variations complicate transportation planning, as some areas experience reduced commuting demand, while others see new patterns emerge due to hybrid work models. This is further explored in Section 3.4.1 regarding the impacts of the COVID-19 pandemic and Section 3.4.2 regarding historical travel trends.

Remote work reduces the need for some workers to commute daily, potentially reducing emissions from passenger vehicles (private autos, trucks, and vans) due to overall less fuel consumption and less congestion. For example, in the New York–Newark NY/NJ/CT urban area (as defined by the U.S. Census

based on population density), traffic delays in 2023 were 23 percent lower than pre-pandemic levels in 2019, suggesting that remote work has played a role in reshaping commuting patterns and reducing roadway congestion.¹⁵ However, while remote work has reduced some peak-period commuter traffic, this is offset by an increase in midday travel for errands such as grocery shopping or childcare. In fact, from 2019 to 2022, the number of short trips (less than three miles) taken between 11:00 a.m. and 1:00 p.m. by work from home employees in the U.S. surged by more than 400 percent.¹⁶ These patterns suggest that while telecommuting can reduce longer-distance commutes, it may lead to more frequent short-distance trips. The long-term transportation and environmental impacts of widespread remote work will likely depend on how travel behaviors continue to evolve and how transportation systems adapt to these changing patterns.

Remote work is also reshaping land use patterns as many residents have moved from the urban core to suburban communities within the region, while others have left the state entirely. A review of the U.S. Census Bureau's ACS by *The New York Times* revealed that the New York metropolitan area experienced a net migration loss of 116,000 remote workers from 2020-2021, although this was undoubtedly influenced by the pandemic.¹⁷ The increased flexibility in workplace arrangements has made it easier for employees to visit the office occasionally or not at all, driving population growth in suburban and exurban areas where housing is more affordable and spacious. This shift is changing both residential trends and the demand for local infrastructure, services, and transportation in these outer regions. However, this trend has moderated, and even reversed, in recent years. According to NYMTC's population forecasts, the planning area, comprised of both urban and suburban counties, did lose less than 1 percent of its population from 2020 to 2022, but the region is expected to grow through 2055—regardless of trends in remote work.

The rise in remote work has significantly impacted office space utilization in the region. Office vacancy rates have doubled from 6 percent in 2020 to 12 percent as of spring 2024, with Manhattan experiencing even higher rates of up to 15 percent.¹⁸ As seen in Figure 3.22, Manhattan has experienced the biggest increase in office vacancy rates since 2020 compared to neighboring communities in the outer boroughs and the metropolitan ring surrounding the city (including parts of New Jersey, Long Island, and as far as the Lower Hudson Valley). In response to the continued growing surplus of office space, also driven in part by a 'flight to quality' away from older and more outdated facilities, some buildings are being converted into residential units. This shift presents several potential implications, including alterations in travel patterns and new opportunities to integrate affordable housing into central business districts. Ultimately, it is unclear how persistent remote work will be. By some measures, for example, office occupancy rates have returned to 80 percent of their pre-pandemic levels.¹⁹ In the New York metropolitan area, office occupancy rates in December 2024 ranged from 30 percent to 68 percent depending on the day, reflecting the variability of office occupancy by day, season, and industry.²⁰ It is important to note however, that even prior to the pandemic, office occupancy was not at 100 percent, reflecting these key factors.

Figure 3.22 Percentage Point Change in Office Vacancy Rate (Q1 2020–Q1 2024)

Source: New York City Comptroller.

Finally, if remote work continues to grow, not all groups benefit. Occupations which are at the highest risk of being left behind in a remote work boom include food service, hospitality, retail, and jobs in the transportation, warehousing, and logistics sector. These jobs tend to be staffed by already vulnerable groups and are likely to be negatively impacted should remote work continue to grow.²¹

ON-DEMAND ACCESS

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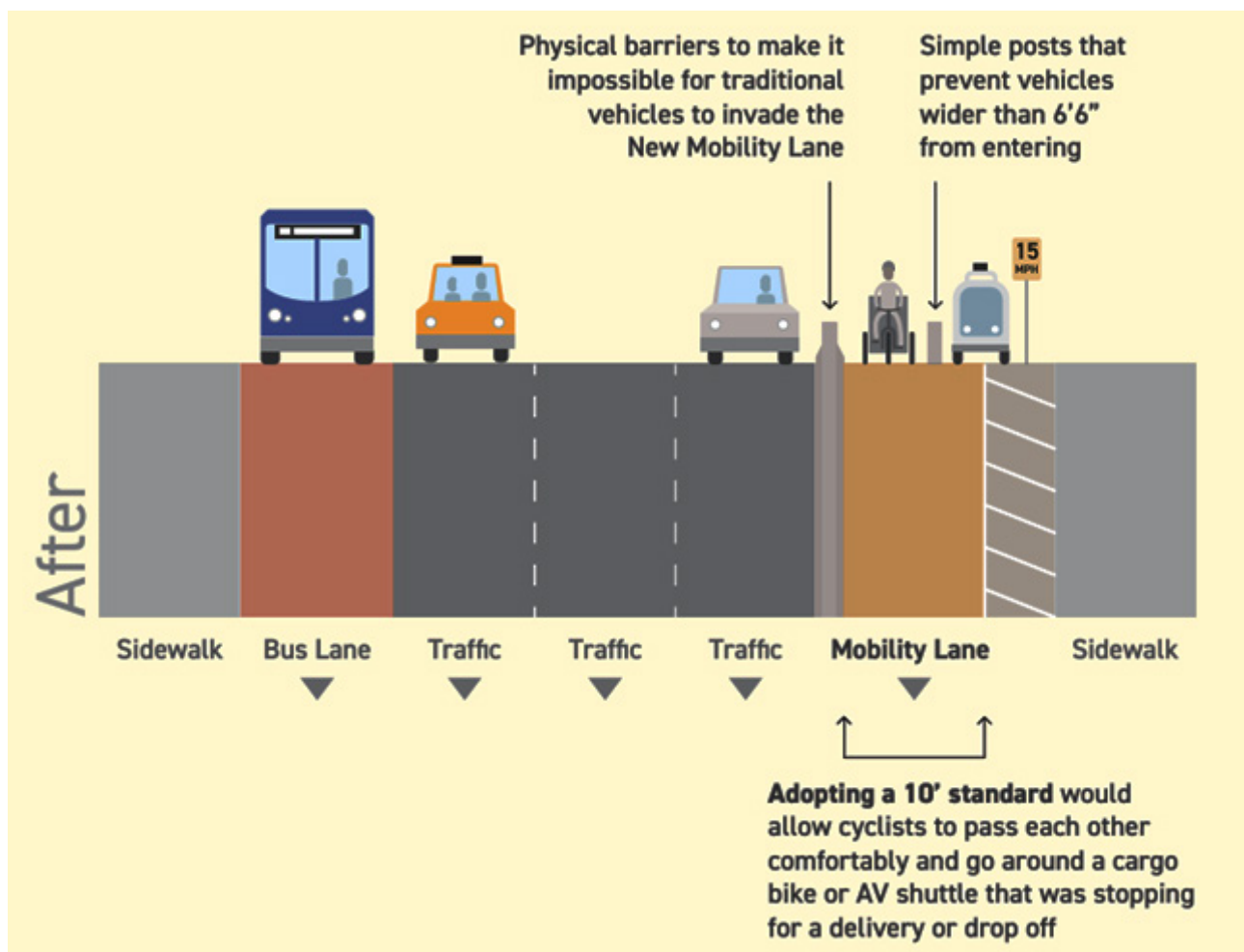
On-demand access includes all economic activities that are technology-enabled and offer the consumer access to the product or service shortly after they request it; it may also be referred to as “just-in-time” delivery in freight planning. Like work from home, the pandemic accelerated the demand for near instant access to everyday essentials and non-essentials such as grocery and meal delivery, transportation, doctor’s appointments, movies, shopping, and more. What began as a safer alternative to in-person visits has become an entire economic sector. Facilitated by technology solutions for payment and location tracking, as well as growing demand for gig employment, on-demand consumers enjoy greater convenience, speed, and simplicity in their goods and services. The NYMTC region has become a testing ground for on-demand companies, an extension of the growing e-commerce market. This market is expected to grow, with cascading implications for long-range transportation planning.

The on-demand economy threatens to upend traditional consumer behavior, potentially leading to the closure of movie theaters, grocery stores, retail establishments, and brick and mortar banks. This creates opportunities for redevelopment, such as affordable housing in commercial districts. This may then affect transportation needs with reduced trips for errands and entertainment—creating an opportunity for sustained VMT reduction but potentially harmful to transit or bikeshare revenues. Additionally, the shift to on-demand access has changed the geographic distribution of warehousing and fulfillment centers. Speedy delivery requires a network of urban and suburban micro-fulfillment centers, shifting freight traffic from long-haul freight routes to local streets. For example, third-party delivery services like Instacart, DoorDash,

and UberEats have opened “dark” stores in the region that resemble mini warehouses stocked with groceries. Workers then transport these items to the customer via truck or bicycle.²²

On-demand services have prompted a shift in the types of vehicles used for delivery, especially in denser districts within the NYMTC region. The uptick in deliveries has resulted in an increasing reliance on smaller, faster modes of delivery like e-bikes, scooters, and drones. Smaller vehicles like bikes or scooters can reduce road congestion, but their sheer volume increases clutter in bike lanes and pedestrian areas. They can also pose safety concerns when they do not follow traffic rules. A proposal by Cornell Tech offered a solution to the evolving landscape of miniature cargo delivery vehicles—converting bicycle lanes into “mobility lanes” that are wider than bike lanes to accommodate a wider range of non-vehicular transport, with physical barriers from traffic (Figure 3.23).²³ As seen in other trends, the effects of on-demand access, micromobility, distribution innovations, and shared mobility are forcing transportation agencies to rethink traditional street design, potentially making space for new and emerging modes of urban goods delivery.

Figure 3.23 Illustration of “New Mobility Lanes”



Source: Rebooting NYC: An Urban Technology Agenda for the Next Administration., 2021.

An attendee at the *Moving Forward 2055* Curb and Parking Management Forum noted that the most important use case of curb management is “neighborhood loading zones in NYC— [which are] important post-COVID as 1 in 5 New Yorkers receive a package each week.”

One potential upside is that on-demand services, particularly in food and grocery sectors, reduce personal vehicle trips. A study by Argonne National Laboratory found that while e-commerce (a large component of the on-demand economy) has generated an increase in parcel truck delivery trips, e-commerce still reduces VMT and fuel consumption due to an overall decrease in shopping trips.²⁴ Even with less fuel-efficient freight vehicles, the mileage saved in the economies of scale associated with goods delivery still produces net reductions in emissions compared to personal vehicle trips. In the longer term, more fuel efficient, or fossil-fuel-free freight vehicles can multiply the environmental benefits of the on-demand economy.

On-demand access is an important transportation alternative for people who may find travel difficult, such as those with special needs or mobility impairments. On-demand access to goods and services can supplement paratransit. However, a study of telehealth usage in New York City during the pandemic found that older adults (over 65 years) and ethnic minorities (specifically African Americans and Non-white Hispanic residents) were more likely to use the Emergency Room and doctor’s office visits over telehealth, reflective of national trends in groups affected by the digital divide.²⁵ Increased promotion of telehealth and other on-demand services can better support historically underserved populations by providing more convenient access to services such as preventative healthcare, as well as alleviate the burden on human service transportation systems.

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3.6.2 SHARED MOBILITY

Shared mobility refers to transportation services and resources that are shared among multiple users as part of a multimodal transportation network that offers on-demand, integrated services. Shared mobility is part of the new mobility marketplace, offering consumers flexible, tech-driven, and user-centered mobility solutions. The field of shared mobility is rapidly evolving and quickly gaining in the mobility marketplace. 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. Over 92 percent of attendees at the Transportation and Technology Topical Forum indicated that they use shared mobility, with 61 percent noting that they use shared mobility regularly.

MOBILITY ON DEMAND

Mobility on demand, or MOD, is a component of the on-demand economy. Users can book transportation services such as ride-hailing, ridesharing, carsharing, bikeshare, or transit in some cases, as they need them.

Ride-hailing is one of the most visible types of MOD; customers can order and pay via mobile app for a car ride from an Uber or Lyft driver. Uber and Lyft are the most popular types of ride-hailing services in

New York City, comprising 71 percent of licensed vehicles.²⁶ Ride-hailing supplements, or in some cases, replaces traditional taxi services, transit or active transportation, or personal vehicle usage. At its best, ride-hailing is sustainable and fair, facilitating carpools (or rideshares) and reducing pollution through a fleet of zero-emission vehicles while connecting users to mobility opportunities they may not have otherwise had.

A 2018–2019 study of ride-hailing trips taken in metropolitan regions in California found that 47 percent of the trips replaced a more sustainable mode such as public transit, carpool, walking, or cycling. An additional 5.8 percent of trips represented “induced travel”, meaning that the person would not have taken the trip if an Uber or Lyft had not been available.

However, several studies show that in most cases, ride-hailing worsens pollution more than the status quo.²⁷ This is attributed to increased traffic congestion, especially in urban environments. One study found that the entrance of transportation network companies (TNC) such as Uber and Lyft increased road congestion by almost 1 percent and the duration of congestion rose by almost 5 percent.²⁸ Initiatives such as New York City’s Green Rides aim to reduce ride-hailing related emissions by requiring that all rideshare trips be either zero-emission or wheelchair accessible by 2030.²⁹

Carsharing is another form of MOD for short-term vehicle rentals, facilitated through a membership-based system where users can reserve a vehicle online or via an app, access it at designated parking locations, and pay only for the time they use it. In 2018, NYC DOT launched a pilot program to expand carsharing into communities that had less access to carsharing systems. A study of the program found that roundtrip carsharing in New York City mostly served as a substitute for traditional car rental, ridesharing, personal vehicle ownership and transit.³⁰ Compared to ridesharing, carsharing may be more effective at reducing VMT and emissions. Across the membership base, VMT was reduced by 7 percent and key pollutants were reduced by 6 percent; an additional 7 percent of carsharing members in the program avoided a car purchase. In this capacity, carsharing has the potential to advance the region’s sustainability goals.

MOD has extended into public transit through the rise of “microtransit.” Microtransit blends traditional public transit with ridesharing by offering shared rides, often facilitated by mobile app or a phone request, along dynamic routes that respond to real-time demand rather than sticking to fixed schedules or stops. Using smaller vehicles like vans or shuttles, microtransit has expanded within the NYMTC region, both as a complement to traditional transit services and as a supplement to paratransit. This demand-response model provides a cost-effective solution for areas where fixed-route services are not viable, such as offering on-demand trips within specific zones or transfers to nearby transit hubs. Its integration with paratransit has proven particularly valuable, as the proportion of older adults increases, and the cost of operating paratransit rises. In fact, a review of several transit agencies that implemented paratransit services using Uber/Lyft and taxis found that these options were more cost-effective than traditional paratransit trips.³¹ This highlights the potential for microtransit to improve service and reduce costs for both users and transit agencies:

- » In 2017, MTA launched a pilot program called “E-Hail”, an on-demand service that offers participating Access-A-Ride paratransit customers the opportunity to book trips in real-time through five taxi or for-

hire vehicle services.³² The program has since been expanded multiple times, most recently in July 2024 which increased the trip subsidy to \$60 for the 1,600 current customers.³³

- » The SCT On-Demand program offers two zones for transit on-demand rides in South and East Hampton, operating seven days a week, all year long from 6:00 a.m. to 8:00 p.m.³⁴ Riders can travel anywhere within their zone for \$2.25 or less, identical to the fixed route transit system.

There seems to be continued interest in MOD as a strategy for improving and expanding transit systems, with reservations. For example, one survey respondent from Suffolk County indicated that they would like a solution such as “direct shuttle pick-up” in areas where transit does not operate, improving their access to public transportation. Another respondent from Nassau County, however, said that their biggest concern is replacing bus service with rideshare, especially for disabled and low-income riders.

MOBILITY AS A SERVICE

Mobility as a Service (MaaS) is the integration of various forms of transport services into a single mobility service accessible on demand.³⁵ Users can plan, book, and pay for multiple types of mobility services (such as public transit, bike sharing, carsharing, ride-hailing, and more) through a unified interface, typically via a mobile app. Experts generally consider there to be four levels of integration as shared in Figure 3.24.³⁶

Figure 3.24 Levels of MaaS Integration

LEVEL 1	Integration of Information
» Travel information is provided through (multimodal) travel planners, which may or may not include information on routes and costs.	
LEVEL 2	Integration of Finding, Booking, and Payment
» MaaS facilitates the finding, booking, and payment of individual trips. The added value of level 2 is that users can find, book, and pay for their trip at a single service point (e.g., through an app with a pre-registered credit card).	
LEVEL 3	Integration of Transportation Services into Passes and Bundles
» The service meets the full daily mobility needs of individuals and families by offering different means of transport through bundles and/or passes such as a universal mobility pass for bikeshare, rail, bus, and carsharing. This level better meets the needs for individuals replacing personal car ownership.	
LEVEL 4	Integration of Societal Goals
» MaaS extends beyond liaising between the demand for and supply of mobility. Supply and demand are now combined with goals such as reducing the use of cars or promoting livability in the cities. This may constitute tiered pricing for economically underserved individuals or prioritizing the most eco-friendly modes of transportation in trip planning.	

Source: Netherlands Institute for Transportation Policy Analysis.

MaaS is still an evolving concept, and most mobile applications are still at Level 1 or 2, but this could change rapidly over the next 20 years. The NYMTC region, like much of the country, does not currently have a fully integrated MaaS solution. MTA offers OMNY, a contactless fare payment system available on smart phones, smart watches, the OMNY card, and contactless credit or debit cards.³⁷ MTA is currently working on solutions for combining fare payments and ticketing across subways, buses, paratransit, and commuter rail, while simultaneously phasing out MetroCards.³⁸

***Moving Forward 2055** respondents were interested in incorporating MaaS into OMNY as a singular payment mechanism and as a method for improving paratransit. Participants suggested that a fully integrated app that allows users to book their rides, track ride progress, and communicate with dispatch and drivers would be a huge benefit.*

The widescale implementation of MaaS could significantly affect how community members travel in the region. MaaS makes it easier for residents to access a growing and diverse range of transportation options, from on-demand options to public transit, which facilitates a car free or car-light lifestyle. MaaS will also create new data for transportation providers that can be used to better understand travel patterns and help agencies to adjust services in response to dynamic needs. This will enable more efficient use of transportation resources and may lead to demand-responsive transit systems that adapt in real time to user needs. However, many agencies and MaaS providers will need to be mindful of data and user privacy concerns.

MICROMOBILITY

Micromobility is any small, low-speed, human- or electric-powered transportation device, including bicycles, scooters, electric-assist bicycles, electric scooters (e-scooters), and other small, lightweight, wheeled conveyances. In 2020, New York State and New York City legalized the use of Class 1, Class 2, and Class 3 ebikes and standing escooters, as seen in Table 3.38 (note: these devices were in use prior to legalization by delivery drivers and other users).³⁹ Since then, escooters and ebikes (both shared and personally owned) have proliferated across the NYMTC study area. Growth in micromobility usage will impact the region’s sustainability goals, transportation safety, and access in underserved communities.

Table 3.38 Ebike Classifications

Class 1 EBike	Class 2 EBike	Class 3 EBike
Electric Bike with Pedal Assist	Electric Bike, Throttle up to 20 mph with Operable Pedals	Electric Bike, Throttle up to 25 mph with Operable Pedals

Note: Permitted in bike lanes and streets with speeds no greater than 30 miles per hour (mph).

Source: NYC DOT.

Micromobility devices facilitate a car-free or car-light lifestyle, and because they are either electric or human-powered, they are one of the cleanest modes of transportation. Ebikes and escooters are used as a first and last-mile connection to public transit as well as a substitute for shorter car trips. One study

estimated that a 5 percent increase in trips made by bicycle and electric micromobility instead of cars globally would reduce CO₂ emissions by 7 percent —the equivalent of taking more than 134 million cars off the road by 2030.⁴⁰ Shared systems (like Bethpage Ride, the Suffolk County bikeshare program seen in Figure 3.) expand access to micromobility devices for residents who cannot afford one, fostering multimodal transportation environments.

Figure 3.25 Bethpage Ride, Long Island's Regional Bike-Sharing Program



Source: Connect Long Island, 2024.

While largely beneficial for the environment, electric micromobility devices have been contested throughout the region for their potential safety risks, including high speeds, conflicts with other cyclists and pedestrians, and unsafe device operation. In their Electric Micromobility Action Plan, New York City highlighted risky behaviors of e-micromobility operators, including running red lights and stop signs or traveling on sidewalks, as well as the usage of legal and illegal electric mopeds.⁴¹ These concerns were echoed by *Moving Forward 2055* survey respondents:

- » *New York City Environmental Justice Focus Group participants expressed their safety concerns with the expansion of scooter and moped use in the City in bike lanes and on sidewalks.*
- » *"I am very concerned about bicycles and scooters in the city. They are a huge hazard because many riders do not follow basic traffic rules, and they need to be enforced." –Survey respondent from Manhattan*
- » *"Improve vehicular classification for the dozens of emerging micromobility devices in NYC. Legislation/enforcement around electric mopeds, e-scooters, pedal assist ebikes, and others often get lumped together due to anemic classification. A focus on top speeds and weight would be useful metrics for better disaggregating the different kinds of electric bikes/scooters than just the blanket label "ebike". –Survey respondent from Manhattan*

One respondent, however, noted that these dangers are likely concentrated within a handful of users. They said, “I think that it’s created an excuse for people to be against micromobility and micromobility infrastructure because they see delivery people, they see teenagers on skateboards and scooters, and they lump bicycles all with that to make the argument that it’s the real traffic hazard in New York City.”

While there are dangers associated with micromobility usage, it is still seen as a crucial component of the micromobility ecosystem and a way to expand transportation access for zero car households. Micromobility can serve as a lower-cost alternative to traditional modes of transport in areas where public transit is limited, particularly in low-income neighborhoods or areas with poor connectivity. In 2021, New York City sponsored a shared scooter pilot program in the Bronx. The Bronx program was highly successful; users recorded 3.8 million trips among more than 157,000 accounts. In May 2024, the City announced that they would be expanding the program to eastern Queens.⁴²

Moving Forward 2055 community members shared that micromobility’s impact would be even greater with public sector investment in microhubs (small, strategically located facilities that serve as points where people can access shared mobility options like bikes, e-scooters, or e-bikes), safe charging for e-bikes, expansion of bike sharing programs, and improved networks for non-vehicular travel. However, many respondents also noted that active transportation requires enhanced facilities for users such as off-road trails and protective barriers. These amenities also support micromobility usage and are especially important for less experienced riders who may be more likely to engage with a shared micromobility system. Ultimately, a safe, accessible micromobility network supports a less car-centric transportation ecosystem that has the potential to advance multiple *Moving Forward 2055* goals.

3.6.3 TECHNOLOGICAL ADVANCEMENTS

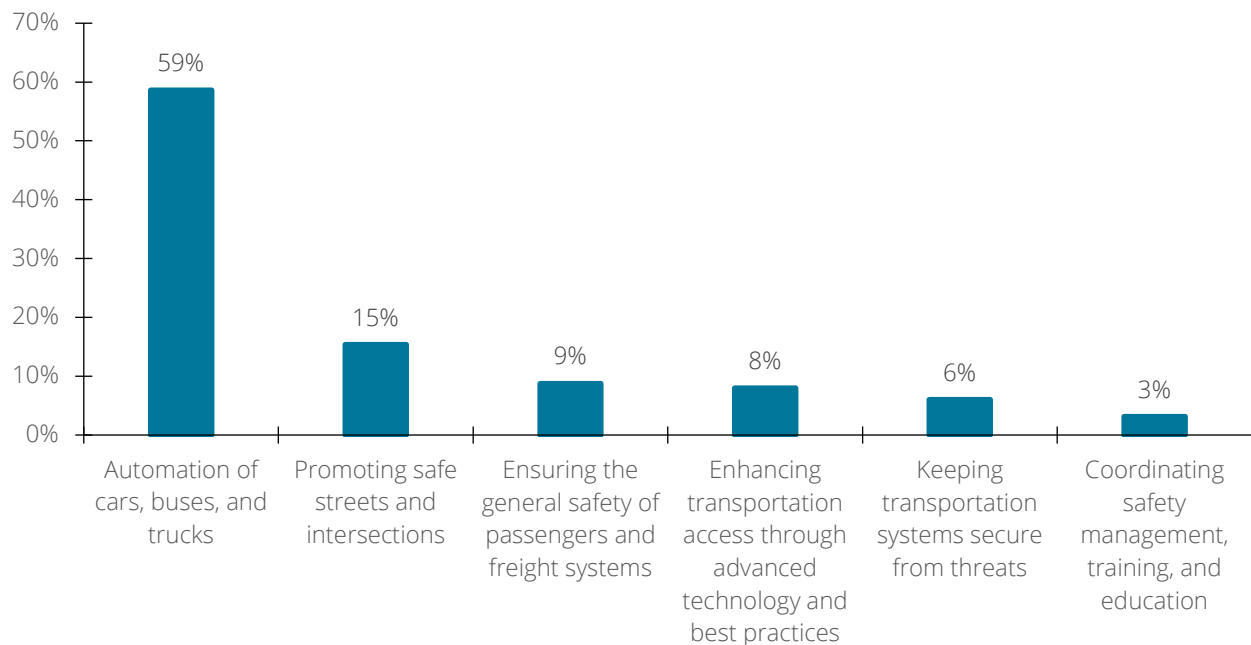
Advancements in transportation technology have huge implications for the efficiency, safety, sustainability, and accessibility of the transportation system. They also have the potential to impact the labor force, both positively and negatively. The scale and scope of these advancements are yet to be determined, but the current and maturing landscape of technologies such as autonomous vehicles, connected and intelligent transportation systems (ITS), urban air mobility (UAM), high-speed rail (HSR), and artificial intelligence (AI) are a peek into future mobility patterns.

AUTONOMOUS VEHICLES

Autonomous vehicles (AVs) are modes of personal or shared transportation in which some aspects of control are automated by the car itself.⁴³ There are multiple applications for AVs, including personal vehicles, freight, transit, and robotaxis. Many personal vehicles today offer a low level of automation, such as adaptive cruise control, lane keeping, or parking assistance. Higher level automation where a driver is not needed—often referred to as autonomous, self-driving, driverless, or robotic—is currently limited only to carefully controlled environments. Widescale adoption of autonomous passenger vehicles depends on a lot of factors, including state and Federal standards for vehicle manufacturers, the progress of technological development, and consumer interest and affordability. Assuming vehicle manufacturers meet their target dates for AV launches, with a medium level of customer adoption despite higher costs, experts estimate

that 12 percent of vehicles sold by 2030 will have autonomous driving systems.⁴⁴ By 2037, this will grow to nearly 40 percent of vehicle sales. In areas like the NYMTC region, with higher incomes and longer commutes, AV adoption may surpass typical expectations. In fact, over 50 percent of respondents to the NYMTC *Moving Forward 2055* Survey chose automation of cars, buses, and trucks as the highest funding priority for advancing transportation safety and security in the region, seen in Figure 3.26.

Figure 3.26 Survey Respondents Priorities for Advancing Transportation Safety and Security in the Region



Source: NYMTC.

Currently, AV testing is largely focused within New York City, but there is potential for it to expand into the outer regions in the future as infrastructure, regulations, and needs evolve. The Port Authority of New York and New Jersey (PANYNJ), for example, has been testing self-driving technology since 2022. The agency started with automated bus platooning and lane-keeping technology and in 2024 introduced an autonomous shuttle for customers at JFK Airport, following a successful demonstration at Newark Airport.⁴⁵ Other AV tests have occurred on private roads in New York City, and in 2024 New York City announced a new permitting system for AV testing on public roads, including the testing of “robotaxis” with safety drivers.^{46,47} New York City has one of the largest taxi markets in the country, potentially ripe for the introduction of self-driving cabs, but the development, testing, and regulatory environment is extremely complex. Furthermore, the expansion of AV technology into suburban and rural areas within the NYMTC area will require significant updates to infrastructure, including smart roadways, communication networks, and safety regulations.

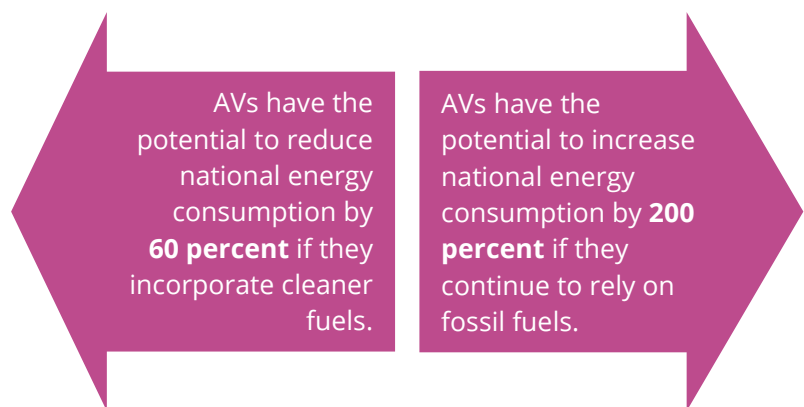
The NYMTC region—particularly urban environments—represents one of the most challenging street networks in the world, complicating the landscape for future AV operation.

A study of AV crash data revealed that vehicles with advanced driving systems have a lower crash rate than their human operated counterparts—but not in all conditions. AVs were over five times more likely to crash during dawn or dusk, and nearly twice as likely when making a turn.

While AVs have a significant road ahead before they are ready for mass adoption, there are opportunities for NYMTC and member agencies to improve the safety environment for future AV usage. This includes infrastructure upgrades and maintenance such as clear lane demarcations and consistent road signage; redesigning urban roadways to be more AV-friendly such as the usage of roundabouts; introducing intelligent and connected infrastructure such as smart traffic signals; and providing dedicated lanes for AVs and protected space for vulnerable road users when in mixed traffic.

In addition to safety, AVs have significant potential impacts on the region's pollutant reduction goals. A U.S. Department of Energy study estimated that widescale adoption of AVs could reduce energy consumption by 60 percent nationwide or increase it by 200 percent, depending on the assimilation of cleaner fuel sources into light-duty AV fleets, illustrated in Figure 3.27.⁴⁸ This wide range reflects the variability in how AVs can influence vehicle efficiency and use through changes in vehicle design, travel behavior, and external policies. While most of the policies will be developed at the state and Federal level, there are opportunities to advance the Shared Regional Vision at the local level. For example, requirements that robotaxi operators be pollution-free (similar to New York City's Green Rides program) can advance local sustainability efforts.

Figure 3.27 Potential Impacts of AVs on Pollution Reduction



Source: U.S. Department of Energy

There is also huge potential for the introduction of self-driving technology in freight applications; some pilot demonstrations are currently underway across the country. Industry experts estimate that the current truck driver shortage, estimated at approximately 80,000 drivers nationwide, will double by 2030 due to aging driver demographics and increased freight demands.⁴⁹ AVs tend to perform better in relatively uncomplicated traffic situations, such as Interstates, which make them a prime candidate for long-haul trucking. The optimal truck routes for AV freight applications are over 200 miles long to and from the region and are generally located in testing-friendly states. Once close to the destination, a human driver could take over for the last few miles to better navigate more complex urban environments. With capacities for alternative fuels, platooning and other vehicle efficiency measures, autonomous trucks can also improve sustainability in the region. While there are numerous opportunities for self-driving trucks, it is ultimately

the decision of the private sector—primarily freight shippers—if they would like to integrate autonomous technologies into their transportation operations. Further, many members of the public still feel reticence at the expansion of self-driving trucks.

61 percent of attendees at the Transportation and Technology Public Forum answered that they would not feel safe sharing the road with driverless trucks.

EMERGING TRANSPORTATION MODES AND SERVICES

AVs may receive a lot of public attention, but there are numerous other emerging transportation modes that can change how residents and visitors to the region travel in the future. Emerging transportation modes encompass new modes, technologies, and systems that integrate advanced technologies, improve efficiency, and foster sustainable practices. For the purposes of *Moving Forward 2055*, this will primarily focus on connected and ITS, high-speed and advanced rail systems, and UAM.

ITS uses technology to make travel safer, more efficient, and more convenient. NYSDOT and many member agencies currently employ ITS in-traffic signals, automated toll collection, and advanced transit systems. Current usage of ITS varies across the NYMTC area. New York City, for example, introduced a wireless infrastructure network in 2020 that supports communications for all the city's ITS devices, including traffic cameras, variable messaging systems, vehicle detection devices, and traffic signals.⁵⁰ Rockland County's TOR buses on State Route 59 utilize Traffic Signal Priority technology to help speed transit trips along this congested corridor, and all TOR buses are equipped with both onboard and exterior cameras and technology that will enable real-time information in a future ITS project. In 2024, Westchester County began its project to install new software and technologies on the Bee-Line system that support planning and scheduling, dispatch, garage management, and store security video footage.⁵¹ In *Moving Forward 2055* feedback sessions, community members from across the region voiced their particular interest in technology-driven improvements for transit.

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Participants in the Lower Hudson Valley Coordinated Human Services Focus Group wanted to see more electronic signage used to provide real-time information on bus and train schedules, and the Long Island Coordinated Human Services Focus Group participants called for the use of app technology to provide real-time information about elevator availability at transit stations and to track paratransit drivers.

HSR is a type of passenger train transportation that uses specialized rolling stock and dedicated tracks to travel at much faster speeds than traditional rail. On dedicated passenger tracks, such as Amtrak's Acela service in the Northeast, trains can reach speeds of up to 150 mph but typically travel closer to 70 mph. By comparison, HSR reaches speeds over 200 mph. Advocates in the NYMTC region have long called for an HSR system that would better connect the Northeast. The Northeast High Speed Rail Coalition, for example, has called for a line to transport passengers between New York City and Boston in under two hours.⁵²

Community members in the region have expressed their support for faster, more efficient rail options; one respondent from Westchester County called for agencies to standardize and modernize long-range transit. They emphasized, “You can’t over-invest in this.” However, previous HSR plans have been delayed by a lack of funding (the proposal is estimated to cost over \$50 billion), environmental concerns, and the difficulties in procuring right of way.

UAM is the use of small, highly automated aircraft to carry passengers or cargo in urban and suburban areas. UAM includes traditional helicopters, uncrewed aerial vehicles (unmanned aerial vehicles (UAV), commonly known as drones), and short and vertical take-off and landing (VTOL) aircraft. While NYMTC is only responsible for surface transportation planning, UAM has potential applications in passenger usage, freight, and as a substitute for traditional taxis. New York City has explored UAM infrastructure and applications including commercial heliports on buildings. In 2023, New York City announced that it would enhance infrastructure at the Downtown Manhattan heliport that would support electric-powered aircraft that would take off and land vertically, advancing the administration’s vision of an aerial sustainable transportation hub⁵³, as early as 2025 with private sector support.⁵⁴ And in 2024, the City piloted drones equipped with loudspeakers to warn residents of potential flash flooding.⁵⁵

While UAM can be leveraged for personal and public sector applications, it also has significant potential to improve freight logistics. UAM complements other trends explored in this chapter, including on-demand access and distributed manufacturing. The PANYNJ tested using a drone to carry goods across the Hudson River between Brooklyn and New Jersey, part of a strategic vision to establish fixed drone routes that could be used to deliver high-value cargo across the region (Figure 3.28).⁵⁶ UAM, using small drones or cargo-specific aerial vehicles, could revolutionize last-mile delivery by bypassing congested road networks and delivering goods directly to customers or distribution centers. UAM could also improve freight delivery in areas that are difficult to access by traditional vehicles, such as remote locations or highly dense urban environments with limited road infrastructure.

Figure 3.28 PANYNJ Drone Test



Source: PANYNJ, 2024.

Collectively, these transportation modes impact congestion, infrastructure, sustainability, land use, and safety—encompassing many of the plan’s goal areas. HSR represents a transformative alternative to traditional rail, personal vehicle travel, and even commercial flights for longer-range trips. Similarly, UAM has great potential at transforming shorter range trips; one air taxi provider estimated that they could transport passengers from Manhattan to JFK Airport in seven minutes, compared to a 50-75 minute car ride.⁵⁷ With more transportation options, typical roadway traffic can be more diffused across the entire transportation network, reducing congestion and improving the region’s overall resilience. Alongside expanded mobility

choices, ITS can be a solution for persistent roadway traffic, monitoring traffic conditions and potentially responding in real-time through managed lanes, signal timing, and in-vehicle route recommendations. To better support multimodal integration, cities may explore building transportation hubs—supported by ITS—that facilitate fast, easy transfers between rail, urban air, and ground modes. In this type of multimodal ecosystem, the region is likely to benefit from reductions in transportation-related pollution.

More mobility choices and technologies may also shape land use and infrastructure investment decisions—from the roadway to the track to the air. ITS and AV integration require substantial investments in infrastructure, including sensor networks, communication systems, and advanced traffic management technologies. Long-term, transportation planners will need to prioritize the development of HSR corridors that connect major urban centers, especially as a sustainable alternative to congested highways or short-haul flights. This requires significant coordination between municipalities, regions, and state authorities. UAM, such as flying taxis, requires new types of infrastructure, including vertiports and air traffic management systems for low-altitude airspace. Planners must identify potential sites, navigate regulatory challenges, and ensure integration with ground transportation. Additionally, faster rail and air mobility may lead to the growth of exurban areas as people can live farther from work or urban centers, reducing central business district density. This creates more distributed patterns of travel, increasing demand for regional transportation systems. Roadways could be repurposed for transit or active transportation infrastructure, as could parking lots.

The next era of transportation is undoubtedly technology driven, with cascading impacts for cybersecurity. With increased connectivity comes greater vulnerability to cyberattacks. Transportation networks must safeguard against breaches that could disrupt connected and AVs, rail systems, or air mobility infrastructure. Similarly, community members may not be able to opt out of ITS integrated transportation modes, which may compromise their privacy preferences. Further, with the growth of UAM, low-altitude airspace must be carefully regulated, and cities will need new protocols for managing air traffic safety, particularly in dense urban areas.

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ARTIFICIAL INTELLIGENCE

AI powers many of the innovations already discussed, including AVs, MaaS, and freight and transit efficiencies. AI uses algorithms and computational models that allow machines to process information, make decisions, and execute actions that improve operational efficiency. Member agencies in the NYMTC region have used AI in multiple capacities, primarily transit, safety, and traffic analytics:

- » MTA expanded Automated Camera Enforcement (ACE) for bus lanes on 14 routes across Brooklyn, Queens, Manhattan, and the Bronx.⁵⁸ The ACE program captures vehicles violating bus lane, double parking, and bus stop rules in real-time. The test phase of the project resulted in a 5 percent increase in bus speeds, 20 percent decrease in collisions, and up to a 10 percent reduction in certain pollutants. The program also averted repeat offenders. ,
- » Dutchess County and MTA use AI to track bus maintenance, helping to reduce costs.^{59, 60}
- » MTA has also begun using AI for preventative maintenance on its bus fleet.⁶¹

- » The PANYNJ has explored the use of AI to better understand traffic conditions related to Hudson River crossings such as traffic congestion, pollution, and safety hazards.⁶²

Like many of the trends discussed in this chapter, AI is part of a complex and interdependent ecosystem of transportation innovations; AI powers MOD, MaaS, AV, and ITS, magnifying its impact. As a component of ITS, AI can analyze real-time data from traffic sensors, cameras, and connected vehicles to predict congestion patterns and optimize traffic signals, predict and respond to incidents such as crashes or road closures, dynamically adjusting traffic and signals to improve traffic flow. Managed lanes can maximize the capacity of the roadway network to dynamically respond to traffic conditions and driver needs. Over time, this can reduce congestion, improve travel times, and decrease fuel consumption.

Similar to its usage in transit systems, AI can also be used to monitor transportation infrastructure, such as roads, bridges, and railways, by detecting early signs of wear and tear. Predictive maintenance powered by AI can prioritize repairs before infrastructure failures occur, improving safety and reducing long-term repair costs. By improving the efficiency of roadway networks and averting expensive and time-consuming road repairs, AI improves asset management and system resiliency, advancing regional goals.

Additionally, AI can be leveraged to improve route planning for transit systems and freight. AI can analyze transit demand in real-time and adjust schedules, routes, and fleet sizes accordingly. This approach is especially valuable in mixed-service systems that incorporate microtransit or other demand-response services, minimizing the labor cost of on-demand service. This would make public transit more responsive to fluctuations in demand, reducing wasted capacity and providing a more efficient service. Similarly, AI can be used in freight planning to optimize routes and minimize delivery times. For example, with digitally connected urban loading zones powered by in-vehicle AI interfaces, a truck driver may be able to optimize their route to time drop-offs when the loading zone is free—minimizing time spent idling and potentially backing up traffic. With autonomous buses and trucks, the power of AI expands even further.

AI has a lot of potential for transportation applications, but this is mitigated by concerns about cost, scalability, agency familiarity, and long-term obsolescence. To be fully utilized, AI would necessitate a fully digital network management system, connected infrastructure and vehicles, and staff capable of managing the system. In the NYMTC region, member agencies have varying levels of interest and integration of AI systems; inconsistent adoption of AI across the region has created disparities in transportation management and efficiency. This reflects the different priorities at agencies; overcoming this would require upscaling resources, new requirements in the employment market, and supporting the build out of internal and external infrastructure to support new innovations in AI—effectively future-proofing a rapidly evolving technology. Many of these may be beyond the agency's control to implement.

An attendee at the Transportation and Technology Public Forum echoed that a main risk or barrier for infrastructure or traffic control impacted by automation or AI is that “system complexity can make automation/AI training more difficult.” Another noted that conventional “ITS investments [are] quickly becoming obsolete.”

AI also prompts significant concerns regarding personal privacy, fairness,, and cybersecurity risks. AI systems, particularly in transit, rely on large amounts of data, including real-time tracking and passenger behavior. While this data enhances efficiency and safety, it raises significant concerns about personal privacy. The collection and analysis of sensitive data could lead to potential misuse, surveillance, or data breaches if not managed with strict privacy protections.

Similarly, AI has come under fire for biases in the algorithms or models used. AI biases can lead to unequal service provision, reinforcing existing socioeconomic disparities. This occurs when AI models rely on incomplete or skewed data, prioritize cost efficiency, or reflect historical biases. As a result, underserved communities, such as low-income or rural populations, may receive fewer services or slower responses. For example, ride-hailing algorithms like those used by Uber or Lyft have been criticized for contributing to “algorithmic redlining,” where certain neighborhoods receive fewer or slower services based on historical demand. Addressing these concerns requires intentional efforts to ensure that AI-driven transit systems are fair, transparent, and designed with broader social goals in mind.

Broadly, AI is also at risk of cyberthreats. Hackers could target AI algorithms, disrupt services, or manipulate data, potentially causing widespread transit delays or safety hazards. Additionally, breaches of sensitive rider data can compromise personal privacy. To mitigate these risks, transit agencies must invest in robust cybersecurity measures, continuously update software, and ensure strong encryption and authentication protocols are in place. This issue is explored further in the Disruptors section.

3.6.4 *DISTRIBUTION INNOVATIONS / GOODS MOVEMENT*

3-73

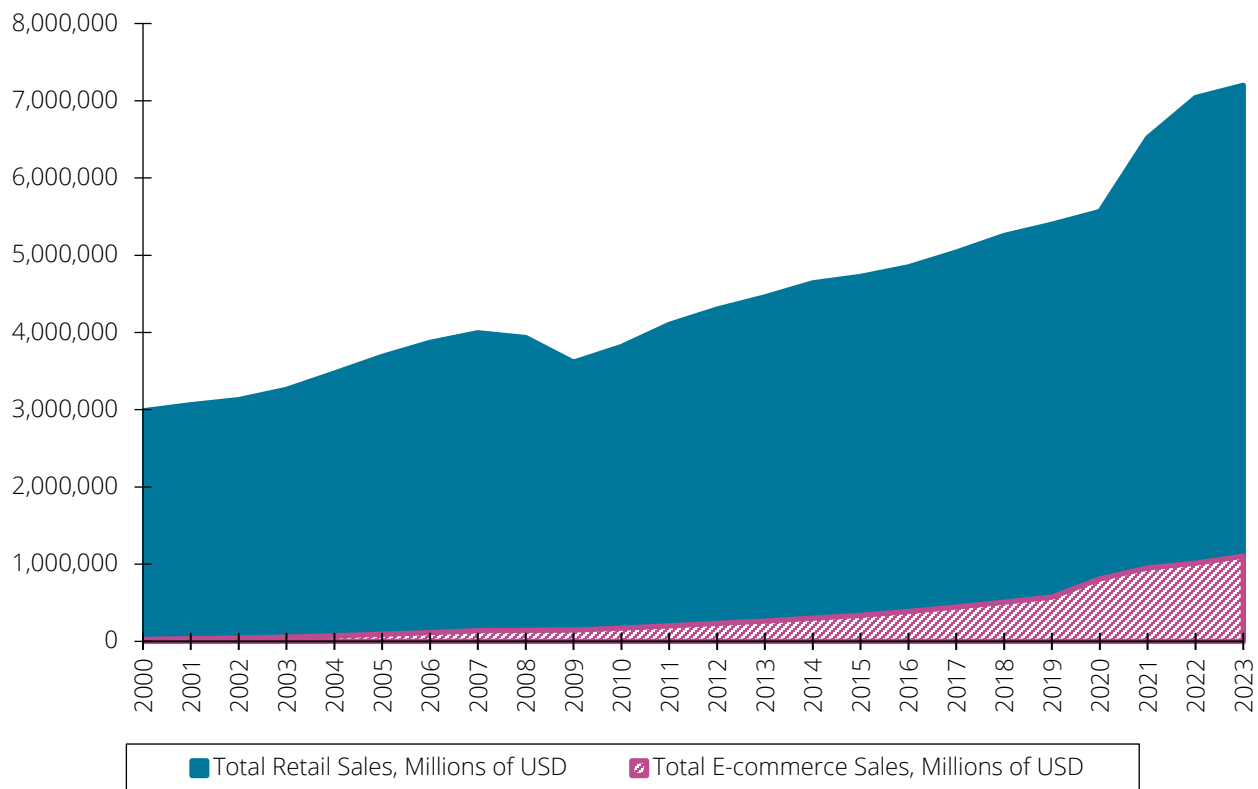
Supply chains and commodity movements are being revolutionized by economy-wide transformations in data availability and connectivity. These trends will continue to affect the NYMTC planning area as businesses deploy new technologies and processes to improve the efficiency of goods movement, reduce costs, comply with regulatory or customer-driven demands, and improve profitability. Distributed manufacturing and e-commerce represent a blend of both new business models and a revamping of traditional practices that help companies capitalize on opportunities that technological developments (such as secure online payment portals, real-time inventory management, and 3D printing) 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 are difficult to gauge. Additionally, disruptive events like the COVID-19 pandemic can accelerate—or stall—the adoption of new techniques and innovations, making it essential to understand trends in distribution innovation.

E-COMMERCE

E-commerce, the buying and selling of goods online, has experienced remarkable growth in the U.S. over the past few decades. Since the early 2000s, unadjusted e-commerce sales have surged from \$27.6 billion in 2000 to \$1.1 trillion in 2023, representing a 40-fold increase (Figure 3.29).⁶³ This expansion has far outpaced the growth of traditional brick-and-mortar sales, with quarterly e-commerce sales rising by an average of 18.3 percent year-over-year, compared to just 4 percent for total retail sales. Consequently, e-commerce's share of total U.S. retail sales has grown dramatically, from less than 1 percent in 2000 to

over 15 percent in 2023. The onset of the COVID-19 pandemic in 2020 further accelerated this trend, driving a 93 percent increase in total e-commerce sales between 2019 and 2023.

Figure 3.29 Growing E-Commerce Sector (2000–2023)



Source: U.S. Census Bureau, 2024.

E-commerce has significantly reshaped the way consumers order, purchase, and receive goods (Table 3.39) with far-reaching implications for transportation, especially in areas such as last-mile delivery, intermodal transportation, and consolidation in fulfillment centers. Now, there is high demand for faster and more flexible delivery options, which puts pressure on logistics networks and increases the volume of smaller direct-to-consumer (D2C) deliveries. The rise of D2C e-commerce, where products are sold directly to consumers without third-party retailers or wholesalers, has driven substantial growth, with D2C e-commerce sales more than doubling from \$76.7 billion in 2019 to \$175 billion in 2023.⁶⁴ The shift away from traditional brick-and-mortar retail has driven massive increases in shipping demands, especially in last-mile logistics. Many retailers, for instance, now rely on shippers like USPS, UPS, and FedEx, or, in some cases, build their own delivery networks, such as Amazon.

Table 3.39 Traditional Commerce versus E-Commerce

Potential Impacts	Traditional Commerce	E-Commerce
Delivery	Consumers typically drive to stores to purchase goods and take them home, reducing the need for direct delivery to individual residences.	Consumers order goods online. The goods are then delivered directly to their home. Consumers typically expect quick delivery, ranging from 15 minutes to two days.
Warehouse & Fulfillment Centers	Inventory is stored at retail locations, and goods are delivered to these stores in bulk via freight. Customers make the final transportation leg themselves.	Requires large-scale fulfillment centers located near urban areas or strategically along transportation corridors to fulfill orders quickly. These centers receive bulk shipments from manufacturers and distribute smaller packages to consumers.
Frequency and Volume of Shipments	Bulk deliveries are made less frequently to centralized retail locations. Individual customers handle the transportation of goods from the store, reducing the frequency of professional deliveries.	Requires smaller, more frequent shipments to individual customers. These smaller parcels demand a higher number of delivery vehicles, including trucks, vans, and even bikes in some urban areas.
Curbside and Parking Needs	Customers visiting physical stores require ample parking, particularly in suburban and mall environments. However, these trips are less likely to require curbside management outside of high-density urban areas.	With home delivery becoming the standard, there is a greater need for curbside management in cities to accommodate delivery vehicles. Cities may need to allocate space for quick pick-up and drop-off to reduce traffic disruption.
Supply Chain Complexity	Supply chains are more linear and stable, with goods moving from manufacturer to retail store with fewer intermediary steps.	Requires an intricate, technology-driven supply chain that focuses on speed, flexibility, and customization. Goods may pass through multiple warehouses, distribution centers, and delivery networks before reaching the customer.

Source: Cambridge Systematics.

The volume of e-commerce shipments and pressure to provide quick deliveries has increased the demand for last-mile delivery services, particularly in urban areas. And in the dense and congested NYMTC planning area, the surge of vehicles related to last-mile delivery has significantly increased congestion and gridlock.

One attendee of the Curb and Parking Management Forum stated that the most important use case of curb management is “neighborhood loading zones in NYC—important post-COVID as 1 in 5 New Yorkers receive a package each week.”

Personal vehicles, scooters, and ebikes used for deliveries contribute to rising traffic volumes and create traffic patterns that deviate from historical norms. This shift in traffic patterns, combined with the high volume of delivery vehicles can increase the likelihood of crashes and congestion, especially when delivery vehicles park in unauthorized locations such as bus lanes or bike lanes.⁶⁵ These conflicts may require municipalities to retrofit or re-engineer roadway design to accommodate competing curb and lane usages

for delivery, transit, active transportation users, trash pick-up, and pedestrians. Insufficient design for the sidewalk, curb, and roadway could lead to issues for persons with mobility impairments. Curb management practices can respond to this new reality with policies such as requiring dynamic curb use to reserve space for delivery vehicles during peak times. Greater collaboration between firms and NYMTC could enable more efficient planning for both. For instance, sharing data on shipping routes and delivery schedules may improve curb management practices like implementing dynamic parking pricing and establishing dedicated loading zones for deliveries.

An attendee at the Curb and Parking Management Public Forum noted that curb data specifications vary depending on land use and time of day, which makes it more difficult to work with curb data and potentially harder to do effective curb management.

E-commerce depends on two key factors: a global supply chain relying on high-volume, low-cost products and an intermodal logistics model that prizes efficient, cost-effective, and flexible transportation solutions with quick shipping times. Intermodal transportation refers to the movement of goods using multiple modes of transport, such as trucks, trains, ships, and planes, without handling the goods themselves when changing modes. The rise of intermodal logistics requires better coordination between air, rail, ports, and road infrastructure, adding pressure on the region's multimodal hubs such as the Port of New York and New Jersey.

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An attendee at the Transportation and Technology Public Forum noted, “for us in NYC, we may need to pay more attention to technologies and information systems (and funding) to optimize the use of our 500+miles of shorelines and waterways.”

New York City is already exploring opportunities to capitalize on waterways for goods movement through the “Blue Highways” project. This initiative focuses on the best practices to modernize marine infrastructure, expand access to the waterfront, and facilitate last-mile deliveries using marine vessels (see example in Figure 3.30).⁶⁶

The NYMTC region may also explore the feasibility of freight villages that can help to alleviate pressure on existing infrastructure. Freight villages are designated logistics hubs that bring together multiple transportation modes (road, rail, and air) and integrate warehousing and distribution facilities in a single location. In the NYMTC region, expanding these hubs outside the most congested urban areas could allow for more efficient transfer of goods and alleviate inner-city congestion. By situating freight villages in strategic locations, such as at the intersections of major highways or near rail corridors, planners could reduce the number of trucks entering the city, consolidating shipments for more efficient last-mile delivery.

Figure 3.30 Example of Integrated Marine and Last-Mile Freight in London



Source: Streetsblog NYC, 2022.

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E-commerce's global supply chain has added impacts on the region's ability to withstand disruptions in trade such as political disputes, natural disasters, or as seen most recently, pandemics. Many industries such as high-tech manufacturing and automotive goods were forced to a standstill when they were unable to import materials and products from overseas. The reliance on long-distance shipping for sourcing and delivering goods creates bottlenecks when any part of the supply chain is disrupted, leading to delays in delivery times and inventory shortages. This lack of resiliency exposes e-commerce businesses to risks like port congestion and transportation delays, which may highlight the need for more localized or diversified supply chains to improve reliability and efficiency in the long term.

Commerce has traditionally relied on consolidated fulfillment centers located on the outskirts of metropolitan areas or in industrial zones to organize and ship inventory. Nowadays, e-commerce's predominance and increasing customer expectations for delivery speed have made it necessary for firms to hold massive stocks of inventory closer to population centers. The growing encroachment of industrial fulfillment needs in residential and mixed-use areas has significant transportation, environmental, and public health impacts on these communities; these effects are further explored in the Distributed Manufacturing section below.

DISTRIBUTED MANUFACTURING

Distributed manufacturing is a production model where the manufacturing process is decentralized and carried out at multiple smaller-scale facilities, typically closer to the end consumer, rather than at a single, large, centralized facility as seen in e-commerce. Distributed manufacturing is often used by industries and businesses that rely on localized, flexible, and on-demand production—in contrast to the global e-commerce model. It often includes the creation of different components or entire products in various smaller facilities, leveraging advanced technologies like 3D printing to manufacture products locally and quickly, reducing the need for long-distance shipping. Distributed manufacturing is a key feature enabling just-in-time inventory management, a popular supply chain paradigm in which a producer receives materials for production exactly when production begins and keeps as little stock as possible.⁶⁷

Distributed manufacturing often involves placing smaller, localized production and warehousing facilities closer to consumer markets, rather than in sparsely populated areas further from residential communities as often seen in consolidated fulfillment centers. Huge investments have been made to build and lease warehouses in the NYMTC planning area. The warehouse availability rate in New York City and New Jersey is under 2 percent, lower than every other municipal area besides Los Angeles, reflecting the demand for warehousing space in the region.⁶⁸

Because of the heightened economic demand in the NYMTC planning region, many of the commodities shipped to customers in the region originate from manufacturing and distribution centers located outside of the region. Namely, these areas are New Jersey, the upper Hudson Valley in New York, western Connecticut, and eastern Pennsylvania, especially the Lehigh Valley. Known for its farmland, the Lehigh Valley's first distribution center was a 100,000 square foot Nestle facility, built in 1994.⁶⁹ Since the late 2000s housing crisis, development in the valley has accelerated, culminating in 44 million approved square feet of industrial and warehouse space since 2015 in Lehigh and Northampton counties. This square footage is equal to over 1000 acres.

Further, the PANYNJ lists 62 warehousing and distribution partners outside of the NYMTC planning region on its website ranging from Carlisle, Pennsylvania to Lodi, New Jersey.⁷⁰ This is a fraction of the true total as New Jersey has over 3,000 warehouses that are responsible for 380,000 daily truck trips. These warehouses comprise 527 million square feet, a figure that has grown by 35 percent during the last two decades.⁷¹ Connecticut has 8 Amazon facilities located west of the Connecticut River, while New Jersey and Pennsylvania have more than 40 each.⁷²

The presence of these warehouses is a strain on surrounding communities: heavy vehicle traffic, including trucks, truck parking needs, requirements for access to Interstate highways, and transportation needs for employees who staff the facilities. In New York City, the addition of several warehouses has produced multiple concerns from local residents regarding pollution, pedestrian safety, and other hazards.⁷³ Air pollution has worsened dramatically in the Lehigh Valley to the point that the Asthma and Allergy Foundation of America named Allentown, PA the most challenging city in the United States to live with asthma.⁷⁴ Local advocates point to pollution caused by diesel trucks as a key cause of this development^{75,76} and multiple campaigns have emerged in the Lehigh Valley to lessen truck pollutants.^{77,78}

Policy recommendations to address the twin issues of warehouse scarcity and their impact include repurposing parking garages for use as fulfillment centers or New York City's plan to shift truck freight onto barges with waterfront shipping hubs.⁷⁹ NYMTC member agencies may experience localized traffic impacts in their communities and can explore improved access to these centers by optimizing roadways, such as dedicated truck lanes, or intersection improvements, as well as leveraging intermodal options.⁸⁰ Additionally, the clustering of fulfillment centers may require zoning adjustments and collaboration with freight and logistics operators to mitigate environmental and noise impacts in surrounding communities, especially in underserved areas that disproportionately house these types of land uses.

Distributed manufacturing also increases the demand for truck parking in residential and mixed-use areas. Due to a lack of authorized truck parking—particularly in urban areas—trucks often resort to parking on streets designed for local traffic rather than designated loading zones, leading to congestion, noise, and safety hazards. Residents may find it challenging to access their homes, and there can be increased wear and tear on local infrastructure. In 2023, due to resident concerns, New York City launched a citywide crackdown on illegally parked trucks, especially in Queens and Staten Island.⁸¹⁻⁸² As a result, the New York City Council passed a bill to develop three or more locations for off-street commercial parking by 2025.⁸³ As goods movement increases, NYMTC member agencies may need to explore the creation of truck parking lots as well as other solutions such as street parking near fulfillment centers.

There are also known health consequences of warehouses in densely populated areas and vulnerable groups, including people of color and low-income residents are disproportionately affected by the health consequences, including asthma.⁸⁴ Nearly three million people (see Figure 3.31) live within half a mile of a warehouse within the five boroughs of New York City, and low-income residents are 19 percent more likely to live in a warehouse district than higher-income peers. With the e-commerce boom unlikely to subside, member agencies may explore opportunities for delivery fleets to transition to cleaner fuels..

Figure 3.31 Residents Living Within a Half Mile of Warehouse in the Region



Five Boroughs

- » 3 million residents total
- » Black residents are 17% more likely; Hispanic/Latino residents are 13% more likely
- » Low-income residents are 19% more likely

South Bronx

- » 233,000 residents total
- » Asthma-related emergency room visits among children ages five-17 years old are three times higher than across the five boroughs

Long Island

- » 2.5 million residents total
- » Black residents are 30% more likely; Hispanic/Latino residents are 26% more likely
- » Low-income residents are 29% more likely

Hudson Valley

- » 457,000 residents total
- » Black residents are 101% more likely; Hispanic/Latino residents are 66% more likely

Source: Environmental Defense Fund.

shifting focus from long-haul freight to more localized delivery systems. This change would likely demand investments in regional transportation networks, such as rail freight terminals, intermodal hubs, and improved highways connecting urban centers.

Finally, as manufacturing is spread across more locations, workers may no longer commute to large central factories but instead to smaller, more distributed facilities. This shift would require transportation planning to accommodate a more dispersed commuter network. Public transit options may need to be expanded into suburban or previously underserved areas, or incentivize alternatives like ridesharing, biking, or microtransit solutions that connect to employment hubs. Planners may also need to rethink how to manage peak commuting periods, which could become more diffused across regions and times of day.

3.7 DISRUPTORS CHANGING TRANSPORTATION

Disruptors, unlike trends, are less predictable forces that can drive transformative change. While trends tend to follow more gradual patterns, disruptors can cause sudden shifts in economies and mobility. For instance, unexpected population losses could drastically alter who is traveling, how they travel, and when. This inherent uncertainty complicates long-term planning. By recognizing the potential impacts of these disruptive changes, NYMTC's planning area and the wider multistate metropolitan region can better assess future challenges and understand how uncertainty may shape their transportation goals.

3.7.1 SEA LEVEL RISE AND EXTREME WEATHER

Since 1980, the U.S. has sustained at least 323 disasters where overall damages/costs reached or exceeded \$1 billion (including Consumer Price Index adjustment to 2021). The total cost of these 323 events exceeds \$2.195 trillion.⁸⁵ In the NYMTC region, Hurricane Sandy is estimated to have caused \$65 billion in damages and economic loss, with the Department of Transportation receiving \$12.4 billion, the second largest portion of recovery funds (behind Department of Housing and Urban Development in 2013 to rebuild.^{86,87}

As the fifth U.S. National Climate Assessment underscores, it is assumed that there will continue to be an increase in extreme 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 and topography of the New York coastline; and (3) the topography of islands and river valleys throughout the planning area. The New York City Mayor's Office identified four extreme weather hazards impacting the region, including coastal surge flooding, chronic tidal flooding, extreme rainfall, and extreme heat.⁸⁸

The impacts of these hazards on the transportation system and everyday life include inaccessible roadways and transit systems due to flooding and storm surges, damage to infrastructure from flooding and extreme heat, and increased maintenance frequency/reduced lifecycles due to flooding and extreme heat.⁸⁹ Bridges are one such transportation infrastructure that are particularly vulnerable to damage and erosion from these hazards, according to a 2019 study. The expedited damage to asphalt, steel, bridge joints, and pavement also exhausts agency funding and resources.

Federal funding programs such as the Bridge Improvement Program through IIJA provide \$10 billion of competitive grant funding annually for bridge replacement, rehabilitation, preservation, and protection projects and can help relieve some of the cost to create more resilient transportation infrastructure, but these funds are available in the short-term. Long term impacts for bridge and pavement management costs are still uncertain.⁹⁰ Other resilience funding through the IIJA includes the Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) Grant program which programs \$848 million annually towards supporting planning activities, resilience improvements, community resilience and evacuation routes, and at-risk coastal infrastructure.

Extreme weather can also impede the movement of people and goods, limiting access to certain roadways, ports, and railways, as well as making traveling alternative transportation modes (walking/biking/transit) more hazardous for individual health. The New York Climate Impacts Assessment identifies three main ways extreme weather events impact the movement of people, including:

- » Impeding safe vehicle operation (through poor visibility and reduced traction);
- » Creating delays by cutting off travel routes and increasing congestion; and
- » Slowing emergency response and repair efforts.⁹¹

According to data from TRANSCOM, between 2022 and 2024, weather-related incidents caused 2,122 roadway delays or closures and 520 transit service disruptions.³ On roadways, the most frequent issues were downed trees (49 percent) and flooding (33 percent). Similarly, on transit lines, half of all disruptions were weather-related, including track, equipment, signal, and switch problems. Prolonged incidents were more common for transit, with nearly 8 percent of disruptions lasting over a day, compared to 3.5 percent for roadways. Geographically, 37 percent of the weather-related roadway delays or closures occurred in Westchester County, while 39 percent of transit disruptions were concentrated in New York County, reflecting the density of transit lines there. Such closures can cause congestion due to bottlenecks and rerouting, leading to longer travel times and travel delays. This has a costly impact especially on goods movement and the supply chain, where traffic congestion in New York cost the trucking industry \$4.9 billion in 2021, and 89 percent of New Yorkers depend exclusively on trucks to transport their goods.^{92,93}

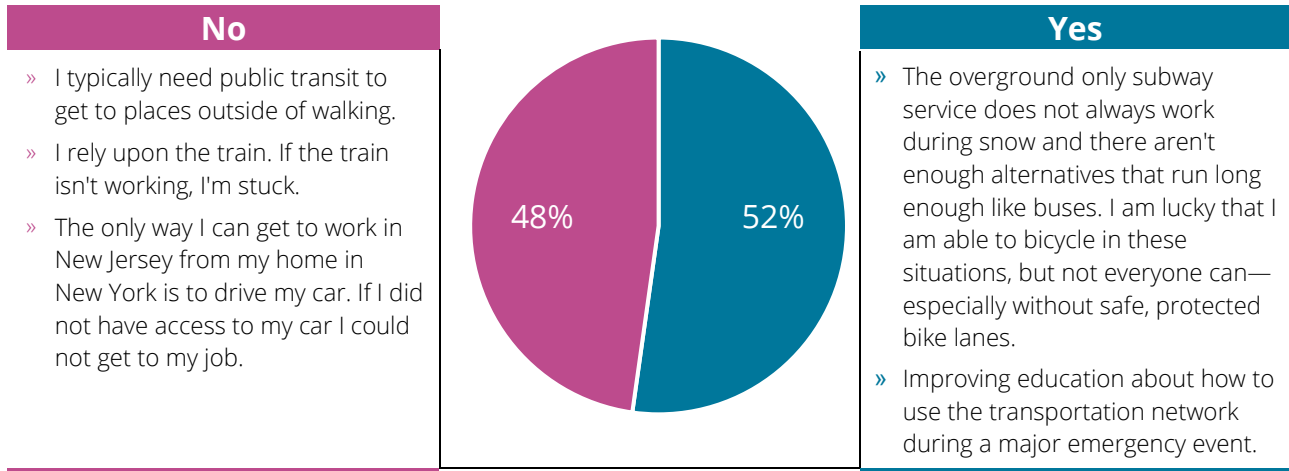
Extreme weather events have a more significant and prolonged impact on both roadway safety and efficiency, as well as transit service. According to the Hurricane Sandy Rebuild Strategy Report, “Hurricane Sandy was the worst disaster for public transit systems (e.g., bus, subway, commuter rail) in the nation’s history.” Commute times to New York City pre- and post-Sandy almost tripled for Transit (Subway and Bus) and Drive Only modes from around 40 minutes to over 120 minutes. Before Sandy, 46 percent of workers used the Subway to commute, where only 11 percent did in the days following the storm.⁹⁴ This was attributed in part to a number of subway stations being flooded in Lower Manhattan immediately following the storm. While storms are a major concern to the region’s mobility, extreme heat also poses a concern. In July 2024, the Third Avenue Bridge connecting the Bronx and Manhattan was stuck halfway open for almost

³ TRANSCOM roadways include major highways, local streets, bridges, and tunnels. Transit encompasses buses, subways, and commuter trains. Ferries did not have any reported weather-related disruptions during this time period.

four hours due to overheating machinery and the heat expansion of its steel.^{95, 96} Heatwaves have also been an issue for the NYMTC planning area's transit infrastructure, with the MTA's railroad tracks experiencing buckling and overhead wire issues.⁹⁷

Would you be able to complete your typical daily tasks if your preferred mode (car, bus, bike, etc.) was not available?

Figure 3.32 *Moving Forward 2055* Responses



Source: NYMTC.

Overall, extreme weather events, increased temperature, and sea level rise will continue to present threats despite ongoing policy efforts.. It is assumed that the cost and damage caused by these threats will continue to increase the costs of maintaining the transportation system in NYMTC's region. Agencies can plan for more resilient communities and use technologies to forecast impacts, but there is still a high level of uncertainty impacting transportation programming and planning over the next 30 years. This includes an increase in capital costs to maintain the system, cost to repair damage from extreme events, and a potential shift in mode share for people and goods movement as communities adapt.

POLICIES

During the decade of the 2010s, extreme weather events increased consideration of resiliency and 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. Both Federal, state, and local governments are enacting policies to build more resilient transportation and land use. The fifth U.S. National Climate Assessment notes the raising national actions being taken to adapt to employ mitigation strategies, such as land management strategies and expanding renewable energy options.⁹⁸ The NYMTC Region has taken on many efforts to adapt and mitigate the impacts of extreme weather events. The impacts of these policies may change the way people live and move throughout the region:

- » New York City identified strategies in the report: [The New Normal: Combating Storm-Related Extreme Weather in New York City \(2021\)](#). This includes creating better partnerships and communication

channels between departments, emergency response agencies, and the traveling public. The City has also incorporated new technologies such as the Flood Sensor Network that would provide early warning detection and feed into the ITS system sharing variable signage to notify drivers of roadway hazards and reduce risk of congestion and safety risks caused by extreme weather.

- » The [NYC Stormwater Resiliency Plan \(2021\)](#) is a 10-year plan aimed at short-term initiatives and investments to accelerate preparation for possible near-term emergencies. This includes \$2B of investment in southeast Queens in comprehensive drainage system improvements and \$200M in the roadway network, as well as over 10,000 green infrastructure assets in construction or constructed.
- » In January 2022, Mayor Adams established the MOCEJ to prepare for the impacts of extreme weather disruptors and address remediation efforts from a fairness perspective.⁹⁹ Their work includes focusing on transforming the electrical grid to 100 percent clean energy by 2040, improve energy efficiency in buildings and remediate flooding and heat risks, increasing access to carbon-neutral and sustainable transportation modes (80 percent by 2050), and investing in social justice.
- » The [Long Island Sound Comprehensive Conservation and Management Plan \(2015\)](#) aims to improve water quality and restore and protect the Sound's ecological balance, as well as build sustainable and resilient communities. Progress has been made in improving the health of the Sound but new threats like sea level rise are affecting it. Advancing regional partnerships, implementing more complete knowledge/testing of contaminants, and developing watershed-based planning are all strategies proposed to help meet these regional goals.

Additional key policies include the use of technology and the fair implementation of adaptation and mitigation strategies. Land use and transportation decisions have a long history of disproportionately impacting certain communities and demographics. Despite recent efforts to mitigate these negative impacts, sea level rise, increased heat, and extreme weather events can exacerbate this disparity. According to the New York Climate Assessment:

“Climate-related disruptions to roadways also disproportionately impact economic sectors and industries that rely on an on-site workforce to provide services or perform physical labor. Sectors and industries in New York that rely on an on-site workforce include health care, childcare, agriculture, construction, utilities, transportation, manufacturing, and hospitality.”

Each year there are an estimated approximately 350 heat-related deaths on average in New York City.¹⁰⁰ The lack of green space, limited access to air conditioning, poor housing related to health effects from heat are all issues disproportionately impacting underserved communities.

Online tools, such as those created by New York City MOCEJ provide environmental data such as flood inundation risk, hazardous materials, etc. at the census block level to help visualize risk to disproportionately burdened communities and provide the opportunity to make fair and informed decisions.¹⁰¹

Attendees at the Transportation and Technology Public Forum noted that extreme weather trends should be a consideration when planning for smart systems for transportation, including consideration of how increased storms, lack of water, etc. impact technology.

Like MOCEJ's Mapping tool, 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.

3.7.2 ENERGY TRANSFORMATION

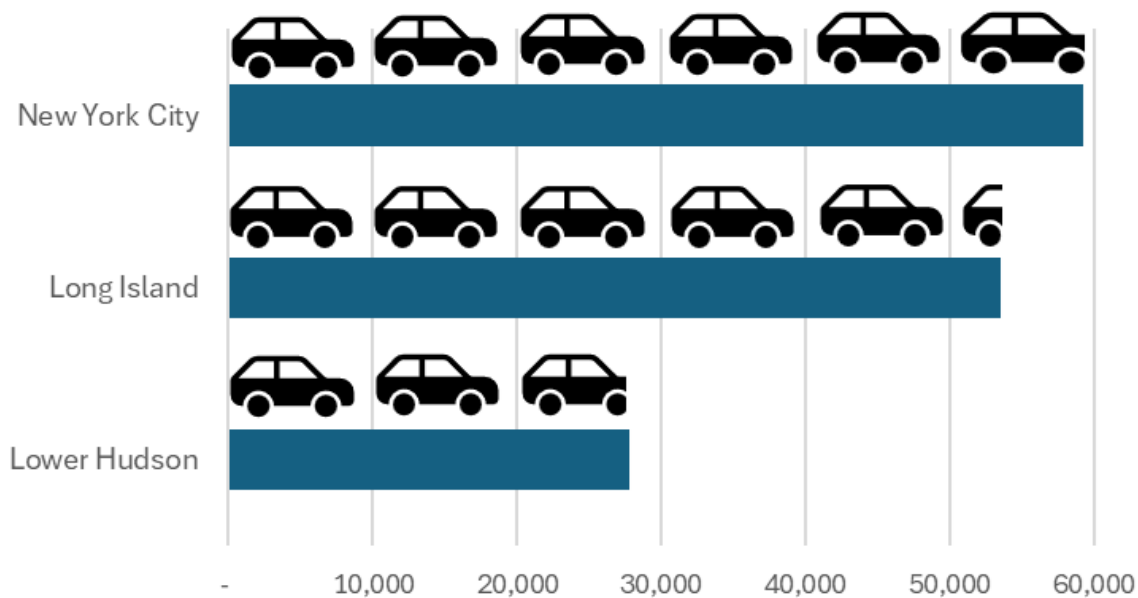
Energy transformation is a key strategy to reduce the multitude of harmful impacts of air pollution. For transportation, this energy transformation is seen in the systematic shift from the reliance on fossil fuels (such as gasoline and diesel) to alternative and renewable energy sources (such as electricity, hydrogen, biofuels, natural gas, propane, and renewable biodiesel) in powering various modes of transport. Energy prices, often impacted by geopolitical conflict, have also varied over the last decade, with periods of consistently high prices placing more onus on fuel-efficiency. According to USEPA, average real-world fuel economy for all vehicle types reached a record high 26.0 miles per gallon (mpg) for the 2022 model year, up from 25.4 mpg for the 2018 model year.¹⁰²

Participants in the Lower Hudson Valley Environmental Justice Focus group, Lower Hudson Valley Coordinated Human Services Focus Group, and New York City Coordinated Human Services Focus Group noted the need to move the transportation system away from dependency on oil, expressed interest in seeing more electric buses and other less energy-intensive transportation options in their communities, and called for cleaner and more environmentally friendly transportation options.

Due to the increased emphasis on supporting cleaner energy opportunities, alternative fuel and energy sources have begun to increase. These include Electric (EV), Compressed Natural Gas (CNG), Liquid Natural Gas (LNG), Liquefied Propane (LPG), Hydrogen (HYD), and BioDiesel (BIO). Electric micro-mobility options are another opportunity to replace shorter SOV trips, though there are some barriers to education and safety that limit overall adoption and use.

Electric vehicles (EV) and hybrid electric vehicles (HEV) have emerged as a desired alternative to gas and diesel engine vehicles. In 2023, New York State had approximately 131,250 registered light-duty EVs, making it one of the leading states for EV adoption.¹⁰³ EVs can be charged from standard electricity sources, while HEVs combine an internal combustion engine with an electric motor. 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. 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 less pollutants, and cost less to operate.

Figure 3.33 Electric Vehicle Registrations in 2023

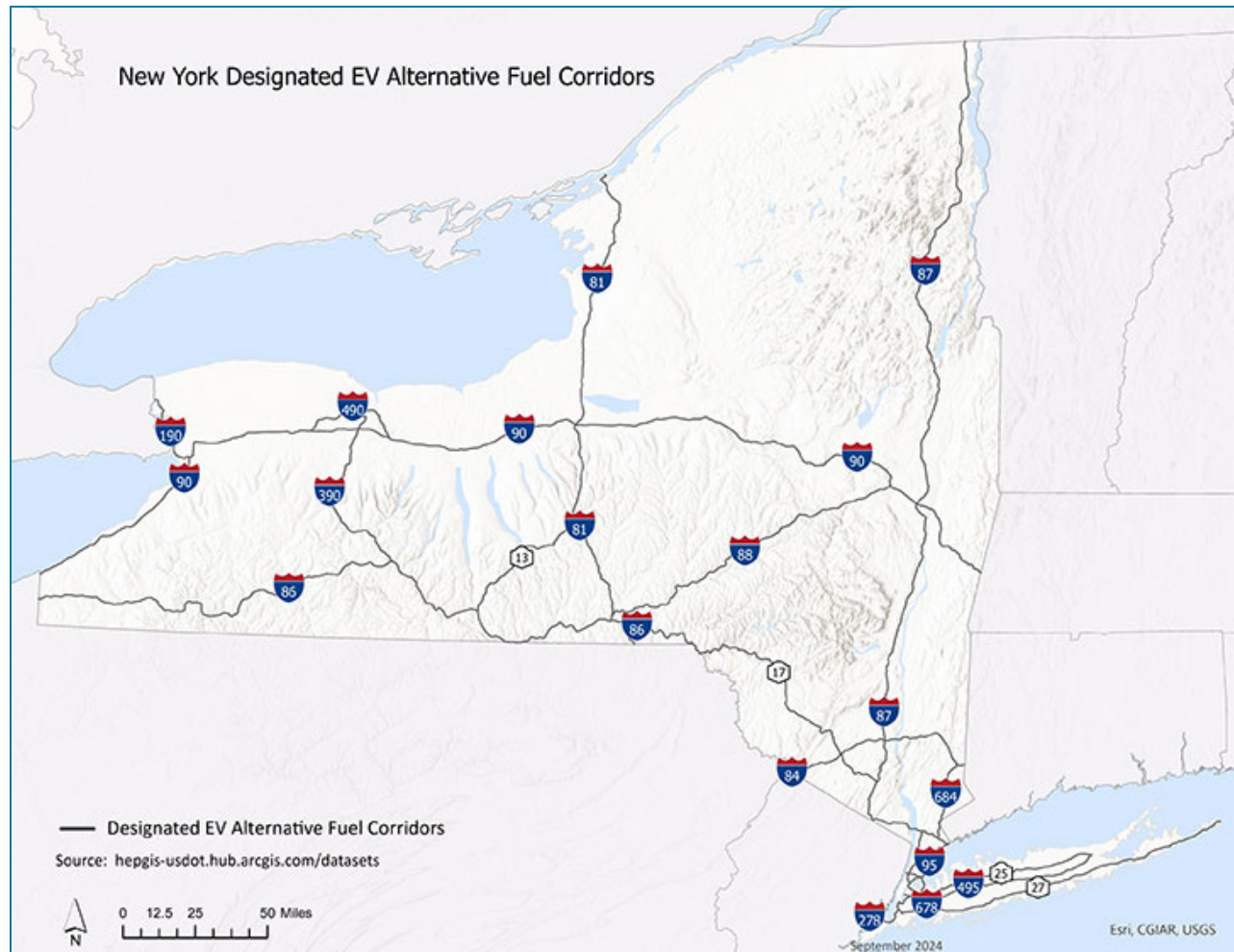


Source: NYSDOT, 2023.

There are still issues with the range, commonly referred to as “range anxiety,” that many consumers feel limits an EV’s practicality. Constrained infrastructure development for charging has been a barrier to the emerging EV market, though there are national efforts to improve EV charging infrastructure through planning and funding implementation. In September 2022, NYSDOT submitted the state’s National Electric Vehicle Infrastructure (NEVI) Plan, a requirement for receiving Federal funding for EV charging infrastructure. The state received approximately \$175 million over five years to fund and construct EV charging stations along the state’s most-traveled Interstate and state highways that make up the Alternative Fuel Corridors (AFCs) (see Figure 3.34). In the New York City Metro Area, AFCs include Interstates 84, 684, 95, 495, 278, 678, 287, and NY routes 25 and 27.¹⁰⁴ In December 2023, the state opened New York’s first NEVI-funded EV fast charger in the Hudson Valley. The NEVI Plan is part of the state’s larger Clean Transportation Roadmap, overseen by the New York State Energy Research and Development Authority (NYSDOT), which explores options for reducing pollution and highlights barriers, rates of technology adoption, and policy impacts.¹⁰⁵

The National Renewable Energy Laboratory, part of the U.S. Department of Energy, estimates that the U.S. will need 182,000 fast chargers for EVs by 2030. There are currently fewer than 40,000, according to the DOE, with about a quarter of those in California.¹⁰⁶

Figure 3.34 New York Designated EV Alternative Fuel Corridors



Source: NYSDOT, 2023.

With the rise of EV and HEV popularity, as well as increasing fuel efficiency, revenue from Federal and state gas taxes are decreasing, impacting capital planning budgets. One study in California estimated a \$4.4 billion or a 31 percent decrease in revenues over the next decade.¹⁰⁷ Many states are looking into alternative revenue streams such as road or cordon pricing, battery taxes on EV registration, VMT fees (also known as road user charges), and dedicating a portion of sales taxes for transportation funds to fill the gap.

An attendee at the afternoon Alternative Energy Public Forum noted that the most important projects/initiatives to them included converting public transit vehicles to cleaner fuels or electricity, converting school buses and vans to cleaner fuels or electricity, and converting public (i.e., agency/municipal) vehicle fleets to cleaner fuels or electricity.

In addition to AFVs for consumers, there are also opportunities to integrate alternative fuels into freight applications for light, medium, and heavy-duty vehicles. Companies like Amazon and FedEx are investing in electric delivery vans, a trend particularly visible in urban centers like New York City. EVs offer the dual benefits of zero tailpipe pollutants and quieter operation, making them ideal for densely populated areas where air quality and noise pollution are critical concerns. However, for larger freight vehicles, battery weight and range limitations remain significant barriers, especially for long-haul operations. Other potential fuel types such as natural gas, propane, hydrogen, and biodiesel are also relevant and have great potential for reducing freight-related pollution but are limited by a lack of refueling infrastructure. As the latter expands, however, the rise in alternative fuel freight vehicles has significant capacity to advance the region's vision for a more sustainable transportation system, including goods movement.

POLICIES

Alternative energy fuels are seen as a strategy to reduce transportation pollution, improving air quality and public health, along with additional environmental benefits. In 2019 New York State signed the Climate Leadership and Community Protection Act (Climate Act) into law. The Climate Act requires New York to “reduce economy-wide GHG emissions 40 percent by 2030 and 85 percent by 2050 from 1990 levels.”¹⁰⁸ This policy has set a direction for New York's future invest priorities within the green economy. Other related policies and key targets are presented in Table 3.40.

Communities across New York State are implementing new policies, largely focused on vehicle procurement and infrastructure programs for charging and fueling, to help meet these targets in the transportation sector. Within the NYMTC area, these efforts include:

- » Promoting alternative modes of transportation to help diversify the network to move goods and people.
- » Advancing high-efficiency, low-emission alternative transportation technologies in the region's freight fleet as outlined in NYMTC's Clean Freight Corridors Planning Study.
- » Installing charging infrastructure along major corridors and promoting installation at multifamily homes and businesses.
- » Helping accelerate electric car sales to over 30,000 since 2011 through the ChargeNY program.
- » The Town of Hempstead installed the first hydrogen fueling station on Long Island.

Table 3.40 Energy Policies and Goals

Policy	Goal
New York State Transportation Energy Policy	» 100% of all car, truck, and bus sales are zero-emission vehicles by 2045.
NYC Clean Fleet Plan	» Goal: all on-road vehicles in the fleet will be all-electric or plug-in electric models by 2040.
Westchester County Bee-Line hybrid and electric bus fleet	» As of 2024, the County aims to replace its remaining 21 diesel buses with hybrid or EVs within the next two years.
Department of Energy, Alternative Fuels Data Center	» For state agencies, fleet decarbonization plans must meet the following schedule: » All state light-duty vehicles must be zero emission vehicles (ZEVs) by December 31, 2035. » All state medium/heavy duty vehicles must be ZEVs by December 31, 2040. » 100% of new passenger vehicles sold in New York must be ZEVs by 2035. » All sales or leases of new light-duty passenger vehicles in New York must be ZEVs by 2035, and all sales or leases of new medium- and heavy-duty vehicles must be ZEVs by 2045. All new off-road vehicle and equipment purchases must be zero emission by 2035. » Beginning July 1, 2027, school districts may only purchase or lease zero emission school buses when entering new purchase or lease contracts.
New York MTA Climate Policy	» Reduce operational pollution in alignment with aggressive 2040 targets(from a 2015 operational baseline) by converting nearly 5,800 buses to zero-emissions, retrofitting existing facilities, investing in energy-saving technologies, and more. » The MTA has committed to transition 100% of its bus fleet to zero-emission models by 2040; light-duty non-revenue fleets to 100% zero-emissions by 2035, and medium- and heavy-duty non-revenue fleets by 2040. » Reducing pollution from locomotives on Metro-North and Long Island Rail Road, and replacing diesel non-revenue locomotives in the subway with hybrids.

New alternative energy solutions also bring new challenges. One emerging barrier that impacts the implementation of these policies, especially the increased shift in EVs, includes concerns surrounding the sustainability and risk of reliance on the antiquated electric grid. EV's growing impact is estimated to require \$2 trillion of investments to the nation's electric infrastructure in order to support the transition to EV and clean energy.¹⁰⁹ The risk to the grid is largely caused by widespread EV adoption creating a huge surge in power demand, the reliability of which is already at risk from extreme weather. Additionally, the extraction of lithium, and the manufacturing and recycling of EV batteries is extremely toxic and water intensive. As resource extraction, EV production and operation, and battery development and disposal methods continue to evolve, so does the total sustainability impact of EVs. A 2022 study by the Department of Energy analyzed the lifecycle pollution of EVs (also known as "well to wheel") and affirmed that battery EVs, with both current and future tech, as well as an assessment of electric grid mixes, are still among the most sustainable option for light-duty motor vehicles.¹¹⁰ There are also additional costs to investing in re-training to ensure an adequate workforce for maintenance of both EVs and the charging infrastructure.

Another potential risk to the shift to clean and alternative energies includes political support on the national and local scale. This is also impacted by overall public opinion on the safety and efficacy of emerging energy

alternatives. With so many policies offering financial support and incentives to build out necessary infrastructure improvements, a lack of investments and support could greatly impact the private market's role of innovation and the development of alternatives. These risks increase the uncertainty in long-term planning, especially as it relates to project selection and future investments in the transportation system.

3.7.3 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. These patterns can significantly alter transportation and the way people and goods move in the region. While *Moving Forward 2055* addresses population trends through forecasts and assumptions, there are levels of uncertainty in the impacts of these shifts that can greatly impact transportation planning for the future.

Aging populations create generational differences in transportation needs and preferences. The emergence of new generations in the workforce introduces new technologies and preferences, as seen through the rise of the gig-economy, or economic activity of typical service sector jobs performed by temporary or freelance workers (ex: Uber, Lyft, Doordash, Instacart, etc.). It can also generate new concerns, such as the upscaling of job requirements and resources, leaving knowledge and skill gaps in the workforce. The geographic population shifts of in-and-out migration also creates new nodes for network connectivity, putting pressure on transit and transportation agencies to shift and expand service areas. These unforeseen challenges are hard to predict when conducting long-range planning, but transit and transportation agencies still must adapt to these shifts as they arise.

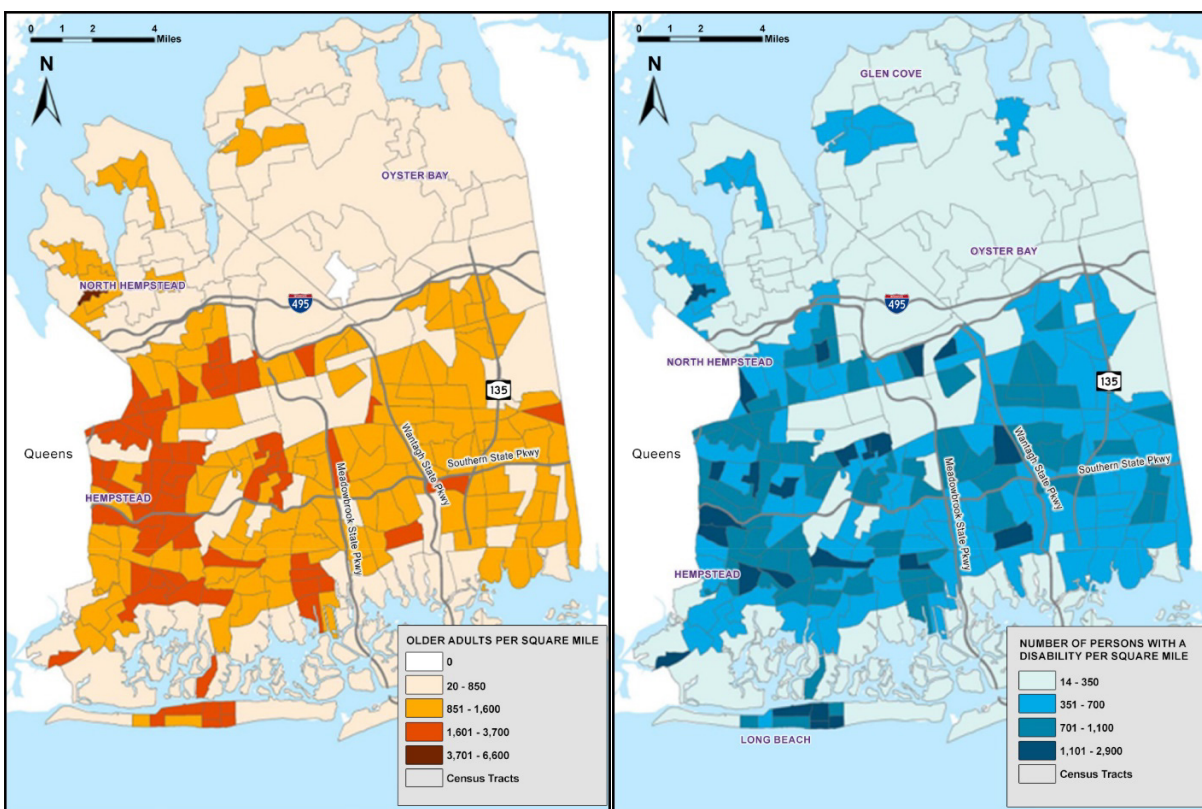
AGING POPULATION

One of the most prominent demographic trends during the period of *Moving Forward 2055* will be the aging of the population in NYMTC's planning area. This trend is colloquially known as the "Silver Tsunami" and has been more significant in recent generations with the growing success of healthcare and medicine that extend human lifespans. Aging populations are found in both high- and low-density areas within the state. In the NYMTC region, Manhattan, Nassau, and Putnam counties have the highest proportion of seniors; Putnam County had the greatest increase in elderly adults from 2000 to 2022. According to Hudson Valley Pattern for Progress' report, the median age in the United States has been steadily trending upwards since the 1970s and has increased every year for the last 10 years. New York State and the NYMTC planning area have an average median age around 40 years old, while more suburban counties are trending well above the regional average (Nassau, Suffolk and Westchester Counties are around 42 years old, while Putnam is 44.3 years old).¹¹¹ In 2023, the population 65 years and older living in the NYMTC planning area was 2.2 million or 18 percent of the population, up from 1.9 million or 15 percent of the total residential population.¹¹² This figure is expected to continue to increase with the continued aging of the Baby Boom generation and advancements in medicine and healthcare.

Long Island Coordinated Human Services Focus Group participants raised concerns about the accessibility of transportation services for older individuals and individuals with disabilities, particularly the distance between subway stations and the need for more escalators and elevators at busy stations.

Changes to the age structure of the population influence travel patterns in the region. One report estimated the demand for medical services and shifting housing needs as two potential impacts affecting the population and employment sectors.¹¹³ 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 the NYMTC region, many of the counties that have high proportions of elderly adults overlap with higher rates of persons with disabilities. Figure 3.35 illustrates the overlap in older adults and persons with disabilities, as well as the breadth across the county. 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, although earlier reports found that they are using public transit more and more.¹¹⁴ According to FHWA, the percentage of licensed drivers who were 65 and older in 2022 in New York was just over 23 percent, up from 21 percent in 2018.¹¹⁵ In the United States, 51.5 million licensed drivers were 65 and older in 2022, up from 45 million in 2018. The proportion of licensed drivers 65+ has risen from 14 percent in 2001 to 21 percent in 2021.¹¹⁶

Figure 3.35 Older Adults and Persons with a Disability in Nassau County



Source: U.S. Census Bureau, 2014–2018 ACS 5-Year Estimates.

Measures that can accommodate an aging population's mobility needs include more specialized transportation designs, such as “Complete Streets,” that are designed and operated to enable safe use and support mobility for all users. These include people of all ages and abilities, 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. Two emerging trends that may impact older drivers include the rise of AVs and the integration of technology in scheduling transportation services. The National Highway Traffic Safety Administration (NHTSA) explored the impact of older drivers and self-driving technology, specifically as it relates to the potential safety benefits. Currently, the impact is not fully known given the lack of access to AVs to the general public, though reports suggest the potential additional cost of purchasing self-driving vehicles will make them unaffordable for aging populations. Another hurdle to general adoption of driverless technologies for older drivers is trust in these new systems. Research did find safety benefits of intuitive in-vehicle information systems, though there is a negative impact to driver safety as the number of systems increases.¹¹⁷

The continued 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. It also creates concerns as technologies are embedded into transportation demand through trip scheduling software and the rising popularity of mobile ticketing and payments. The use of these technologies creates accessibility issues due to knowledge gaps for aging populations that rely on these services. The NYS Office of Aging identified “Technology Access and Development” as an organizing pillar to their Master Plan for Aging (2023), specifically calling out the need to “enhance meaningful access to technology through training and technical assistance for older adults on how to use common devices such as tablets and smart phones.”¹¹⁸ An emphasis on education with new technologies will be a key determinant for adaptability for older generations.

SHIFTING MODE CHOICE

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 1996) 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. Generation Z, those born between 1997 and 2012, are getting their driver’s licenses at lower rates than their predecessors—25 percent and 45 percent for 16- and 17-year-olds, respectively, compared to 43 and 62 percent for teens in 1997.¹¹⁹

Other research has found that Millennials, although they rode fewer vehicles than Baby Boomers (those born between 1946 and 1964), had greater 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.¹²⁰

Multiple survey respondents emphasized the need to plan for and invest in alternative modes of public transportation and move away from prioritizing cars.

Generation Z, also known as Zoomers and iGen, (born between 1997 and 2012) 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:¹²¹

Millennials and those in the younger cohort of Gen Z are more than twice as likely than Gen X (1964-80) 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 percent of Millennials said that their preferred mode of transport was the car they own, in comparison to 81 percent of consumers from other generations.

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.

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.¹²²

One impact of new technologies includes the rise of the gig-economy.¹²³ Internal Revenue Service 1099 tax forms show a 250 percent growth in the total number of people collecting money from platform gig work between 2017 and 2021.¹²⁴ Pew Research Center surveyed U.S. adults in August 2021 and found that 16 percent of Americans have ever earned money through an online gig platform, 30 percent of which were ages 18 to 29.¹²⁵ One appeal of the gig-economy is setting your own schedule and working more flexible hours outside the traditional "work hours". For ride-hailing platforms, the largest volume of activities happens during evening off-peak hours (8:00 p.m. to 9:00 p.m.), a shift from the traditional morning and evening peaks, while almost 50 percent of all completed trips occur between Tuesday and Thursday.¹²⁶

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. 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 and when mobility demand occurs. 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.

MIGRATION PATTERNS

With natural birth rates declining across the NYMTC planning area, the increasing cost of living, and older generations leaving the area for warmer climates, migration patterns have a significant impact on the overall growth of populations and the economy in the region. During the pandemic, suburban and rural areas within the greater New York City metro region saw a significant increase in inflow migration from New York City residents. According to NYMTC's 2055 adjusted forecasts, the Mid-Hudson subregion is assumed to have a greater growth than anticipated through 2055, partially due to Pandemic relocations. The Hudson Valley gained a majority (82 percent) of its inflow between 2019 and 2021 from New York City counties (approximately 94,500 residents).¹²⁷ This trend is also supported by the uptick in remote/hybrid work models that allow for longer, less frequent commutes. The inflow migration out of New York City into the surrounding suburban counties also increased the demand, and cost, for housing in those areas.

Extreme weather and geopolitical conflict in other parts of the world have caused large displacements of populations seeking refugee status. According to a recent story in the New York Times, 210,000 migrants have arrived in New York City since 2022, with a majority arriving from the U.S.-Mexico border.¹²⁸ The increase in asylum seekers has increased the need for housing and transportation, particularly public transit and its role to facilitate immigrants' access to employment and critical social services. Impact to new housing means higher demand for connections to these temporary housing facilities to immigration services. Due to policies and language barriers, many migrants must rely on transit to access these services and often settle in cities that have robust transit networks. In 2019, immigrants comprised 14 percent of the US population and 32 percent of its transit commuters.¹²⁹ The article describes the role of transit as a tool for integration, stating:

Immigrants' ability to connect to city services and access available resources is key to their integration. Public transit systems that are reliable, safe, and accessible have a role to play, particularly by facilitating immigrants' access to employment and critical social services. Conversely, poor transit systems may inhibit an immigrant's integration experience.

As noted in the Trends section, the volume of transit trips has increased since 2022 but is still about 32 percent less than what it was in 2019, before the pandemic. Understanding and addressing migrant needs may also be beneficial for transit agencies looking to recover ridership from their services. The lack of

permanent housing makes the origin-destination for travel patterns uncertain. Migrants are also more likely to work in the service industry with hours outside the traditional 9:00 a.m. to 5:00 p.m. work schedule, making longer service hours necessary. This is less apparent in areas with robust systems like New York City, but in more rural and suburban regions in the Lower Hudson Valley and Long Island, gaps in services limit accessibility. Regional and local support for more robust alternative transportation networks like multi-use and bicycle infrastructure, as well as the growing popularity in micromobility could fill this gap.

“Reducing costs even further for those unable to pay e.g., disabled, retirees, refugees and low-income groups. Reducing isolation, utilizing transport better and helping with cost of living.” –Survey respondent from Manhattan

3.7.4 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 by determining where people live, and where and how they travel.¹³⁰

The NYMTC region experienced a shift of people moving from cities to suburbs, consistent with broader trends in metropolitan areas across the country. In the 2010s, population growth in New York City slowed significantly to under 1 percent. At the same time, suburban areas in the larger New York-Newark-Jersey City metropolitan area were growing at a modest rate (0.15 percent), which was consistent with their growth at the start of the decade. Since the pandemic, counties within the region have experienced population shifts, making it difficult to be certain of the direction of population trends based on the last five years. However, population decreases between 2019 and 2023 in Bronx, New York, and Queens counties paired with increases in Nassau, Rockland, Suffolk, and Westchester counties 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. Based on variation of population loss and gain across urban and suburban counties and between time periods within the same counties, (2019 to 2021 compared to 2021 to 2023), it remains to be seen whether the underlying trend since 2019 will turn out to be growth of the urban core versus suburbanization and whether the COVID-19 pandemic will have affected this trend in ways that are discernable beyond 2030.

WAREHOUSING

The advent of shared mobility and e-commerce is beginning to affect land use patterns and may continue to do so. NYMTC’s Regional Freight Land Use Study (2021) Literature Review found, “Perennial issues of traffic and congestion, coupled with the continued growth of e-commerce and the associated pressure for faster delivery times, have led to intensified demand for urban warehouse space and last-mile distribution centers.”¹³¹ The Port of New Jersey and New York is the second busiest port in the US. post-pandemic, making the NYMTC area and surrounding region a key node on the global supply chain. The pandemic and

subsequent lockdowns caused major disruption to the global market chain. Post-pandemic, supply chain fluidity and resilience has become a key goal for the region.

Information and communication technologies, as well as vehicle technologies, could significantly influence future locations and distribution of residential, commercial, and industrial land uses. This includes warehouse automation, distributive manufacturing such as 3D printing, and autonomous delivery vehicles.¹³² This is particularly true given the growth of e-commerce, which is altering commercial land use at various locations in New York City's multistate metropolitan region through siting of intermodal centers, warehouses, and distribution centers, as well as industrial properties. Many of these warehouses are replacing agricultural land uses.

SEA LEVEL RISE AND EXTREME WEATHER

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 multistate 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:

- » 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 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 DCP 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.

- » To prevent its sewer system from being overwhelmed, New York City has begun to incorporate “green infrastructure” alongside its transportation infrastructure. The South Battery Park City Resiliency Project, for example, would result in the installation of a continuous flood barrier in the Battery Park area.

Incorporating extreme weather in future land use planning may reduce housing options in flood-prone and vulnerable areas, replacing them with open space. This can help reduce the cost of damage during extreme weather events, but it can also exacerbate the demand for building new housing, especially affordable options.

HOUSING COSTS

Residents in the NYMTC region face higher costs for housing than the rest of the state and many parts of the country. New York City residents, in particular, suffer from rents that outpace incomes and a significant lack of supply for extremely low-income housing.

- » New York City has a 30 percent homeownership rate compared to the nearly 66 percent national average.
- » From 2010 to 2022, rent costs have increased by 32 percent and home ownership costs have increased by 74 percent in New York City.
- » The median rent in 2021 was around \$1500, with a growing portion of rents now above \$4,000.¹³³

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The overall high cost of housing for both renters and homeowners, coupled with a lack of vacancies and slow growth of inventory, has caused housing costs to rise in the NYMTC region. Based on the ALICE Wage tool (that identifies households that are Asset Limited, Income Constrained, and Employed), the average adult would need to make an hourly wage of \$24.67 to support a survival budget in the NYMTC region. In New York State, 82 percent of the counties can support a survival budget from an \$18 hourly wage for a single adult. None of the counties are within the NYMTC region.¹³⁴

The demand for housing and home ownership is evident in the increasing growth of the suburban counties. Between 2019 and 2023, population decreases were recorded in Bronx, New York, and Queens counties (within New York City), while Nassau, Rockland, Suffolk, and Westchester counties (outside the city) experienced population growth, signaling a shift toward suburbanization. Residents are seeking housing, particularly home ownership, further from the urban core where housing demand and prices are the highest. This increases sprawl and impacts VMT and congestion, especially in areas where there is less connectivity through transit. Most single-family homes available are out-of-reach for first time homebuyers. The “missing middle” housing stock is not only desired by first-time homebuyers, but also older generations looking to age in place. The demand for this housing also increases prices, and with newer housing being built at higher prices, entering the housing market is seen as “unattainable” for some.

In Nassau and Suffolk Counties, however, population growth has been faster than the increase in households, indicating that zoning rules and financial challenges might be limiting new housing construction in those suburban areas. For renters, new zoning regulations such as allowing—or even

encouraging—accessory dwelling units (ADUs) can help increase the rental stock and regulate rental prices, but not all communities are supportive of expanding/building multifamily dwelling units. In December 2024, New York City amended zoning regulations that would permit the construction of new residential units to provide more housing stock.¹³⁵ With New York being a Home Rule state, communities have authority over local zoning. Both “Not in my backyard” and “Yes in my backyard” trends make long-term housing development patterns uncertain.

ADAPTIVE REUSE

Community developers are looking for solutions to site new businesses in urban areas without much undeveloped space remaining and are looking at infill. This process of repurposing old/underutilized buildings or other infrastructure for new uses is known as adaptive reuse. Key areas of adaptive reuse include office buildings in New York City, warehouses in suburban malls and box stores, and housing/mixed use development in underutilized malls. New York City's Local Law 43 established the Office Adaptive Reuse Task Force, whose purpose is to explore opportunities to convert outdated office space to other potential uses, especially housing. In its 2023 study, the Task Force found allowing most office buildings constructed in 1990 or before to convert could enable new homes for as many as 40,000 New Yorkers in the next 10 years.¹³⁶ Recommendations also included tax incentives to support affordable housing options and retrofitting space for childcare facilities. By converting office space, which is normally busy 9:00 a.m. to 5:00 p.m. Monday through Friday, to mixed-use space, Central Business Districts are becoming the “24-hour city”, changing the way residents, commuters, and visitors travel to and around the space.¹³⁷

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In suburban areas, malls are a key focus of adaptive reuse. Many malls, developed at the height of consumer spending in the 1980s through 2000s, were the center of suburban life. The advent of e-commerce decreased the need for brick-and-mortar stores, with the demand switching to warehousing space. While this phenomenon was occurring before the pandemic, e-commerce popularity sped up the decline of shopping malls. Given the large footprint and access to utilities, malls have begun to diversify uses beyond retail. In an analysis of 135 mall redevelopment projects, JLL found that 53.6 percent include housing, while less than 34 percent convert to office and 85 percent of projects retain retail on the site.¹³⁸

Incorporating newer, denser mixed land-uses at former mall centers may significantly shift travel patterns. Overall VMT may be reduced by replacing shorter SOV commercial trips with multimodal or transit trips (based on density/proximity), though it may increase the total frequency and duration of trips to the area. It may also relieve housing demand and the warehousing boom, connecting employment opportunities with alternative housing options. Major mall conversion efforts in the NYMTC region include the Palisades Mall in Rockland County.

TRANSIT-ORIENTED DEVELOPMENT

New York has a long history of developing around transit. From the suburban towns that grew along streetcar and rail lines in the late 1800s to the “Terminal City” neighborhood build alongside Grand Central in the early 1900s, the region has prospered by taking advantage of the symbiotic relations between development and transit. In the NYMTC planning area, significant transit-oriented development (TOD)

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 has transformed 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.

Moving Forward 2055 Survey respondents from Nassau County, Suffolk County, Westchester County, and Brooklyn all commented on the need for affordable housing near transit and voiced their support for more transit oriented development.

Dedicated funding and policies are incentivizing TOD. The IJA continues the competitive TOD planning program, providing \$50 million in funding over five years for efforts associated with an eligible transit project.¹³⁹ Suffolk County was awarded planning funding through the Pilot Program for TOD Planning (2022) for Route 110 Transit-Oriented Development Corridor Comprehensive Plan: Huntington Section. Other notable TOD projects include development around MTA stations in Bayshore, Babylon (Wyandanch Station development boasts 300 residential units, a park, and a YMCA) and the Village of Westbury in Long Island. Outside of Long Island, along the Hudson River and Metro-North Railroad's Hudson Line, multiple higher density developments have been also developed in recent years or are in the works in Yonkers and points north.

Overall, land use patterns are determined by many factors, including generational preferences, changing business models, regional transportation infrastructure, and real estate cost trends. They are especially impacted by local zoning regulations which are put in place at the municipal level, which produce varying results in terms of development patterns and corresponding housing affordability. Nevertheless, it is clear that land use patterns are important drivers of change by determining where people live, and where and how they travel.

3.7.5 CYBERSECURITY

The Cybersecurity & Infrastructure Security Agency (CISA) defines cybersecurity as "the art of protecting networks, devices, and data from unauthorized access or criminal use and the practice of ensuring confidentiality, integrity, and availability of information."¹⁴⁰ Cyber threats include attacks to a network's software, firmware, or hardware that can erase or alter programming or steal key information for ransom. According to the FBI, cyberattack complaints in New York State increased 53 percent between 2016 and 2022, jumping from 16,426 incidents in 2016 to 25,112 in 2022. Estimated losses in New York from cyberattacks in 2022 totaled over \$775 million, while losses nationwide totaled \$10.3 billion.¹⁴¹

Much of the transportation network and critical infrastructure rely on connectivity and software to function, whether ITS systems, electric grid, connected vehicle, or scheduling software. This connectivity leaves

systems with multiple vulnerabilities, including emerging systems like Connected and AVs (CAV). Possible impacts for CAVs include impacts to vehicle safety functions, disrupt vehicle-to-vehicle (V2V) or vehicle-to-infrastructure (V2I) communications, or breach confidential data. For ITS, cyber-attacks can disrupt traffic management, public transit operations, and vehicle navigation. A cyber-attack in April 2024 shut down all KC Scout systems in the Kansas City metro area in Missouri, leaving traffic cameras, tracking systems and message boards down for months.¹⁴²

Governments, public agencies, and civic institutions are often targeted by cyberattacks. Cybersecurity policies help protect systems against attacks. The Federal government created a new State and Local Cybersecurity Grant Program (SLCGP), committing \$1 billion over four years to help states, local governments, rural areas, and territories address cybersecurity risks and improve their critical infrastructure resilience through the BIL. Each state or territory that applies must establish a Cybersecurity Planning Committee and a Cybersecurity Plan. The 2023–2024 enacted NYS Budget included \$42.6 million to expand the State Police Cyber Analysis Unit and create a new specialized Industrial Control System (ICS) Assessment Team within DHSES.¹⁴³ New York City also adopted a new policy to standardize cyber security.

The risks of cyber-attacks are impacting more than system security measures. The system complexity required to withstand attacks can make automation/AI more difficult, in addition to the difficulties of upscaling resources and workforce skills. This gap in skills may become an issue for the future workforce. Other issues include the public distrust in relying on AI systems because of safety and security risks.

Attendees at the Transportation and Technology Public Forum noted that a main risk or barrier for travelers using new apps/utilities was “concerns over hacking, “data storage and management,” and “trust.”

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3.8 INFORMING MOVING FORWARD 2055

MPOs are required to follow a performance-driven, outcome-based approach to transportation decision-making, which can be heavily influenced by their understanding of the future trends and disruptors. The assessment of trends and disruptors affects NYMTC’s performance-based planning and programming process in numerous ways:

- » Proactively identifying trends and disruptors helps NYMTC to adjust their long-term goals and develop performance measures that are forward-looking. For instance, as AVs become a part of mainstream consumer behavior, the Council may set new safety and infrastructure targets tailored to accommodate AVs.
- » This can be supplemented by scenario planning, which will help the region to explore how possible ranges or impacts of trends and disruptors affect key planning factors such as travel demand, mode choice, and population and employment growth.

- » The exploration of trends and disruptors may prompt NYMTC to explore a reshuffling of priorities for system preservation and enhancements. For example, member agencies could invest further in pavement resiliency measures to mitigate the damage of extreme weather events.

3.8.6 RISKS AND OPPORTUNITIES

Transformational changes and the future of mobility will influence *Moving Forward 2055'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 2055* 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 in Table 3.41.

Table 3.41 *Moving Forward 2055* Goals: Risks and Opportunities Matrix

Goal	Trend & Disruptor Risks	Trend & Disruptor Opportunities
SAFETY AND SECURITY We seek to establish and maintain a transportation system for which safety and security are maximized for people and goods across all uses and modes	» Cybersecurity procedures not keeping pace with tech advancements, leaving systems vulnerable. » Shared mobility services, e-commerce, and other technological advancements may not protect personal data, rider privacy, or security of digital transportation infrastructure. » Legislature is slow to regulate emerging technologies, leading to potential safety concerns. » "Silver Tsunami" of older transportation users leads to increased vehicle accidents, pedestrian fatalities, etc. » Transportation agencies are not prepared for the costs of cybersecurity upgrades or ransomware attacks. » Threats to individual safety and national security if digital transportation infrastructure is not protected.	» Incorporate, scale, and future-proof cybersecurity measures into infrastructure and smart technology systems. » AI and connected/autonomous vehicles (C/AV) can improve passenger and pedestrian safety by reducing driver error.

Goal	Trend & Disruptor Risks	Trend & Disruptor Opportunities
INFRASTRUCTURE We seek to establish and maintain a transportation system for which infrastructure is maintained and improved in a sustainable manner.	» Cost of repairing Infrastructure damaged by extreme weather events. » Budget prioritization of maintaining systems vs implementing new technologies. » Increased competition for curb space and truck parking due to increased freight traffic. » Micromobility usage outpaces development of safe, protected infrastructure. » Difficulty integrating emerging transportation and technologies with existing infrastructure.	» Infrastructure and services that support first and last mile connectivity can complement public transit and shared mobility services. » Use AI to reduce maintenance frequency and cost, improve safety, and efficiency in infrastructure, public transit, and other modes.
RESILIENCY We seek to establish and maintain a transportation system for which resiliency is supported through mitigating, adapting to, and responding to chronic and acute stresses and disruptions.	» Supply chains are vulnerable to weather, workforce disruptions, etc. impacting goods movement. » Extreme weather events can damage infrastructure, increasing repair and maintenance costs. » Extreme weather events disrupt transportation services and network. » Charging/fueling infrastructure for alternative fuel vehicles is hindered by a limited number of locations, and grid capacity or reliability.	» Distributed production and 3D printing can mitigate supply chain vulnerabilities and improve efficiency. » Green infrastructure can improve resiliency to extreme weather events and sea level rise.
CONGESTION We seek to establish and maintain a transportation system for which congestion is mitigated through investments and technology in support of healthier communities, more seamless travel, improved quality of life, and regional economic competitiveness.	» Decreased transit ridership leads to increased congestion. » Increased e-commerce and localized production leads to increased freight traffic, especially in residential areas. » On-demand transportation options such as Uber or Lyft have been shown to increase congestion. » AVs can contribute to congestion by increasing the ease of driving and reducing usage of other modes.	» Reduced congestion and vehicle miles traveled due to virtual economy, technological advancements. » Scooter and bikeshare can support first and last mile travel options, supplementing public transit. » Technological advancements such as C/AVs, AI, and ITS can improve safety, efficiency, and optimization of travel. » Changing demographic patterns may increase usage of flexible and on-demand transportation options that mitigate the need for a personal vehicle. » Road pricing may impact trip timing and mode decisions, leading to changes in congestion locations and severity.

Goal	Trend & Disruptor Risks	Trend & Disruptor Opportunities
LAND USE We seek to establish and maintain a transportation system for which land use decisions are encouraged in support of strategic transportation enhancements and improving modal choices.	» Conflicts between residential, commercial, and industrial land uses and local, regional, and state land use policies. » Increasing sprawl due to rise in housing costs, work from home opportunities, and technological advancements that improve long-distance travel; may result in limiting transit-oriented development (TOD). » Reduced demand for commercial real estate due to an increase in telework. » Increase in warehousing in residential areas due to rise in e-commerce and distributed manufacturing.	» Potential for adaptive reuse of unused brick-and-mortar retail and service spaces. » Shared mobility services support denser land uses and reduced parking demand. » C/AVs can reduce parking demand, especially in dense areas, with self-parking and pick-up options. » Promote TOD to reduce sprawl. » Preserve green spaces and incorporate green infrastructure. » Encourage investment and redevelopment in city centers. » Smart growth and TOD can reduce the need for long commutes, decrease traffic congestion, and improve the safety of vulnerable road users.
FAIRNESS & ACCESS We seek to establish and maintain a transportation system for which fairness in transportation is advanced and access to opportunities is improved for all communities.	» Uneven distribution of burdens across transportation investments and policies. » Knowledge gaps in new technology impacting accessibility. » Some labor roles cannot work from home, increasing their transportation burden and cost. » Emerging transportation modes cannibalize public transit, impairing fiscal sustainability for transit system. » Underserved communities may not have reliable access to emerging transportation modes. » Micromobility devices impair safe, accessible sidewalk usage. » Low-income residents are more likely to be affected by extreme weather events. » Older adults unable to access transportation services. » Bias in AI models can lead to unjust decisions, prejudice, unequal access	» Opportunity to introduce a fairness-based framework into decision-making processes. » Improving transportation services and infrastructure for vulnerable groups such as older adults improves safety and accessibility for all users. » Expanding remote work options offers better access to employment opportunities for individuals in remote or underserved areas. » Virtual telehealth services can bridge gaps in access to quality healthcare for marginalized communities. » Expanding shared mobility options in underserved areas can improve access to essential services and employment opportunities, reducing transportation disparities, especially for zero and one car households. » Investing in resilient infrastructure in low-income and under-served communities can reduce the disproportionate impact of extreme weather on these groups.

Goal	Trend & Disruptor Risks	Trend & Disruptor Opportunities
ENVIRONMENT We seek to establish and maintain a transportation system in which environmental impacts—including harmful air pollutants—are significantly reduced through technology applications, increased use of greener travel options, and improved efficiency.	» Increasing air pollution from freight travel. » Increasing air pollution from AVs and other emerging transportation modes. » Increase in noise pollution in residential areas from truck traffic, warehouses, and truck parking. » Increase in toxicity and water consumption related to the extraction of resources, production, and disposal of lithium batteries for EVs.	» Lower pollution levels due to travel changes related to virtual economy and travel patterns of younger adults. » Lower pollution levels if shared mobility vehicles are alternative fuel. » Technological advancements such as C/AVs can reduce pollution through improved fuel economy, even more so if they are alternative fuels. » Distributed production and 3D printing reduces freight travel and pollutions. » Introduce environmental framework into decision-making processes. » Potential for Federal, state, or local funding to support environmental impact mitigation and adaptation projects. » Public education campaigns can support the adoption of greener transportation modes. » Shared mobility services, the virtual economy, the rise in alternative fuel vehicles, and technological advancements can reduce the number of fossil fuel powered vehicles, reducing pollution and improving public health.

3.8.7 CONCLUSION

The assessment of trends and disruptors is critical to long-term transportation planning, particularly in a dynamic and continually evolving region like NYMTC's. Trends provide a framework for understanding gradual and predictable changes, while disruptors introduce uncertainty and rapid shifts that can dramatically alter transportation needs. Both forces must be considered to develop resilient transportation systems that can adapt to population shifts, technological advances, and environmental challenges. By analyzing these factors, planners can better anticipate emerging challenges, identify opportunities, and make informed decisions that align with regional goals, ensuring the transportation network remains functional and fair in the face of both gradual and transformative changes.

ENDNOTES

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