

State of Play: Benefits of Mobility Efficiency Strategies in New York State



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State of Play: Benefits of Mobility Efficiency Strategies in New York State

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Abstract

Mobility efficiency strategies are policies, programs, and designs that enable people to reach destinations with less reliance on single occupant vehicle trips. This report (1) describes the variety and prevalence of mobility efficiency strategies nationally and in New York State; (2) summarizes the economic, environmental, health, safety, and equity impacts of the described mobility efficiency strategies; (3) details available analytical tools estimating economic and environmental benefits; and (4) identifies knowledge gaps. Through structured literature review, synthesis, and analysis of public data, the report underscores that a growing body of research demonstrates significant benefits from mobility efficiency strategy implementation, although these benefits are highly context dependent. Additionally, the report finds that land-use planning is foundational to expanding mobility efficiency—dense, mixed-use zoning and development enables more efficient and effective provision of public transportation, walking, and biking infrastructure, in addition to strengthening the effectiveness of pricing policies. The report finds that four areas of additional research would be helpful to transportation agencies and policymakers in New York: field research specific to a range of community types in the State, analysis of impacts on a broader range of business types, analytical tools to estimate potential economic impacts of strategies, and research into the combined impacts of the strategies. Subsequent phases of this project will address some of these gaps through field research and original data analysis. Research applications, beyond informing the following stages of this project, include delivering a cogent state of play to NYSERDA and other state agencies to aid in investment strategy and program designs.

Keywords

Active transportation
Land use reform
Micromobility
Mobility efficiency
Multimodal transportation systems
Parking and congestion pricing policies
Public transportation
Transit-oriented development
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Vehicle miles traveled (VMT)

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Acronyms and Abbreviations

BCR	Benefit-cost ratio
CO ₂	Carbon dioxide
DOT	Department of Transportation
HOT	High occupancy toll
HOV	High occupancy vehicle
FHWA	Federal Highway Administration
GDP	Gross domestic product
GHG	Greenhouse gas
kWh	Kilowatt hours
MPO	Metropolitan planning organization
MW	Megawatts
NO _x	Nitrogen oxides
NYS	New York State
NYSERDA	New York State Energy Research and Development Authority
PM	Particulate matter
SO ₂	Sulfur dioxide
TOD	Transit-oriented development
UZA	Urbanized area
VOC	Volatile organic compound
VMT	Vehicle miles traveled

Definitions

Active transportation	Forms of human-powered travel used for everyday trips, including walking, biking, and other non-motorized modes (e.g. scooters or skateboards).
Congestion pricing	A transportation policy charging drivers a fee to use specific roads, lanes, or geographic areas to reduce traffic congestion, improve travel reliability, and encourage use of alternative modes.
Microtransit	A shared, demand-responsive transportation service that uses small vehicles operating on flexible routes, usually allowing riders to request trips in real time via a mobile app, rather than following fixed schedules or routes.
Mobility efficiency strategies	Policies and projects that enable people to reach destinations with less reliance on single occupant vehicle trips.
Parking mandate	Also known as a minimum parking requirement. A regulation that requires new residential or commercial developments to include a specified number of parking spaces, regardless of actual demand. Typically based on a building's size or use.
Transit-oriented development	A land use and planning approach that concentrates housing, jobs, and services within walking distance of high-quality public transportation to reduce car dependence and support multimodal travel.

Executive Summary

Mobility efficiency strategies are policies and projects that enable people to reach destinations with less reliance on single occupant vehicle trips. They include:

Active transportation investments, including sidewalks, bikeways, and shared bike and scooter programs, which allow people to walk, bike, and roll safely and comfortably.

Public transportation enhancements, spanning bus, rail, and on-demand services that provide reliable, efficient mobility choices.

Land-use reforms that enable compact, mixed-use development; remove minimum parking requirements; and/or encourage growth around public transportation hubs to improve destination access.

Market-based pricing policies such as congestion pricing and parking pricing that manage demand, free up roadway space, speed up high value trips, and make multimodal travel more efficient.

A substantial and growing body of literature shows positive economic, environmental, health, and safety impacts of mobility efficiency strategies.

The magnitude of impact is highly context dependent. Land use decisions are critical to enable the other mobility efficiency strategies to be effective. Denser development and a mix of land uses enable public transportation, walking, and biking to be viable alternatives to driving for a larger number of trips. Policy signals like congestion pricing and parking pricing are more impactful when travelers have convenient alternatives to driving.

While mobility efficiency strategies can be implemented in rural, suburban, and urban areas, they will look different depending on context. As this report is sponsored by the state of New York, it includes an emphasis on the Empire State, which boasts rural towns and mid-sized cities along with the dense metropolis of New York City. Wherever possible, we provide data by metropolitan or micropolitan area and provide information on the impacts of these strategies in multiple regions.

Providing safe walking paths can be particularly impactful in reducing fatalities and injuries in areas with few safe walking paths and a large number of people who cannot afford to drive.

Mobility efficiency strategies are especially important to those who cannot operate their own vehicle due to age, ability, income, or other factors. In addition, allocating costs to drivers through market-based pricing avoids shifting expenses to residents who do not drive.

While impacts vary greatly depending on context, Table 1 provides examples of these benefits.

Table 1. Examples of Mobility Efficiency Strategy Benefits

Strategy	Example Economic Benefit	Example Environmental or Safety Benefit
Active transportation	172 percent increase in retail sales at local businesses after 2013 conversion of a parking area to a pedestrian plaza in Brooklyn (New York City Department of Transportation 2014)	68 percent reduction in traffic fatalities and 35 percent reduction in pedestrian injuries after adding seven miles of protected bike lanes on Queens Boulevard in Queens, New York (Meyer 2024)
Public transportation	Retail sales along a bus corridor in the Bronx increased 71 percent after implementing bus only lanes and transit signal priority (New York City Department of Transportation 2012)	Traveling by light rail in Buffalo has 88 percent lower greenhouse gas emissions (GHG) per passenger mile than driving alone (McGraw, et al. 2021)
Land use and parking reform	Removing parking minimums in Buffalo allowed developers to transform an empty parking lot into a traditional main street with ground floor commercial space and 70 new homes, just one of many projects that would not otherwise have been permitted (Gould 2023) (Bipartisan Policy Center 2013)	In Austin, TX, land use reform that allows greater development of multifamily and mixed-used development near public transportation could reduce per capita vehicle miles traveled (VMT) by 12 percent, building energy use by 16 percent, and GHG by 14 percent (Grunwald 2023)
Market-based pricing policies	Congestion pricing in New York City increased morning vehicle speeds through bridges and tunnels by 23 percent. Retail sales, hotel occupancy, office leasing, and jobs all increased in the affected area even while VMT fell 7.1 percent (MTA Bridges & Tunnels 2026) (New York State 2025)	When San Francisco piloted demand-responsive parking, cruising for parking dropped 43 percent, and VMT fell 30 percent in pilot areas (Jose 2017)

Mobility efficiency strategies reduce vehicle miles traveled (VMT) by providing alternatives to driving alone. Historically, transportation planning focused on supporting increased VMT as an important way to support economic growth. Recent research indicates, however, that in developed countries where highway infrastructure is already robust, increased vehicle travel does not increase productivity. In fact, it can reduce productivity by increasing public

infrastructure needs, the cost of travel, and barriers to walking. Atlas data analysis shows that for four of New York's metropolitan areas, VMT per capita decreased over the last decade, while gross domestic product (GDP) per capita increased steadily during that same time frame.

While there is a large and growing body of research supporting the benefits of mobility efficiency strategies, key research gaps remain. Four areas of additional research would be helpful to transportation agencies and policymakers in New York: field research specific to a range of community types in New York State, analysis of impacts on a broader range of business types, analytical tools to estimate potential economic impacts of strategies, and research into the combined impacts of the strategies. Subsequent phases of this project will address some of these gaps through field research and original data analysis.

1. Introduction

Mobility efficiency strategies are policies and projects that enable people to reach destinations with less reliance on single-occupant vehicle trips. These strategies include providing options to walk, bike, or take public transportation. They also include supportive land use strategies such as zoning reform to allow for compact, mixed used development, making it easier to reach destinations without the need for traveling long distances. In addition, mobility efficiency strategies include supporting policies such as market-based parking and road pricing.¹ In the last twenty years, advancements in communications and battery technologies have led to new mobility efficiency strategies such as shared bike and scooter programs, electric bikes and scooters, and on-demand public transportation options.²

Communities across the United States are implementing mobility efficiency strategies with the goals of expanding affordable transportation options to households, reducing air pollution from vehicles, improving quality of life, and spurring economic development. Simultaneously, some stakeholders worry that reduced parking or curb access could lower customer traffic or complicate deliveries for homes and businesses.

In New York, the New York State Energy Research and Development Authority (NYSERDA), other state and local agencies, and private entities have sponsored pilots and made other investments in mobility efficiency strategies. Analysis showing the strategies' benefits and how to avoid negative impacts can provide input into decision making on future transportation investments.

This report includes information on mobility efficiency strategies across the United States, with a focus on New York State (NYS). It starts with introductory information about how these strategies work. Next, the report provides analysis of four groups of strategies: 1) active transportation, 2) public transportation, 3) land use strategies, and 4) market-based pricing policies. The report also provides information on analytical tools for estimating strategy benefits and concludes with a summary of knowledge gaps and opportunities for future research.

This state of play report is the first product of a three-phase project sponsored by NYSERDA. It relies primarily on literature review and analysis of readily available data. The next phase of the project consists of original field research on the economic impacts of mobility efficiency strategies in three regions of NYS. The third phase will include in-depth analysis of sales and travel data to discern the magnitude of economic impacts of a range of mobility efficiency strategies in varying contexts within the state and the development of an analytical tool to estimate impacts.

1.1 Economic Impacts

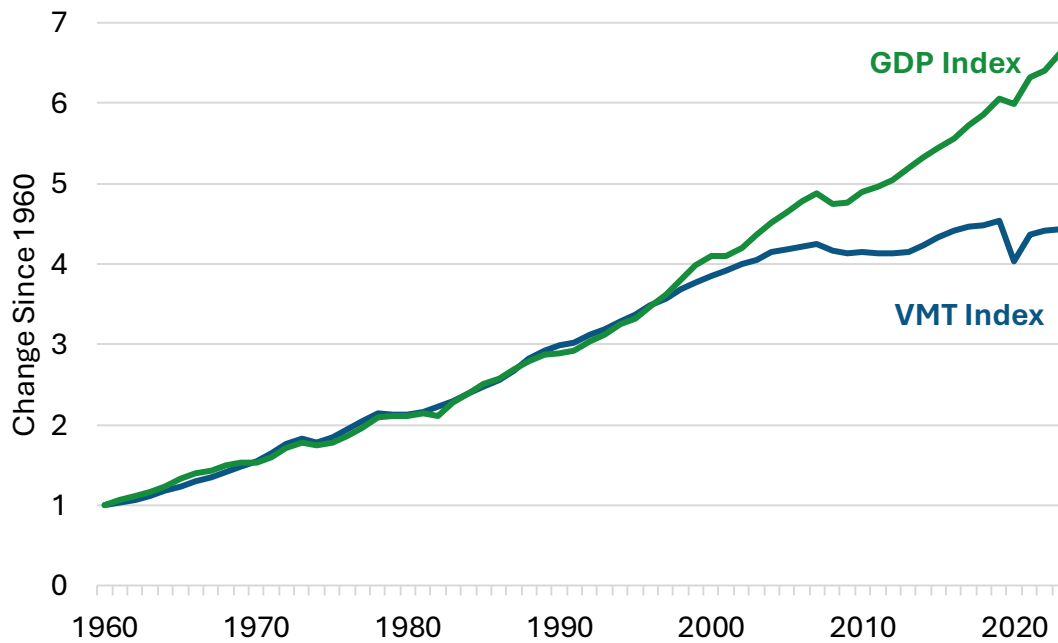
Mobility efficiency strategies can lower costs for households and help local businesses³ by improving access to destinations. This section discusses the relationship between VMT and Gross Domestic Product (GDP), the mechanisms by which mobility efficiency strategies provide economic and equity benefits, examples of benefits in New York, and impacts on businesses that rely on vehicle travel.

1.1.1 Increased VMT is not required for increased GDP

Since the 1950s, many planning processes have treated accommodating projected vehicle travel growth as an important way to support economic growth. As shown in Figure 1, VMT grew nearly in lockstep with gross domestic product (GDP) in the United States until the late 1990s, which is consistent with historical planning paradigms. However, beginning in the late 1990s, VMT showed signs of leveling off while GDP continued growing at a similar pace; this suggests the relationship between economic growth and vehicle travel has changed and raises questions about planning assumptions based on continued VMT growth. Additionally, recent research indicates that in developed countries where highway infrastructure is already robust, increased vehicle travel does not increase productivity (Litman, *The Mobility Productivity Paradox* 2025).

Figure 1. U.S. Productivity and Vehicle Travel Trends Over Time

Source: VTPI analysis of FHWA and BEA data (Litman, The Mobility Productivity Paradox 2025)



This national trend is also evident across a wide range of states, including New York. NYS has one of the highest GDP per capita and lowest VMT per capita in the United States (Lovaas 2012). While New York City heavily influences the state totals, the phenomenon is not limited to New York City. Between 2012 and 2023, VMT decreased while GDP increased in the large metropolitan areas of Albany-Schenectady-Troy and Syracuse as well as in the New York metropolitan area (see Appendix A). This trend is also visible in the smaller metropolitan area of Glens Falls, NY.

Some studies show that *increased* VMT is associated with *reduced* productivity (Litman, The Mobility Productivity Paradox 2025) (Lovaas 2012) (Winkelman 2011). Between 2000 and 2010, states with *less* urban highway expansion had *greater* productivity growth (Phillips 2014). Increased VMT can reduce productivity through higher user costs, increased public infrastructure needs, and barriers to walking (Litman, The Mobility Productivity Paradox 2025) (Lovaas 2012) (Winkelman 2011).

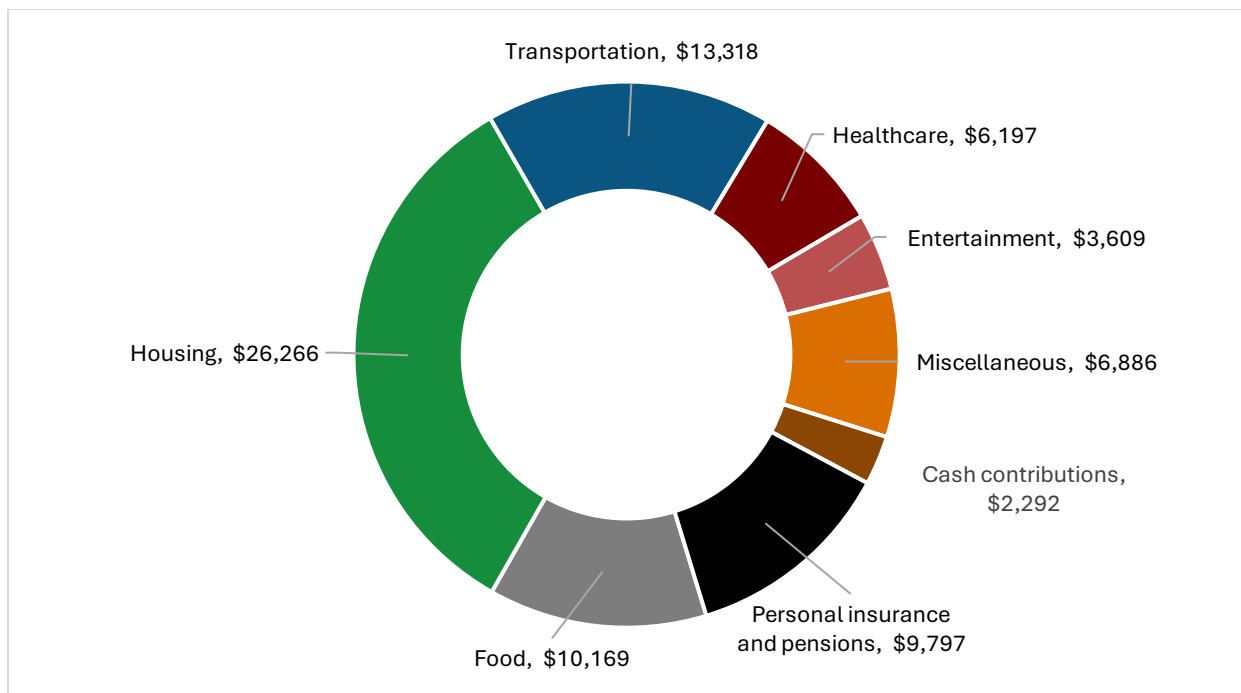
In sum, growth in VMT is not required for growth in GDP.

1.1.2 Mobility Efficiency Strategies Can Lower Costs for Households, Reduce Public Expenses, and Increase Access to Opportunities

Providing low-cost transportation options such as public transportation and safe paths for walking reduces reliance on driving and frees up household budgets for other needs. Nationally, the average household spends about \$13,000 per year on transportation, including about \$12,000 on private vehicle expenses such as vehicle payments, gas, insurance, and maintenance (Figure 2) (Bureau of Labor Statistics 2026).

Figure 2. Average Annual Household Expenses in the United States, 2024⁴

Source: (Bureau of Labor Statistics 2026).



Car insurance prices in New York are 36 percent higher than the national average, making car ownership even more expensive in the Empire State (Forbes 2025). If households can reduce the number of vehicles they own or the amount they drive, thereby reducing vehicle wear and tear and gasoline expenses, they can realize significant cost savings. In addition to enabling reduced private vehicle ownership costs, mobility efficiency strategies can also lead to cost savings for the public, as they reduce costs from the subsidizing of parking and roadways, which are borne by all consumers and taxpayers regardless of whether they drive.

Furthermore, for households that are cost burdened by transportation, lower-cost options can enable necessary travel (e.g., work, school, and healthcare⁵) that they may have previously

foregone. As of 2024, about nine percent of New York households outside of New York City had no car, and another three percent had four or more members and only one car (U.S. Census Bureau 2026). These represent particularly disadvantaged populations, as transit is less prevalent outside of New York City, so they have far fewer options for getting around without a car. Additionally, in areas where transit is limited, transit-reliant travelers suffer higher wait and commute times, imposing a non-monetary opportunity cost. Greater availability of mobility efficiency options can reduce these costs (Jenkins, et al. 2020) (Litman, Evaluating Public Transit Benefits and Costs: Best Practices Guidebook 2026).

1.1.3 Mobility Options Can Help Local Businesses

Mobility efficiency strategies make it easier, safer, and more comfortable to reach destinations by walking, biking, or public transportation, and can create vibrant retail zones where foot traffic spurs retail sales. A 2023 study that interviewed businesspeople in five U.S. cities where protected bike lane networks are expanding quickly found strong support and gathered quotes such as: “I own the office. I know that if we have protected bike lanes out there, it will improve my property value” (PeopleForBikes and Alliance for Biking & Walking 2023).

Researchers at the University of California, Davis analyzed 23 studies in the United States and Canada and found that building or improving bicycle and pedestrian facilities generally has positive or no economic impacts on nearby retail and food service businesses (Volker and Handy 2021).⁶ In a 2012 study, New York City’s Department of Transportation found that retail and food service businesses along a set of new protected bike lanes experienced retail sales increases of up to 49 percent (New York City Department of Transportation 2012).

Importantly, sales and employment tend to go up even where a vehicle lane or parking is removed (Portland State University 2019). This is a key finding for businesses concerned that their revenue could be negatively impacted by removing parking or a vehicle lane to make space for a bicycle lane, pedestrian access, or bus lane. Studies also frequently find that increased sales from pedestrians and transit users make up for or exceed any lost sales from motorists, especially for food service businesses (J. Volker, et al. 2019). Before and after data for pedestrian and bicycle improvements along fourteen corridors in six cities—Indianapolis, Memphis, Minneapolis, Portland (Oregon), San Francisco, and Seattle—showed that the projects had either positive or a statistically insignificant impacts⁷ on employment, sales, and retail taxes (Portland State University 2019).

The cost savings from mobility efficiency strategies can also free up household budgets for more patronage of local business. In terms of any losses from reduced spending on motor vehicles, since the production of motor vehicles and fuels is largely automated and relies heavily on imported components, spending in these areas tends to create fewer local jobs and stimulate less regional economic activity compared to other types of consumer spending (Litman, *The Mobility Productivity Paradox* 2025). Owning one fewer vehicle saves about \$5,000 in vehicle costs in addition to a 15 percent reduction in housing costs (if parking is not bundled) (Litman, *Evaluating Transportation Affordability: How PLanning Can Better Respond to Demands for Lower Cost Travel* 2025). Where these savings are re-spent is contingent on whether the household is high- or low-income (Whitmore Schanzenbach, et al. 2016); lower-income households are likely to prioritize healthcare, food, and other essential services, while higher-income households shift more toward discretionary and retail spending (Board of Governors of the Federal Reserve System 2025).

1.1.4 Mobility Options Are Benefitting New York

The New York City Department of Transportation (NYCDOT) used sales tax data to evaluate the economic impact of mobility efficiency strategies, examining seven treatment corridors and nineteen control corridors across three boroughs. It found increased retail sales from the strategies analyzed: protected bicycle lanes, traffic calming, pedestrian infrastructure (refuges, crosswalks, plazas, reconfigured intersections), repurposing parking for pedestrian and public space, improved bus service, dedicated bus lanes, advanced traffic signals with remote communications, and market-based parking pricing (New York City Department of Transportation 2014) (New York City DOT 2012). NYCDOT examined pre- and post- intervention sales tax filings, leases and rents, market property values, business creation, business losses, employment, zoning and permits, and median wages. The most noticeable economic impacts were on retail sales. For instance, after MTA launched a higher level of bus service along Fordham Avenue in the Bronx in 2008, including converting a parking lane to a bus only travel lane, off-board fare payment, and traffic signal priority for buses, bus speeds increased 20 percent, ridership increased 10 percent, and retail sales increased 71 percent at locally-based businesses compared to 23 percent borough-wide (New York City DOT 2012).

Buffalo became one of the first U.S. cities to eliminate minimum parking requirements city-wide in 2017. Within the first five years of having this new flexibility, developers renovated dilapidated historic buildings into housing and retail, which would have been prohibitively expensive if they

had needed to retrofit with parking (Gould 2023). Since the cost to build parking is passed on to residents, removing parking mandates can reduce housing costs.

In Albany, joint efforts by the city, transit agency, and private developers are improving public transportation services and building compact, mixed-used development around transit nodes, spurring economic development and improving the efficiency and convenience of the transit system (CDTA 2025). These efforts were initiated nearly 20 years ago and continue today (Regional Plan Association 2007) (CDTA 2012). Similarly, the small city of Glen Falls, New York, is capitalizing on its historic core and prioritizing walking, biking, and transit investments to spur economic growth (City of Glen Falls n.d.). Glen Falls received a grant from the New York State Smart Growth Program in 2023 for these efforts (New York State n.d.).

1.1.5 More Research is Needed on Supporting Businesses During Infrastructure Construction and on a Broader Range of Businesses

Mobility efficiency strategies that require prolonged construction can disrupt local businesses during the construction period by disrupting both vehicle traffic and foot traffic. Some mobility efficiency strategies do not require lengthy construction timelines (e.g., bike lanes) while others (e.g., light rail construction and major intersection redesigns) do. For instance, business owners along the Purple Line light rail corridor in Maryland report that construction staging restricts access and diminishes foot traffic (Washington Express n.d.). The Maryland Department of Transportation is offering grants ranging from \$5,000 to \$40,000 to local businesses to help cover some of their losses until construction is complete, after which they expect increased business (Olaniran 2025).⁸

Impacts on business will also vary by the type of business. Most research so far has focused on local retail and food service businesses, finding positive impacts. Businesses with greater dependencies on customers that rely on vehicle access may experience more significant impacts. Businesses may also be concerned about strategies impeding loading zones or deliveries. The field would benefit from more research on impacts on a broader range of businesses and on policies to support businesses during construction.

1.1.6 Key Takeaways

When convenient options are available to walk, bike, or take public transportation, resources not spent on driving alone can be freed up for other uses. Strategies that increase the number of people that can access a local business, rather than the number of cars, can increase patronage

at local businesses. Prolonged construction can cause serious disruption to affected businesses, however, and the field would benefit from more research on how to support businesses during infrastructure construction.

1.2 Air Quality, Health, GHG, and Safety Impacts

In addition to the economic impacts discussed above, mobility efficiency strategies generally have positive impacts on air quality, health, GHG emissions, and safety.

1.2.1 Mobility Options Improve Air Quality and Reduce GHG

Mobility efficiency strategies lower air pollution by providing alternatives to driving.

Transportation is responsible for about half of all U.S. emissions of nitrogen oxides (NO_x) as well as emissions of volatile organic compounds (VOCs), particulate matter (PM), sulfur dioxide (SO₂), and various air toxics. Most transportation emissions are from car and truck tailpipes, but PM pollution also comes from tire wear (Piras 2024). Exposure to these pollutants is associated with asthma, respiratory illness, cancer, and premature death (U.S. Department of Transportation, U.S. Department of Energy, U.S. Department of Housing and Urban Development, U.S. Environmental Protection Agency 2023). Transportation emissions can be especially harmful because they are emitted at ground level near where people live, work, and attend school, increasing exposure for nearby communities and sensitive populations. The resulting health burdens often disproportionately impact low-income and historically marginalized communities as they are more likely to live near major transportation infrastructure like highways (U.S. Department of Transportation, U.S. Department of Energy, U.S. Department of Housing and Urban Development, U.S. Environmental Protection Agency 2023). Providing options to walk or bike instead avoids these emissions entirely, and public transportation options have lower per passenger mile emissions than driving alone (Hodges 2010).

Transportation is the largest source of U.S. GHG emissions, and the average gasoline powered car in the United States emits just shy of one pound of carbon dioxide (CO₂) per mile (U.S. Environmental Protection Agency n.d.). The buildup of GHG in the Earth's atmosphere is increasing average temperatures, sea level, and the frequency and severity of flooding, heat waves, and other extreme weather events. These impacts in turn threaten human health and safety, infrastructure, livelihoods, and ecosystems (U.S. Global Change Research Program 2023). Mobility efficiency strategies reduce GHG by providing alternatives to driving alone.

The magnitude of emissions reduction is dependent on the particular strategy and the context. For instance, walking and biking are only suitable alternatives to driving for short trips. Vehicle

trips of less than one mile account for nine percent of household vehicle trips but less than one percent of total daily vehicle miles (Federal Highway Administration 2014). As such, the magnitude of potential mode shift from driving to walking is small unless accompanied by greater land use density that allows for more destinations within one mile. Public transportation can provide alternatives to driving for longer trips but requires at least some density of shared rider origins and destinations to make it cost efficient. About 35 percent of household vehicle trips are less than five miles, accounting for 15 percent of daily vehicle miles (Federal Highway Administration 2014). Trips within this middle range could be suitable for bikes or e-bikes with sufficient bike infrastructure. However, again, the strategy would only apply to 15 percent of vehicle miles traveled, limiting the total miles from mode shift and the resulting emissions impact.

Nonetheless, these strategies have measurable emissions reductions in addition to safety, equity, and economic benefits. NYS planning documents recognize them as an important complement to a broader transportation strategy in which the shift from gasoline to electric vehicles represents the largest source of emissions reductions. For instance, the New York Climate Act Scoping Plan recommends three sets of mobility efficiency strategies for reducing transportation emissions: 1) enhancing public transportation and mobility alternatives, 2) promoting smart growth and mobility-oriented development, and 3) facilitating market-based solutions and financing to reduce transportation emissions (New York State 2022).

Emissions benefits tend to be even higher when considering full life cycle emissions⁹. For instance, providing walking options and allowing denser development reduces emissions from constructing and maintaining parking, roads, and vehicles, and from extracting, refining, transporting, and burning fossil fuels.

1.2.2 Mobility Efficiency Strategies Improve Safety and Health

The safety benefits of mobility efficiency strategies can be substantial. The Federal Highway Administration (FHWA) cites reductions in crashes involving pedestrians of up to 40 percent for crosswalk visibility enhancements, 47 percent for road diets, 49 percent for bike lanes, and 89 percent for walkways (Federal Highway Administration n.d.). Public transportation is also much safer than driving. The fatalities per VMT in buses are one-third that of personal automobiles (Morency 2018). Mobility efficiency strategies also improve safety by reducing risk exposure. Over 40,000 people die in car crashes in the United States each year (Federal Highway Administration n.d.).¹⁰ Every 100 million vehicle miles reduced through mobility efficiency strategies is expected to avoid 75 injuries and save one life at current rates reported by National

Highway Traffic Safety Administration (NHTSA) (National Highway Traffic Safety Administration 2025). People from low-income and marginalized communities are disproportionately harmed by pedestrian crashes because they are less likely to own a car and more likely to walk—often along unsafe routes due to limited alternatives (Badger, The hidden inequality of who dies in car crashes 2015). Providing safe walking and biking infrastructure therefore directly advances equity by improving safety and access for those who rely most on these modes.

Walking and biking also improve health through physical activity. Active transportation integrates physical activity into daily routines, leading to sustained physical activity that reduces the risk of cardiovascular diseases, diabetes, obesity, metabolic syndromes, and several kinds of cancer; physical activity also contributes to brain health, higher sleep quality, and positive mental health outcomes like lowered anxiety and depression (Centers for Disease Control and Prevention 2025). Increased walking and biking is encouraged by other mobility efficiency strategies, such as rezoning and transit-oriented development (U.S. Department of Transportation, Climate Change Center 2024).

1.2.3 Key Takeaways

Mobility efficiency strategies provide important safety benefits along with mobility options for those who cannot afford private vehicles. They also reduce harmful emissions by providing more energy efficient alternatives to driving, though their emissions impact is limited to those trips for which they can provide a suitable alternative. Finally, as low-income and marginalized communities have disproportionately borne the brunt of the negative impacts of our transportation system, strategies that reduce emissions and improve safety disproportionately benefit these communities.

2. State of Play by Mobility Efficiency Strategy

This section explores the landscape of mobility efficiency strategies across the United States, organized into the categories of active transportation, public transportation, land use strategies, and market-based pricing. Each section is subdivided into subcategories of strategies, such as shared bike and scooter programs, bus and rail, or zoning reform. Each subcategory provides information on the prevalence of each mobility efficiency strategy nationally and in New York and synthesizes the literature on impacts of each strategy on economic conditions, air quality, health, safety, equity, and other areas.

2.1 Active Transportation

Active transportation works to make mobility more efficient and reduce vehicle miles traveled (VMT) by making non-car transportation easier, safer, and cheaper. This encourages shifting from vehicle travel to these activities, which are better for human health and the environment. Active transportation strategies include shared bike and scooter programs, support for bike and scooter ownership, and investment in sidewalks and bike lanes.

Generally, active transportation is a suitable alternative to driving very short trips, which are a small share of overall car travel. The safety and mobility benefits from this mode shift tend to be higher than the environmental benefits to individuals who cannot or do not own a car. The potential for mode shift rises considerably when paired with supportive land use that enables a greater density of destinations (see Land Use Strategies).

2.1.1 Shared Bike and Scooter Programs

Shared bike and scooter programs allow users to easily rent these devices for short local trips. Docked bike-share uses fixed stations for pick up and return while dockless systems allow parking anywhere in the service zone.

2.1.1.1 *Prevalence*

Shared bike and scooter options have soared in popularity. According to the North American Bikeshare and Scootershare Association, 354 cities in the United States have at least one bikeshare or scootershare system (North American Bikeshare and Scootershare Association 2024). The number of trips taken on e-bikes in North America grew 62 percent from 2023 to 2024 and trips on e-scooters grew 22 percent. Public bikeshare and scootershare coverage has ebbed and flowed over time: the number of cities served by docked or dockless bikeshare

systems peaked at 201 in 2018, fell to 107 in 2020, and recovered to 137 by mid-2025 (Bureau of Transportation Statistics 2026). The number of cities served by scootershare systems peaked at 189 in 2022 and slowly declined to 133 in 2025, driven by consolidations and bankruptcies.

Like other outdoor activities, bikeshare and scootershare systems are affected by weather, and therefore seasonal and regional variations. In the 2023 New York Cycling Census, weather was the second-most commonly cited barrier to cycling in the state, and it was a more common concern in rural areas than in urban areas (Urban Cycling Solutions 2023). Data on utilization of projects funded by the Clean Transportation Prizes bears this out as well: vehicle miles traveled via shared e-bike programs dip in colder seasons and rebound in warmer seasons, while vehicle miles traveled via EV programs do not (Atlas Public Policy n.d.). Some shared bike and scooter systems in snowy environments close for the winter. Some studies have suggested that the availability of safe infrastructure plays a role in cyclists' decisions to ride in cold weather, and improvements to snow clearing could increase ridership in the winter (Bergstrom and Magnusson 2003) (Sustainable Urban Transport Project 2020). The National Association of City Transportation Officials suggests de-icing and snow clearing or snow removal from bike lanes can help improve access to safe infrastructure in winter months (National Association of City Transportation Officials n.d.).

Shared Mobility Inc. (SMI), which began as CarShare Buffalo in 2009, runs several shared mobility programs in Buffalo, New York, including e-bike "libraries," incentive programs for e-bikes, electric transportation demonstration events, and bicycle courier services (Shared Mobility Inc. n.d.). There are several other bikeshare programs across many regions of New York, including the Capital District, Greater Binghamton, the Buffalo-Niagara region, Syracuse and central New York, the Hudson Valley, the Southern Tier, Tompkins County, the Genesee Valley, and the Mohawk Valley (511NY Rideshare n.d.).

2.1.1.2 *Impacts*

Economic: A survey of businesses¹¹ showed that 20 percent of the businesses reported a positive impact of bike sharing on sales, 36 percent said there was no change, and 43 percent were unsure of impact, while only one percent reported a negative impact. Furthermore, 70 percent of businesses identified a positive impact on the neighborhood while seven percent said the impact was neutral, 22 percent were unsure, and only two percent said bike sharing made the neighborhood worse (Buehler and Hamre 2014). In addition, 61 percent of surveyed businesses would have either a positive or neutral reaction to replacing car parking in front of their business with a bikeshare station (Buehler and Hamre 2014). Surveys like these indicate

potential economic benefits, but data on actual business revenues before and after bike and scooter share implementation would be more definitive. As that data is not currently available, the field would benefit from additional research specific to bikeshare and scooter share projects. Data availability is greater for projects that construct sidewalks and bike lanes (see Pedestrian Infrastructure Strategies and Bicycle Lanes).

Environmental: Bike-share and scootershare have the potential to reduce thousands of tons of GHG emissions per year by avoiding private vehicle travel. According to a 2020 analysis of bikeshare programs in major cities across the United States, GHG savings from these programs avoided up to 5,417 tons of CO₂-equivalent (CO₂e) that year (Kou, et al. 2020). An e-bike library in Buffalo, organized by the Local Initiatives Support Corporation (LISC) and funded by NYSERDA, along with an e-bike incentive program led by InnoEnergy in Westchester County, also funded by NYSERDA, together reduced 41 metric tons of CO₂e between January 2024 and September 2025 (Atlas Public Policy n.d.). Active transportation impacts on emission reduction tend to be small in comparison to total emissions from transportation. Nonetheless, the emissions benefits are real and are in addition to larger safety and health benefits.

Safety: E-scooter users can experience crashes with other road users and pedestrians, and safety regulations are not uniform nor are they well communicated to riders (Kazemzadeh, Haghani and Sprei 2023). A 2022 study comparing e-scooter crashes to bicycle crashes found that e-scooter riders are more likely to have face and head injuries, which the authors at least partially attribute to less frequent helmet use (Benhamed, et al. 2022). More research is needed to understand the unique characteristics of each micromobility mode to determine safety benefits or concerns.

Health: Shared mobility programs increase physical activity, which is associated with better physical and mental health outcomes (Auchincloss, et al. 2022) A 2021 study found that in 2019, bikeshare systems generated an additional 30 million hours of physical activity performed, resulting from 136 million shared micromobility trips (Clockston and Rojas-Rueda 2021). Those trips also directly result in annual savings of 737 disability-adjusted life years¹² and \$36 million in avoided public health costs (Clockston and Rojas-Rueda 2021). The city of Rochester found in a 2018 Health Impact Assessment that its bikeshare programs increased physical activity, reduced chronic disease risk factors like obesity and hypertension, improved connectivity to local services, and that these impacts were disproportionately higher in census tracts with high chronic disease prevalence (Woelk 2018).

2.1.1.3 Key Takeaways

Shared bike and scooter programs active, lower-carbon transportation alternatives to driving. However, programs that utilize electric bicycles and scooters face additional safety concerns, including the potential for increased face and head injuries from electric scooters. Despite these concerns, there is evidence that these programs have little to no negative impacts on businesses and are in fact viewed as benefiting their neighborhoods.

2.1.2 Programs to Support Electric Bike/Scooter Ownership

E-bike ownership provides flexibility of vehicle ownership for short- to medium-distance travel without the added costs or GHG emissions of cars. However, the average e-bike costs \$1,500-\$2,500, making it a significant investment for most Americans (REI Co-Op n.d.).

2.1.2.1 Prevalence

To address the issue of upfront costs for e-bikes and e-scooters, many states and localities have instituted rebates for e-bike purchases. There are more than 160 e-bike incentive programs in the United States and Canada as of February 2024, though these programs cover a minority of the population and frequently run out of funding due to high demand (Jones, et al. 2024) (Bigazzi and Berjisian, Modeling the impacts of electric bicycle purchase 2021). Rebate amounts range from \$300 per bicycle in Vermont to \$2,000 for low-income residents in California (Tenways 2025). Colorado's popular program offers a \$225 tax credit for e-bikes. Since launching in 2023, over 34,000 Coloradans have applied for a rebate, nearly 8,000 people have received them, and 89 percent of those receiving a rebate said they would not have bought the e-bike without the incentive (Colorado Energy Office n.d.) (Colorado Energy Office n.d.). California's e-bike incentive was also popular but was defunded after distributing 2,100 vouchers across two rounds in a single year due to state budgetary constraints (Zukowski, CARB defunds California e-bike incentive program 2025).

Shared Mobility Inc. (SMI) offers e-bike incentive programs in two parts of New York. In Westchester County, SMI provides \$1,000 point-of-sale rebates to households under 80 percent of the area median income (Shared Mobility Inc. 2025). In Buffalo and Niagara Falls, SMI is piloting a \$650 point-of-sale rebate for households under 60 percent of the area median income (Shared Mobility Inc. 2025).

2.1.2.2 *Impacts*

Environmental: E-bikes and e-scooters are shown to reduce GHG emissions by shifting travelers from carbon-intensive private vehicles. A 2025 study in British Columbia found that the recipients of e-bike subsidies reduced their CO₂ emissions by 16 kilograms per week a year after the purchase of their e-bikes (Bigazzi, Hassanpour and Bardutz, Travel behaviour and greenhouse gas impacts of income-conditioned e-bike purchase incentives 2025). The study found that 23 percent of high-income participants and 76 percent of low-income participants would not have purchased an e-bike without the rebate (Bigazzi, Hassanpour and Bardutz, Travel behaviour and greenhouse gas impacts of income-conditioned e-bike purchase incentives 2025).

Safety: E-bikes and e-scooters present a unique safety challenge; there are concerns about lithium-ion battery fires posing dangers to riders (Preston 2024). New York City is attempting to solve this issue by incentivizing battery swapping to ensure batteries degrade more slowly (New York City Department of Transportation n.d.).

Health: Studies have found that riding electric bicycles can improve cardiovascular health. Even with motor assistance, a 2021 study found that a three-mile commute by electric bike increases heart rate and metabolic activity to levels that meet exercise-intensity thresholds recommended by the American College of Sports Medicine and the World Health Organization (Alessio, et al. 2021). Participants also reported positive experiences and reached recommended exercise intensities even if they had never previously ridden an electric bike, suggesting strong potential for broader uptake of electric biking (Alessio, et al. 2021).

Evidence on the physical health impacts of electric scooter use remains limited. However, riding electric scooters has been shown to confer mental health benefits. A 2023 United Kingdom study of 2,402 shared electric scooter users found that scooter use reduced stress, improved mood, and increased access to local services [73].

2.1.2.3 *Key Takeaways*

E-bike and e-scooter subsidies are a topic of discussion across the United States but are not currently widespread. There is evidence that where they do exist, they can help avoid CO₂ emissions by encouraging shifting from vehicle travel to e-bike or e-scooter travel.

2.1.3 Pedestrian Infrastructure Strategies

Increasing the prevalence and safety of pedestrian travel options can encourage shifting from short-distance car travel to walking. Building sidewalks, managing traffic flow, and designing streets with all users in mind can improve pedestrian safety and make walking a viable alternative to driving for short trips.

2.1.3.1 Prevalence

Walking infrastructure is less prevalent than driving infrastructure in the United States, making it more difficult and dangerous to walk than drive in many areas (Smart Growth America 2024). There have been recent efforts at multiple levels to expand and improve pedestrian infrastructure, primarily to improve safety, but also to provide viable options to walk rather than drive.

The federal government established the Safe Streets and Roads for All grant program in the Infrastructure Investment and Jobs Act to fund local street safety projects across the United States from 2022 to 2026. As of early 2026, about \$4 billion has been awarded to almost 2,400 projects in 50 states, Washington D.C., and Puerto Rico (U.S. Department of Transportation n.d.). In New York, Mount Kisco, New York City, and Rochester have all been awarded implementation grants, while many other cities and regions in the state such as the Capital District, Monroe County, New Rochelle, and Rye have been awarded grants to establish action plans.

Separately from the federal government, over 60 cities across the country, including New York City, have committed to the Vision Zero Network, which aims to reduce pedestrian deaths to zero (Vizion Zero Network 2025). Core principles encouraged by the network include speed management and making streets safe for both pedestrians and drivers (Vizion Zero Network 2018).

2.1.3.2 Impacts

Economic: There is a significant body of evidence that road safety improvements for pedestrians have no negative impacts on businesses and can even improve the economic positions of businesses. A 2021 review of studies examining the economic effects of active transportation on businesses found that “pedestrian facilities” such as curb extensions, street trees, lighting, pedestrian plazas, and roadways converted to pedestrian space contributed to positive economic outcomes for local businesses adjacent to these facilities (Volker and Handy 2021). In the case of a 2013 conversion of a parking area to a pedestrian plaza in Brooklyn, New

York, the New York City Department of Transportation found a 172 percent increase in retail sales at local businesses (New York City Department of Transportation 2012).

A University of Minnesota study of nine “Complete Streets¹³” projects in 2022 found that these projects benefited businesses¹⁴ through higher investment, increased property values, and decreased vacancies (Fonseca-Sarmiento 2022). Further, several interviewees suggested that projects increased pedestrian activity. A Smart Growth America study examining 37 projects across the United States found that these projects improved safety for all road users, notably including pedestrians, also saving \$18.1 million in collision and injury costs in one year (Smart Growth America 2015).

Benefit cost analyses of pedestrian improvement projects often find high returns, with benefits to health, safety, environment, household budgets, and economic development far outweighing costs of construction (Bland 2024). Health and safety benefits typically make up the largest portion of benefits (Bland 2024). Benefit cost analyses often do not include all benefit categories. Access to education and employment, and increased employment, income, productivity, and tax revenues are shown to be benefits of active transportation in the literature but are not often included in benefit cost analyses. As such, benefit cost ratios would be even higher if including the full range of benefits (Litman, Evaluating Active Transport Benefits and Costs 2026).

Environmental: To the extent that pedestrian infrastructure strategies increase pedestrian activity, they can decrease VMT and therefore GHG emissions. For example, a 2011 study in Washington found that every one percent increase in the ratio of sidewalk area to street area was associated with a 0.05 percent decrease in vehicle miles traveled (Frank, et al. 2011).

Health: Pedestrian infrastructure improvements such as Complete Streets encourage walking, which reduces the risk of health conditions such as obesity and breast cancer (American Heart Association n.d.) (Shreves, et al. 2025). Residents of highly walkable neighborhoods have a one-and-a-half times higher likelihood of meeting American exercise guidelines, compared to residents of low-walkability areas (Wang, Narcisse and McElfish 2023). These residents were also 24 percent less likely to have obesity and had lower average body mass indexes (Wang, Narcisse and McElfish 2023).

2.1.3.3 Key Takeaways

Ultimately, there is significant evidence across the United States and in New York that pedestrian infrastructure strategies have neutral to positive economic impact on local businesses and have positive impacts on GHG reduction and safety efforts.

2.1.4 Bicycle Lanes

Providing bike lanes and trails makes cycling a safer, and therefore more appealing, mode of travel for short- to medium-distance travel. In addition to encouraging drivers to shift to cycling and increasing safety for cyclists, this can have positive downstream effects for local businesses, such as more frequent visits and increased street safety at storefronts.

2.1.4.1 Prevalence

As of a 2021 survey, 30 states had at least one protected bike lane (The League of American Bicyclists n.d.). Access to this built infrastructure remains spotty nationwide. According to the National Survey of Pedestrian & Bicyclist Attitude & Behaviors, 26 percent of Americans have access to both bike paths and lanes, 24 percent have access to paths but not lanes, seven percent have access to lanes but not paths, and 43 percent do not have access to either (The League of American Bicyclists n.d.).

Many cities in New York have extensive networks of bike lanes, including Buffalo, New York City, and Rochester. Buffalo has over 170 miles of dedicated bike lanes, shared lanes, and multi-use paths. This network records daily bike traffic counts averaging between 300 to 550 each day (GObike 2020). New York City boasts the largest bike network in North America with 1,550 lane miles (555 of which are protected bike lanes) (Parks and Trails New York 2025). Per the United States Decennial Census' American Community Survey, there are over 620,000 cycling trips in a typical day in New York City (U.S. Census Bureau n.d.). New York City's bike network focuses on access, resulting in 99 percent of New York residents living within one mile of the network (New York City DOT n.d.). Rochester adopted the City's first Bicycle Master Plan in 2011, and has since installed 50 miles of bike lanes, 35 miles of bike boulevards,¹⁵ and three miles of cycle tracks (City of Rochester n.d.).

New York is home to the longest multi-use state trail in the country, the Empire State Trail, which spans 750 miles from New York City to Canada and from Albany to Buffalo (Parks and Trails New York 2025). One major segment of this trail is the Erie Canalway Trail (ECT), which runs from Albany to Buffalo and recorded more than 3.8 million annual visits between 2020 and 2024

(Parks and Trails New York 2025). The ECT possesses many features that make it attractive to cyclists. Approximately 85 percent of the ECT is separated from road vehicles, creating a safer and more pleasant experience for cyclists (Parks and Trails New York 2021). While the large cities along the trail—Rochester, Buffalo, and Albany—saw the highest number of visits (Parks and Trails New York 2014), the ECT also passes through numerous smaller cities and towns that offer cyclists opportunities to stop for food, lodging, and local attractions.

2.1.4.2 *Impacts*

Economic: Bike lanes are shown to provide economic benefits to the communities where they are located. By providing greater access to mobility, they increase property values, save companies money on parking, and lower health costs by fueling more active transportation (Andersen and Hall 2023). In some cases, they can bring tourism revenues as well. A 2014 study of the ECT estimated approximately 1.6 million annual visits generated \$253 million in sales and \$28.5 million in taxes, and supported 3,440 jobs and \$78 million in labor income (Parks and Trails New York 2014). Given annual visitors have more than doubled since 2014, the ECT likely generates significantly higher economic activity today. Notably, the 2014 study found that only 2.5 percent of visitors came from outside the 35 counties adjacent to the trail, yet they represented 21 percent of total spending, suggesting opportunities for growth in nonlocal tourist visitation.

Overall, the evidence suggests bike lanes and related street safety projects do not harm nearby retail and often produce neutral to positive economic outcomes, even when they reallocate space previously used for cars or parking. A review of 23 studies finds that cyclists and pedestrians spend roughly similar amounts per trip as drivers in downtowns and retail corridors, and that bike lanes and cycle tracks are associated with positive impacts for retail and food service businesses, including in cases where travel lanes or parking were removed (J. Volker, et al. 2019). Corridor-level evaluations using taxable sales data and control comparisons likewise report no adverse sales impacts after safety and bike-related street redesigns in Seattle and in other cities (Osterhage, et al. 2024) (Liu and Shi 2020). Beyond corridor effects, some national-level evidence suggests bicycle infrastructure spending can also support broader job creation through direct, indirect, and induced employment impacts (Garrett-Peltier 2011).

Environmental: There is evidence that bike lanes reduce CO₂ emissions by reducing VMT as well. A 2014 addition of bike lanes in Davis, California led to a 243 percent increase in bicycle traffic (Gudz, Fang and Handy 2016) and a reduction of 24.4 metric tons of CO₂e emitted per year (J. Volker, et al. 2019).

Safety: The safety benefits of bike lanes, especially protected bike lanes, are well documented. A 2012 study in the American Journal of Public Health found that protected bike infrastructure could reduce the risk of cycling injuries by 90 percent compared to a street with no cycling infrastructure (Teschke, et al. 2012). Not only cyclists benefit; a 2019 study in the Journal of Transport & Health found that all road users benefit from protected bike lanes because they lead to higher intersection density, which is associated with overall lower speeds (Marshall and Ferencak 2019).

Health: In addition to the health benefits inherent in increased safety benefits, a poll found that three-quarters of Americans support bike lanes in their area and nearly half say they increase quality of life (Ballard 2025). Bike lanes encourage cycling, which improves strength and flexibility, improves coordination and balance, induces cardiovascular and metabolic health, and provides a low-impact form of exercise (Cleveland Clinic 2022). In fact, according to a study of over 250,000 participants over five years, those that commuted by cycling had a 46 percent lower risk of developing heart disease and had a 52 percent lower mortality rate from heart issues (Celis-Morales, et al. 2017).

2.1.4.3 Key Takeaways

Ultimately, there is significant evidence across the United States and in New York that bike lanes have positive or neutral economic impact on local businesses and have positive impacts on GHG emission reduction efforts and safety.

2.2 Public Transportation

Public transportation encapsulates services such as bus, van, and rail, including light rail, heavy rail, and commuter rail systems. Public transportation systems—especially bus and rail—produce benefits by moving large numbers of people efficiently, reducing the need for individual vehicle trips and improving access to destinations. Over time, public transportation has evolved to provide further access via new technologies, like demand-responsive microtransit systems able to serve lower-demand areas. This section examines these mobility efficiency strategies and their economic, environmental, and social impacts.

2.2.1 Bus and Rail

Expanding and improving public transportation services enhances the efficiency of the transportation system by moving more people at lower cost and lower environmental impact. Expansion includes extending rail and bus service to additional areas or increasing service levels

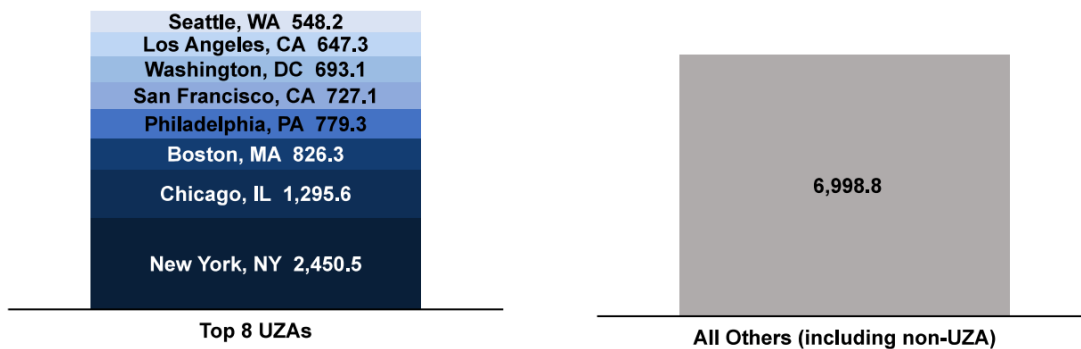
for lower wait times to incentivize use. Improvements include connection hubs, crosstown routes, flexible services, route optimization, dedicated bus lanes and transit signal priority, which can improve bus efficiency, incentivize ridership, and decrease VMT (Duffy 2025) (Planning n.d.) (McCahill 2024).

2.2.1.1 Prevalence

Almost all U.S. cities and towns have some level of public transportation service, though the magnitude of that service varies greatly across the country. Where high-quality service is available, bus and rail ridership is strong (U.S. Census Bureau n.d.). Not surprisingly, where little service is available, ridership is low. More than half of rail, bus rapid transit,¹⁶ and ferry service is concentrated in eight metropolitan areas (Figure 3) (Federal Transit Administration 2024). In New York, commuting patterns show both statewide concentration and strong local variation. The 2024 American Community Survey reported that 49 percent of commuters in New York City commute using public transportation (U.S. Census Bureau n.d.). Other cities in New York also exceed the national average of three percent transit commute share, including Buffalo (7.4 percent) and Rochester (5.2 percent) (U.S. Census Bureau n.d.).

Figure 3. Rail, Bus Rapid Transit, and Ferry Directional Route Miles by UZA¹⁷, 2023

Source: (Federal Transit Administration 2024)



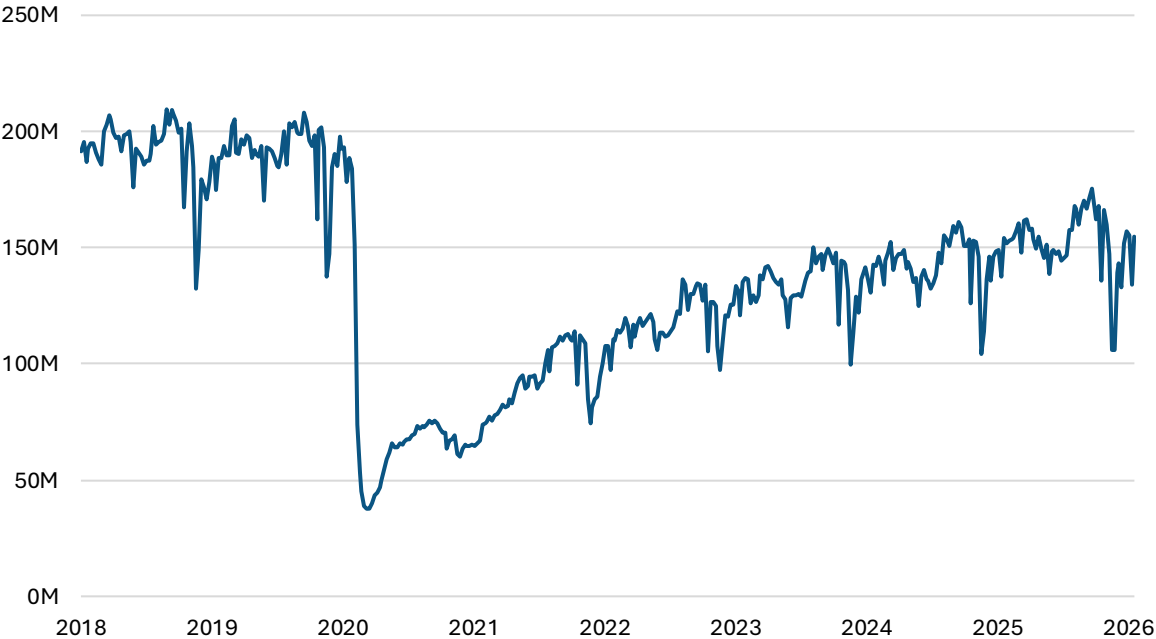
Public transportation ridership fell steeply during the COVID-19 pandemic and then rebounded gradually to 85 percent of pre-pandemic levels as of April 2025 (Figure 4) (American Public Transportation Association, Transit n.d.). Bus ridership fell less than rail ridership, decreasing to 28 percent of pre-pandemic levels in April 2020 as compared to 10 percent for rail. Bus ridership was also quicker to recover and recovered more thoroughly, reaching 86 percent of pre-pandemic levels in 2024 as compared to 76 percent recovery for light rail and 71 percent for heavy rail (American Public Transportation Association 2025). Bus riders tend to be more

dependent on public transportation than rail riders, with lower incomes and higher likelihood of working in service rather than office sectors (American Public Transportation Association 2007).

Transit systems in small-to-mid-sized cities rebounded faster than the largest metro areas, with cities under 100,000 recovering to 88 percent of 2019 ridership by December 2024, while cities greater than two million recovered to 78 percent (American Public Transportation Association 2025).

Figure 4. National Weekly Public Transportation Ridership, 2018-2026

Source: (American Public Transportation Association, Transit n.d.).



Trends in NYS are similar to those seen nationwide with some exceptions (Table 2). Albany and Poughkeepsie are two of nine cities nationwide where ridership rebounded to above pre-pandemic levels by December 2023 (Genhofer 2024). In Albany, the Capital District Transportation Authority attributes this trend to its expanded rapid transit network and its Universal Access program, which offers free or subsidized transit to employees and students of over 40 organizations (Genhofer 2024) (CDTA 2023). Increasing service following its long-range plan after the pandemic combined with expanding access allowed the region to eclipse most of its historical ridership counts (CDTA 2023) (Deuso 2026). Meanwhile, in Poughkeepsie—which topped the list with service recovery at 150 percent over pre-pandemic levels—explanatory factors have not specifically been reported, but municipalities with smaller systems are more

likely to serve customers who are transit dependent and do not have jobs that allow for remote work driving a faster return of daily trips (Fitzpatrick and Beheraj 2023) (Mass Transit 2025).

In New York City, bus ridership currently matches or exceeds pre-pandemic levels on several routes (New York State Comptroller Thomas P. DiNapoli n.d.) (Moovit 2026). The bus rebound is partially attributed to expanded services, including during off-peak hours and occasionally including 24-hour service, as well as network redesigns and the rollout of congestion pricing (Metropolitan Transit Authority 2025). Outside of New York City, commuter rail continues to unevenly recover with ridership remaining below 2019 levels; only during holidays and special events have Metro-North and the Long Island Railroad hit pre-pandemic levels (Taruma n.d.). The Niagara Frontier Transportation Authority reports ridership at 64 percent of pre-pandemic levels as of the end of fiscal year 2025, while in late 2024 the Rochester-Genesee Regional Transportation Authority reported 76.5 percent of pre-pandemic ridership (Niagara Frontier Transportation Authority n.d.) (Democrat and Chronicle 2024).

Table 2. Annual Public Transportation Ridership in New York State, 2018-2025

Data shows total passenger trips per year by transit system; data was pulled March 3, 2026.

Source: (American Public Transportation Association, Transit n.d.).

Year	Albany	Buffalo	Ithaca	Rochester	NYC
2018	14,164,344	23,055,510	3,888,498	13,837,107	3,559,944,387
2019	14,949,842	24,096,970	4,260,865	14,775,463	3,878,317,752
2020	10,361,470	13,516,161	1,495,015	8,810,489	1,690,967,639
2021	10,660,527	12,294,054	2,083,462	7,118,076	1,937,613,268
2022	12,701,973	13,854,574	2,451,003	8,448,228	2,564,234,339
2023	15,444,178	15,417,930	2,195,212	9,482,043	3,026,157,596
2024	17,580,526	15,782,409	2,819,606	10,677,239	3,072,714,216
2025	18,186,318	15,500,595	2,472,723	10,712,687	3,415,203,764

It is important for public transportation service redesigns to consider non-commute trips, which represented 72 percent of trips in 2022 (Federal Highway Administration 2022). This is compounded by the share of people working from home either occasionally or primarily, which quadrupled between 2019 to 2024, rising to 23 percent (United States Census Bureau 2023) (Borkowski and Kaynas 2025). Generally, it is more difficult for transit agencies to serve non-commute trips; commute trips are more straightforward because they tend to have common downtown destinations and regular schedules and rush hours (Rowlands and Hadden Loh 2023) (Dudhe, Kumar Agarwal and Vishwakarma 2023). It is easier to serve non-commute trips if the land uses are mixed and dense. This underscores the need to integrate land use and transportation planning, as discussed in *Combining Mobility Strategies Amplifies Benefits*.

2.2.1.2 Impacts

Economic: Public transportation investments can generate significant economic growth in the short- and long-term (Group 2020). Every dollar invested in public transportation generates about five dollars in direct and indirect economic benefits, according to analysis by the American Public Transportation Association (O'Leary 2025). For individuals, using public transportation instead of driving can yield large household savings; in 2023, frequent public transportation users saved more than \$13,000 annually once vehicle maintenance, fueling, and fares were accounted for (A. P. Association 2023). At the macroeconomic level, each \$1 billion invested in public transportation is associated with about 50,000 jobs, \$2.9 billion in business sales, \$1.8 billion in GDP, \$1.2 billion in labor income, and nearly \$400 million in tax revenue (Economic Development Research Group, an EBP Company 2020). Public transportation improvements advance equity as public transportation is disproportionately utilized by lower-income households (Clark, Basinger and Maloney 2017) (DiNapoli and Jain 2024) (Morrison and Dallman 2025).

Environmental: Public transportation generally emits fewer GHG emissions per passenger mile than driving, yielding emissions benefits when it displaces vehicle travel (Board 2021). In 2018, public transportation avoided 63 million metric tons of CO₂ domestically. The average public transportation trip emits 55 percent fewer GHG emissions than a single occupant vehicle trip (Board 2021). While the average U.S. bus system emits lower GHG per passenger mile than the average single occupancy vehicle trip (Hodges 2010) (McGraw, et al. 2021), emissions savings vary greatly by transit system and depend on the number of riders per vehicle, the efficiency of the vehicle, fuel type, and operating conditions. For instance, the New York City subway, New York City Transit buses, and the Buffalo light rail emit 89 percent, 38 percent, and 78 percent lower CO₂ per passenger mile respectively than driving alone (McGraw, et al. 2021). Further service expansions and network improvements—like the city of Rochester's planned hubs, crosstown buses, and flexible routes—can further increase the emissions reduction benefits garnered (Duffy 2025) (Planning n.d.).

Safety: Enabling people to shift from driving to public transportation also improves safety. The U.S. average per vehicle mile fatality rate for buses is one third that of personal automobiles (Morency 2018). Transit-priority street designs may also improve safety. For example, speeding, a major factor in serious crashes, dropped by 15 percent when dedicated bus lanes were added to roadways in Albuquerque (McCahill 2024).

2.2.1.3 Key Takeaways

Public transportation provides a more energy-efficient, lower cost, and safer alternative to single occupancy vehicle travel. Public transportation investments are associated with substantial economic returns and household cost savings, while also delivering lower per-passenger-mile emissions than driving. Low-income households rely more heavily on public transportation than higher income households and thus stand to benefit from public transportation improvements. Finally, public transportation improves safety by offering a safer alternative to driving.

2.2.2 Electric Microtransit

Microtransit refers to shared vehicles operating on a flexible route that riders can summon via an app on their phones. This is designed to substitute for private vehicle travel or for public transportation when it is unavailable. Microtransit has the potential to reduce VMT by reducing private, single-occupancy vehicle travel, if it has sufficient occupancy. This report focuses on electric microtransit, which relies on electric vehicles, due to its greater emissions reduction potential.

2.2.2.1 Prevalence

Electric microtransit services are nascent in the United States. Although microtransit using conventional vehicles is meeting the last-mile needs of commuters in at least 18 states across the country (National Center for Applied Transit Technology 2023), electric options are much more limited.

One example within NYS is CircuitNR, which the city of New Rochelle has operated since 2019 (New Rochelle n.d.). The on-demand electric shuttle is available to be hailed in person and via its own app (New Rochelle n.d.). It is free to riders and is funded by local and federal programs (Katz 2019) (Edwards 2021). The program covers the city's main arteries, including the downtown area, neighborhoods to the south and east of downtown, and rides to parks and beaches in the summer, and is available daily (New Rochelle n.d.).

2.2.2.2 Impacts

Economic and Equity: Microtransit provides mobility to low-income groups who would otherwise use more expensive ride hailing services. A study of an on-demand microtransit service in the Minneapolis area found that 58 percent of microtransit users would have otherwise used ride hailing and another 18 percent would have taken private cars (Liezenga, et

al. 2024). There are no studies of the economic effects of microtransit on retail sales, but it is reasonable to assume that providing greater mobility increases access to businesses.

For instance, a battery-electric microtransit shuttle fleet in the Rockaways and western Suffolk County helped people reach destinations they otherwise would not have been able to afford to reach reliably; service ended in March 2026 after public funding ended. According to surveys of riders, prior to the microtransit fleet being deployed, 55 percent of individuals reported they frequently had trouble getting places and missed many events due to lack of transportation options. After implementation of microtransit, that number dropped to 36 percent (Atlas Public Policy n.d.). This project was funded by the NYSERDA Clean Transportation Prizes program.

Environmental: As with any mode shift strategy, the environmental benefit of microtransit depends heavily on what mode the passenger would have used otherwise. Microtransit provider Via notes that 41 percent of Via rides replaced trips previously served by private vehicles, indicating that almost 60 percent of Via riders would have otherwise taken public transportation, walked, biked, or not made the trip at all. While emissions from Via trips were 35 percent lower than if the passengers had used other modes (Jiang 2023), the number would have been even higher if it were displacing a higher percentage of private vehicle trips rather than pedestrian or public transportation trips. A study in San Diego and Lemon Grove, California found that microtransit reduced VMT and boosted job accessibility, especially in areas with lower access to fixed route transit, but also slightly decreased fixed-route transit ridership (Hyland, et al. 2025). In New Rochelle, NY, in its first two years of operation, CircuitNR saved over 60,000 vehicle miles through more than 50,000 trips (New Rochelle n.d.).

2.2.2.3 Key Takeaways

Microtransit provides increased access to mobility, particularly for low-income populations. Multiple studies have found that microtransit can bring low-income riders closer to jobs and other opportunities. However, these services also have the potential to shift trips away from less carbon-intensive modes like walking and biking.

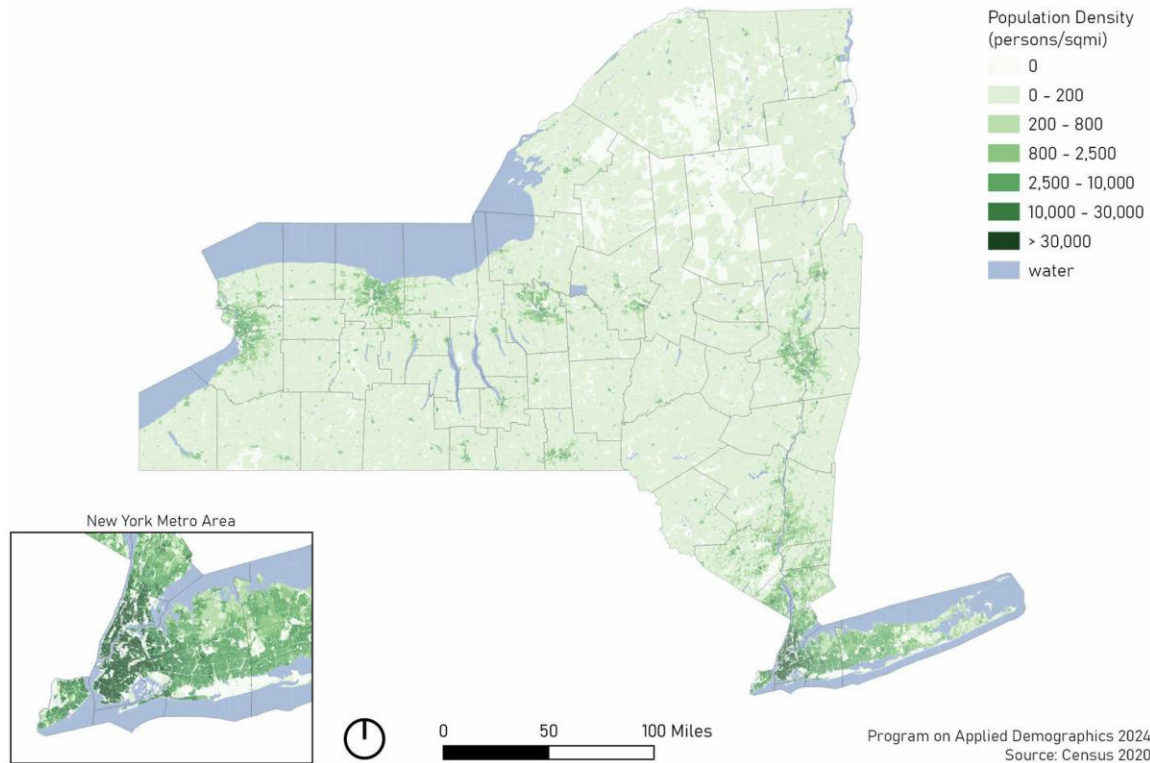
2.3 Land Use Strategies

Greater density decreases VMT and emissions from transportation (Freemark 2024). Key strategies to induce greater density include changes to municipal zoning, transit-oriented development, and removing parking mandates. Greater density also increases the effectiveness of public transportation and active transportation. NYS's population density is shown in Figure 5. The state is facing a large housing gap, particularly of dense urban housing (Regional Plan

Association 2024). Housing challenges are exacerbated by the fact that most of the residential land in New York is zoned to prohibit anything but single-family homes (Bronin, Markley and Derickson 2025). Limiting housing production to a single, land-intensive housing type can suppress the development of medium-density and multifamily housing that may be desired by residents.

Figure 5. New York State, 2020 Population Density

Source: Program on Applied Demographics, The Cornell Jeb E. Brooks School of Public Policy (Kwong 2024).



Expanding housing supply can reduce cost pressures for current and future renters. Property owners and developers—particularly in transit-rich areas—are well-positioned to deliver new housing with the right policy framework. Transit agencies benefit from higher ridership as more residents locate near frequent service, and local governments capture fiscal gains through increased property values and tax revenues. When local governments make investments in public transportation infrastructure, the surrounding land and property values increase (American Public Transportation Association and National Association of Realtors 2019). The local government and/or transit agency can then collect increased revenue from increased property taxes, parking fees, or negotiated payments from developers to mitigate the impacts of development (National Academies of Sciences, Engineering, and Medicine 2016).

Simultaneously, without complementary protections, upzoning may expose low-income urban residents to displacement. Small landlords and locally owned businesses may face rising property taxes or commercial rents, and homeowners may resist changes to neighborhood form. Finally, households that remain car-dependent may perceive losses where land-use and parking reforms move faster than the availability of reliable transportation alternatives.

Addressing the imbalance in housing supply is not zero-sum. Policy interventions to balance the trade-offs include:

- Meaningful community engagement at the local level along with state policy that enables growth across geographic regions,
- Affordable housing strategies that reduce displacement risk, such as tenant first right of refusal,¹⁸
- Pairing efficient reform timelines with meaningful community engagement,
- Integrating land use and transportation planning processes that often take place at different public agencies,
- Weighing efficient land use against uneven geographic barriers, and
- Allowing for both market flexibility and local regulatory certainty (U.S. Department of Transportation, Climate Change Center 2024).

2.3.1 Zoning Reform

Local zoning codes dictate what can be built and where. For much of the twentieth century, most local zoning codes limited density and separated residential and commercial uses, making it difficult to reach most destinations without a personal vehicle. Many current zoning reform efforts focus on enabling more housing types, higher densities, and mixed-use patterns that shorten trip distances and reduce car dependence (U.S. Department of Transportation, U.S. Department of Energy, U.S. Department of Housing and Urban Development, U.S. Environmental Protection Agency 2023).

Some jurisdictions are transitioning from zoning codes that focus on separating land use to alternatives like form-based codes—regulating buildings and public spaces’ forms—and performance-based codes—regulating measurable outcomes like jobs, affordable housing, traffic, or environmental targets. This strategy supports compact, walkable development aligned with community goals like spurring economic development, increasing the supply of affordable housing, and improving air quality (U.S. Department of Transportation, U.S. Department of Energy, U.S. Department of Housing and Urban Development, U.S. Environmental Protection

Agency 2023) (South Texas Surveying Associates Inc. 2024) (Weil Huennekens n.d.) (Form-Based Codes Institute n.d.) (Building Design + Construction 2014).

2.3.1.1 Prevalence

Zoning reform has gained significant momentum across the United States over the last decade, as municipalities and states grapple with a national housing affordability crisis. While restrictive, single-family-only zoning still dominates—covering roughly 75 percent of residential land in many U.S. cities—efforts to allow higher density are becoming more common (U.S. Department of Transportation, U.S. Department of Energy, U.S. Department of Housing and Urban Development, U.S. Environmental Protection Agency 2023). A 2022 study found that zoning codes supporting mixed-use, walkable development had been adopted by 17 percent of jurisdictions in 2010, increasing to 26 percent of jurisdictions by 2020 (Steutville 2022).

While zoning decisions are traditionally made at the local level, some states have passed legislation requiring changes to local zoning across their states, primarily to increase housing supply and consequently make housing more affordable. For instance, Oregon and California have adopted legislation that legalizes duplexes and accessory dwelling units (ADUs) in most residential areas throughout their states (Schuetz 2023).

New York Governor Hochul proposed similar legislation to legalize ADUs in 2022 and again in 2023, but it did not pass, with opposition summed up as “Local Control, not Hochul Control” (Hodgon 2025). In response, the Governor switched tactics to incentives, issuing an executive order in July 2023 requiring certain state grants related to housing and development to prioritize “Pro-Housing Communities” for funding. These are communities that adopt zoning reform to allow greater density, streamline permitting, and expand affordable housing supply (Hodgon 2025). As of February 2026, 554 communities (approximately 55 percent of all New York towns, cities, and Tribal communities)¹⁹ have submitted letters of intent to be designated as “Pro-Housing Communities” and 401 have been certified (New York State Homes and Community Renewal n.d.).

Prior to the Governor’s efforts, some New York jurisdictions had been pursuing zoning reforms for many years. Buffalo, New Rochelle, Kingston, and Port Chester have adopted form-based codes. New Rochelle’s code supports large-scale housing approvals, including affordable units, and downtown public-space and business activity (Weil Huennekens n.d.) (City of Buffalo n.d., City of New Rochelle n.d., City of Kingston 2023, Village of Port Chester, New York 2020). In addition, NYS has a smart growth program that provides grants and technical assistance to

municipalities on allowing and encouraging mixed-use, compact development (New York State n.d.).

The Town of Ramapo, NY provides an example of how zoning reform can allow for increased density, enabling people to drive less. Ramapo changed its zoning in 1969 to allow for construction of new multifamily housing, which was previously not permitted, and to encourage high-density housing options (Weil Huennekens n.d.). Between 1970 and 2019, the city's rezoned regions saw a population increase of 456 percent, or from 2,900 to more than 16,000, to a density of about 22,000 people per square mile (Weil Huennekens n.d.). In the rezoned areas, a quarter of households do not own a vehicle, compared to only six percent elsewhere in the county. This demonstrates how zoning reform can increase housing affordability and reduce transportation expenses.

2.3.1.2 Impacts

Economic: Rezoning for density, mixed-use, or performance targets is associated with increased employment, income, neighborhood productivity, property values, and tax revenues (Litman, *The Mobility Productivity Paradox* 2025). Dense, multimodal areas have higher taxable values per acre when compared to vehicle-oriented zoned sprawl (Litman, *The Mobility Productivity Paradox* 2025). Placing companies in proximity builds a concentration of jobs that boosts economic productivity and draws in further investment (U.S. Environmental Protection Agency 2013). An environment that facilitates and promotes social interaction between firms fosters greater exchange of ideas, innovation, and economic activity (U.S. Environmental Protection Agency n.d.). Retail establishments are better able to attract customers when they are situated in locations that offer multiple access options and feature a diverse, active surrounding environment. A nationwide study of office and retail properties found that, on a 100-point scale, a 10-point increase in walkability corresponded with a nine percent rise in market value and a seven percent increase in net operating income (Pivo 2011).

Environmental: Zoning reform also reduces emissions. An analysis using 2023 data found that state-level land use reform is capable of reducing 70 million tons of CO₂e by 2033 in the United States (Muralidharan, et al. 2024), equivalent to 178 billion miles driven by an average gasoline car (U.S. Environmental Protection Agency n.d.). About 80 percent of the pollution reduction would come from reduced VMT while the remainder would come from more efficient buildings and the preservation of natural carbon sinks that would otherwise be lost to sprawl.

A modeling study analyzing growth scenarios for Albuquerque found that compact, infill-focused reform could reduce transportation-related emissions by about one-fifth in the city by 2040 versus a 2012 baseline (U.S. Department of Transportation, Climate Change Center 2024). A study in California found that increased density via upzoning reduces emissions from VMT by about 30 percent at the census-tract scale or smaller (C. A. Association 2024), rising to 65 percent when multiple land-use strategies are combined (Project 2025).

Equity: Equity impacts are complicated. Upzoning can expand housing supply and—if intentionally planned—support more diverse income integration while reducing transportation cost burdens for lower-income households facing long commutes (Urban Align 2025). However, by creating a more desirable place in which to live, increased development can raise property values and rents, making it harder for long-term, low-income residents to remain. Some studies suggest that high density development in low-income neighborhoods does not raise rents. For instance, a study of large, new apartment buildings constructed in low-income areas found that new buildings decrease rents in nearby units by about six percent. Pairing zoning changes with anti-displacement measures and deep community engagement can encourage equitable outcomes (U.S. Department of Transportation, Climate Change Center 2024) (Smart Growth America 2025). Several examples in NYS demonstrate this strategy, like in Albany (Ward 2026), Buffalo (Steuteville 2022) (Buffalo Green Code 2016), and Rochester (City of Rochester 2026) between 2016 and 2026. Common mechanisms used include instituting housing funds, preservation programs, and sustained community engagement processes that directly shape both the zoning framework applied and associated investments directed.

2.3.1.3 Key Takeaways

Zoning reform can deliver economic, environmental, and affordability benefits by enabling compact, mixed-use, and higher-density development. Evidence links upzoning and related reforms to stronger economic indicators and sizable emissions-reduction potential at the state and project scales. Equity outcomes can be positive but require complementary anti-displacement policies and robust community engagement to avoid harm.

2.3.2 Transit-Oriented Development

Transit-Oriented Development (TOD) is a planning strategy that creates compact, walkable, mixed-use communities centered around high-quality public transportation hubs. By locating housing, jobs, and services within a short walk (typically a half mile) of public transportation, TOD reduces car dependency, boosts ridership, and fosters sustainable, vibrant urban

growth. Benefits are largest as cities move from low density (less than 2,000 residents per square mile) to moderate density (greater than 4,000 residents per square mile), when public transportation becomes reliable enough to compete with driving and shorter trip distances make walking and biking more practical (U.S. Department of Transportation 2025).

2.3.2.1 Prevalence

Communities across the United States are pursuing TOD. Examples include major TOD projects in Atlanta and Austin, as well as eleven projects in ten states, as diverse as Tennessee and Hawaii, that received federal TOD planning grants in 2024 (Federal Transit Administration n.d.).

In NYS, New Rochelle, Buffalo, the Bronx, and several municipalities on Long Island provide examples of major TOD efforts. A 2011 study guided redevelopment around New Rochelle's Intermodal Transit Center to improve pedestrian and bike connections, bring redevelopment opportunities, and reduce parking requirements to enable denser mixed-use growth (New York Metropolitan Transportation Council n.d.) (City of New Rochelle n.d.). The city folded its findings into its Master Plan and is advancing a pedestrian-oriented, net-zero Transit Center with new public spaces and mixed-use facilities. This illustrates how long-range, community-driven planning can modernize transit districts and support housing and economic development (City of New Rochelle n.d.) (Gillespie 2024).

Similarly, in Buffalo, the Niagara Frontier Transportation Authority's 2025 Transit Development Plan sets short-, mid-, and long-term priorities to improve regional connections and expand the Buffalo Metro Rail, exemplified by a proposed 6.4-mile light rail extension that was selected based on development potential, travel patterns, and ridership (NFTA-METRO 2025). The project intends to connect major activity centers, support affordable housing, and advance regional TOD plans, spurring density (Project 2025) (NFTA-METRO 2025).

A study by the NY-CT Consortium Sustainable Communities on the Bronx's six existing and two proposed Metro-North Railroad stations and their surrounding communities began in 2011, with results released in May 2014 (Department of City Planning, Ciy of New York 2014). The study evaluated the potential for TOD improvements to expand housing and economic growth, as well as the walkability of the neighborhood. The study considered the impact of mixed-use development, rezoning for density, and improving public transportation and intermodal connections, which would enable Bronx residents to more easily travel to local and regional job centers (Department of City Planning, Ciy of New York 2014). Today, the two proposed stations—Marris Park and Parkchester/Van Nest—are under construction as part of the Penn

Station Access project and their surrounding areas have been rezoned with TOD in mind. The project resulted in 7,000 new housing units and 10,000 jobs via the Bronx Metro-North Station Area Plan (Authority 2026) (Department of City Planning, City of New York n.d.).

On Long Island, several TOD initiatives have been developed around a Long Island Rail Road (LIRR) station. Wyandanch Rising came about via the Wyandanch community, beginning in 2002 and spearheaded by local residents (Town of Babylon Department of Planning & Development 2023). The town built a high-density downtown, investing \$500 million in 40 acres to add hundreds of new residential units—mostly affordable housing—close to the LIRR (Town of Babylon Department of Planning & Development 2023). The newer Patchogue project is funded with \$160 million, including an \$8 million award from the Long Island Investment Fund, to construct the 262-unit Carriage House (MacLennan 2025). Carriage House will also be comprised of retail and community office spaces, and plentiful parking designed to be connected to the LIRR and downtown area (MacLennan 2025). Finally, the Ronkonkoma Hub is an expansive 53-acre, \$1.2 billion project—partially funded with a \$55 million capital grant awarded by Empire State Development in 2017—erecting a novel downtown area by the local LIRR station (Governor Hochul Unveils the Next Phase of the \$1.2 Billion Transit-oriented Hub Station Yards, Creating More Than 1,400 Housing Units on Long Island 2024). The project is anticipated to create 2,500 permanent jobs, 388 homes, 489 residential units, massively expand retail and office spaces, and construct a public plaza with 1,200 parking spaces (Governor Hochul Unveils the Next Phase of the \$1.2 Billion Transit-oriented Hub Station Yards, Creating More Than 1,400 Housing Units on Long Island 2024). All three projects came about differently but resulted in economic vitality and revitalized connectivity around their LIRR stations.

2.3.2.2 Impacts

Economic: Integrating public transportation with development boosts ridership and fare revenue while also providing improved transportation access to businesses. The increased development also generates additional tax revenue. The magnitude of impact is dependent on local conditions such as existing infrastructure, public transportation options, agency size, and broader economic conditions in the area (U.S. Department of Transportation, Climate Change Center 2024) (National Academies of Sciences 2014). In Washington DC, transit-rich areas have twice as many businesses and three times as many jobs as vehicle-oriented areas, and property values are three times higher; land and buildings near metro stations generate \$3.2 billion in annual property tax revenue, as more than half of businesses and three-quarters of jobs are located within a half mile of a metro station or bus stop (Washington Metropolitan Area Transit

Authority n.d.). Similarly, in the Dallas–Fort Worth region, light-rail stations produced over \$18 billion in direct economic impact over 25 years, alongside rent increases (10 percent residential; nearly 13 percent commercial) and higher property tax revenue (Dallas Area Rapid Transit 2025).

Environmental: Pairing upzoning with TOD can expand housing choices, improve access to jobs and services, and reduce VMT (U.S. Department of Transportation 2025). A 2023 study of three high-growth metro areas found that rezoning land along transit corridors and enabling housing development on underused urban land closer to downtown can cut VMT by up to 13 percent and emissions by up to 14 percent (Grunwald 2023). A California study found transit-oriented communities average 17 to 26 VMT and 16 to 25 pounds of CO₂ daily compared to 45 VMT and 70 pounds in other communities (a 42 to 62 percent VMT decrease and a 64 to 77 percent CO₂ decrease) (U.S. Department of Transportation 2025) (California Air Pollution Control Officers Association 2021).

Safety: Communities with TOD are safer; public transportation is about 20 times safer than driving, with one-tenth the fatality rate per mile compared with car passengers (Washington Metropolitan Area Transit Authority n.d.) (U.S. Department of Transportation 2025). Further, TOD-driven street redesign for pedestrians and micromobility creates opportunities for safer movement and lower traffic speeds.

Health: TOD communities also help to improve human health and allow for more social interaction. Transit riders walk about a half hour more per day on average than non-transit riders (Washington Metropolitan Area Transit Authority n.d.). Researchers from Texas A&M University studied people who moved from a car-oriented neighborhood to a walkable one and found that residents improved both physical activities and social interactions after moving to the walkable environment (Zhu 2013).

2.3.2.3 Key Takeaways

TOD delivers benefits by making public transportation a practical substitute for driving through better connectivity and moderate-to-high density, especially when equity measures are embedded (U.S. Department of Transportation 2025). New Rochelle and Niagara Frontier’s efforts show how long-range, community-driven planning can reshape station areas to support mixed-use development, connectivity, and housing (Project 2025) (New York Metropolitan Transportation Council n.d.). Evidence from multiple regions points to economic gains like business and job concentration, higher property values, and tax revenue (Washington Metropolitan Area Transit Authority n.d.) [120]; environmental gains like lower emissions (U.S.

Department of Transportation, Climate Change Center 2024) (U.S. Department of Transportation 2025) (California Air Pollution Control Officers Association 2021); and safety and health co-benefits tied to public transportation use and safer street design (Washington Metropolitan Area Transit Authority n.d.) (U.S. Department of Transportation 2025).

2.3.3 Remove Parking Mandates

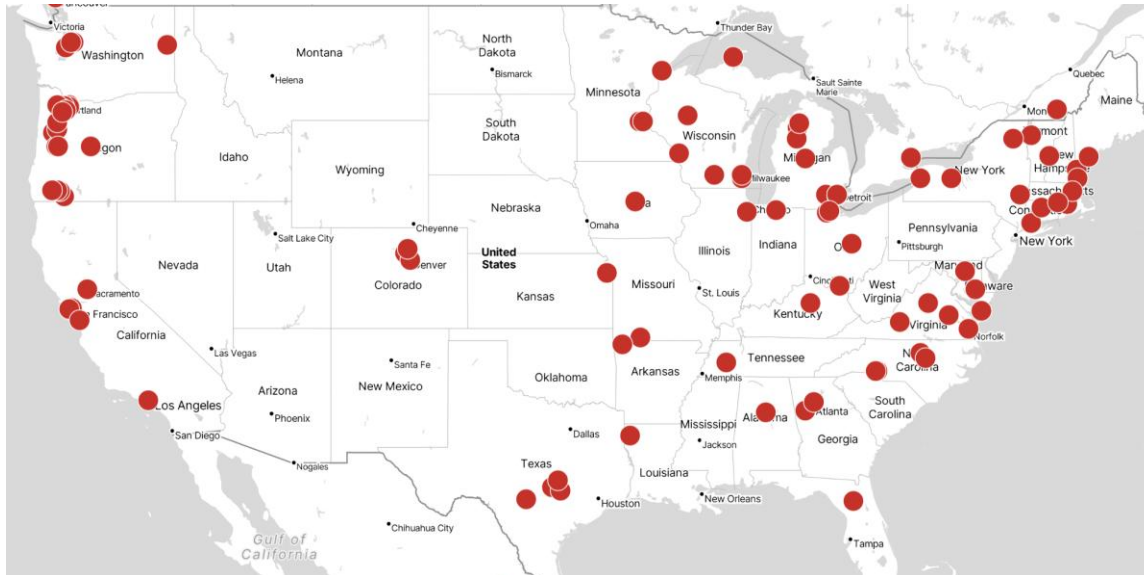
In most U.S. cities, developers are required to provide a specific number of parking spaces based on the size of commercial areas or the number of residential units. These parking minimums originated in the 1920s and became common practice during the 1950s as car ownership increased. However, mandating parking can distort the market, resulting in an excess of parking spaces (Shoup 2011). For instance, 29 percent of land in downtown Salt Lake City is taken up by parking (Fox 2023). This oversupply uses up valuable land, encourages urban sprawl, and increases reliance on cars (Grabar 2024). As such, removing parking mandates can provide economic benefits by allowing the land to be put to a more productive purpose, and environmental benefits by reducing reliance on cars.

2.3.3.1 Prevalence

A growing number of communities in the United States (including 51 in New York) have removed at least some parking minimums, typically in the commercial core; 103 nationally (four in New York) have removed all parking minimums (Figure 6) (Parking Reform Network n.d.). In 2017, Buffalo was one of the earliest U.S. cities to do so. The others in New York are Canandaigua, Saranac Lake, and Hudson (Parking Reform Network n.d.). Notably, three out of four of these cities have fewer than 15,000 residents, indicating this may be a promising strategy for smaller communities to facilitate more walkable towns. Removing parking minimums allows for greater flexibility with land development and with responding to changing market conditions.

Figure 6. Cities with All Parking Minimums Removed

Source: Parking Reform Network (Parking Reform Network n.d.).



According to the National Zoning Atlas, 88 percent of land zoned for residential use in NYS has a minimum parking requirement (Bronin, Markley and Derickson 2025). However, on top of state, county, or municipal parking requirements, property developers, investors, and lenders may dictate parking availability in development deals; this may result in private parking requirements that exceed regulatory minimums or re-imposed minimums via their own private negotiation processes in areas that have done away with regulatory minimums (Urban Land Institute, Center for Sustainability and Economic Performance 2019) (Berg 2025).

2.3.3.2 Impacts

Economic: Removing parking mandates has positive economic impacts by lowering construction costs from building parking, allowing more land to be put to other uses and enabling more walkable, attractive areas (Yanocha 2023) (Badger, Why Does This Building by the Subway Need 193 Parking Spots? (Yes, Exactly 193.) 2024). One study estimated that parking increases apartment rents by \$225 per month per spot and demonstrated how parking requirements reduce available space for housing (Figure 7) (Goodman 2015).

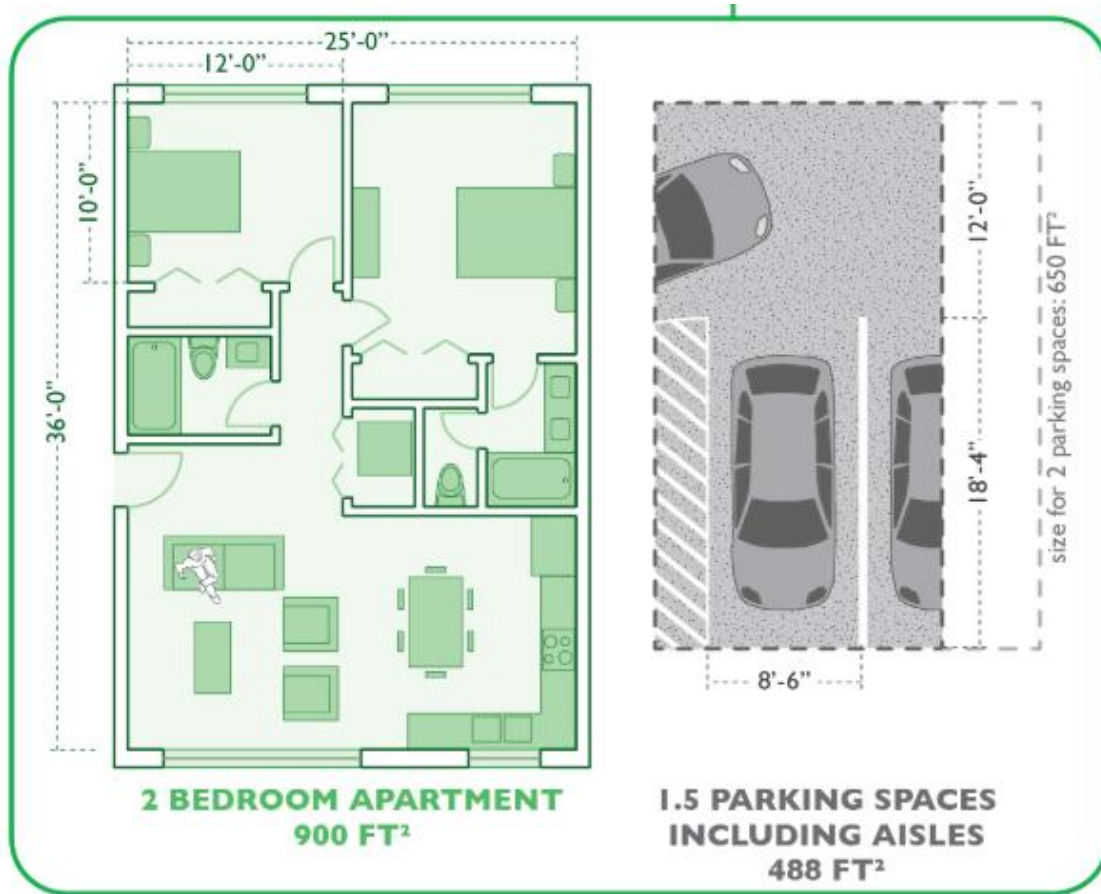
Buffalo became one of the first U.S. cities to eliminate minimum parking requirements city-wide. With this new flexibility, developers renovated dilapidated historic buildings into housing and retail, which would have been prohibitively expensive if they had needed to retrofit with parking. Developers were also able to replace a former gas station with 32 new affordable homes and

transform an empty parking lot into a traditional main street with ground floor commercial space and 70 new homes (Gould 2023) (Bipartisan Policy Center 2013).

Figure 7. Average Parking Space Required per Apartment compared to Living Space

The average parking minimum in Oregon and Washington State is 1.5 parking spaces per apartment. Figure 7 compares required parking space to living space, showing that eliminating parking mandates would free up valuable space that could be used for housing.

Source: Sightline Institute (Sightline Institute 2013). Used with permission.



Environmental: Removing parking mandates can free up land for other purposes, including vegetation that can absorb stormwater runoff and offer habitat and aesthetic benefits. For instance, many cities, including Albany, Buffalo and Ithaca, use small strips of land along streets or parking areas as rain gardens to capture stormwater (Rain Check: Clean Water for Buffalo n.d.) (County n.d.). Municipalities can also incentivize developers to install rain gardens on developments sites (U.S. Environmental Protection Agency 2012). Less space devoted to parking allows more space for these other uses. A typical rain garden ranges from 100 to 1,500 square feet (University of Maryland n.d.), in other words, from the size of a quarter of a parking spot to the size of ten parking spots.

In terms of emissions benefits, a study found that providing fewer parking spaces for housing developments can reduce GHG emissions from resident vehicles by up to 14 percent by providing a disincentive to drive (CAPCOA 2021) (U.S. Department of Transportation 2025).

2.3.3.3 Key Takeaways

Allowing developers and the market to determine the right number of parking spaces to build rather than setting mandatory minimums allows for right-sizing parking rather than over-providing. Cities that have removed parking minimums have seen developers build fewer parking spaces and have reaped economic and environmental benefits.

2.4 Market-Based Pricing Policies

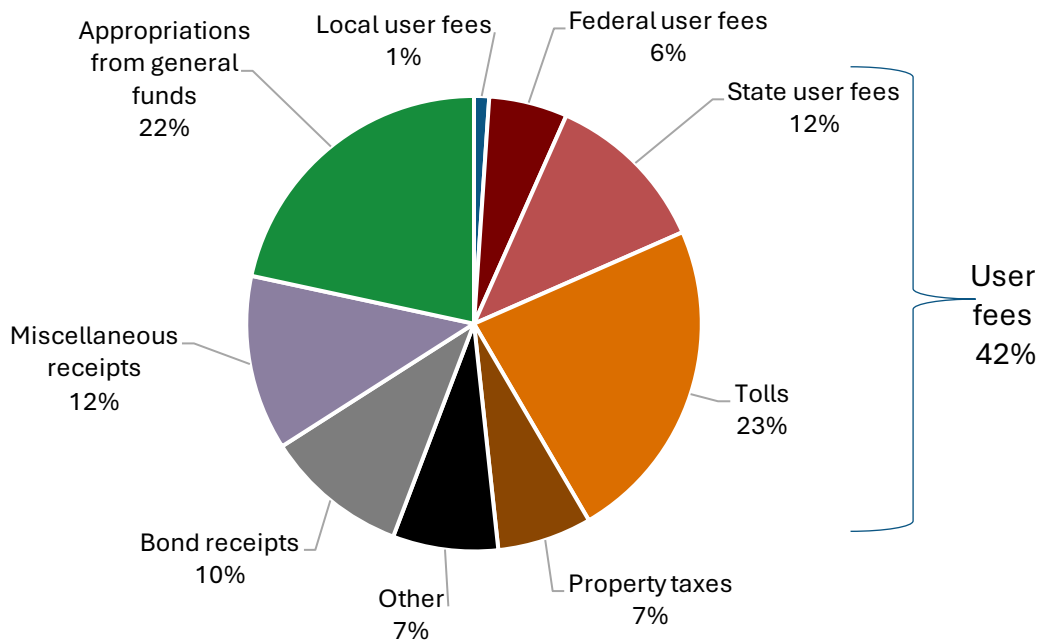
Market-based pricing policies encourage more efficient use of the existing transportation network rather than expanding it. Pricing roadways and parking based on how much the market is willing to pay makes transportation more efficient, bringing both economic and environmental benefits.

Pricing shifts who pays for what benefits, meaning some individuals will pay less and others will pay more. While most roadways are “free” to use, they are not actually free, in that someone pays for them. In NYS, 42 percent of highway revenue comes from road user fees (i.e. gas taxes, tolls), while the majority (58 percent) is from general appropriations and other revenue sources that impact New Yorkers whether they drive or not (Figure 8). As such, there is logic in shifting the cost of the roadway to those who use the roadway through pricing. In addition, someone’s use of the roadway imposes costs on others by increasing congestion and emitting air pollution. Pricing can help internalize these costs.

Nonetheless, road pricing and other market-based pricing policies increase costs for those who use the road, and as a percentage of income will impact lower income drivers more. Providing viable alternatives to driving is critical to mitigate impacts on low-income drivers who are priced out of using the roadway. Many congestion pricing programs use revenues to pay for public transportation as an alternative to driving, which may make lower income populations better off by providing low-cost mobility.

Figure 8. Sources of Funds Used for Highways in New York State

Source: Federal Highway Administration (Federal Highway Administration 2025).



2.4.1 Congestion Pricing

Congestion pricing helps reduce traffic by charging vehicles to use certain highways. Like other services, drivers pay a fee for access, prompting them to weigh whether the trip is worth the cost. As a result, some choose alternatives—carpooling, public transportation, traveling at off-peak times, or skipping the trip altogether. This shift reduces congestion and ensures faster travel for those willing to pay for higher-value trips. Congestion pricing revenue can be reinvested in ways that benefit travelers and businesses that may be negatively impacted. For instance, congestion pricing revenue in New York City and Northern Virginia is reinvested into public transportation, providing more travel alternatives.

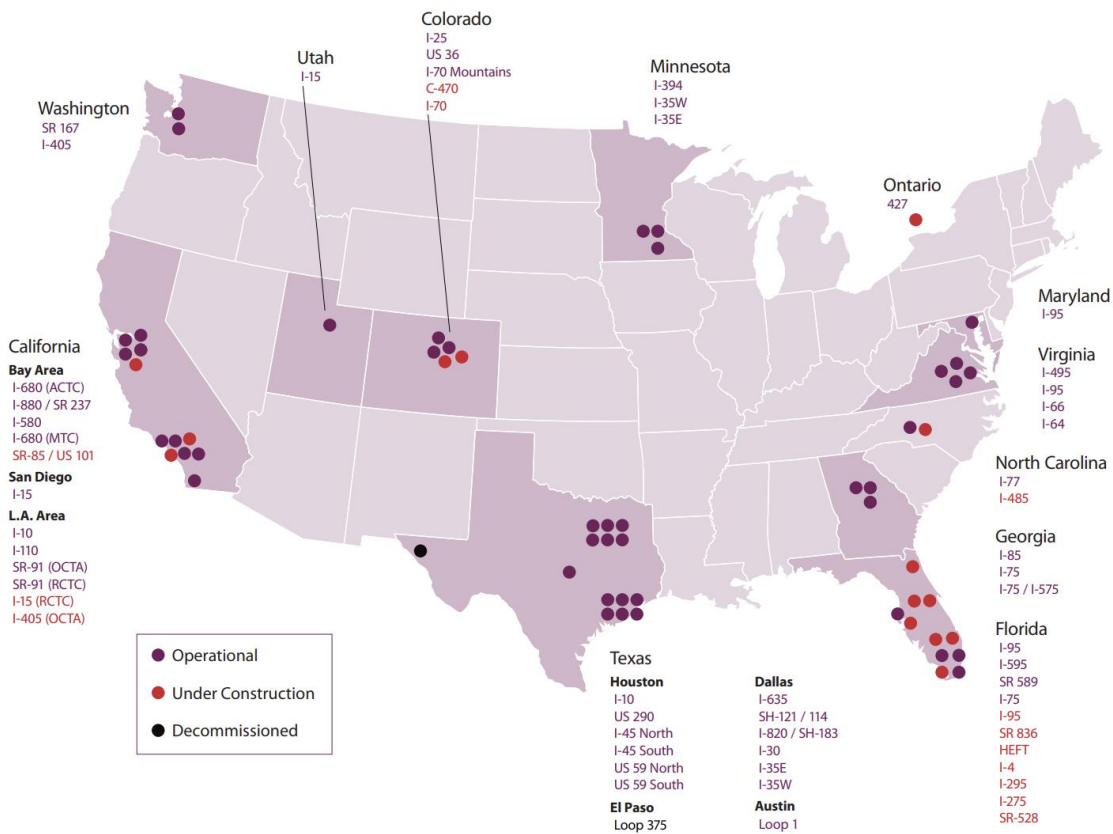
There are two main types of congestion pricing: price-managed lanes, and cordon pricing. With price-managed lanes, tolls vary based on real-time traffic conditions. By adjusting prices to maintain free-flow speeds, these systems keep highways moving efficiently even during peak demand. Cordon pricing, on the other hand, charges vehicles a fee to enter a designated zone.

2.4.1.1 Prevalence

Several states use price-managed lanes (Figure 9). Most of these lanes are either new capacity or conversions of High Occupancy Vehicle (HOV) lanes to High Occupancy Toll (HOT) lanes.²⁰ Very few are conversions of existing un-priced lanes to priced lanes.

Figure 9. Price-Managed Lanes

Source: FHWA (Federal Highway Administration 2019). Data is as of June 2019.



As for cordon pricing, cities like Singapore, Stockholm, and London have successfully used this approach for years to reduce congestion, improve travel times, fund public transportation, and cut pollution. Interestingly, public support was low before implementation but rose significantly afterwards as residents and businesses experienced the benefits firsthand (Tri-State Transportation Campaign n.d.). In January 2025, New York City became the first U.S. city to launch cordon pricing. A February 2025 poll found that six in ten voters in NYS were in favor of congestion pricing continuing, with support higher in New York City and lower outside the city (Reid n.d.). Other U.S. cities are considering implementing congestion pricing, including Boston, Chicago, Los Angeles, and San Francisco (Zukowski, 5 cities with congestion pricing 2025).

2.4.1.2 Impacts

Interstate 66 (I-66) congestion pricing in northern Virginia displays the benefits of price-managed lanes. The Northern Virginia Transportation Commission estimated that since 2017, congestion pricing on Interstate 66 and investing \$178 million from the revenues into public transportation has resulted in multiple benefits, discussed below.

New York City's cordon pricing has so far demonstrated the economic, environmental, and safety benefits that the state was aiming for in implementing it. Under this program, passenger vehicles pay \$9 during peak hours and \$2.25 overnight to enter Manhattan's central business district (CBD), with higher rates for larger trucks. Taxis and for-hire vehicles are charged \$0.75 or \$1.50 per trip within, to, or through the district—costs passed on to customers (MTA 2025). Drivers pay via E-ZPass or receive a toll bill by mail.²¹ Revenue from the program is dedicated to improving public transportation.

Economic: Economic benefits from Northern Virginia's congestion pricing include:

- \$25.9 million in fuel cost savings for commuters,
- \$67.7 million in regional economic benefit from reduced travel delay, and
- 1.9 million hours of travel time savings (Northern Virginia Transportation Commission n.d.).

Before pricing, traffic delays cost the New York City economy \$20 billion annually (Partnership for New York City 2006). Analyses from MTA Bridges & Tunnels and New York City DOT into New York City's cordon pricing program shows:

- Vehicle speeds across bridges and through tunnels improved 23 percent in the mornings year-over-year between January 2025 (the start of the program) and October 2025 (latest available data), benefiting commuters and deliveries;
- Average vehicle speeds in the congestion relief zone rose 4.6 during the same time period;
- Pedestrian activity in the area rose 8.4 percent; and
- Retail sales, hotel occupancy, office leasing, and jobs have all increased in the zone even while VMT in the zone fell 7.1 percent (MTA Bridges & Tunnels 2026) (New York State 2025).

Economic benefits of congestion pricing are not limited to these two examples. Economic modeling of cordon pricing found increases in welfare of residents as well as GDP growth

(Safirova 2006). An Federal Highway Administration (FHWA) study of congestion pricing found that it generates positive benefit cost ratios (BCR) and no significant negative economic impacts (Federal Highway Administration 2008). For instance, London’s congestion pricing had an estimated BCR of 1.4. Businesses within the London charging zone outperformed those outside and most of them support continued congestion pricing (Federal Highway Administration 2008). Research findings suggest that impacts on low-income households can be negligible or positive if revenues are used to increase alternative travel options such as public transportation (Federal Highway Administration 2008). Notably, both Northern Virginia and New York City reinvest revenue from congestion pricing into public transportation. Under New York City’s congestion pricing, bus ridership increased 12 percent, subway ridership seven percent, and bus speeds climbed—some routes by as much as 25 percent faster than in 2024, reversing a longstanding decline in bus speeds (New York State 2025).

Environmental: A study of sixteen congestion pricing systems in eleven cities found they can reduce GHG emissions at low cost and that they can achieve broad acceptability with thoughtful design (Veitch 2024). Congestion pricing in London decreased carbon dioxide emissions by 10 to 14 percent with the cordon (Federal Highway Administration 2008). After New York City’s congestion pricing program was implemented, GHG emissions in the congestion relief zone fell 6.1 percent and 311 complaints about honking and noise fell 45 percent (MTA Bridges & Tunnels 2026) (Cook, et al. 2026) (New York State 2025). In Northern Virginia, expanded public transportation in the I-66 corridor avoided 197 million VMT since 2017 and has 75 percent lower GHG emissions per passenger mile compared to single occupancy vehicle trips (Northern Virginia Transportation Commission n.d.).

Safety: In New York City, after congestion pricing started, crashes dropped 14 percent. The Northern Virginia Transportation Commission estimates that its congestion pricing so far has avoided 293 automobile crashes (Northern Virginia Transportation Commission n.d.).

2.4.1.3 Key Takeaways

Congestion pricing and parking pricing make travel faster and easier for high value trips while encouraging use of more efficient modes of transportation. They can also raise revenue for public transportation, expanding options for travelers of all incomes.

2.4.2 Parking Pricing

Parking pricing aligns the cost of parking with demand, encouraging drivers to shift to other modes when alternatives exist (Initiative for Climate Action Transparency 2020). It also ensures

reliable parking availability, reduces cruising for parking, and cuts traffic and emissions (U.S. Department of Transportation, Climate Change Center 2024) (Initiative for Climate Action Transparency 2020). Smart parking technologies like sensors, real-time displays, and public-facing price maps further improve efficiency by guiding drivers to open spaces.

2.4.2.1 Prevalence

Parking pricing in the United States is highly localized, with paid parking primarily concentrated in dense city centers, while free parking remains dominant elsewhere. Some cities are implementing demand-responsive parking pricing, including San Francisco and Columbus, Ohio. Several also pair pricing with the removal of parking mandates to enable more productive land use (U.S. Department of Transportation, Climate Change Center 2024). In New York, Ithaca's 2026 rate reforms increased downtown garage and street prices to boost turnover and support walking, biking, and public transportation (City of Ithaca n.d.) (Fingerlakes1.com 2025) (Salzone 2026). In Canandaigua, NY, a 2023 parking study provides the occupancy and user data necessary to design a demand-responsive pricing system (Bergmann 2023).

2.4.2.2 Impacts

Economic: Parking pricing provides significant economic benefits by optimizing urban space usage, generating municipal revenue, and reducing congestion-related costs. Key benefits include increased turnover for businesses, funding for infrastructure (e.g., public transportation and sidewalks), reduced cruising for parking which reduces emissions and wasted time, and correcting market-distorting subsidies for car travel.

San Francisco was the first U.S. city to adopt demand-responsive pricing across all 28,000 of its parking meters after a successful pilot. The pilot, which ran from 2011 to 2013, showed clear benefits: sales tax revenues grew 35 percent in pilot areas compared to less than 20 percent elsewhere (Jose 2017). A pilot in a downtown neighborhood of Washington, D.C. with 1,000 parking spaces implemented demand-based pricing bands that ranged from \$1 per hour to \$5.50 per hour (District Department of Transportation 2019). The pilot achieved user experience goals such as decreasing time to find a parking spot and decreasing congestion while commercial sales did not deviate from citywide trends, suggesting that the pilot did not adversely affect commercial sales in the area.

Pricing revenues can fund program administration, transit improvements, or local streetscape upgrades, as shown in Columbus, which reinvests parking proceeds into district improvements (U.S. Department of Transportation 2025) (NACTO 2019). However, technology-enabled systems

require upfront investment in meters and sensors, costing several hundred dollars each to purchase, install, and maintain (U.S. Department of Transportation 2020) (U.S. Department of Transportation 2020).

Environmental and Safety: Parking pricing reduces cruising and unnecessary driving, directly lowering emissions in high-demand, economically active areas (U.S. Department of Transportation 2024). San Francisco’s pilot demonstrated the environmental value of demand-responsive pricing, reducing cruising by 43 percent and VMT by 30 percent, with corresponding reductions in emissions (City of Ithaca n.d.). Fewer circulating vehicles also improve road safety for pedestrians and cyclists by reducing traffic conflicts (Sha 2024).

Equity: By allocating costs to drivers using parking spaces, pricing avoids shifting expenses to residents who do not drive (Litman, *The Mobility Productivity Paradox* 2025) (U.S. Department of Transportation 2024). Proportionally, a greater fraction of vehicle-less households are low-income; the National Equity Atlas notes that about a fifth of households below 200 percent of the federal poverty line do not have access to a vehicle, compared to five percent of higher-income households, according to data from 2022 (National Equity Atlas 2022).

However, parking pricing can represent a daily cost, which on a percentage of income basis is a greater cost for low- and moderate-income households. This is particularly a problem for households that lack access to reliable public transportation and are unable to adapt their commutes in response to pricing, particularly those in affordable housing concentrated farther from urban centers (Jenkins, et al. 2020) (Mengedoth 2023).

Revenues can be reinvested to support equitable mobility, including subsidized transit passes, improved first- and last-mile options, or streetscape upgrades in underserved areas (U.S. Department of Transportation 2024). Columbus’s reinvestment model demonstrates how pricing can deliver localized benefits while still ensuring curb access (NACTO 2019) (short north arts district n.d.). Flexible permits, tiered rates, and discounted transportation options—approaches used in Columbus—help maintain affordability while still managing demand effectively (The City of Columbus n.d.).

2.4.2.3 Key Takeaways

Parking pricing is a proven, data-driven strategy that reduces congestion, emissions, and cruising while improving access to high-demand destinations (U.S. Department of Transportation, Climate Change Center 2024) (Initiative for Climate Action Transparency 2020).

Cities such as San Francisco, Columbus, and Ithaca show that frequent, incremental price adjustments can improve car turnover, support local businesses, and encourage the use of sustainable transportation (Jose 2017) (NACTO 2019) (City of Ithaca n.d.). When paired with clear goals, robust data, transparent communication, and strategic reinvestment, parking pricing can create economic, environmental, and equity benefits simultaneously (U.S. Department of Transportation, Climate Change Center 2024) (U.S. Department of Transportation 2025) (U.S. Department of Transportation 2024) (Sha 2024).

2.5 Combining Mobility Strategies Amplifies Benefits

Combining multiple transportation strategies creates communities where people can choose the travel mode that best fits their needs. In auto-oriented areas—where public transportation is limited, sidewalks and bike lanes are missing, and homes, jobs, and services are far apart—driving becomes the only practical option for nearly every trip.

By contrast, communities that invest in a range of transportation choices enable people to walk or bike for short trips, use public transportation for longer ones, and connect more easily between modes. Walkability and shared bikes and scooters help bridge the “first mile/last mile” gap by enabling convenient access to public transportation stations. Parking reform frees up land previously devoted to parking, enabling denser, more walkable, and more affordable development that can be better served by public transportation. Pricing strategies—such as congestion or parking fees—encourage travelers to consider alternative modes, while improving roadway performance for those who do drive. Overall, when households have more viable travel options, they can own fewer cars or none at all, significantly reducing transportation costs.

Furthermore, the strategies working together can create walkable, vibrant, and attractive communities, spurring increased visitation and foot traffic. The result is increased patronage to local stores, restaurants, and other businesses. In fact, studies from multiple sources show how compact development, walkability, and providing a range of transportation options combine to benefit businesses, real estate developers, and local governments through increased productivity and innovation, improved ability to compete for labor, and stronger retail sales (Winkelman 2011) (California Air Pollution Control Officers Association 2021) (Litman, The Mobility Productivity Paradox 2025) (U.S. Environmental Protection Agency 2013) (U.S. Environmental Protection Agency n.d.).

Combining mobility efficiency strategies amplifies their emissions reduction benefits. Modeling by the Institute for Transportation and Development Policy and the University of California, Davis

shows that combining compact, mixed-use development with major investments in transit, walking, and biking can support a major shift away from driving alone. When combined with rapid vehicle electrification, this approach comes close to meeting ambitious climate goals: a 50 percent reduction in greenhouse gas emissions by 2030 and net-zero emissions by 2050 in the United States. No single strategy can achieve these outcomes on its own; success depends on implementing them together (Fulton 2024).

In sum, while implementing individual mobility efficiency strategies yields economic and environmental benefits, implementing a suite of strategies together magnifies the impact of each. In other words, the whole is greater than the sum of its parts.

3. Analytical Tools for Mobility Efficiency

Analytical tools that estimate the economic and environmental impacts of mobility efficiency strategies can help transportation agencies make decisions about investments based on their community's goals. There are multiple tools developed by government agencies and non-profits for estimating air quality and GHG impacts of mobility efficiency strategies. In contrast, we were unable to find analytical tools for estimating impacts of multiple mobility efficiency strategies on local businesses, taxes revenue, wages, employment, and similar indicators. There are, however, tools that calculate how much money a person would save in fuel and maintenance costs from using mobility efficiency strategies, a tool to calculate economic benefits of public transportation, and economic models for analyzing large transportation projects that are not well suited to the neighborhood scale at which most mobility efficiency strategies are implemented. We provide more information on available tools below. Few tools accurately estimate economic and environmental benefits of mobility efficiency strategies at the project level, where most decisions happen. Pedestrian facility usage data is also scarce.

3.1 Economic Impact Analysis Tools

The ecosystem of economic impact analysis tools includes a handful of tools that calculate economic benefits of specific mobility efficiency strategies and a couple of general transportation economic impact analysis tools that are not well suited to estimating economic impacts of mobility efficiency strategies.

3.1.1 APTA Economic Impact Tool

The American Public Transportation Association (APTA) developed this tool to enable public transportation agencies to calculate the economic impact of their transit services using agency budget data. The tool calculates jobs, wages, sales, and value-added supported by agency operations and capital expenditures. It includes both direct and indirect economic effects (American Public Transportation Association n.d.). It does not calculate benefits at the project scale.

3.1.2 RMI's E-Bike Environment and Economics Impact Assessment Calculator

This spreadsheet-based tool from the Rocky Mountain Institute (RMI) calculates how much money a person would save in fuel and maintenance costs from using an e-bike rather than a car. It does not calculate economic impact on local businesses. It also allows users to calculate

reductions of VMT, gasoline, and emissions from e-bike incentive programs and from meeting city-wide goals for e-bike deployment (RMI 2025).

3.1.3 General Transportation Economic Impact Analysis Tools

TREDIS (Transportation Economic Development Impact System) and TranSight are two widely used tools that analyze economic impacts of transportation projects and plans on the economy (REMI n.d.) (TREDIS n.d.). These tools are maintained by private sector companies and are used by numerous state and local transportation agencies. For instance, California DOT used TREDIS to analyze the impact of their long-range transportation plan on jobs, income, gross state product, and freight flows. Maryland used TREDIS to analyze the impact of the building the Purple Line, a new light rail line. It found that the Purple Line will reduce the number of vehicle trips in the two counties served by the line by 12.1 million trips per year and that construction and operation of the line will create 2,620 net new jobs (National Center for Smart Growth 2017).

However, TREDIS and TranSight are not well suited for analysis at the sub county scale (National Center for Smart Growth 2017), which is the scale at which most mobility efficiency strategies are implemented. As such, there is a lack of tools available to estimate economic impacts of mobility efficiency strategies in any consistent manner.

3.2 Air Quality, GHG, and Health Impact Analysis Tools and Workflows

There are several tools and methods available for calculating the impact of mobility efficiency strategies on air quality pollutants and GHG emissions. They vary in terms of typical use cases and differing levels of time and technical capacity required to use them.

3.2.1 Feeding Travel Demand Model Outputs into MOVES

Combining output from travel demand models with emissions factors in the Environmental Protection Agency's (EPA) MOVES tool is one of the most common ways to estimate the impact of various strategies on transportation emissions (Federal Highway Administration 2013). Notably, that is only one of the many uses of travel demand models, which transportation agencies use widely for planning purposes.

Metropolitan planning organizations (MPOs) generally run travel demand models to forecast traffic on their region's roadways under various scenarios of population growth, economic development, road expansion, and other transportation policies. MPOs then use the model

results for decision-making on transportation investments. MPOs in areas that do not meet, or only recently met, EPA standards for air quality pollutants, must pair the VMT and travel speed output from their travel demand models with emissions factors in the EPA MOVES model to estimate air quality impacts of transportation investment scenarios (Environmental Protection Agency n.d.).

MOVES estimates nitrogen oxides (NO_x), particulate matter (PM), carbon dioxide (CO₂), volatile organic compounds (VOCs), GHGs, and air toxics (Environmental Protection Agency n.d.). While GHGs are not among the emissions that EPA requires MPOs to calculate, many do so anyway as it does not require additional effort if already using MOVES. The fact that this approach is already in use in many metropolitan areas for other purposes is one of the main advantages of this approach to estimating GHG impacts.

Unfortunately, traditional travel demand models do not capture well the impacts of mobility efficiency strategies (Federal Highway Administration 2013). Newer, activity-based models do a better job, but are not in widespread use. Some state DOTs have statewide transportation demand models, but most do not. Travel demand models generally require extensive compute time and are expensive to purchase, calibrate, and maintain.

Fewer than half of MPOs and DOTs nationwide model walking and biking trip demand (The RAND Corporation 2019). For a list of recent advances in this modeling, see NCHRP's *Evaluation of Walk and Bicycle Demand Modeling Practice* (The RAND Corporation 2019). Modeling on the benefits and demand for bicycling and bicycle facilities is available in *Guidelines for Analysis of Investments in Bicycle Facilities* (Krizek, et al. 2006).

3.2.2 EPA CO₂-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA)

This EPA tool helps state and local governments estimate how reductions in PM, sulfur dioxide (SO₂), NO_x, and VOCs and can benefit human health. It estimates the economic value of health benefits, including savings from reduced medical costs and lower mortality (U.S. Environmental Protection Agency n.d.). COBRA is a reduced-form screening model that approximates parts of the process by which air pollution impacts human health. It is generally used for prospective screening or analyses where regulatory-grade modeling is not required. Regulatory-quality analysis typically requires a more resource-intensive set of tools. COBRA is a lower-burden alternative when a screening-level approach is appropriate, as may be the case for small-scale mobility efficiency strategies.

3.2.3 Congestion Mitigation and Air Quality (CMAQ) Toolkit

FHWA maintains the CMAQ Toolkit to aid states, MPOs, and local governments in required reporting of emissions reductions from projects funded under the CMAQ program (Federal Highway Administration n.d.). This tool is a reduced-form, screening-level framework designed for low technical requirements and quick turnaround. While GHGs are not targeted under the CMAQ program, the toolkit provides GHG emission reduction benefits in addition to estimates of the required emissions. The CMAQ Toolkit is a spreadsheet-based tool developed by the U.S. DOT Volpe Center. It can calculate emissions impacts from eighteen CMAQ eligible project types, including bicycle, pedestrian and shared micromobility; traffic flow improvements; and transit bus service expansion. A major limitation is that for strategies that reduce GHG by reducing VMT, like most mobility efficiency strategies, the user must enter their own estimate of VMT reduction. As such, the user would either need to use a travel demand model or review the literature for expected VMT reductions from the strategy.

3.2.4 Transportation Evaluation and Carbon Reduction Tool (TEA-CART)

Georgetown Climate Center and Cambridge Systematics developed TEA-CART to help DOTs and MPOs analyze the impact of various transportation investments on GHG emissions. Users input information about the transportation projects under consideration (e.g., 20 miles of separated bike lanes, number of transit buses to be electrified, or lane miles of new expanded highway). The online tool then calculates GHG impact, relying on GHG impacts that are typical for projects of a given type based on the literature. The tool also outputs NO_x , $\text{PM}_{2.5}$, VMT, and daily active trips (Georgetown Climate Center 2025). This tool requires a low-level effort, like the CMAQ tool, and unlike the travel demand model plus MOVES method.

3.2.5 VisionEval

VisionEval falls in between the resource intensive methods and the lower effort CMAQ Tool and TEA-CART options. It also does a better job of modeling mobility efficiency strategies than traditional travel demand models. VisionEval is an open-source scenario planning tool that uses simplified models to run rapidly (VisionEval Pooled Fund n.d.). It requires some sophistication to use, including the ability to program in R. It estimates VMT, energy use, and emissions. It is able to analyze impacts of changes in land use policies as well as the impacts of expanded roadway networks, public transportation service, and bicycle and pedestrian infrastructure. It has separate modules for state and metropolitan region analyses. Oregon DOT pioneered the design and use

of the tool in partnership with FHWA. Washington DOT, Maryland DOT, Philadelphia, Raleigh, and Atlanta have also used the tool (Oregon Department of Transportation 2016).

3.2.6 Shared Mobility Benefits Calculator

The Shared-Use Mobility Center, a non-profit organization, developed a tool that calculates the GHG emissions benefits of increased use of shared mobility options, including bikeshare, scooters, carshare, telecommuting, transit use, carpools, and vanpools (Shared-Use Mobility Center n.d.). The web-based tool allows users to select the level of emission reduction desired for a particular city, and the web-based tool returns the number of shared bikes, scooters, and cars and degree of transportation electrification that would be required to meet the goal. It also returns the reduction in CO₂ and VMT resulting from the scenario.

3.2.7 Other Tools

There are tools focused on calculating full life cycle emissions, including extracting and transporting fuel, generating electricity used, constructing and maintaining roads, and manufacturing and operating vehicles. The FHWA Infrastructure Carbon Estimator is one such tool (Gallivan 2014). The FTA Transit GHG Emissions Estimator calculates life cycle emissions from construction, operation, and maintenance of rail, bus, and other transit projects (Filloso 2024).

The National Laboratory of the Rockies (NLR) combines transportation, energy, and geospatial models (TEMPO, POLARIS) to analyze energy and emissions impacts of mobility efficiency strategies at local levels and scales up to the national level (National Renewable Energy Laboratory 2025). The Mobility Energy Productivity (MEP) tool, also developed by NLR, is a metric that scores the transportation system in a given area based on its ability to connect individuals to goods, services, and employment with efficient use of time, cost, and energy (MEP: Mobility Energy Productivity Tool n.d.). MEP does not estimate the environmental or economic impacts of transportation projects.

For a comprehensive listing of GHG analysis tools, see the Transportation Research Board's 2022 report, *Reducing Greenhouse Gas Emissions: A Guide for State DOTs* (Transportation Research Board 2022).

4. Knowledge Gaps & Research Opportunities

Atlas analysis of the current literature on the economic and environmental impacts of mobility efficiency strategies reveals four major knowledge gaps and their corresponding research opportunities.

4.1.1 Evidence on Magnitude

A major research gap is a lack of estimates of the level of impacts of mobility efficiency strategies on local business sales and other economic indicators, beyond just positive or neutral impact. The impact of mobility efficiency strategies is highly context dependent and relies on multiple variables. These variables include ease of accessing the commercial corridor from other neighborhoods, population in the immediate area and broader area, income level of the population, accessibility of other commercial areas, and travel options available in the vicinity. As such, the level impact varies depending on these variables, but there is a lack of information on which variables are most critical and the degree to which they impact the outcome. For instance, the impacts of better transit and walking access to a business district would reasonably increase foot traffic, which would then likely increase sales. But by how much foot traffic would increase and what order of magnitude is the impact on sales?

Research opportunity: Field research on the magnitude of economic impact of a variety of mobility efficiency strategies in varying contexts, especially using before and after analysis and comparison to control corridors would be helpful.

4.1.2 Transferability Across Contexts

Having additional field research in the contexts in question would be valuable. For NYS in particular, there has been field research on various strategies in New York City, but less research in all other metropolitan areas. Field research on different neighborhood types, population densities, income levels, travel networks and other factors would help build the knowledge base and assist in estimating impacts of strategies in similar areas.

Research opportunity: For New York, field research on parts of the New York-Newark-Jersey City metropolitan area outside of the central New York City boroughs, and field research on other metropolitan areas in the state would be particularly useful.

4.1.3 Impacts by Business Type

Businesses with greater dependencies on customers that rely on vehicle access may experience more significant impacts. This is similarly the case for businesses that rely heavily on curb space for deliveries. In addition, prolonged construction can disrupt both vehicle traffic and foot traffic to local businesses. Some mobility efficiency strategies do not require lengthy construction timelines (e.g., bike lanes) while others, such as light rail construction and major intersection redesigns, do. Little research exists on these topics.

Research opportunity: Research on impacts on a broader range of businesses, especially those relying heavily on vehicle access for customers and/or deliveries would be useful as would research on policies to support businesses during construction.

4.1.4 Lack of Economic Tools for Mobility Efficiency Strategies

As discussed in the Economic Impact Analysis section, while there are several tools available for estimating the emissions impacts of mobility efficiency strategies, there is a lack of tools for estimating their economic impacts, such as impacts on local business sales, tax revenues, and employment.

Research opportunity: Developing an easy-to-use tool that estimates economic impacts of mobility efficiency strategies in a variety of contexts would be helpful.

5. Conclusion

With the nation's highway system largely developed, emerging transportation research indicates that future improvements in system performance will depend on increasing the efficiency of moving people rather than vehicles alone. Studies show that implementing mobility efficiency strategies can support outcomes such as reduced emissions, improved safety, enhanced equity, and strengthened local economies, helping New York and other states address both current and long-term transportation demands.

While there is extensive research supporting the benefits of mobility efficiency strategies, Atlas recommends further research to fill remaining knowledge gaps: 1) additional field research on the magnitude of economic impact of a variety of mobility efficiency strategies in varying contexts and metropolitan areas; 2) research on economic impacts on a broader range of businesses, especially those relying heavily on vehicle access for customers and/or deliveries; 3) research on policies to support businesses disrupted by construction of transportation infrastructure; and 4) the development of a tool to estimate economic impacts of mobility efficiency strategies in a variety of contexts.

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Appendix A. GDP and VMT Analysis of New York Metropolitan Areas

Figure A-1. Percent Change in GDP and VMT per Capita

GDP: Gross Domestic Product; VMT: Vehicle Miles Traveled

Source: Atlas analysis of data from Federal Highway Administration (Federal Highway Administration n.d.), U.S. Census Bureau (U.S. Census Bureau n.d.) (U.S. Census Bureau n.d.), and U.S. Bureau of Economic Analysis (U.S. Bureau of Economic Analysis n.d.).

Between 2012 and 2023, VMT decreased and GDP increased in four of the Empire State’s metropolitan areas: New York-Newark-Jersey City, Albany-Schenectady-Troy, Syracuse, and Glens Falls.

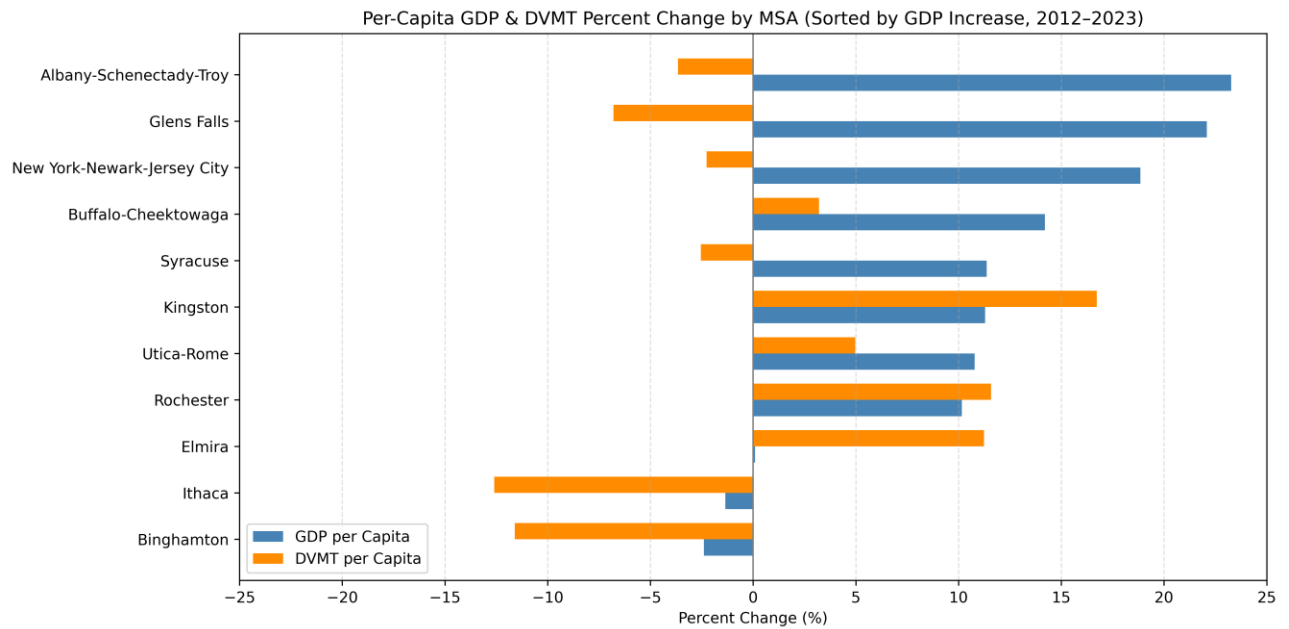
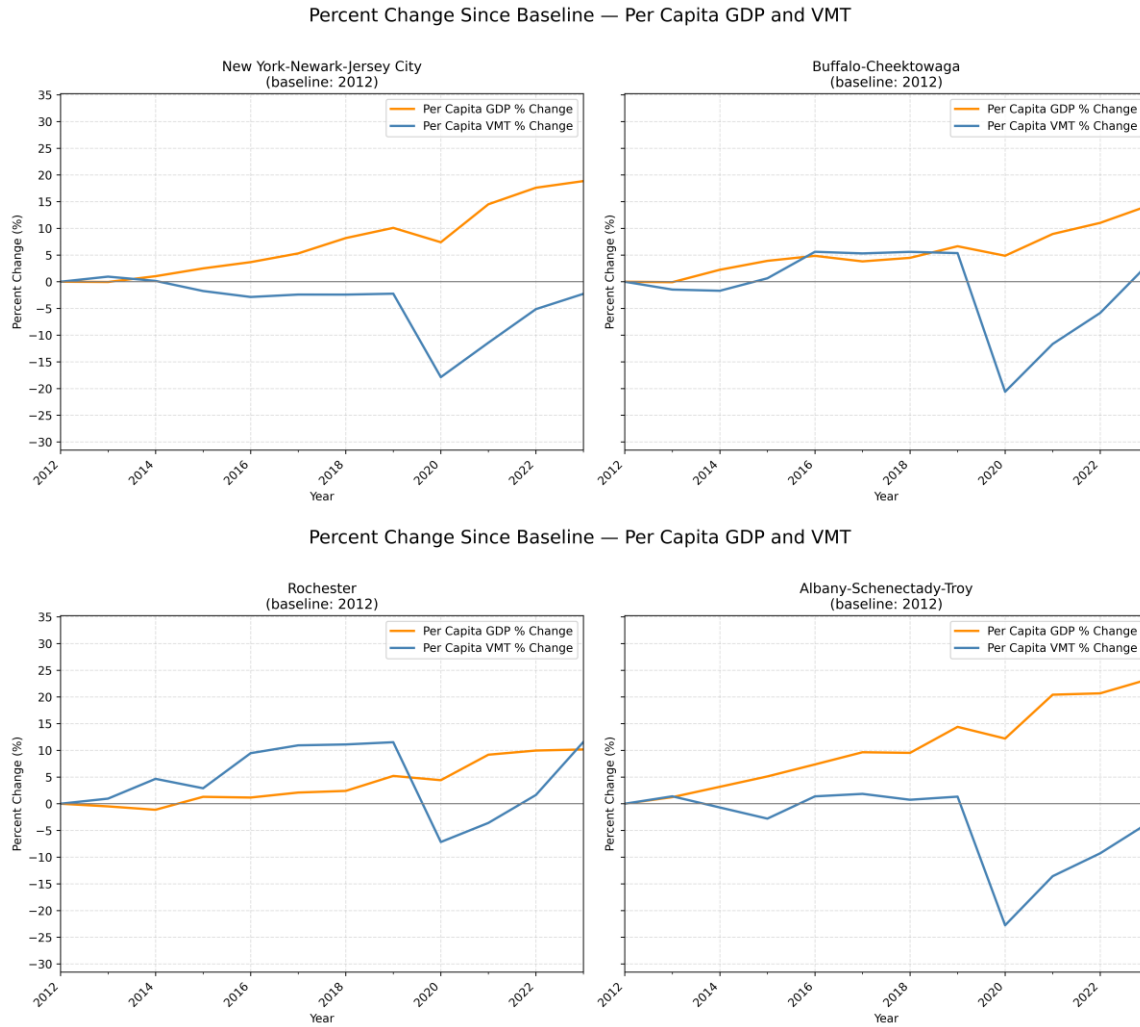


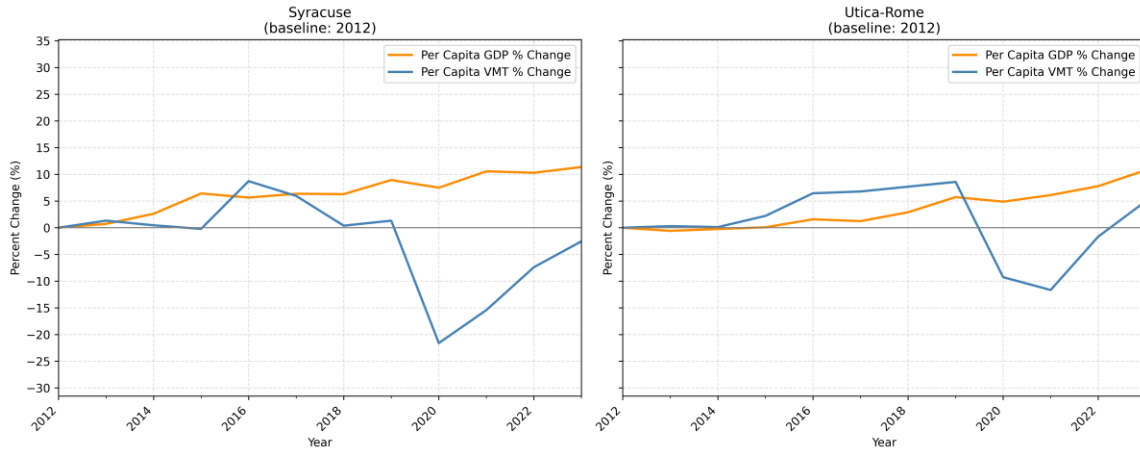
Figure A-2. Percent Change in Per Capita GDP and VMT, 2012-2023

GDP: Gross Domestic Product; VMT: Vehicle Miles Traveled

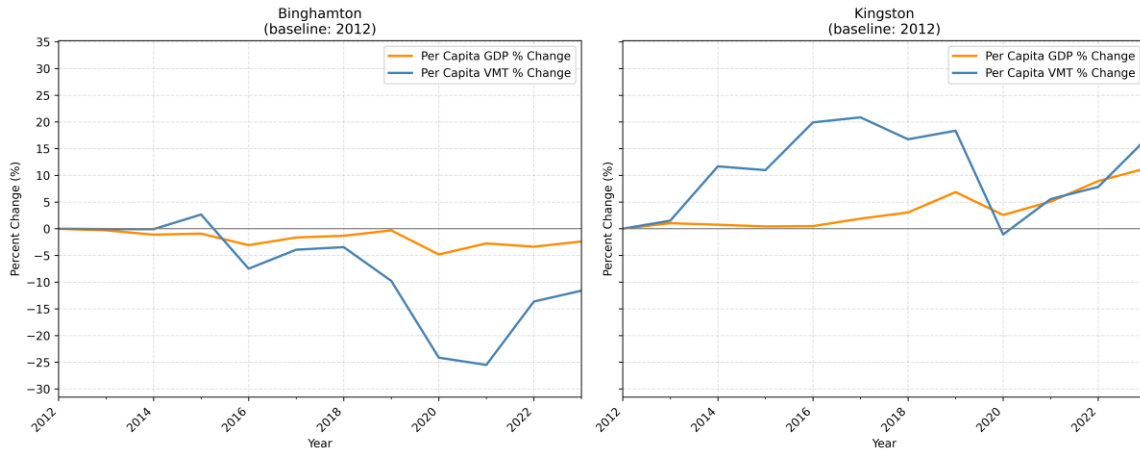
Source: Atlas analysis of data from Federal Highway Administration (Federal Highway Administration n.d.), U.S. Census Bureau (U.S. Census Bureau n.d.) (U.S. Census Bureau n.d.), and U.S. Bureau of Economic Analysis (U.S. Bureau of Economic Analysis n.d.)



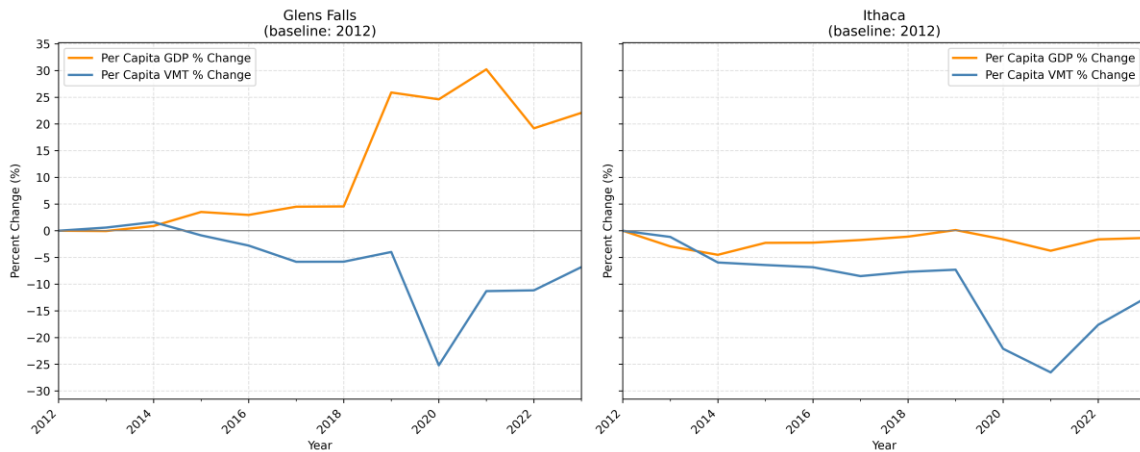
Percent Change Since Baseline — Per Capita GDP and VMT



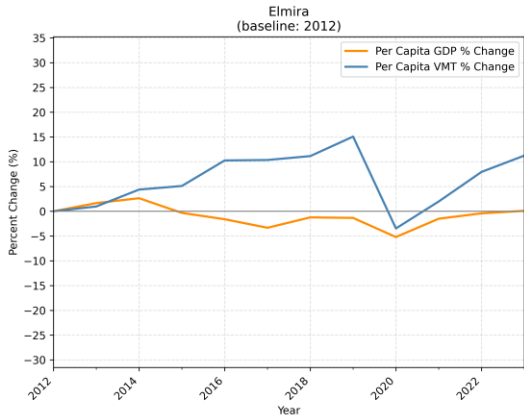
Percent Change Since Baseline — Per Capita GDP and VMT



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Percent Change Since Baseline — Per Capita GDP and VMT



Endnotes

- ¹ Carpooling, vanpool, carshare, and rideshare are also mobility efficiency strategies, but these modes were out of scope for this research.
- ² Vehicle electrification is not included in the definition of mobility efficiency strategies as electric vehicles do not reduce reliance on long single occupant vehicle trips. They are, however, a key strategy for reducing transportation emissions.
- ³ The local businesses discussed in this paper encapsulate a broad range of local businesses, including retail, restaurants, services, and other businesses. When discussing results of particular studies, we include which types of businesses were included in the study.
- ⁴ The latest nationwide data are from 2024, but the latest data for New York are from 2022-2023. The total amount and breakdown of nationwide household expenditures in 2023 are comparable to those of 2024 (Bureau of Labor Statistics 2026).
- ⁵ The link between a lack of low-cost transportation options and missed healthcare appointments is well-documented. For example, in one study of a Nassau County, New York health clinic, nearly one-quarter of clients reported missing or rescheduling appointments due to transportation issues (Guo, et al. 2022).
- ⁶ The authors found three studies that identified negative effects of bicycle facilities, but none of the three used statistical testing to identify whether those effects were statistically significant.
- ⁷ This study compared the fourteen corridors with bicycle and pedestrian street improvements to fourteen control corridors using aggregated trend analysis, difference-in-difference analysis, and interrupted time series analysis. Data was sourced from the Bureau of Labor Statistics Quarterly Census of Employment and Wages and the National Establishment Time Series.
- ⁸ As of December 2025, the program has invested \$2 million in nearly 200 small businesses.
- ⁹ Life cycle emissions refer to the total greenhouse gas emissions created through a product's full life, beginning with materials extraction and ending with proper disposal (Climate Insight n.d.).
- ¹⁰ Highway fatalities dipped into the 30,000 range between 2008 and 2020 but have since returned to the 40,000 range.
- ¹¹ Businesses surveyed in this study belonged to NAICS codes 44 (Retail Trade), 71 (Arts, Entertainment, and Recreation), and 72 (Accommodation and Food Services).
- ¹² A disability-adjusted life year refers to a year spent living with a debilitating health condition, for instance cancer, diabetes, or heart disease (Clockston and Rojas-Rueda 2021).
- ¹³ According to the Congressional Research Service, "complete streets" is a multimodal approach to roadway design and safety that considers all users of transportation infrastructure. A street is considered complete if it facilitates the safe movement of users of all ages, abilities, and transportation modes."
- ¹⁴ Businesses interviewed in this study included "professional services, retail stores, spas and salons, food establishments, and gas stations."
- ¹⁵ A bicycle boulevard is a low-stress, traffic-calmed residential street optimized for cyclists and pedestrians, designed to prioritize them over through-automobile traffic.
- ¹⁶ Bus rapid transit is a high-capacity bus system that mimics the speed and efficiency of rail by using dedicated lanes, off-board fare collection, priority signaling, or other strategies.

- ¹⁷ A UZA, or urbanized area, is a densely populated area with at least 50,000 residents, typically defined by the U.S. Census Bureau to include a central city and its surrounding developed suburban areas. It often corresponds roughly with a metropolitan area.
- ¹⁸ A first right of refusal is a lease clause or legal provision granting a tenant the first opportunity to purchase or lease a property before the owner accepts offers from others.
- ¹⁹ Atlas calculation assuming 933 towns, 61 cities, and 19 Tribal communities in New York State based on Census Bureau data (U.S. Census Bureau n.d.).
- ²⁰ High Occupancy Toll (HOT) lanes allow vehicles with multiple passengers (HOV) to travel free or at a reduced rate, while single-occupant vehicles (SOV) can pay a toll to use the lane.
- ²¹ Pricing for tolls by mail is a few dollars higher.