NYSERDA TRANSPORTATION PROGRAM MARKET CHARACTERIZATION REPORT

Volume 4: Transportation Demand Management Market Characterization and Baseline Assessment

Final

Prepared For:

New York State Energy Research and Development Authority (NYSERDA)
Albany, NY

Jennifer Phelps, NYSERDA Project Manager

Prepared By:

Industrial Economics, Incorporated (IEc)
Cambridge, Massachusetts

Cynthia Manson, Project Manager

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1.   Introduction

In 2014, New York State's transportation sector consumed more than 1,073 trillion Btus of energy, or 39 percent of net energy consumption in the state. In that same year, the transportation sector was responsible for 41 percent of the state's fuel-borne greenhouse gas emissions, largely due to the sector's reliance on petroleum fuel.[1]

Within this context, NYSERDA's Transportation Program has identified several objectives:

- To reduce and diversify the energy consumed by the transportation sector;

- To minimize greenhouse gas emissions; and

- To create economic development opportunities in New York State.[2]

The current Transportation Program, as implemented under NYSERDA's Clean Energy Fund (CEF), works toward these objectives by focusing on three areas: electric vehicles (EVs), public transportation, and mobility management. "Mobility management" encompasses a variety of strategies designed to reduce transportation demand and congestion, including intelligent and adaptive transportation systems and transportation demand management (TDM). TDM is broadly defined as the use of strategies to increase transportation system efficiency, typically by reducing single-occupant vehicle (SOV) demand or redistributing that demand in space or time.

In New York State, TDM initiatives are primarily managed by the New York State Department of Transportation (NYSDOT) as part of its statewide TDM framework. This framework was initially developed and refined based on stakeholder outreach, including a survey of transit agencies, metropolitan planning organizations (MPOs), and other key stakeholders, and seven regional meetings in 2010.[3] NYSDOT's TDM program is wide-ranging, encompassing non-SOV services and infrastructure, parking management, education and outreach, transportation-oriented development, and ridesharing support, among other strategies.[4] As an example, NYSDOT administers the 511NY online portal, which is a

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[1] The remaining 59 percent of emissions from fuel consumption are associated with the residential (20 percent), commercial (12 percent), industrial (six percent), and electric generation (21 percent) sectors. NYSERDA. 2016. Patterns and Trends – New York State Energy Profiles: 2000-2014. October 2016. http://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/Patterns-and-Trends

[2] NYSERDA. 2015. Transportation Program: Product Development, Product Demonstration, and Product Deployment, Program Theory and Logic Model Report. August 2015. https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2015ContractorReports/2015-Transportation-LM-Report.pdf

[3] NYSDOT. 2011. NYSDOT Travel Demand Management (TDM) Statewide Strategic Framework: Opportunities for Advancing Travel Demand Management in New York State. April 12, 2011. http://mobilitymanager.weebly.com/uploads/3/1/4/7/3147084/nysdot_statewide_tdm_framework_webinar_04-12-2011_final.pdf

[4] The term rideshare can be used to describe a number of TDM strategies, including carpool, vanpool, carshare, bikeshare, and ride-hailing (e.g., Uber or Lyft). The 511NY Rideshare database focuses on matching individuals for carpools and vanpools, but also provides information to support public transit, biking, walking, teleworking, and other options.

comprehensive repository of transportation information and a platform for ride-matching. The extent to which NYSDOT is involved in TDM administration is unique among states.[5]

NYSERDA works closely with NYSDOT to ensure that the two organizations' TDM initiatives complement each other. Typically, NYSERDA supports smaller demonstrations and education, while NYSDOT oversees larger, more comprehensive programs.[6] This study considers TDM broadly, such that findings may be relevant to both NYSDOT and NYSERDA. In discussing implications for program strategy, however, this study focuses on the role of NYSERDA's Transportation Program specifically.

The primary goal of this assessment, which focuses exclusively on TDM, is to inform Transportation Program planning and strategy by characterizing the market potential for TDM in New York State and potential areas of engagement for NYSERDA. Table 1-1 summarizes the objectives and methods for this assessment. Additional detail on methods is provided in Section 6.

Table 1-1. Summary of Evaluation Objectives and Methods

		Method (Data Source)				
Evaluation Objective	**Purpose**	**Geospatial Analysis**	**Literature Review and Research**	**Stakeholder Interviews**	**Survey Analysis**	**Discussion in Report**
Identify conditions that are necessary and sufficient for TDM	Assess the market potential for TDM in New York State		✓	✓		Section 2.1
Identify locations in New York State where these conditions are found		✓	✓	✓		Section 2.2
Identify the most significant barriers to increasing TDM adoption in New York State	Identify areas where the Transportation Program is well-positioned to address market gaps or barriers		✓	✓		Section 3
Characterize the types of market actors needed for successful TDM adoption in New York State	Identify key market actors that should be engaged in TDM projects		✓	✓	✓ (MCA survey)	Section 4
Compile baseline data on indicators of interest	Support subsequent evaluation of progress toward program goals		✓	✓		Section 5

This assessment is part of a set of recent studies conducted by Industrial Economics, Inc. (IEc) for NYSERDA on the market for clean transportation and the impacts of key NYSERDA-funded projects. This report is Volume 4 of a five-volume market characterization analysis (MCA). The overall structure includes an executive summary (Volume 1); a central MCA that describes the size and design of New

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[5] Interview with NYSDOT. Conducted February 23, 2017; and interview with Adam Ruder, Program Manager at NYSERDA. Conducted March 24, 2017.

[6] Interview with NYSDOT. Conducted February 23, 2017; and interview with Adam Ruder, Program Manager at NYSERDA. Conducted March 24, 2017.

York State's market for transportation technologies and services, as well as NYSERDA's role in the market, based primarily on a survey of transportation companies and organizations (Volume 2); and two targeted studies of key market segments: a study on electric vehicles (Volume 3), and this study on transportation demand management services (Volume 4). Volume 5 contains supplemental appendices.

Separately, NYSERDA has published six case studies documenting impacts of projects funded by the Transportation Program; these include workplace TDM, workplace EV charging stations, adaptive traffic controls, electric transport refrigeration units (eTRUs), an airport departure manager, and rail car efficiency.[7] Of note, this report builds on research conducted by IEc for the case study of TDM strategies at the Buffalo Niagara Medical Campus (BNMC). In addition to describing the outcomes of that project, the case study also discussed barriers to TDM adoption at BNMC and more broadly, as well as implications for Transportation Program strategy. Information collected from interviews for that case study, as well as insights into market structure, are incorporated and expanded upon in this report.

Buffalo Niagara Medical Campus TDM Case Study Summary

The Transportation Management Association (TMA) established with NYSERDA funding in 2013 continues to operate, and many aspects have been improved or expanded since then, including:

- Alternative transportation incentives (e.g., discounted transit passes, SmartCard system)
- Parking management (e.g., parking fees, residential permit parking in adjacent neighborhoods)
- TDM marketing and "one-stop shop" user website
- Bicycle routes and infrastructure at BNMC and throughout greater Buffalo
- Incorporation of TDM into "complete streets" policies in downtown Buffalo

More broadly, TDM adoption depends on:

- Access to a diverse portfolio of transportation offerings
- A critical mass of commuters for whom it is convenient to take alternative transportation
- Engagement from key stakeholders such as transit agencies and top-level management at workplaces
- Data-driven analysis to identify target populations and appropriate TDM strategies
- Integration with local planning efforts to address land use, job access, and transportation affordability

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[7] The six case studies are available here:

- NYSERDA. 2016. NYSERDA Transportation Program Case Study: Transportation Demand Strategies at the Buffalo Niagara Medical Campus. September 2016. https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/2016-Transportation-Case-Study-Buffalo-Niagara-Medical-Campus.pdf
- NYSERDA. 2017. NYSERDA Transportation Program Case Study: Leviton's Electric Vehicle Charging Station Demonstration. March 2017. https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2017ContractorReports/Transportation-Case-Study-Report-Leviton.pdf
- NYSERDA. 2017. NYSERDA Transportation Program Case Study: KLD's Adaptive Control Decision Support System for Traffic Management. January 2017. https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/Adaptive-Control-Decision-Support-System-Traffic-Management-Transportation-cs.pdf
- NYSERDA. 2016. NYSERDA Transportation Program Case Study: Public Transit Research and Development Funding for Alstom Transportation. September 2016. https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/Alstom-Transportation-cs.pdf
- NYSERDA. 2016. NYSERDA Transportation Program Case Study: Saab Sensis Advanced Airport Departure Manager. December 2016. https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/Saab-Sensis-Advanced-Airport-Departure-Manager-Transportation-cs.PDF?la=en
- NYSERDA. 2016. NYSERDA Transportation Program Case Study: Electric Refrigeration Transportation Network. November 2016. https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/2016-transportation-case-study-electric-refrigeration.pdf

2. TDM Market Potential

The following section discusses the market potential for TDM in New York State by identifying locations that appear to be well-suited to TDM programs. Section 2.1 identifies factors specifically associated with successful TDM programs based on interviews and other research, and Section 2.2 describes the geospatial analysis conducted to map these factors across the state. Although the discussion highlights implications for TDM programs and strategies, this section considers TDM in general, such that the conclusions may apply to either NYSDOT's or NYSERDA's TDM efforts. Implications for NYSERDA's Transportation Program specifically are discussed in more detail in Sections 3 and 4.

2.1 Conditions Necessary and Sufficient for Successful TDM

To begin, this assessment considered the types of conditions that are, in general, necessary and sufficient for successful TDM program development and implementation. IEc identified these factors based on a review of existing literature, including guidance documents, best practice documents, and policy reports, as well as interviews with academic researchers and nonprofit organizations focused on advancing TDM. These factors can be organized into four categories: availability of transportation options beyond SOVs, population or employment density, a focus on populations with particular interest in TDM, and other logistical considerations.

- **Availability of transportation options beyond SOVs:** A diverse portfolio of TDM strategies should be offered to encourage travelers to explore new transportation options beyond SOVs and to ultimately shift their transportation behavior.[8] This includes public transportation that is widely accessible, affordable, and paired with real-time tracking data to ease travel planning, as well as other potential TDM options including carpool, vanpool, carshare, bikeshare, biking, or telecommuting, among others. To most effectively facilitate non-SOV travel, these options should be accompanied by parking fees or other economic and policy incentives, Guaranteed Ride Home programs to ensure that commuters feel comfortable using alternative transportation, and non-SOV infrastructure such as park-and-ride lots, bike lanes, secure bike parking, and high-occupancy vehicle (HOV) lanes.

- **Population or employment density:** Cost-effectively decreasing SOV use by switching to public transportation, biking, or other alternative transportation options requires a large number of people that follow similar transportation patterns, such that investment in shared vehicles and accompanying infrastructure is economical.[9] Urban areas lend themselves naturally to TDM because of the large number of people moving around a relatively confined geographic area. Likewise, areas with large employers or a high density of employers can be well-suited to TDM because of the large number of people traveling to the same location. Literature and interviews did not identify a specific threshold population or employment density for TDM success but

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[8] NYSDOT. 2011. New York State Travel Demand Management Program Analysis - Statewide TDM Framework - Key Issues/Potential Solutions. August 2011.

[9] Interview with Creighton Randall, Program and Development Director at the Shared Use Mobility Center. Conducted May 3, 2016.

emphasized the importance of having clusters of residences, commercial centers, and employers that can form the basis of the TDM program.[10]

- **Populations with particular interest in TDM:** Certain populations may be more interested in and quicker to adopt alternative modes of transportation than others. NYSDOT guidance suggests that elderly, mobility-impaired, and low-income individuals, as well as university students, can be particularly good candidates for TDM because of the systemic mobility challenges faced by those populations (e.g., inability to drive, lack of vehicle access).[11] Another potential target population is workplaces or municipalities that have already established transportation or environmental programs. These locations may be more interested in adopting alternative modes of transportation because of their familiarity and engagement with concepts of behavior change and sustainability. Similarly, residents living near park-and-ride lots and individuals who have signed up for rideshare services (e.g., NYSDOT's 511NY Rideshare database) but are not currently using rideshare may be promising audiences to target.

- **Other logistical considerations:** Many other factors can influence the success of a TDM program, although they may not be strictly necessary for success. One common example is perceptions of local public safety and security.[12] In areas where public safety and security are a concern, individuals may not feel comfortable walking to or waiting for public transportation, or leaving bikes in unsecured areas susceptible to theft. As a result, TDM programs should pay close attention to security around bus stops and other public transportation access points, lighting along biking and walking paths, and the availability of secure bike parking facilities. In addition, TDM programs could consider emphasizing employer shuttles, "safe walk" escorts, or other last-mile solutions that increase safety and comfort.[13]

Finally, interviewees indicated that one of the single most important factors in ensuring the success of a TDM program is the engagement of key stakeholders, such as the local transit agency and high-level management at workplaces implementing TDM. Efforts to establish TDM programs can be difficult to implement without a local "champion" for the program.[14]

2.2 TDM Priority Areas in New York State

To assess priority areas for TDM in New York State, IEc conducted a geospatial analysis of the factors necessary for a successful TDM program. IEc attempted to account for as many of the factors described above as possible using readily available data. As shown in Table 2-1, this study was able to incorporate

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[10] Interview with Mike Galligano, CEO and Rachel Heckl, Director of New Initiatives at Shared Mobility Inc. Conducted February 7, 2017.

[11] NYSDOT. 2011. New York State Travel Demand Management Program Analysis - Statewide TDM Framework - Key Issues/Potential Solutions. August 2011.

[12] Interview with Yeganeh Hayeri, Assistant Professor at Stevens Institute of Technology's School of Systems and Enterprises. Conducted March 29, 2016.

[13] "Last-mile" transportation options are those that help individuals get from an alternative transportation hub (e.g., bus stop, carshare lot) to their final destination.

[14] Interview with Joseph Tario, Senior Project Manager at NYSERDA. Conducted April 6, 2016.

at least one factor from each of the four primary categories. Key factors that were *not* incorporated into the analysis due to lack of available data are: public transit affordability, non-SOV transportation options beyond carshare or bikeshare, non-SOV infrastructure, existence of municipal or employer-based transportation or environmental programs, and engagement of key market actors.

Table 2-1. Data and Methods for Geospatial Analysis

Factor		Data Source	Geographic Resolution	Methods and Key Assumptions
Non-SOV Transportation Options	Public Transit	American Community Survey (ACS) 2014	Block Group	Percent of all workers that take public transportation to work. Arrived at threshold of 11.9% after categorizing through "quantile" in GIS.
	Park-and-Ride Lots	NYS GIS	Point	Locations shown for illustrative purposes only, given difficulty in mapping transit routes.
	Carshare or Bikeshare Program	Shared Mobility, Inc., Zipcar.com, Bikeshare.com	Town	Areas where carshare or bikeshare is present or under development.
Population/ Employment Density	Population Density	ACS 2014	Block Group	Arrived at threshold of 366 people/sq km after excluding NYC and categorizing through "quantile" in GIS.
	Large Employer	NYS Dept. of Labor, NYS Pollution Prevention Institute (NYSP2I)	Town	Based on two combined data sets: 1. Largest private sector employers in each of 10 NYS regions from the NYS Dept. of Labor. Excluded companies likely to have multiple locations (e.g., grocery chains). Identified towns for the included companies using online searches. 2. Hospital locations and size (number of beds) from NYSP2I; excludes NYC. Arrived at threshold of 370 beds through "quantile" in GIS.
Populations with TDM Interest	Large University	NYSP2I	Town	Arrived at threshold of 5,666 students through "quantile" in GIS. Data set excludes NYC.
	Low-Income Population	ACS 2014	Block Group	Percent of households below poverty level. Use federal poverty rate of 14.3% as threshold.
	Older Population	ACS 2014	Block Group	Percent of population over 65. Arrived at 26.7% threshold using "natural breaks" in GIS.
Other Considerations	Public Safety and Security	NYS Division of Criminal Justice Services	County	County-level index (property plus violent) crime rate per 100,000 population. Flagged counties with crime rates in top 25% statewide. Locations shown for illustrative purposes only.

For all factors included in the analysis, IEc first mapped them individually, as shown in Figures 2-1 through 2-7. IEc then calculated a TDM priority index score for each town, based on an aggregation of the factors. The index score ranges from 0-6 and was calculated by assigning one point for each of the following (see Table 2-1 above for explanations of the derivation of the threshold values):

- The town has a carshare or bikeshare program;

- The town includes at least one block group with population density above 366 people per km^2;

- The town has a large employer, defined as either a hospital with more than 370 beds or an employer on the New York State Department of Labor's list of the largest private sector employers in each region of the state;

- The town has a university with more than 5,666 students;

- The town includes at least one block group with more than 14.3 percent of households below the poverty level; and

- The town includes at least one block group with more than 26.7 percent of its population over 65.

Although IEc did not incorporate public transit into the index itself, to inform program strategy decisions, IEc presents the results of the index in two ways: first, in Figure 2-8, considering all areas regardless of public transit commuting rates, and second, in Figure 2-9, considering only those towns with "high" public transit commuting rates (greater than 11.9 percent in at least one block group within the town). Differences between these two presentations of the index indicate areas that may be well-suited to TDM but require additional emphasis on public transit accessibility and use. Additional detail on methods is included in Section 7 and Appendix D (see Volume 5 of this MCA).

As shown in Figures 2-1 through 2-7, the results of mapping the individual factors are not surprising. Public transit commuting and population density are highest downstate and surrounding major cities like Buffalo and Albany, but low elsewhere. Carshare and bikeshare programs and large universities are similarly clustered around major cities. Large employers are more evenly distributed across the state as a result of the New York State Department of Labor's publication of separate rankings for each region of the state. The low-income and older population metrics show much more variation across the state than the other metrics, and both tend to be lower downstate and in suburban areas, in contrast to metrics like public transit commuting.

> **High priority locations for TDM programs, according to the index** (scores of 5 or 6):
> - New York City
> - Much of Long Island (Brookhaven, Hempstead, Huntington, Islip, North Hempstead)
> - Other areas in the downstate region (Eastchester, Mount Pleasant, Poughkeepsie)
> - Albany
> - Buffalo
> - Cortland
> - Ithaca
> - New Paltz
> - Potsdam
> - Rochester
> - Schenectady
> - Sweden
> - Syracuse
> - Utica
> - Vestal

Similarly, the overall index shows that the highest priority areas for TDM (locations with the maximum score of 6) include many areas downstate and large cities, including Albany, Buffalo, Ithaca, Rochester, and Syracuse. Areas with scores of 5 include Cortland, New Paltz, Potsdam, Schenectady, Sweden (home to the College at Brockport, State University of New York), Utica, and Vestal. The inclusion of Buffalo, Rochester, and Albany among the highest priority areas helps validate the index. Buffalo has already emerged as a TDM leader, as demonstrated in the case study of TDM efforts at BNMC. Rochester and Albany have both demonstrated interest through the presence of carshare programs and planned bikeshare programs; as a result of their interest, these cities could be natural places to expand TDM efforts.[15]

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[15] Locations with scores of 3 or lower are unlikely to be good candidates for TDM because they generally scored points for populations with potential interest in TDM, but not for carshare, bikeshare, or potential TDM hosts (universities/employers).
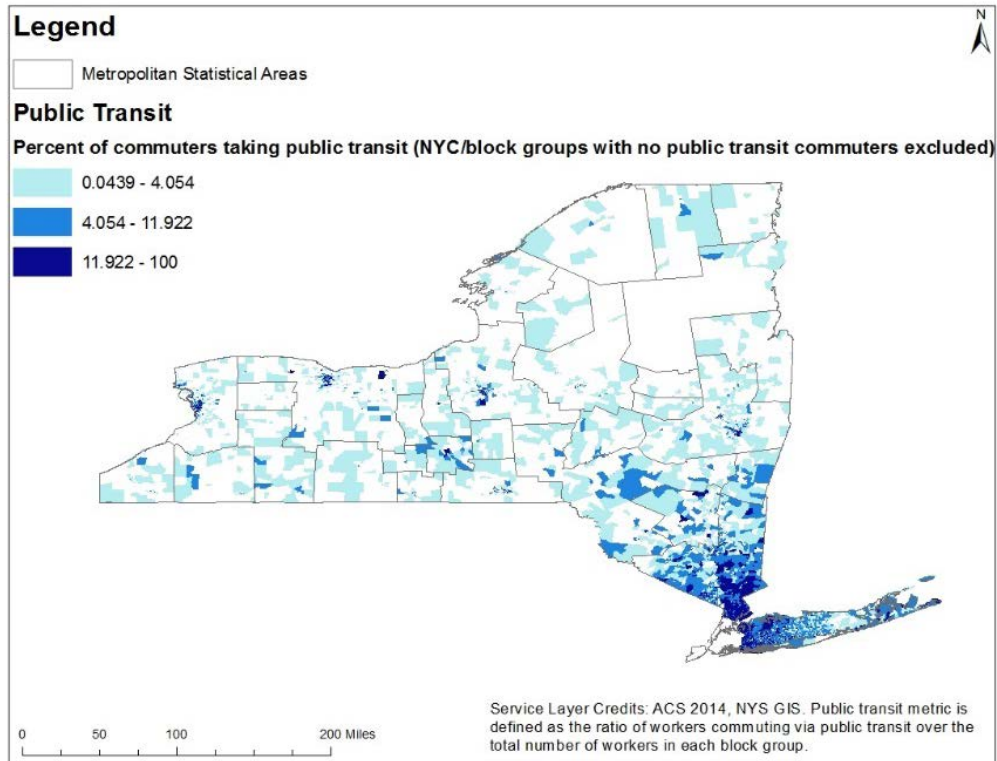
Figure 2-1. Public Transit Commuting

Legend

☐ Metropolitan Statistical Areas

Public Transit

Percent of commuters taking public transit (NYC/block groups with no public transit commuters excluded)

☐ 0.0439 - 4.054

☐ 4.054 - 11.922

☐ 11.922 - 100

0   50   100   200 Miles

Service Layer Credits: ACS 2014, NYS GIS. Public transit metric is defined as the ratio of workers commuting via public transit over the total number of workers in each block group.

Figure 2-2. Carshare and Bikeshare Programs

Legend

☐ Metropolitan Statistical Areas

Carshare or Bikeshare Present

☐ No

☐ Yes (Considered high priority in Index Score)

0   45   90   180 Miles

Service Layer Credits: NYS GIS, Zipcar, BikeShare. Areas with bikeshare services pending are included.
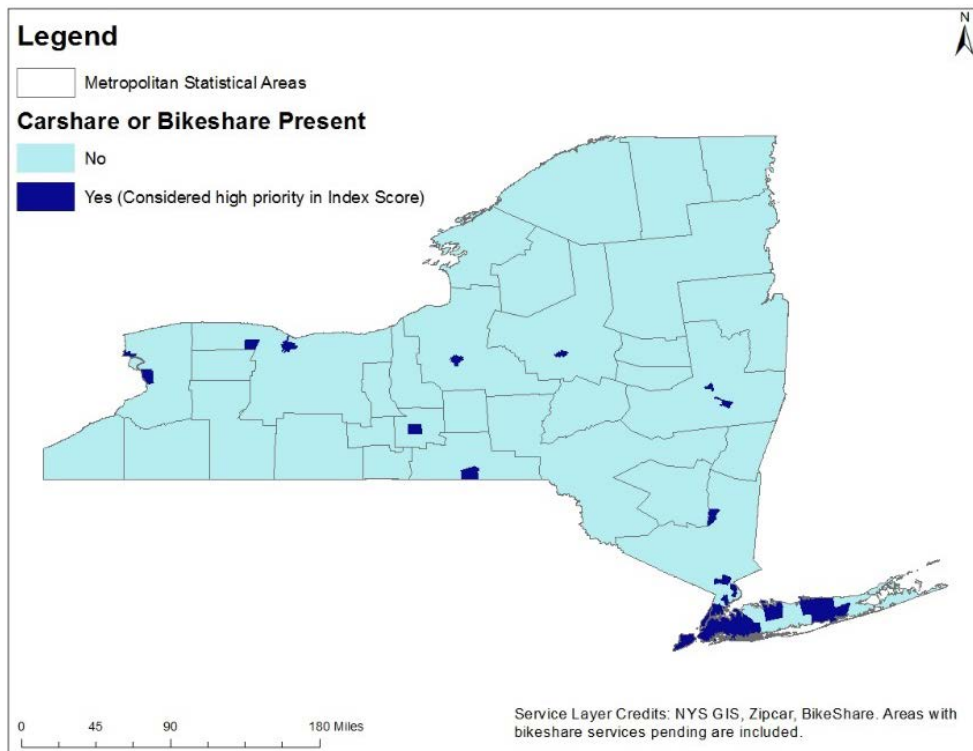
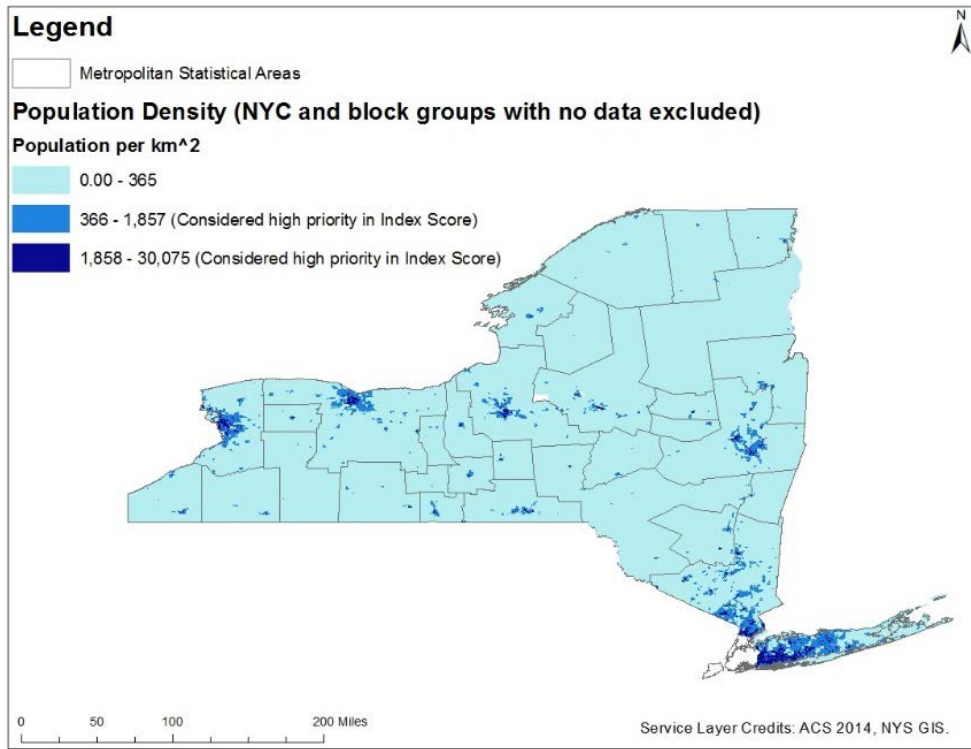**Figure 2-3. Population Density**
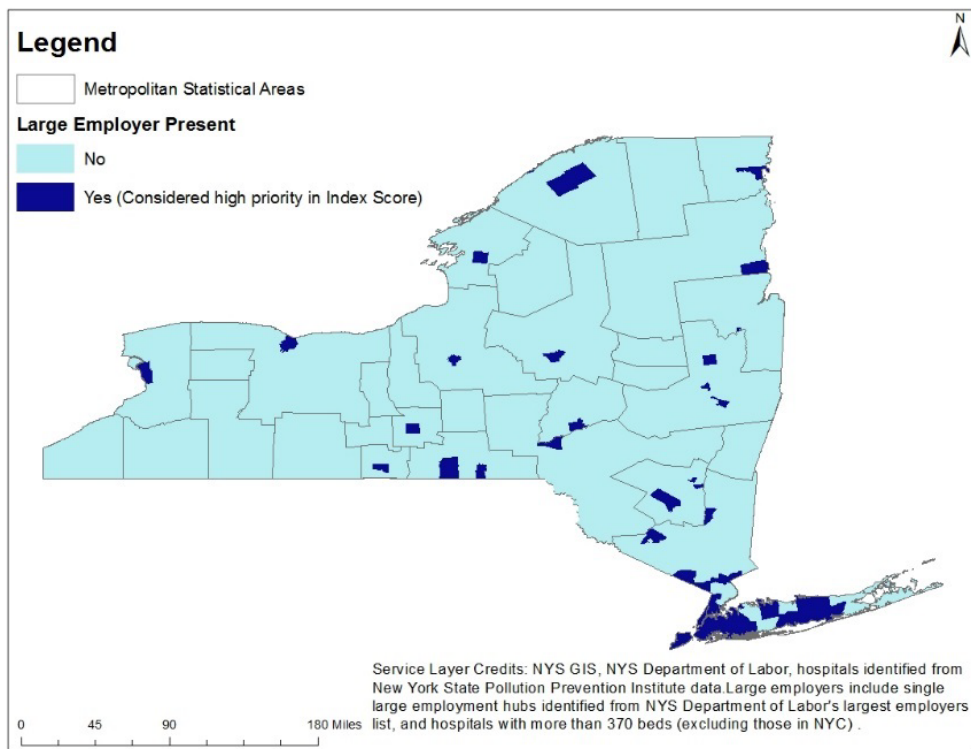

Figure 2-4. Large Employers
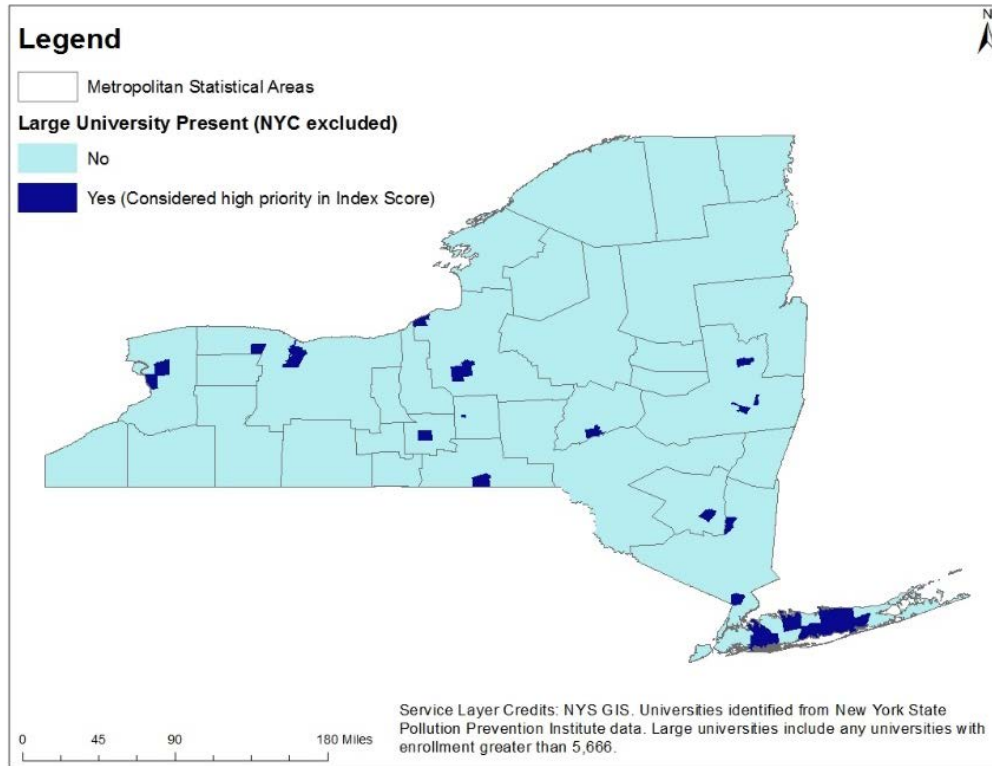
Figure 2-5. Large Universities

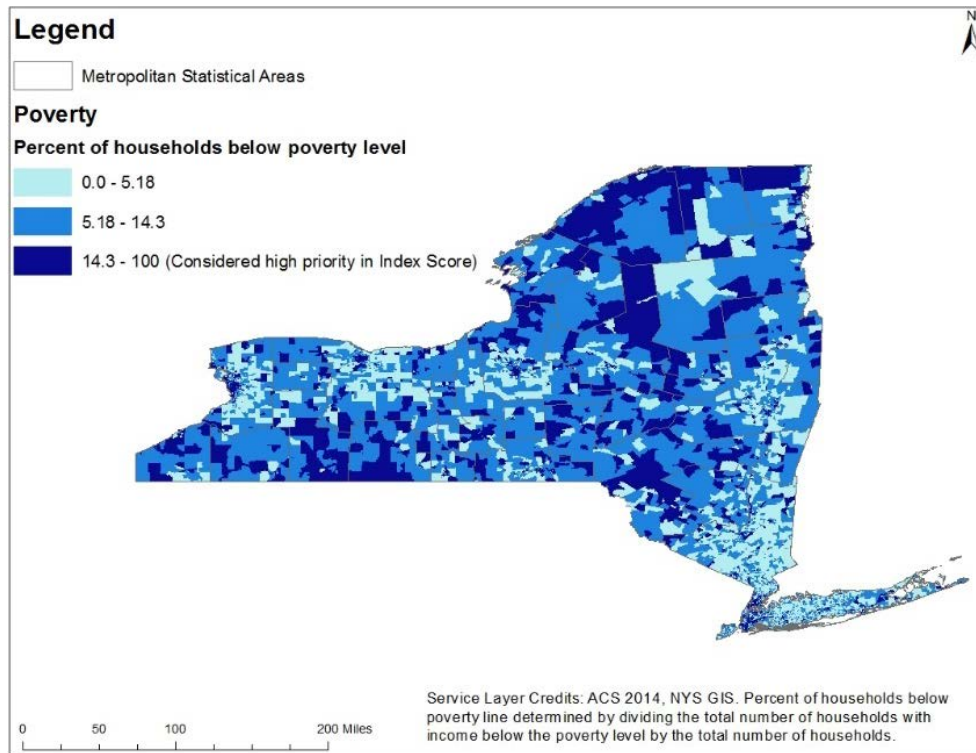**Figure 2-6. Low-Income Populations**
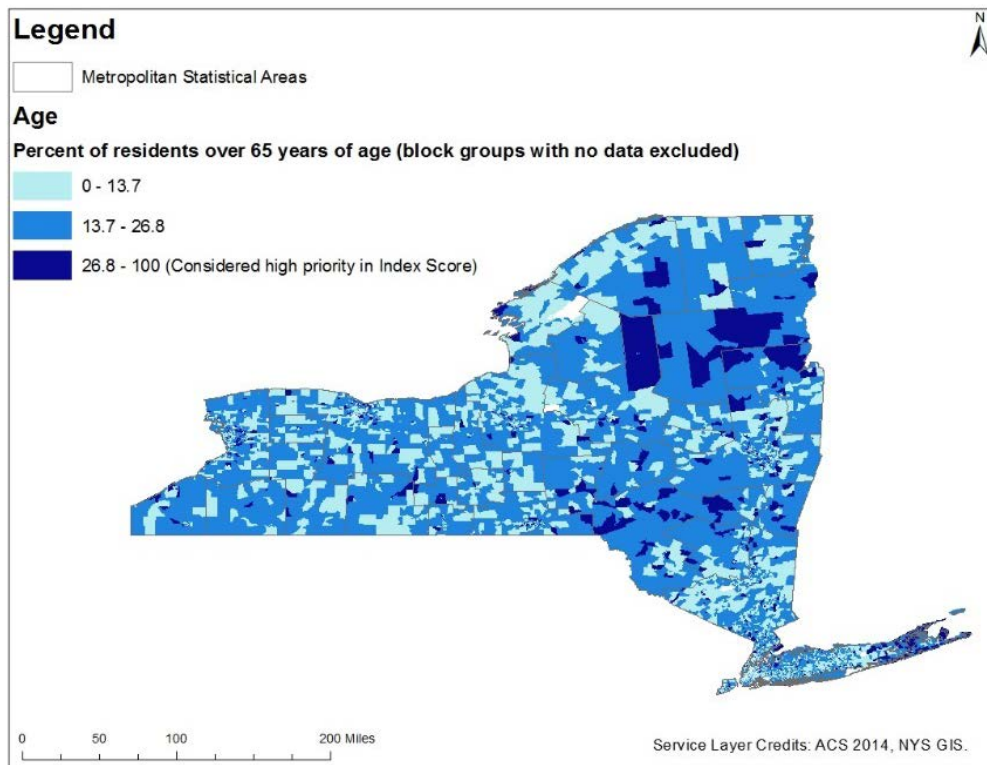
Figure 2-7. Older Populations

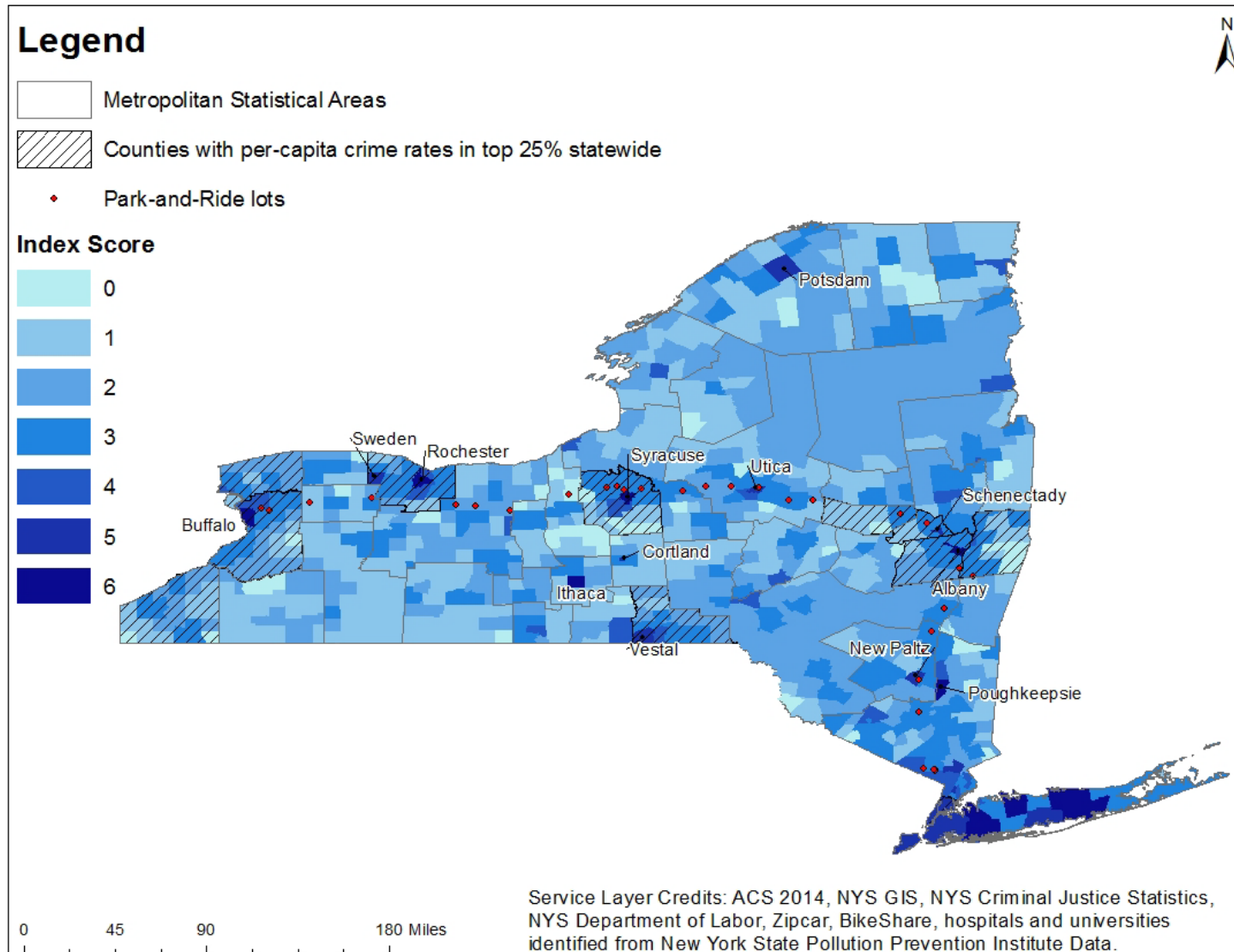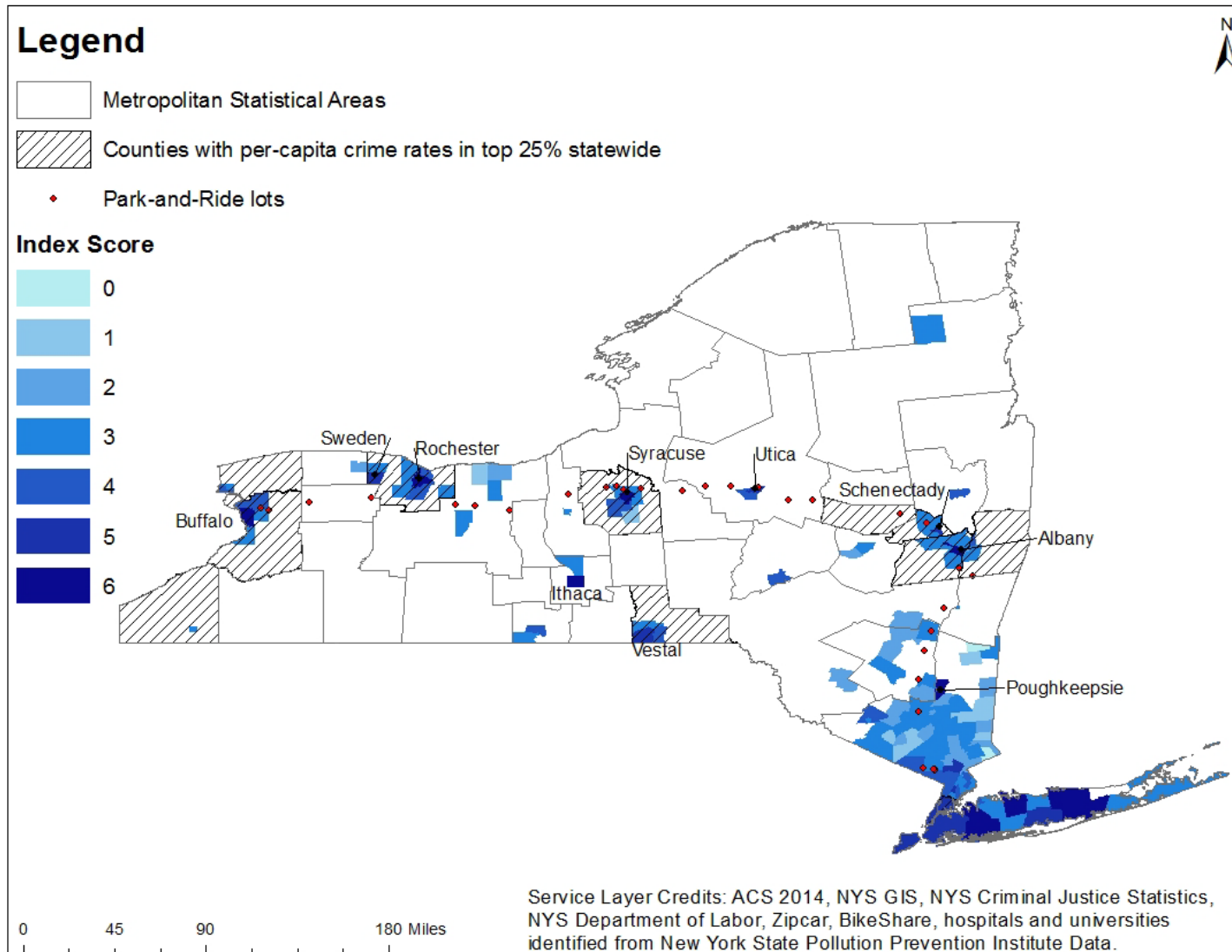**Figure 2-8. TDM Priority Index Score – All Towns**

Figure 2-9. TDM Priority Index Score – Towns with High Public Transit Commuting Only

The results of the analysis suggest several implications for TDM strategy:

- Portions of some cities, such as Syracuse, Schenectady, and Sweden, have particularly high public transit commuting rates and may therefore be receptive to complementary TDM options such as carpooling, bike commuting, or bikeshare.

- Other areas, such as Potsdam and Vestal, have low public transit commuting rates and may benefit from strategies aimed at increasing ridership (e.g., employer shuttles to nearby transit routes, employer discounts for transit passes, real-time transit trackers).

- Many of the largest cities are also located in counties that report above-average property and violent crime rates, which may affect the TDM strategies tried or the messaging used to promote those strategies. For example, in areas where public safety and security is a concern, TDM programs could ensure that outdoor public transit stops are well-lit, bike parking facilities can be securely locked, and shuttles, "safe walk" escorts, or other last-mile solutions are available.

- Finally, many of the high-priority areas earned their top scores because of the presence of a large employer. If NYSERDA or NYSDOT is able to engage these employers in setting environmental or transportation goals (e.g., reduce corporate environmental footprint, defer parking garage expansion), TDM programs may be more likely to succeed.

Appendix E includes a complete listing of the index scores for each town, as well as the average public transit commuting rate across all block groups in the town and whether the town is included in a county with above-average crime rates, as a proxy for potential public safety and security concerns.

As noted, a few key factors were not included in the analysis of priority areas. Most notably, interviewees indicated that one of the single most important factors in ensuring the success of a TDM program is the engagement of key stakeholders, including the local transit agency and high-level management at workplaces, but the geospatial analysis was not able to account for the likelihood that such engagement exists.[16] Other factors that could be added to refine subsequent analyses include the involvement of local employers in NYSDOT's 511NY Rideshare database as a proxy for employer interest in TDM; average elevation change as an indicator of whether walking, bike commuting, and bikeshare are feasible strategies; and housing costs as a percentage of average income as a proxy for residents' economic incentive to adopt TDM strategies.

In addition, this town-level analysis could miss priority areas if factors such as public transit systems span neighboring towns, or if neighboring towns have complementary characteristics that could, together, support regional TDM (e.g., a large employer in one town, with a ridesharing service in a neighboring town). This may be particularly true where the density of employers or student population is low in individual towns but high across the region. Although this type of complementary-cluster analysis is difficult to do systematically, NYSERDA could review the data on a case-by-case basis to assess whether particular TDM programs would work best on a regional basis.

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[16] Tools such as social network analysis could help identify areas with strong potential for coordinated TDM program implementation, but such an analysis was beyond the scope of this study.

3. Gaps and Barriers in TDM Market

Although the previous section identified a number of high priority areas for TDM initiatives in New York State, widespread adoption of TDM is hindered by remaining gaps and barriers in the market. Specifically, the research conducted for this study identified four key barriers to increased TDM adoption in New York State:

- **Engagement of specific market actors, including public transit agencies, developers, and employers:** Successful TDM programs require a comprehensive restructuring of transportation infrastructure, services, and behavior change.[17] This necessarily involves coordination between multiple market actors, including public transit agencies, which must integrate their services into the TDM program, and developers and employers, which must take a leadership role in implementing the TDM program. Interviewees noted that it can be difficult to engage these stakeholders, and that finding a local champion to advocate for TDM and motivate other stakeholders can be critical. This is exemplified in the results of NYSERDA's TDM efforts. Although the TDM program adopted by BNMC was a success, a similar NYSERDA-supported TDM program at another New York State healthcare facility fell short of its goals due in part to difficulty finding a high-level champion with the influence necessary to engage other stakeholders.[18]

- **Land use planning:** To best support widespread adoption, TDM programs should be integrated into long-term land use planning. For example, compact development, job access initiatives, and "complete streets" that promote walkability and bikeability align well with the goal of TDM to reduce vehicle miles traveled (VMT). A NYSDOT report notes that because some communities in New York State have historically not taken a more holistic approach to community development, infrastructure needed for TDM, such as bike paths, walking paths, and mixed-use residential and commercial city centers, is not routinely integrated.[19] In addition, funding to support "complete streets" redesign and planning continues to be limited in New York State, despite stated interest from state and municipal government.[20]

- **Policy restrictions:** To date, a few specific policies in New York State have limited non-SOV transportation options. For instance, automobile liability insurance policies continue to limit the ability of local carsharing services such as Buffalo CarShare to obtain insurance, slowing growth

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[17] NYSDOT. 2011. New York State Travel Demand Management Program Analysis - Statewide TDM Framework - Key Issues/Potential Solutions. August 2011.

[18] NYSERDA. 2016. NYSERDA Transportation Program Case Study: Transportation Demand Strategies at the Buffalo Niagara Medical Campus. September 2016. https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/2016-Transportation-Case-Study-Buffalo-Niagara-Medical-Campus.pdf

[19] NYSDOT. 2011. New York State Travel Demand Management Program Analysis - Statewide TDM Framework - Key Issues/Potential Solutions. August 2011.

[20] StreetsBlogNYC. 2016. State Legislators Call for Dedicated Complete Streets Funding. February 2016. http://nyc.streetsblog.org/2016/02/19/state-legislators-call-for-dedicated-complete-streets-funding/

in the availability of non-SOV options.[21] State legislation also currently prevents residents from using electric assist bicycles (e-bikes), which have the potential to help address commuters' concerns over last-mile connectivity and encourage more widespread bike commuting. New York State policy also prohibits ride-hailing (e.g., Uber, Lyft) in much of New York State, although policy changes approved by Governor Cuomo in April 2017 lifted this restriction and ride-hailing services are anticipated to begin operating in various areas of the state in July.[22] The Transportation Program has and continues to push for solutions to these policy barriers through its efforts.[23]

- **Offsetting VMT:** Typically, a central goal of TDM initiatives is to reduce transportation congestion or greenhouse gas emissions by reducing VMT. Certain TDM options, however, such as bikeshare, may be used primarily for recreation and may not offset SOV travel. For example, a 2016 survey conducted by Reddy Bikeshare in Buffalo found that only 57 percent of respondents (bikeshare members) reported that *any* of their bike trips substituted for the use of a car or bus.[24] Other TDM options, such as ride-hailing and carsharing, can increase VMT in areas where public transit is available if those services replace bus or subway travel.[25] For these reasons, the messaging surrounding TDM strategies should be tailored to the specific goals of the program.

These barriers do not apply equally across the state. For example, engaging developers, employers, and city planners may be easier in locations like Buffalo, Albany, and Rochester that have already had success with smaller-scale alternative transportation programs. Engagement and integration of a TDM program with local transit agencies may be more difficult in cities like Potsdam and Vestal where public transit ridership is low. Concerns about offsetting VMT are likely to be greatest in large cities with congestion problems, while university students may be particularly receptive to TDM messaging, as a result of universities' emphasis on knowledge sharing and innovation, students' sensitivity to transportation costs, and the easy-to-communicate goal of not bringing cars to campus.

Both NYSDOT and NYSERDA are well-positioned to address these barriers. As a result of its central role in TDM planning and administration across the state, NYSDOT already works with many employers, metropolitan planning organizations, and local transit agencies to host TDM programs and develop supporting infrastructure and services. NYSDOT also already encourages reductions in VMT through its 511NY portal. Because of NYSDOT's statewide focus, however, NYSDOT's ability to tailor these programs to specific locations to demonstrate TDM potential can be limited.

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[21] Buffalo Business First. 2015. Buffalo CarShare Shutting Down. June 2015. http://www.bizjournals.com/buffalo/news/2015/06/10/buffalo-carshare-shutting-down.html

[22] The Cornell Daily Sun. 2017. Uber and Lyft to Expand to Upstate New York. April 2017. http://cornellsun.com/2017/04/11/uber-and-lyft-to-expand-to-upstate-new-york/

[23] The Cornell Daily Sun. 2017. Uber and Lyft to Expand to Upstate New York. April 2017. http://cornellsun.com/2017/04/11/uber-and-lyft-to-expand-to-upstate-new-york/ and NYSERDA. Presentation feedback from Joseph Tario, Senior Project Manager at NYSERDA. Provided April 26, 2017.

[24] Shared Mobility, Inc. Results provided by Mike Galligano via email on April 14, 2017.

[25] Interview with Yeganeh Hayeri, Assistant Professor at Stevens Institute of Technology's School of Systems and Enterprises. Conducted March 29, 2016.

By focusing on small-scale, targeted demonstrations and education and outreach, NYSERDA can complement, and potentially leverage, NYSDOT's ongoing efforts. In the short term, NYSERDA may be able to leverage NYSDOT's existing relationships with transit agencies and 511NY Rideshare employer partners to target demonstrations and outreach campaigns in high priority areas like those identified in Section 2. The Transportation Program can also continue to provide outreach, advocacy, and research support to promote solutions to policy barriers.

In the longer term, the Transportation Program can leverage its relationships with other NYSERDA programs, such as Clean Energy Communities, to encourage integration of TDM considerations into land use planning and policy, relying in part on best practices and guidance compiled by NYSDOT.

In addition, although NYSDOT's role in statewide TDM administration is unique among states, approaches to addressing these barriers can be informed by best practices and lessons learned from other states. For example:

- Based on the results of a multi-state outreach effort, the Federal Highway Administration (FHWA) recommends **taking an evolutionary approach to TDM**, beginning with the simplest, easiest-to-communicate options and expanding from there.[26] This recommendation aligns well with NYSERDA's focus on demonstration projects. For instance, in the short term, NYSERDA can continue to support local or employer-based initiatives such as carshare or bikeshare to introduce TDM concepts to commuters, laying the foundation for subsequent participation in more comprehensive TDM initiatives, including 511NY Rideshare and other NYSDOT programs.

- FHWA also found that successful TDM programs often require transit agencies to **shift focus from the construction and deployment of transportation systems to the operation and management of those systems**. In addition, TDM generally requires transit agencies to increase their emphasis on customer engagement and communication. These strategies align well with NYSERDA's focus on outreach and education, although, as noted above, NYSERDA should coordinate closely with NYSDOT to leverage NYSDOT's existing relationships with local transit agencies. One example of this is the "System Reimagining" campaign carried out in Houston, TX. This campaign resulted in a widespread redesign of the city's bus system in 2015 based on extensive community outreach and information collection.[27] Although the redesign was initially successful at increasing ridership, recent declines have been attributed to a changing local economy and insufficient marketing.[28] Indeed, interviewees emphasized the importance of marketing campaigns for TDM initiatives in general, noting that TDM programs often fail to

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[26] Federal Highway Administration. 2013. The Active Transportation and Demand Management Program (ATDM): Lessons Learned. March 2013.

[27] METRO. System Reimagining FAQs. Accessed May 22, 2017. http://www.ridemetro.org/Pages/Reimagining-FAQs.aspx

[28] Begley, Dug. Metro approves performance report which calls for public image improvement. Houston Chronicle. January 25, 2017. http://www.houstonchronicle.com/news/transportation/article/Metro-approves-performance-report-which-calls-for-10884030.php

garner enough interest and participation because of a lack of emphasis on consumer outreach and education.[29]

- Finally, the FHWA notes that **obtaining TDM funding may be most successful if TDM is included as part of a comprehensive project**.[30] As one example, Bellevue, WA, has pursued an integrated land use plan to not only revitalize businesses in downtown areas, but also to facilitate walking, biking, carpooling, and public transit by promoting changes to infrastructure and parking management.[31] Importantly, integrating TDM into broader land use planning requires close collaboration among stakeholders. NYSERDA could leverage its connections with NYSDOT, municipal governments, and other NYSERDA programs such as Clean Energy Communities to integrate TDM into other funded projects.

In addition to the best practices compiled by FHWA, NYSDOT guidance also suggests continuing to **support intelligent transportation systems (ITS) technologies that promote real-time data tracking** of carshare, bikeshare, public transit, and travel patterns.[32] These technologies can help simplify non-SOV travel planning, while also providing comprehensive data that can be used to demonstrate the benefits of TDM to policymakers and potential travelers.

Given the complexity of implementing TDM and the specific barriers that remain in New York State, NYSERDA's strategy for addressing these barriers will require engaging and coordinating with a diverse group of stakeholders. The next section therefore focuses on understanding the current composition of the market for TDM services in New York State, and the extent to which specific types of market actors are engaged.

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[29] Interview with Mike Galligano, CEO and Rachel Heckl, Director of New Initiatives at Shared Mobility Inc. Conducted February 7, 2017.

[30] Federal Highway Administration. 2013. The Active Transportation and Demand Management Program (ATDM): Lessons Learned. March 2013.

[31] City of Bellevue. 2015. Bellevue Transportation Demand Management Plan 2015 – 2023. December 2015. http://www.chooseyourwaybellevue.org/SiteAssets/about-plans-activities/TDM_plan_FINAL_lower_res_revised_01_15_2016.pdf

[32] NYSDOT. 2011. Opportunities for Advancing Travel Demand Management in New York State. April 2011.

4. Key Market Actors

Interviews and literature review conducted for this assessment emphasized the need to engage multiple types of market actors as a critical requirement for the widespread adoption of TDM, although engagement remains a key barrier. Specifically, interviewees noted that the broad scope of TDM – integrating new transportation technologies, infrastructure, the provision of transportation services, and consumer outreach and education – generally requires significant involvement from the public, private, and nonprofit sectors. Actors include:

- **Public sector:**

    o   Transit agencies to improve public transportation access and supporting infrastructure.

    o   Municipalities to encourage TDM adoption through supportive land use planning, parking management and complete streets policies, and public safety measures.

    o   Metropolitan planning organizations (MPOs) to promote compact development, integrated biking and walking infrastructure, HOV lanes, and park-and-ride facilities.

- **Private sector:**

    o   Transportation service providers to offer non-SOV transportation options, such as bikeshare, carshare, ride-hailing, and ride-matching.

    o   Software developers to provide real-time tracking data, online TDM platforms, and integrated communications for non-SOV transportation options.

    o   Employers to educate employees on non-SOV transportation options and incentivize TDM adoption, including offering incentives for taking alternative transportation, participating in Guaranteed Ride Home programs, establishing parking fees, and providing options for telecommuting.

    o   Building developers and property managers to support alternative transportation through provision of bike racks, carshare parking spaces, and other amenities and infrastructure.

- **Nonprofit sector:**

    o   Environmental- and transportation-focused organizations to educate potential travelers on the benefits of TDM, and to engage directly with both private and public sector organizations to advocate for strategies and policies that support TDM.

To understand the current involvement of transportation companies and organizations in the TDM market in New York State, this assessment relied on the market characterization survey conducted by IEc in 2016, as detailed in Volume 2 of this MCA.[33] The survey results show that, overall, the types of key

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[33] While NYSERDA's recently-completed inventory of clean energy companies also provides detail on the transportation focus of the companies and organizations that make up the New York State transportation market, the inventory did not specifically

market actors listed above are well-represented in the pool of companies working on TDM in New York State. Of the 109 companies and organizations included in the market characterization survey, 17 indicated that they are already participating in the TDM market, and an additional 27 indicated that they might be interested in working on TDM in the future. These respondents represent a wide range of firm types, with particularly high representation from consultants, transportation service providers, public sector organizations, and nonprofit organizations. Specifically, they include a number of municipalities and regional planning organizations, TDM service providers, and research organizations. The companies and organizations participating or interested in the TDM market are located in all regions of New York State, although they are concentrated in New York City and Western New York.

Notably, the survey generally did not reach three key segments of the TDM market: local transit agencies, software developers, and developers and employers (i.e., potential TDM hosts). Although the survey did reach a large number of public sector organizations, it was not designed to comprehensively survey local transit agencies. In addition, the survey was not designed to reach potential host sites. Because these types of companies were not the target audience for the survey, the small number of respondents in these categories does not necessarily indicate that they are not involved in the market for TDM in New York State. However, interviews and other research conducted for this study suggest that transit agencies have not historically prioritized TDM planning, while a large number employers are engaged through NYSDOT's 511NY Rideshare program.[34] In addition, software developers may not have been well represented in the survey if these companies work primarily in fields other than transportation.

The current composition of the TDM market suggested by the survey, and NYSERDA's role in it, indicates that NYSERDA may be well-positioned to facilitate introductions between several key market actors, including outreach-focused nonprofit organizations, TDM service providers, and planning organizations. As one example of this, NYSERDA is currently working with Shared Mobility, Inc., a nonprofit organization with a focus on TDM, to help facilitate TDM services across New York State. At the same time, to address gaps in the market, NYSERDA could collaborate with NYSDOT to target outreach and education to 511NY Rideshare employer partners and to leverage NYSDOT's connections to local transit agencies.

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indicate which companies and organizations were involved with TDM. Instead, the inventory grouped companies and organizations into the much broader "traffic management" category, which could include TDM but also includes a wide range of other transportation services.

[34] Interview with Mike Galligano, CEO and Rachel Heckl, Director of New Initiatives at Shared Mobility Inc. Conducted February 7, 2017; and NYSDOT. 511NY Rideshare Your Employees Are The Keys To Your Success. https://511nyrideshare.org/web/statewide-511ny-rideshare/employers

NYSDOT's Role in TDM

As noted previously, NYSDOT is the central market actor for TDM in New York State. NYSDOT is responsible for overseeing planning and administration of most of the state's TDM programs. These include, among others:

- 511NY, a free online tool that provides New York State residents with comprehensive TDM information and services (e.g., 511NY Rideshare, a ride-matching platform for carpools and vanpools; NYSDOT's Guaranteed Ride program; and trip planning for public transit, biking, and walking);
- Section 5310 program, which provides funding for projects that increase the mobility of seniors and individuals with disabilities; and
- Job Access and Reverse Commute (JARC) program, which provides funding for projects that help welfare recipients and low-income individuals commute to work. Projects have focused on carpooling, ridesharing, and vanpooling in low-income communities.

The extent to which NYSDOT is involved in TDM planning and administration is unique among states. Because of NYSDOT's central role in the TDM market, communities in New York State benefit from standardized TDM program offerings and services, and NYSDOT benefits from administration efficiencies.

5. Baseline Indicator Values

Although the Transportation Program has not yet filed a CEF Investment Plan for its mobility management program area, Table 5-1 presents the outputs, outcomes, and indicators that the Program proposes to use to assess progress toward its goals. In addition to the indicators proposed by NYSERDA, IEc also identified additional indicators of TDM progress for which data are readily available; these are highlighted in gray in the table. The final column presents the baseline values determined through this assessment.

The baseline values show that both individuals and employers in New York State have already demonstrated interest in TDM program offerings. Approximately 1,000 employers proactively offer TDM opportunities through participation in NYSDOT's 511NY Rideshare program, and 69,665 individuals (0.35 percent of the New York State population) had signed up for the program as of the end of 2016.[35] In addition, 29 metropolitan areas offered carsharing services in 2016, and three offered bikeshare. To date, bikeshare membership has been heavily concentrated in New York City, although two new programs in other regions are anticipated by 2018 and existing programs are expected to continue to expand.[36] Statewide, 46.4 percent of workers above the age of 16 used non-SOV modes to commute to work in 2016.

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[35] The population of New York State was 19,745,289 as of July 1, 2016. https://www.census.gov/quickfacts/table/PST045216/36

[36] Shared Mobility, Inc. Results provided by Mike Galligano via email on February 9, 2017.

Table 5-1. Outputs, Outcomes, and Indicators

Outputs/Outcomes	Indicators[1]	Data Source	Baseline Value (2016)
Employers proactively offer TDM opportunities	# of employer TDM programs (as approximated by # of NYSDOT 511NY Rideshare employer partners)	NYSDOT[37]	~1,000
People shift commuting modes away from SOVs	Commuter mode split (% using SOV)	U.S. Census Bureau, 2014[38]	53.6% of workers age 16+
New carsharing and bikesharing programs launch	# of metro areas with carsharing or bike sharing	Zipcar.com, Bikeshare.com, and Shared Mobility, Inc.[39]	30 (29 carshare; 3 bikeshare)[2]
People participate in ride-matching programs	# of people signed up for NYS ride-matching programs (specifically, 511NY Rideshare)	NYSDOT[40]	69,665
More people use carsharing and bike sharing programs	# of carsharing and bikesharing program members in NYS (includes Reddy Bikeshare and SoBi Long Beach "riders," but only annual members for Citi Bike)	Citi Bike and Shared Mobility, Inc.[41]	127,845 bikeshare riders; carshare data not available
Increased demand for bikesharing programs in NYS	Fleet size of bikesharing programs in NYS	Citi Bike and Shared Mobility, Inc.[42]	8,463 bikes (7,993 in NYC)
Increased use of bikesharing programs in NYS	# of miles ridden through NYS bikesharing programs	Citi Bike and Shared Mobility, Inc.[43]	30.5 million (30.4 million in NYC)
Increased use of bikesharing programs in NYS	# of trips taken through NYS bikesharing programs	Citi Bike and Shared Mobility, Inc.[44]	13.9 million (13.8 million in NYC)
Development and demonstration of products for improved technical performance and business models for TDM programs	# of product development and demonstration projects initiated	NYSERDA	Not yet started

Notes:
1. Gray-shaded indicators denote additional indicators of TDM progress identified by IEc.
2. Two cities, Buffalo and New York City, had both carshare and bikeshare programs in 2016.

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[37] NYSDOT. 2017. 511NY Rideshare Second Quarter Progress Report. February 2017. https://511nyrideshare.org/documents/11420/116339/2016-2017+Q2+Quarterly+Progress+Report+-+Final+Draft+-+2-27-17.pdf/9a28ef63-42ae-4d16-933c-ca6dd341edb9?version=1.0&previewFileIndex

[38] U.S. Census Bureau. 2017. Selected Economic Characteristics 2010-2014 American Community Survey 5-Year Estimates. 2017. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

[39] Zipcar. Where the Cars Are. Accessed February 9, 2017. http://www.zipcar.com/cities; and Bikeshare. Bikeshare Cities. Accessed February 9, 2017. http://bikeshare.com/map; and Shared Mobility, Inc. Results provided by Mike Galligano via email on February 9, 2017.

[40] NYSDOT. 2017. 511NY Rideshare Second Quarter Progress Report. February 2017. https://511nyrideshare.org/documents/11420/116339/2016-2017+Q2+Quarterly+Progress+Report+-+Final+Draft+-+2-27-17.pdf/9a28ef63-42ae-4d16-933c-ca6dd341edb9?version=1.0&previewFileIndex

[41] Citi Bike. December 2016 Monthly Report. https://www.citibikenyc.com/system-data/operating-reports; Shared Mobility, Inc. Results provided by Mike Galligano via email on April 14, 2017; and Buffalo Rising. The Reddy Bikeshare Results Are In…. January 4, 2017. https://www.buffalorising.com/2017/01/the-reddy-bikeshare-results-are-in/

[42] Shared Mobility, Inc. Results provided by Mike Galligano via email on April 14, 2017; and Citi Bike. December 2016 Monthly Report. https://www.citibikenyc.com/system-data/operating-reports

[43] Buffalo Rising. The Reddy Bikeshare Results Are In…. January 4, 2017. https://www.buffalorising.com/2017/01/the-reddy-bikeshare-results-are-in/; Shared Mobility, Inc. Results provided by Mike Galligano via email on April 14, 2017; and Citi Bike. System Data. Accessed February 9, 2017. https://www.citibikenyc.com/system-data

[44] Ibid.

6.   Conclusions

The information collected as part of this assessment documents the opportunities represented by the Transportation Program's focus on TDM and identifies several areas where NYSERDA is well-positioned to advance TDM adoption by addressing key barriers.

First, this study finds that many locations across New York State appear to be strong candidates for TDM initiatives, based on geospatial analysis of a series of factors that research indicates are necessary for successful TDM programs. These locations include much of the downstate region, as well as large cities across the state: Albany, Buffalo, Ithaca, Rochester, and Syracuse all emerged as high priority areas, followed by Cortland, New Paltz, Potsdam, Schenectady, Sweden, Utica, and Vestal. Buffalo has already emerged as a TDM leader; Rochester and Albany have both demonstrated interest through carshare and bikeshare initiatives, and could be natural places to expand TDM demonstrations.

Other areas may require support from NYSDOT or NYSERDA to address key barriers. For example, some areas with low public transit commuting rates may benefit from targeted partnerships with the local transit agency. Literature review and interviews with key stakeholders indicated that TDM programs are unlikely to be successful without engagement from the local transit agency. Similarly, interviews indicated that one of the strongest predictors of a successful TDM program is the engagement of a champion within top-level management at a local developer or large employer.

Because of NYSDOT's central role in TDM implementation and other transportation planning across New York State, NYSDOT likely has relationships with many of the key market actors that would need to be engaged to ensure the success of future TDM initiatives (e.g., transit agencies, large employers interested in transportation planning). NYSDOT generally does not oversee smaller-scale TDM demonstrations, however. To complement NYSDOT's role, NYSERDA's Transportation Program could in the short term:

- **Leverage NYSDOT's existing relationships with transit agencies and 511NY employer partners in high priority areas to encourage adoption of TDM strategies.**

    o In areas with relatively low public transit ridership, NYSERDA could focus on demonstrating strategies that aim to increase ridership, such as employer shuttles to nearby transit routes, employer discounts for transit passes, and real-time transit trackers.

    o In areas with relatively high public transit ridership, NYSERDA could focus on demonstrating complementary TDM strategies such as carpooling, bike commuting, or bikeshare.

- **Leverage existing successful programs (e.g., carshare, bikeshare, workplace transportation or environmental programs) to identify local TDM champions and organizations that can assist with education and outreach.**

    o Since these locations already support some form of TDM or sustainability program, consumer outreach materials could emphasize the environmental and economic benefits

of switching away from SOV use to ensure that alternative transportation options decrease overall VMT and achieve emissions savings.

- o For employers and developers in these areas, outreach materials could emphasize TDM as an alternative solution to parking management needs.[45]

- **Consider whether public safety concerns are dampening local TDM adoption, and encourage local employers and developers to adapt their TDM strategies and messaging accordingly.**

  - o For example, TDM programs could emphasize the safety and security of public transit stops and bike parking facilities, as well as offering shuttles, "safe walk" escorts, or other last-mile solutions.

- **Support R&D related to complementary technologies, such as intelligent transportation systems and real-time transportation data tracking.**

Over the long term, the Transportation Program could:

- **Continue working with policymakers and other NYSERDA programs (e.g., Clean Energy Communities) to encourage integration of TDM into long-term land use planning.**

  - o As noted by FHWA, funding for TDM projects is often easiest to obtain as part of a larger, more comprehensive project. TDM could be easily integrated into plans for urban revitalization, congestion relief, parking management, or greenhouse gas emissions reductions. To the extent that the Transportation Program can collaborate with other programs to encourage municipalities to engage in long-term mobility planning, the adoption of TDM strategies may be more likely to increase.

  - o This type of long-term planning may require transit agencies to shift their focus from the construction and deployment of transportation systems to the operation and management of those systems. To support this shift, NYSERDA can provide particular assistance with demonstrations of consumer engagement and communications technologies.

Despite these barriers, this assessment showed that New York State already has a strong framework for TDM initiatives as a result of the prior and ongoing work of NYSDOT and NYSERDA. In particular, NYSDOT's 511NY Rideshare database has a large number of members and employer participants. In addition, bikeshare programs, while mostly used in New York City, are expanding throughout the state, with two more cities planning to launch programs by 2018. By targeting remaining gaps and barriers in the market and leveraging NYSDOT's existing relationships to provide complementary services, NYSERDA should be well-positioned to further increase TDM interest and adoption.

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[45] NYSERDA. 2016. NYSERDA Transportation Program Case Study: Transportation Demand Strategies at the Buffalo Niagara Medical Campus. September 2016. https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2016ContractorReports/2016-Transportation-Case-Study-Buffalo-Niagara-Medical-Campus.pdf

7. Methods

This assessment relied on a variety of quantitative and qualitative methods to characterize the market potential for TDM in New York State. Primary research conducted for this evaluation included in-depth interviews with NYSERDA, NYSDOT, Shared Mobility, Inc., the Shared Use Mobility Center, an academic researcher in transportation systems, and BNMC, the subject of a case study conducted by IEc for NYSERDA in 2016. Several of these interviews were conducted initially for the BNMC case study, but relevant information was incorporated into this report as well. In addition, this assessment relied on data from a market characterization survey conducted for this MCA in 2016 (see Volume 2 of this MCA for discussion of this data set).

The primary method of analysis for this assessment, however, was a geospatial analysis conducted to identify priority areas for TDM. IEc identified publicly available GIS data sources to represent the factors necessary for successful TDM and supplemented these data with information from stakeholder interviews. IEc first assessed each factor individually to determine suitable threshold values (i.e., low, medium, and high) and then combined the factors to create an index scoring system that allows for comparison across towns. For a detailed description of the methodology, see Appendix D; the remainder of this section provides a high-level summary of each factor and the index score:

- **Public transit**: This metric is based on American Community Survey (ACS) block group-level commuter data.[46] Public transit commuting rates were determined by dividing the number of workers who commute by public transportation by the total number of workers. To best represent the variation in public transit commuting across New York State, IEc eliminated block groups with zero public transit commuting and those in New York City, and then categorized the remaining block groups using quantile breaks in GIS.

- **Park-and-ride lots:** New York State Thruway park-and-ride lot locations were downloaded from the New York State GIS Clearinghouse and included in the final maps to provide context for potential TDM options.[47] These locations were not incorporated into the index score because of the difficulty in mapping travel routes from those lots.

- **Population density:** This metric is based on ACS population data.[48] As with public transit commuting, population density is substantially higher in New York City than the rest of the state. IEc therefore excluded New York City block groups and categorized all others using quantile breaks in GIS.

- **Large employer:** This metric integrates two data sources: (1) lists of the largest employers in each New York State region, as compiled by the New York State Department of Labor, and (2)

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[46] U.S. Census Bureau. 2014 TIGER/Line Shapefiles with Selected Demographic and Economic Data. Downloaded from https://www.census.gov/geo/maps-data/data/tiger-data.html on February 1, 2017.

[47] New York State GIS. NYS Thruway Park and Ride Lots, Revised February 2015. Downloaded from https://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1191 on February 10, 2017.

[48] U.S. Census Bureau. 2014 TIGER/Line Shapefiles with Selected Demographic and Economic Data. Downloaded from https://www.census.gov/geo/maps-data/data/tiger-data.html on February 1, 2017.

hospital data from the New York State Pollution Prevention Institute (NYSP2I), which covers all areas except New York City. [49,50] Large hospitals were identified using quantile breaks in GIS.

- **Large university:** This metric also relies on data provided by NYSP2I, including estimates of student enrollment for all universities outside of New York City.[51] IEc categorized universities using quantile breaks in GIS.

- **Carshare or bikeshare program:** Using information collected from Zipcar, Bikeshare.com, and interviews with Shared Mobility, Inc., IEc compiled a list of towns that have carshare or bikeshare services available or under development.[52,53,54]

- **Low-income population:** This metric is based on ACS poverty data.[55] Poverty status was determined by dividing the total number of households with income below the poverty level by the total number of households. IEc set the threshold for high poverty populations at the national poverty rate of 14.3 percent.

- **Older population:** This metric is based on ACS population data.[56] IEc determined the percentage of the population comprised of older individuals by summing the total number of people aged 65 and over and dividing by the population of each block group. IEc categorized block groups using natural breaks in GIS.

- **Public safety and security:** This metric is approximated using crime rates. The finest scale for crime data that was available statewide was county-level index (violent and property) crime data from the New York State Division of Criminal Justice Services.[57] Because county-level crime data are likely not detailed enough to serve as a true indicator of TDM potential, these data were not incorporated into the overall index score. Instead, counties with crime rates in the top 25 percent statewide were flagged as having potential public safety and security concerns, to inform TDM strategy.

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[49] New York State Department of Labor. 2016. New York's Largest Private Sector Employers. August 2016. Downloaded from https://labor.ny.gov/stats/nys/Largest-private-sector-employers-NYS.shtm on February 20, 2017.

[50] New York State Pollution Prevention Institute. 2016. Data provided by Ava Labuzetta on January 9, 2017, and summarized in: Ava Labuzetta, Melissa Hall, and Thomas Trabold. "Initial Roadmap for Food Scrap Recovery and Utilization in New York State." November 2016.

[51] New York State Pollution Prevention Institute. 2016. Data provided by Ava Labuzetta on January 9, 2017, and summarized in: Ava Labuzetta, Melissa Hall, and Thomas Trabold. "Initial Roadmap for Food Scrap Recovery and Utilization in New York State." November 2016.

[52] Bikeshare. Bikeshare Cities. Accessed February 9, 2017. http://bikeshare.com/map

[53] Zipcar. Where the Cars Are. Accessed February 9, 2017. http://www.zipcar.com/cities

[54] Shared Mobility, Inc. Results provided by Mike Galligano via email on February 9, 2017.

[55] U.S. Census Bureau. 2014 TIGER/Line Shapefiles with Selected Demographic and Economic Data. Downloaded from https://www.census.gov/geo/maps-data/data/tiger-data.html on February 1, 2017.

[56] U.S. Census Bureau. 2014 TIGER/Line Shapefiles with Selected Demographic and Economic Data. Downloaded from https://www.census.gov/geo/maps-data/data/tiger-data.html on February 1, 2017.

[57] Division of Criminal Justice Services, New York State. 2015 County Index Crime Counts and Rates Per 100,000 Population. Downloaded from http://www.criminaljustice.ny.gov/crimnet/ojsa/countycrimestats.htm on February 10, 2017.

IEc calculated the final index score, which ranges from 0-6, for each town by assigning one point for each of the following:

- At least one block group with medium or high population density (at least 366 people per km^2);

- At least one block group with a high proportion (at least 26.7 percent) of residents over age 65;

- At least one block group with more than 14.3 percent of households below the poverty level;

- Having a carshare or bikeshare program;

- Having a university with enrollment greater than 5,666 students; and

- Having a large employer, defined as either a hospital with more than 370 beds or a large employer as identified by the New York State Department of Labor.

Because interviewees indicated that public transit use and accessibility is vital to the success of TDM initiatives, IEc presented the results of the index score in two ways: first, considering all areas regardless of public transit usage, and second, considering only those towns that contained at least one block group with high public transit usage (at least 12 percent). In addition, IEc treated towns and cities with the same name and county as one unit – for example, although the city and town of Poughkeepsie are distinct municipalities for administrative purposes, for the purposes of this analysis, both are assumed to be part of a single metropolitan area and thus receive a single score.

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