Appendix 1

Briefing Books

Energy

Introduction

The role of energy in transportation planning and decision making is significant. As of 2015, the transportation sector accounted for the second highest proportion of energy consumption in the United States with total consumption approaching 30 quadrillion Btu. The transportation industry however is by far the largest consumer of petroleum, requiring upwards of 14 million barrels per day, almost triple that of the industrial sector. The negative consequences of burning petroleum are long-documented and include increased air pollution and the releasing of CO2 gases which contribute heavily to global warming.

The majority of transportation emissions stem from the prolonged dominance of the private automobile as a means of getting from one place to another. This issue is especially prevalent in New Jersey where 80% of all residents commute to work by automobile. The NCHRP's 'Preparing State Transportation Agencies for an Uncertain Energy Future' is meant to assist stakeholders and decision makers in planning various scenarios of energy availability, given the volatile geo-politics and international relations associated with petroleum production and export.

Where Are We Now? Trends & Conditions

- The dominance of the private automobile is attributed to the surge in road and highway infrastructure that occurred in the post-World War II era, at the expense of existing rail and public transit infrastructure.

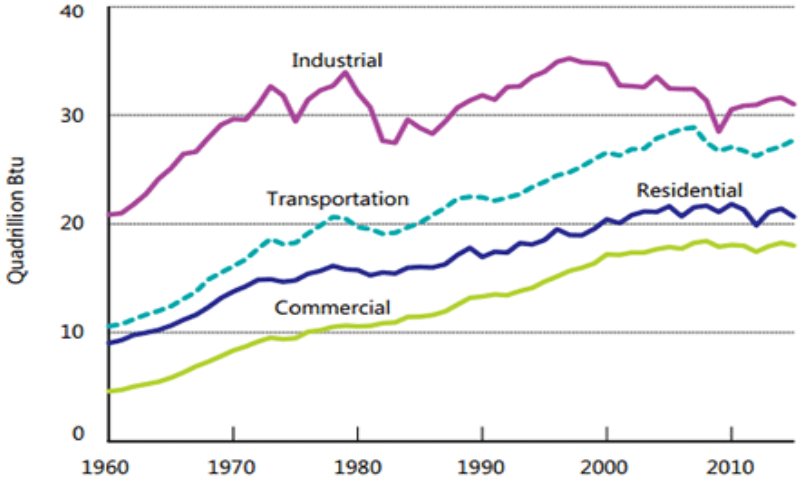


Figure 1: United States Energy Consumption by Sector: 1960-2015 (Source: United States Department of Energy

- As a result, highway dominates, specifically from light duty vehicles, as the mode with the most greenhouse gas (GHG) emissions.

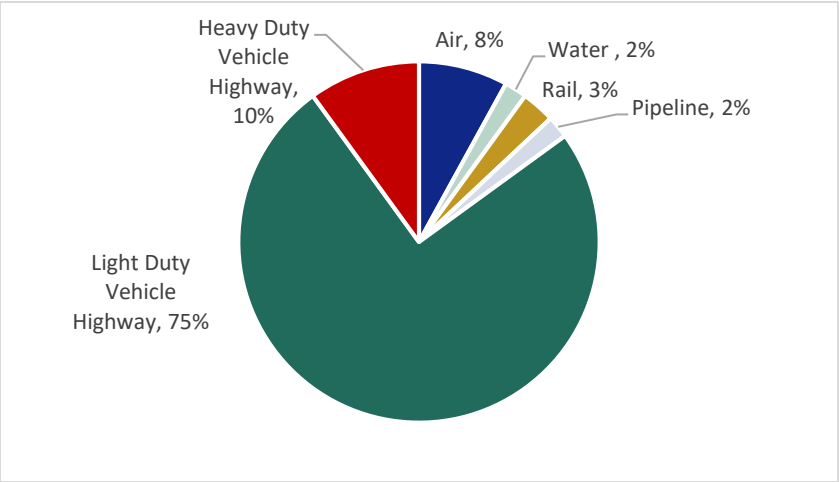


Figure 1: Greenhouse Gas Emissions by Transportation Mode: 2014 (Source: United States Environmental Protection Agency, United States Department of Transportation)

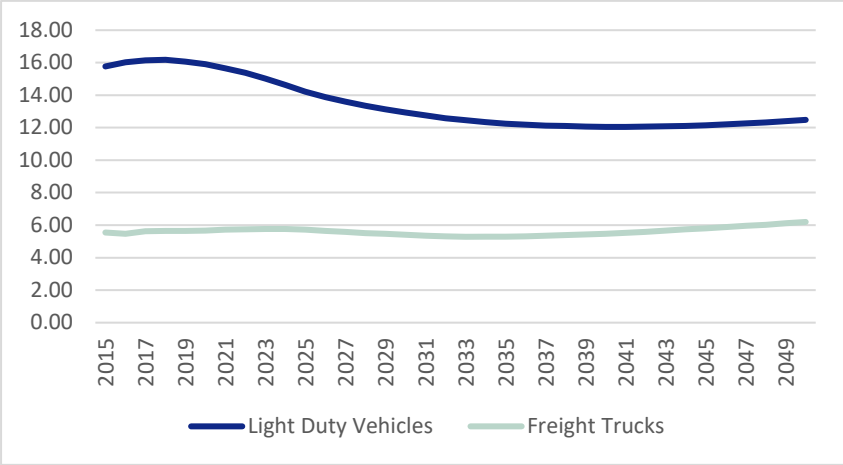


Figure 3: Energy Use by Highway Mode (Source: U.S. Energy Information Administration)

- However, total highway fuel use is expected to drop in the upcoming years, due to stronger regulations on fuel economy and pollutant emissions, especially for light duty vehicles.
- Trends of alternative fuel-powered vehicles research & development are being driven by petroleum price volatility, political instability in other petroleum-producing countries, United States EPA standards and a general movement towards environmental sustainability.

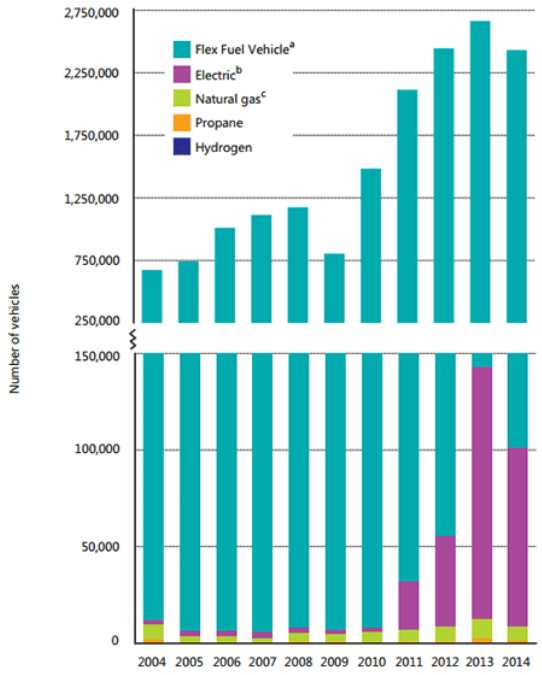


Figure 4: Alternative Fuel Vehicles by Fuel Type (Source: United States Department of Transportation)

- Following failed efforts to develop and successfully market electric vehicles in the 1990s, such vehicles are becoming more common on United States roads.

- Because state and national gas taxes are imposed at a flat rate per gallon, increased fuel efficiency and electric vehicle market penetration will mean less transportation funding from the gasoline tax.

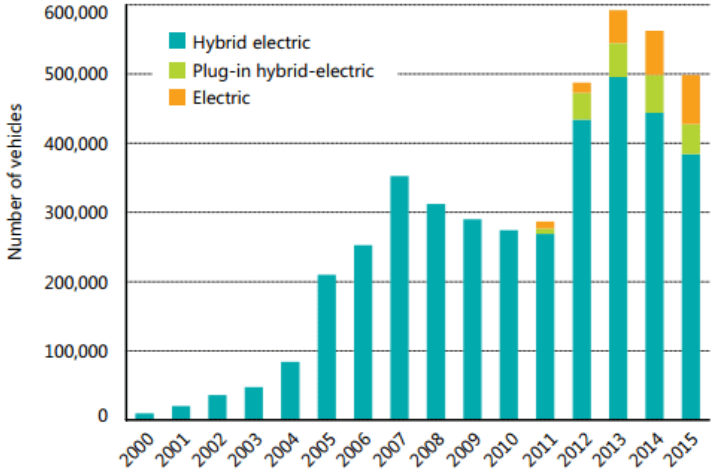


Figure 5: Gasoline Hybrid and Electric Vehicle Sales: 2000-2015 (Source: United States Department of Energy)

- Moving forward, there is a need to reduce transportation emissions, while developing more effective and sustainable means of funding transportation projects.

What Does the Future Hold? Possible Trends

New Jersey's dense transportation infrastructure and suburban, automobile-accommodating landscape make the topic of energy, particularly vital to effective and sustainable future transportation planning and decision making. Based on NCHRP's energy volume, multiple related trends are identified, which will significantly affect the State in the short- and long-term.

Trend 1: Continued Volatility in Petroleum Prices

THE TREND

Uncertain international relations could lead to fluctuations in petroleum prices.

FOR NEW JERSEY THIS MAY MEAN

- Low gasoline prices & increased VMTs in the short-term.
- Stagnant or reduced electric vehicle sales in the short-term.
- Uncertainty about the effects of fuel prices on VMT in the long-term.

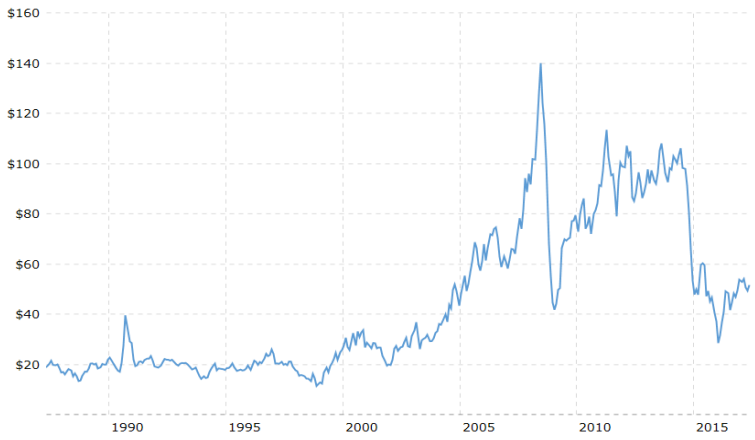


Figure 6: Crude Oil Prices: 1987-2017 (Source: Macrotrends.net)

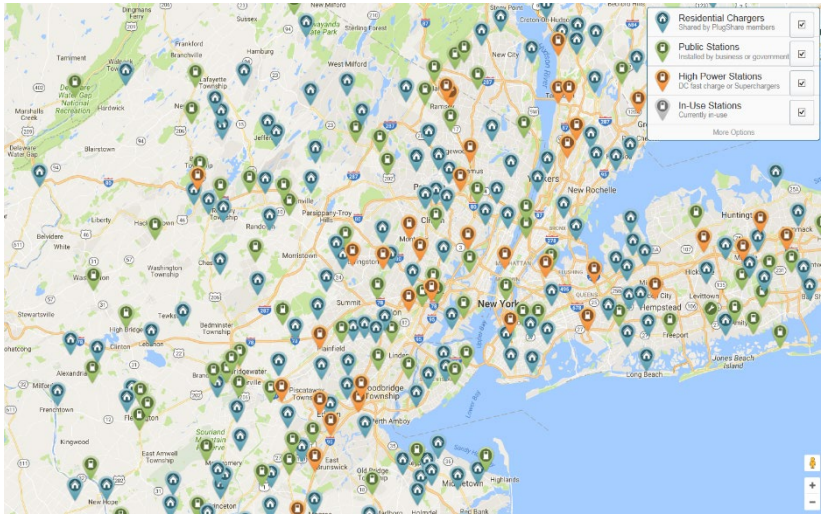
- Crude oil has remained relatively cheap around $50/barrel in recent years, but not too long ago, prices reached almost triple that amount.

Trend 2: Growth in Alternative Fuel Vehicles & Technologies

THE TREND
Continued technological advances and growth of electric vehicle infrastructure.

FOR NEW JERSEY THIS MAY MEAN

- Increased sales of alternative fuel vehicles, dependent on conventional fuel prices.
- Decreased conventional fuel use, dependent on pricing.



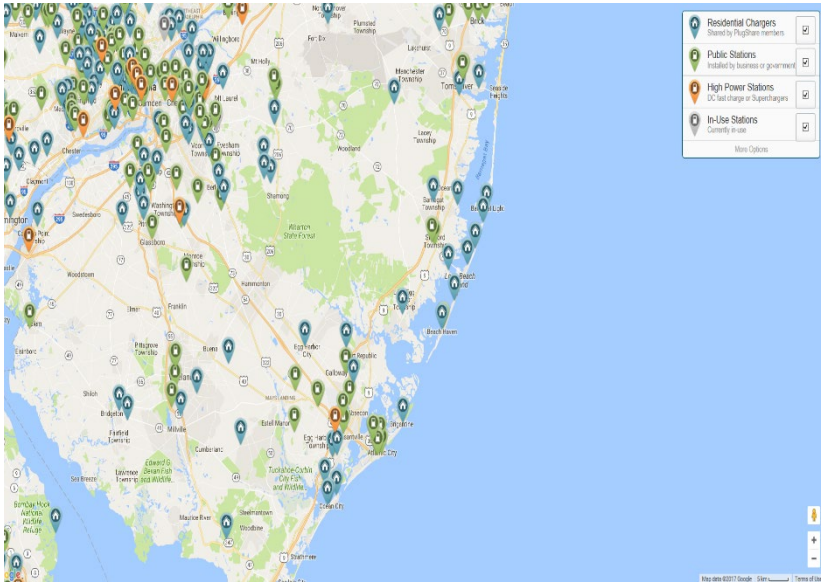


Figure 7 A-B: Electric Vehicle Charging Stations in North (Above) and South (Below) Jersey (Source: PlugShare.com)

Trend 3: Stagnant Gasoline Tax Revenue

THE TREND

New Jersey's gasoline tax was recently raised for the first time in 19 years, making another tax unlikely to occur any time soon.

FOR NEW JERSEY THIS MAY MEAN

- Inadequate funding to address growing multi-modal statewide infrastructure needs.
- Reduced new construction of roads and public transit extensions.

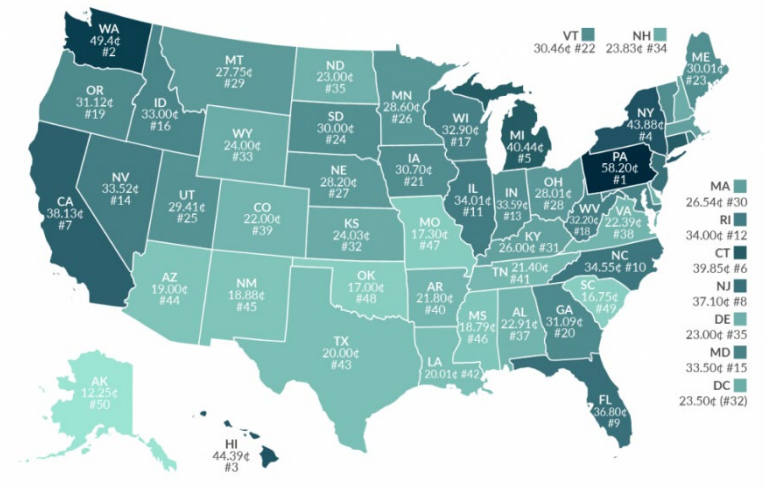


Figure 8: 2017 State Gasoline Taxes (Source: TaxFoundation.org)

- As of 2017, New Jersey has one of the higher gasoline taxes in the United States.
- Despite relatively high gasoline taxes, New Jersey could still see reductions in total state plus federal transportation revenues over the next decade.

Freight

Introduction

The freight transportation system is an integral component of the national and state economy. Each day, upwards of 50 million tons of goods, valued at over $45 billion are transported throughout the United States. Given it's positioning within the heart of the Northeast Corridor Megaregion, direct access to Philadelphia, New York City and the global gateway of the Port of New York and New Jersey, and over 800 million square feet of warehousing and distribution center space statewide, a sizeable portion of these goods make their way to or through New Jersey. The result of its location and well-established transportation infrastructure system, New Jersey's freight and logistics industry employs well over 500,000 people.

The need to maintain an efficient and reliable freight transportation system is reflected by the ever-changing nature of the freight sector. Seemingly simple innovations such as the 1956 invention of the metal cargo container in Newark and the continued process of containerization have had profound impacts on the nature and movement of freight and there is a pressing need to plan for emerging trends, such as autonomous trucks, 3D printing, continued growth in e-commerce, and the potential for those trends to change supply chains and freight travel patterns. The NCHRP's 'Scenario Planning for Freight Transportation Infrastructure Investments' introduces scenario-based decision making as a means of identifying and planning for the effects of such innovations and macro shifts on freight transportation and infrastructure management.

Where Are We Now? Trends & Conditions

- In recent years, containerization and the rise in personal online shopping have significantly influenced national trends in freight movement.

- Containerization provides increased levels of standardization, safety & security, accountability, identity preservation and an efficient method of managing and transferring intermodal cargo, compared to traditional break bulk methods.

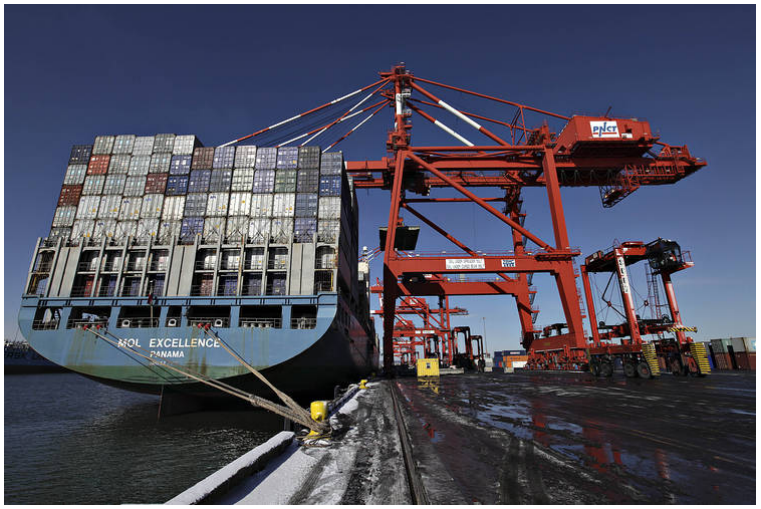


Figure 1: Port Newark (Source: Wall Street Journal)

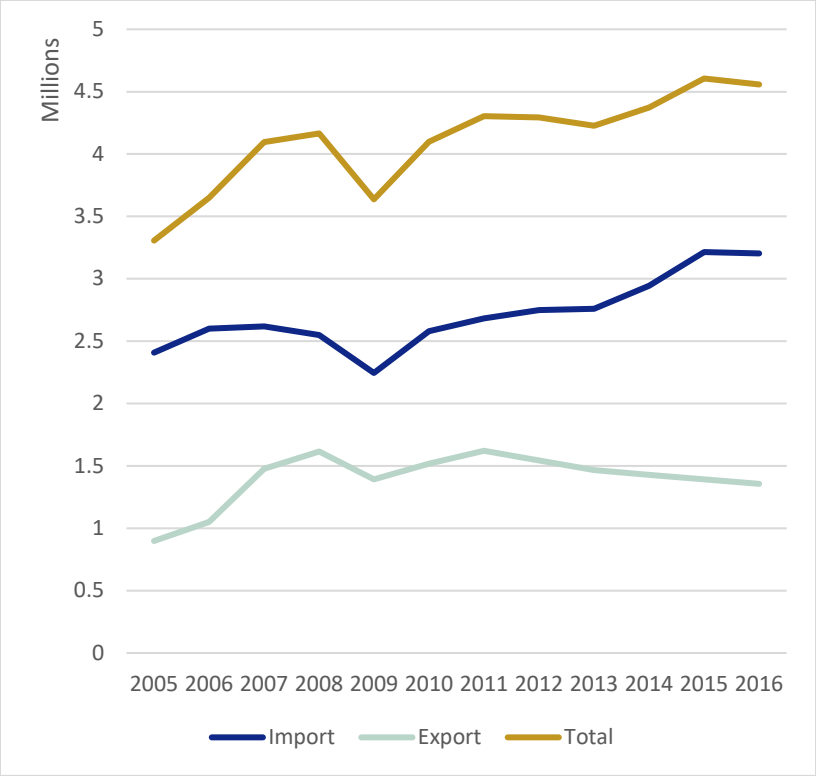


Figure 2: Containerized Cargo Volume, PANYNJ Terminals 2005-2016 in TEUs (Source: Port Authority of New York & New Jersey

- Combinations of increased global trade and containerization have led to increased infrastructure investment needs and spurred projects such as the Panama Canal widening.

- The Panama Canal allows for the passing of ships with a cargo capacity of 13,000 TEU, compared to a previous ceiling of 5,000 TEU and could lead to increased demand at East Coast seaports given the increased access to East Asian markets.

- Despite the investment in the widened Panama Canal however, today's largest container vessels are approaching 20,000 TEU capacity, and are too large to traverse the Canal.

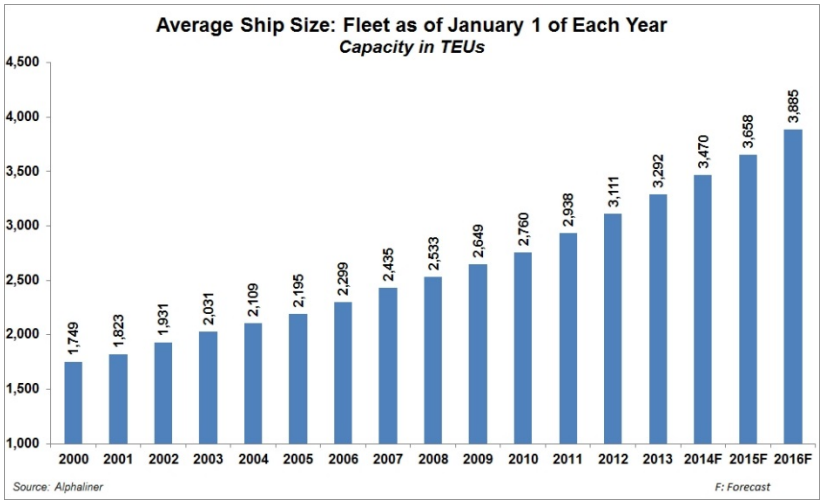


Figure 3: 2000-2014 Average Ship Size by TEUs (Source: Alphaliner)

- Additional freight investments in New Jersey and the United States are taking place to meet this demand, such as the raising of the Bayonne Bridge deck span to accommodate large ships into and out of the Port of New York and New Jersey marine terminals in Elizabeth, Newark, and Staten Island, NY. In 2017, the air draft clearance under the Bayonne Bridge was raised from 151 feet to 225 feet above Kill Van Kull, and in July, the 13,200 TEU container ship OOCL Berlin became the largest ship to call the Port of New York and New Jersey.

- Freight is increasingly being driven by e-commerce giants such as Amazon, as the demand for distribution and fulfillment center space within proximity to large urban areas increases.

Figure 4: Bayonne Bridge Navigational Clearance Project (Source: SILive.com)

Figure 5: The Inside of an Amazon Fulfillment Center (Source: Nooga.com)

- E-commerce will continue to be a significant driver of freight demand, and will continue to change the ultimate destination of shipments to consumers' desired delivery points, instead of to traditional retail stores. Further, because a large share (30%) of e-commerce purchases are returned, a growing "reverse logistics" system handles the shipment and transport of returned items back to the fulfillment center. The e-commerce trend will influence traffic and infrastructure planning for years to come.

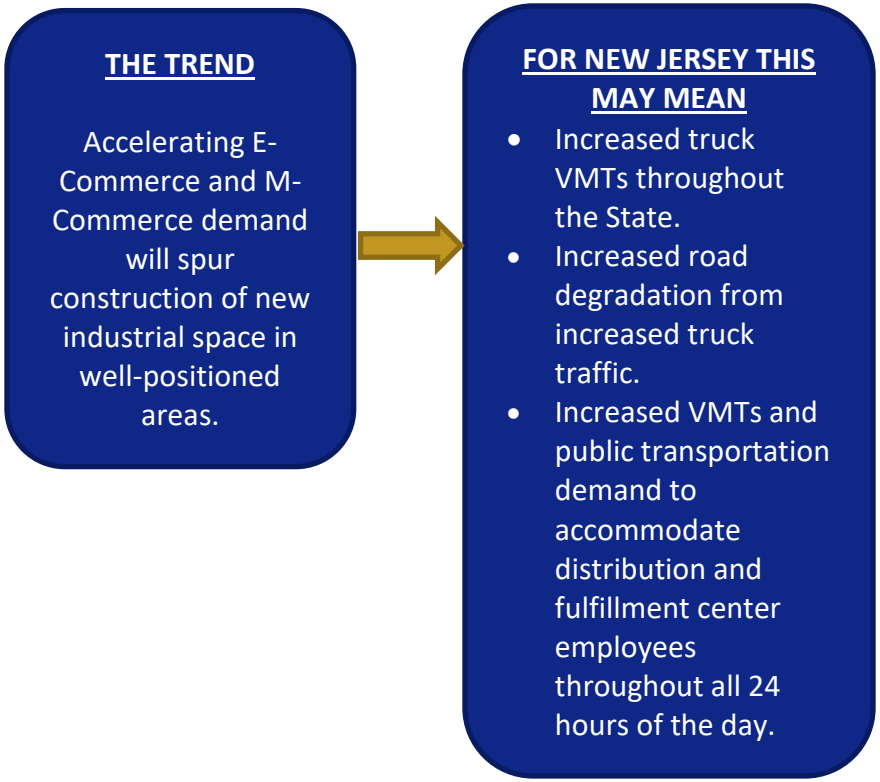
- Autonomous vehicle technologies are being tested for freight applications, and widespread deployments of the technology could come in the near future.

- In the near-term, humans will continue to drive trucks, and in the first generations of autonomous vehicle deployment, humans will be in the driver's seat. For this reason, there remains a need to make truck parking spaces available to drivers when they are needed—primarily in the overnight hours. Drivers must comply with strict hours of service regulations, which require ten hours of rest after being on duty for 14 hours (11 of which may be spent driving). In New Jersey, as well as many other states, there is an insufficient supply of safe, designated parking spaces for truck drivers to use in order to comply with the hours of service regulations.

What Does the Future Hold? Possible Trends

Positioned at the heart of the Northeast Corridor Megaregion and with immediate proximity to New York City and Philadelphia, the implications of an evolving freight industry on New Jersey are significant. Based on the NCHRP's freight volume, multiple related trends are identified which will particularly affect New Jersey and statewide logistics-based planning efforts.

Trend 1: Continued E-Commerce and Mobile (M-) Commerce Growth



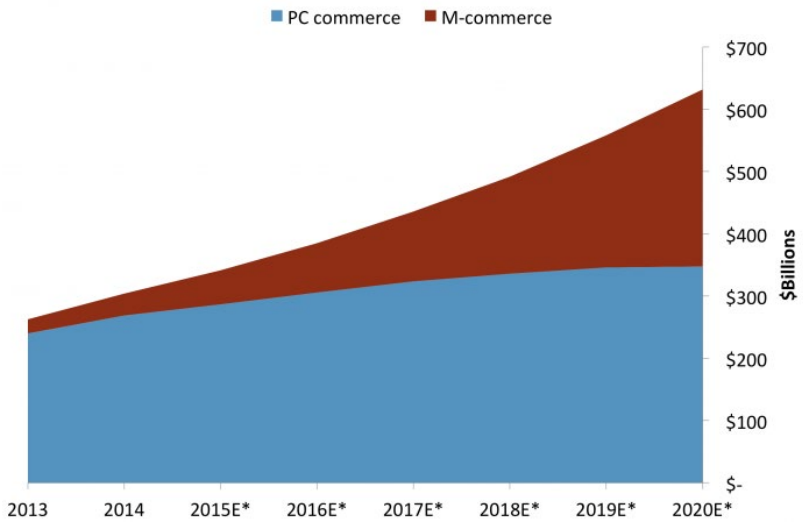


Figure 6: E-Commerce Sales Growth (Source: Forbes.com)

- E-commerce and mobile-based commerce growth are expected to continue in the upcoming years.

Trend 2: 286,000lb Rail Track Capacity Standardization

THE TREND

The Federal Railroad Administration has increasingly advocated for the upgrade of all freight railroad tracks to accommodate loaded rail cars of 286,000 pounds.

FOR NEW JERSEY THIS MAY MEAN

- Increased freight rail traffic.
- Increased multimodal connections throughout the State.
- Increased multimodal traffic.
- Growing pressure to improve lines and structures that are not yet capable of accommodating 286k loads.

Trend 3: Reductions in Truck Parking Availability

THE TREND
Truck parking supply does not meet current or projected future demands.

FOR NEW JERSEY THIS MAY MEAN
- Increased truck parking on road shoulders.
- Increased vehicular accidents involving parked trucks on highways.

Figure 9: Truck Parked on Shoulder of I-287 North in Mahwah, NJ (Source: CBS2)

Trend 4: The Rise of Driverless Trucks

THE TREND
Trucks will likely be the first vehicle types to be affected significantly by driverless technology.

FOR NEW JERSEY THIS MAY MEAN
- In early years of deployment, there will be little change in demand for truck drivers.
- Longer term, there could be reduced demand for long-haul truck drivers offset by increased demand for 'first and last mile' truck drivers.
- Increased truck VMTs.
- Reduced accidents involving parked trucks, especially at night.
- Decreased accidents as a result of computerized driving technology, potentially offset by increased accidents resulting from drivers interacting with increased numbers of trucks.

New Technologies

Introduction

The incorporation of innovative and new technologies will be essential for the provision of effective and sustainable multi-modal transportation, especially in an era of increasing demand and limited funding. Effective use of new technologies will need to involve cooperation amongst multiple entities. In New Jersey, the rapid and unprecedented rise of shared mobility and transportation network companies (TNCs) such as Uber and Lyft, will have multiple consequences on transportation planning and decision making. At the same time, the potential benefits of these new transportation options are significant. From a freight standpoint, driverless vehicles may significantly enhance efficiency, but may also result in lost jobs.

The significant potential and simultaneous unpredictability associated with new technologies, makes related decision making a challenging task. The NCHRP's 'Expediting Future Technologies for Enhancing Transportation System Performance' is meant to assist stakeholders and decision makers in identifying, assessing and implementing technologies of potential benefit to multi-modal transportation planning. Based on these processes, this report focuses on three distinct branches: User Mobility, Public Transportation and Freight.

Where Are We Now? Trends & Conditions

- Traffic related deaths have declined significantly in recent decades as a result of improved vehicle safety and increased seatbelt use.

- In the current decade, Intelligent transportation systems (ITS) are increasingly becoming commonplace, driven by safety and security, and the need to efficiently manage multi-modal passenger and freight transportation on constrained infrastructure systems.

- ITS is a purposefully broad term and refers to the implementation of multiple technologies such as dynamic traffic and weather management, traveler information, electronic payment and pricing, commercial vehicles operations, and transit management.

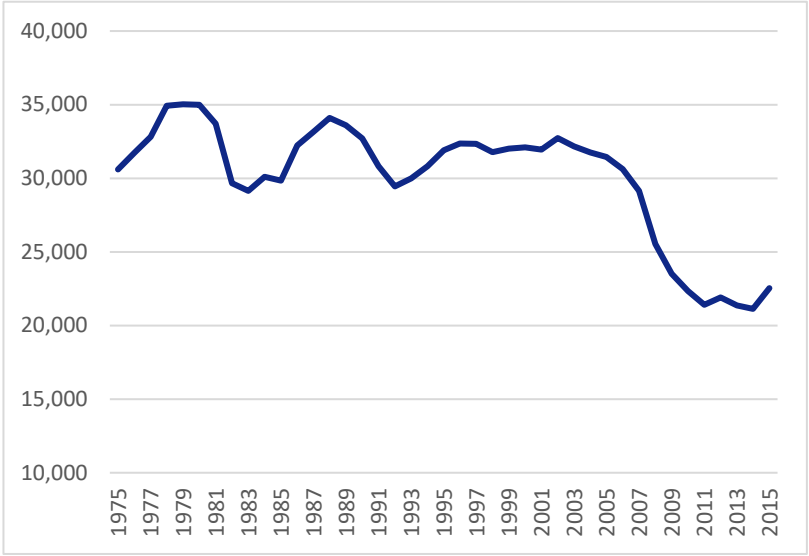


Figure 1: Passenger Vehicle Occupant Deaths
(Source: Insurance Institute of Highway Safety)

- The rise of TNCs, most notably Uber and Lyft in recent years, have significantly affected personal transportation while also affecting the taxi industry.

- New technologies ranging from shared mobility and TNCs to automated connected vehicles allows for the collection of large amounts of data, and optimized decision making. On the other hand, this also raises privacy concerns, especially as consumer data from personal mobile devices play an increasing role in getting around.

Figure 2: Dynamic Travel Time Sign on Interstate 195 East in Upper Freehold Township (Source: New Jersey Department of Transportation)

Figure 3: Connected Vehicles Simulation (Source: Volpe National Transportation Systems Center)

What Does the Future Hold? Possible Trends

Owning to a well-connected and dense transportation network, New Jersey could stand to benefit notably from the impacts of new technologies, especially in the form of ITS. The future scenarios to follow are broken out based on the following categories:

1. Individual Mobility
2. Mass Transit
3. Freight.

Category 1: Individual Mobility

Trend 1: Continued Rise of TNCs

THE TREND

As a result of increased smart phone use and cheaper fares especially in comparison to taxis, ridesharing apps will continue to rise in popularity

FOR NEW JERSEY THIS MAY MEAN

- More trips occurring through rideshare
- Reduced taxi trips, especially in urban areas
- Increased transit use given increased rideshare access to transit hubs, possibly offset by use of ridesharing as an alternative to public transit.
- Decreased VMTs from declining car ownership, possibly offset by increased numbers of rideshare trips.

- The rise of TNCs has almost instantly disrupted the once-dominant taxi industry, with taxi trips falling by at least 30% since TNCs gained traction in 2015.

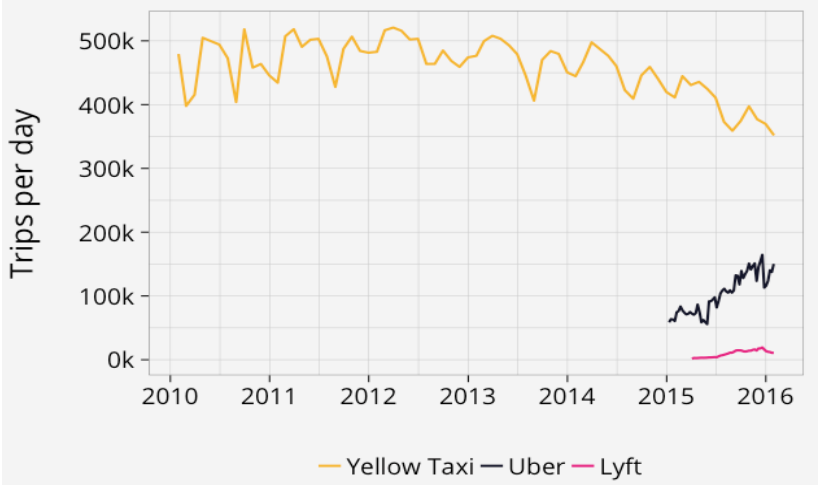


Figure 4: New York City Market Share of Taxis, Uber and Lyft by Year
(Source: New York City Taxi & Limousine Commission Data & ToddWSchneider.com)

Trend 2: Rise of Connected & Automated Vehicles

THE TREND
Billions of dollars in research funding are being poured in to develop and perfect automated vehicles for everyday use

FOR NEW JERSEY THIS MAY MEAN

- Decreased vehicular accidents given superior perception capabilities of connected and automated vehicles.
- Increased vehicle miles of travel due to reduction in travel costs and ability of existing infrastructure to accommodate more vehicles.

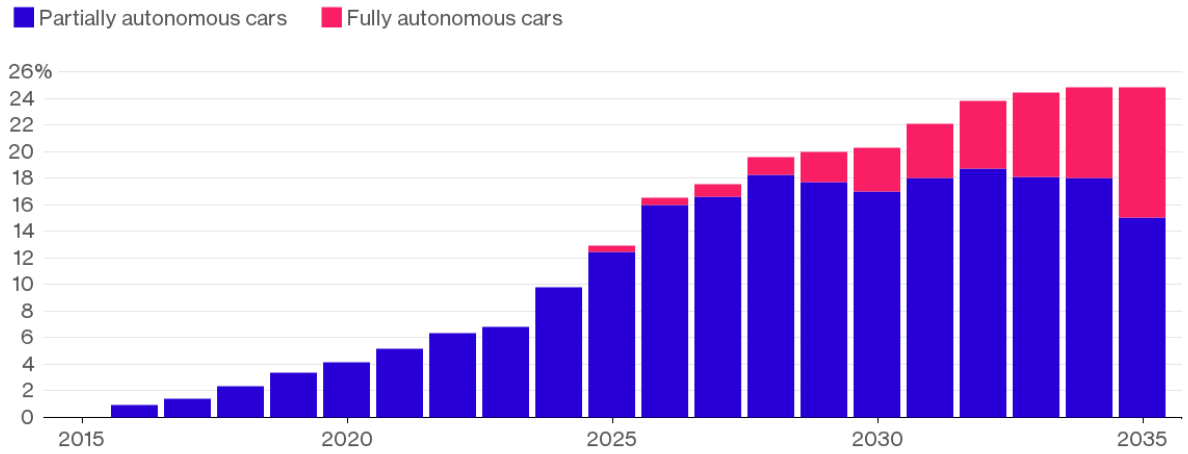


Figure 5: Estimated Future Market Penetration of Partially & Fully Autonomous Vehicles
(Source: Bloomberg & Boston Consulting Group)

Category 2: Mass Transit

Trend 3: Continued Embrace of Mobile Applications

THE TREND

Transit agencies will continue to embrace mobile technology by transmitting more accurate and live information to their users' phones and apps

FOR NEW JERSEY THIS MAY MEAN

- More reliable public transit service
- Potential opportunities and capabilities of multiple transit agencies to coordinate with one another on single user interfaces
- Better data resources for system optimization, fare collection, and user feedback

Trend 4: Vehicle Driver Automation

THE TREND

The technology associated with connected and driverless cars will also affect public transit agencies

FOR NEW JERSEY THIS MAY MEAN

- Shifting roles for public transit vehicle drivers to customer service and safety.
- Increased operating efficiency at bus and rail public transit agencies.
- Increase employment in safety and security at public transit agencies to ensure seamless operation of new system technologies.

Trend 5: Big Data & its Increasing Role in Decision Making

THE TREND

Through the increasing sharing and availability of consumer data, big data will play an increasing role in transportation planning and decision making.

FOR NEW JERSEY THIS MAY MEAN

- Increased accuracy of available multi-modal real-time information.
- Increased oversight capabilities of existing infrastructure and transportation networks.

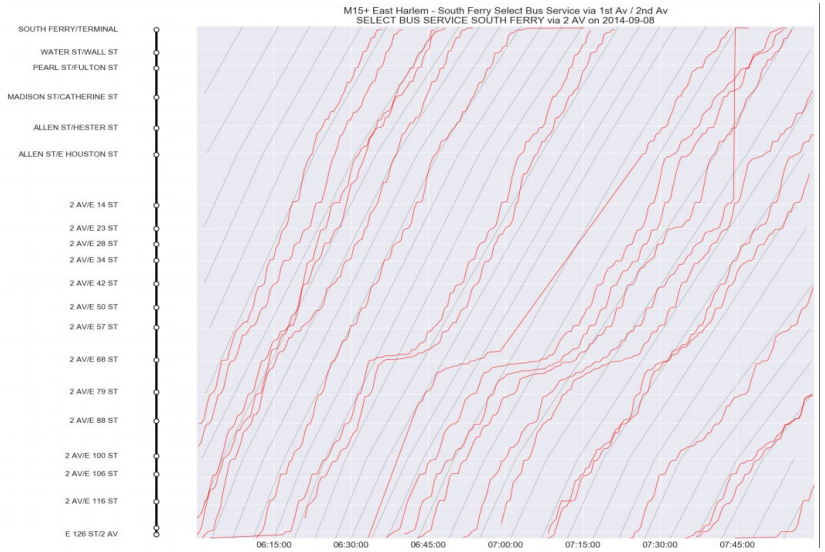


Figure 5: Analytics to Identify Bus-Bunching by Route, and Time-of Day (Source: Cambridge Systematics, Inc.)

Category 3: Freight

Trend 6: Shared Freight 'Mobility'

THE TREND

Co-mingling passenger ridesharing and freight trips, will impact the freight industry

FOR NEW JERSEY THIS MAY MEAN

- Increased freight and supply chain efficiencies as demand for short- and long-haul drivers is met.
- Increased capabilities to address 'first and last mile' freight issues.
- Explosion in data availability can be leveraged to create value, increase accurate predictions, and provide approaches that drive sound transportation planning and decision making.

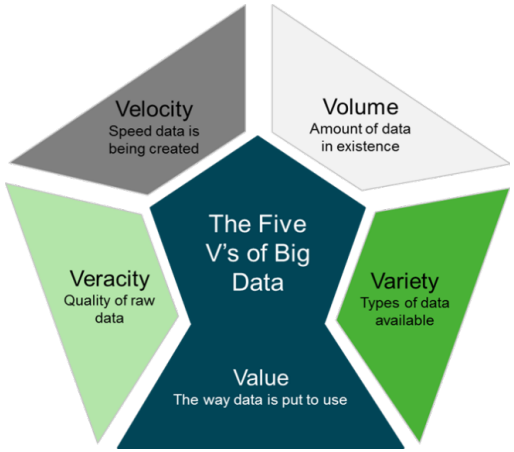


Figure 6: The Five "V's" of Big Data (Source: Deloitte, 2016)

Trend 7: The Rise of Driverless Trucks

THE TREND

Trucks will likely be the first vehicle types to be affected significantly by driverless technology

FOR NEW JERSEY THIS MAY MEAN

- Reduced demand for long-haul truck drivers offset by increased demand for 'first and last mile' truck drivers.
- Reduced accidents involving parked trucks, especially at night.
- Increased truck VMTs
- Decreased accidents as a result of computerized driving technology, potentially offset by increased accidents resulting from drivers interacting with increased numbers of trucks.
- A need to accommodate and plan for truck platoons.

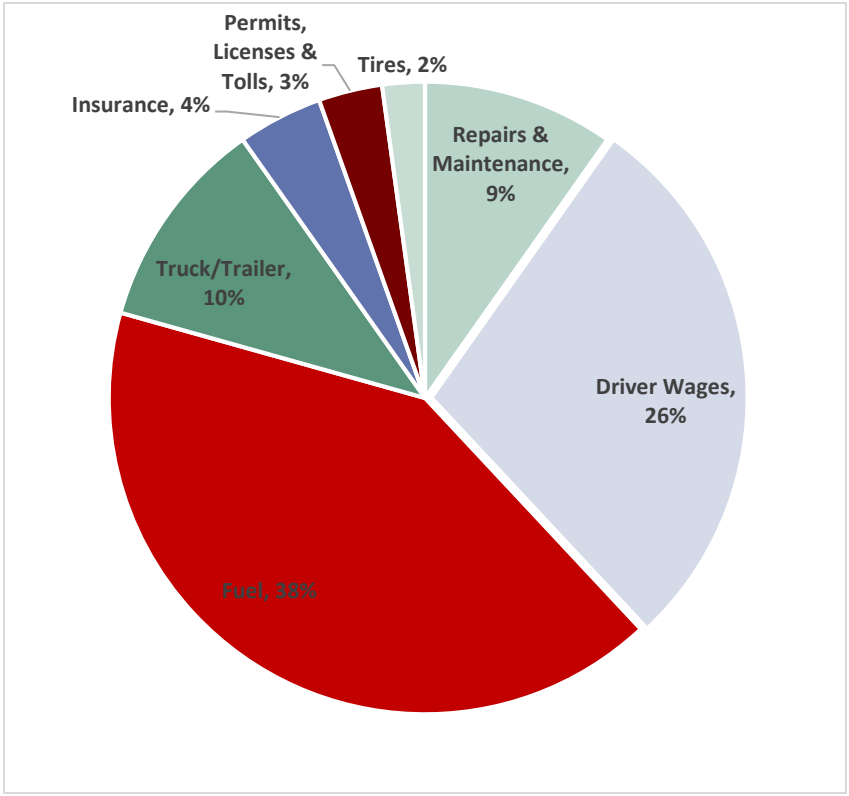


Figure 7: Commercial Truck Operating Costs
(Source: American Transportation Research Institute)

Sociodemographics

Introduction

The United States is in the midst of fundamental population and sociodemographic shifts. Technological advances, altered workplace trends and a general propensity of millennial populations towards cities and mixed-use neighborhoods are just some of the ongoing trends currently affecting the Nation's geographical landscape.[1] Combined with an increasingly aging and diverse population composure, these trends are expected to continue and even accelerate. In fact, by 2050, it is expected that upwards of 80% of the Nation's population will live in one of eleven 'mega-regions' consisting of interconnected metropolitan cities and regions.[2]

The implications of these shifts and trends are especially relevant in New Jersey, given its location in the heart of the Northeast Corridor, the largest of those identified mega-regions. On the one hand, New Jersey's urban cities are undergoing remarkable transformations as a result of proximity and transportation access to New York City. However, many of the State's low density suburbs may need to undergo significant transformations in order to attract and sustain the needs of residents in decades to come. As these changes occur down to the local and neighborhood scales, the effects on transportation habits and travel demand patterns will be substantial.

The NCHRP's 'The Effects of Socio-Demographics on Future Travel Demand' is meant to assist stakeholders in identifying ongoing and future socio-demographic trends and assessing the implications for transportation planning and travel demand forecasting.

Where Are We Now? Trends & Conditions

- Although cities were traditionally the centers of commerce and economic activity, it was the low-density suburbs that grew out of them that significantly shaped modern day transportation habits.
- Suburbia and the automobile-accommodating, low-density lifestyle greatly appealed to veterans returning home from World War II.

Figure 1: Willingboro, New Jersey, 1958 (Source: NJ.com)

[1] https://www.citylab.com/equity/2017/01/flood-tide-not-ebb-tide-for-young-adults-in-cities/514283/

[2] http://www.america2050.org/megaregions.html (Regional Plan Association)

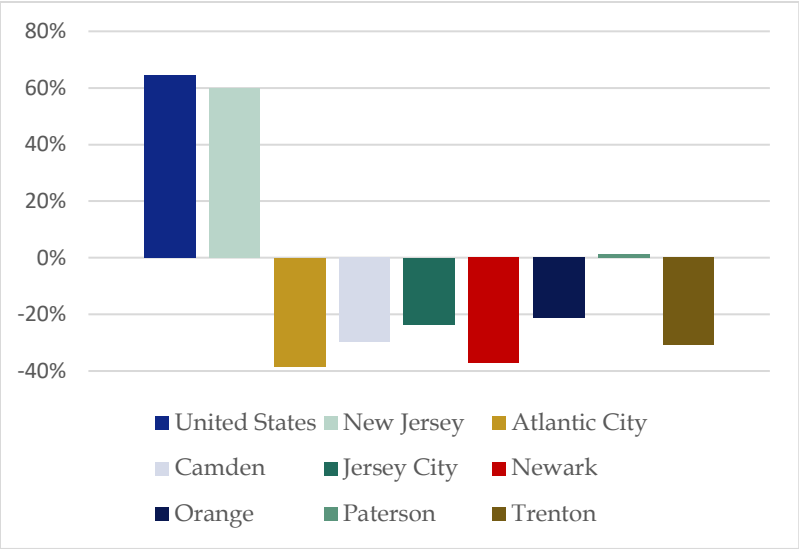


Figure 2: Population Growth of Select Urban New Jersey Municipalities 1950-1990 (Source: United States Census)

- Suburbia's growth came at the expense of traditional urban areas however. Between 1950 and 1990, although New Jersey's population grew by almost 60%, the State's traditional urban cities saw declines of up to 40%.[3]
- As predominantly middle class and wealthy Whites left urban areas for the suburbs, New Jersey's city became increasingly plagued with crime, poverty and disinvestment.
- In recent years however, New Jersey's urban areas are once again growing. Driven by Millennials, transit-served mixed-use neighborhoods, as opposed to front lawns and picket fences, are driving the State's migration patterns.
- Urban areas that suffered decades of neglect are experiencing remarkable renaissances in residential and economic development, while low-density suburban areas are beginning to lag.

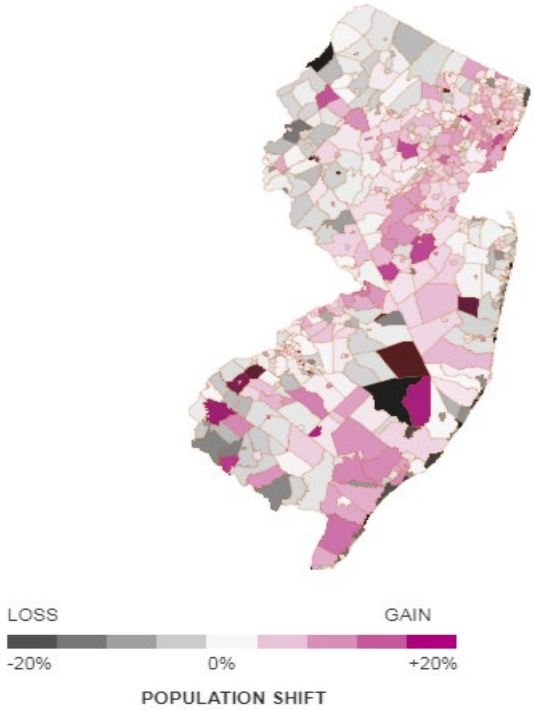


Figure 3: New Jersey Population Shift 2005-2009 to 2011-2015 (Source: nj.com/news/index.ssf/2016/12/4_big_ways_that_new_jerseys_demographics_are_changing.html)

[3] United States Census

Figure 4: Rendering for New Luxury Condominiums in Downtown Jersey City (Source: JerseyDigs.com)

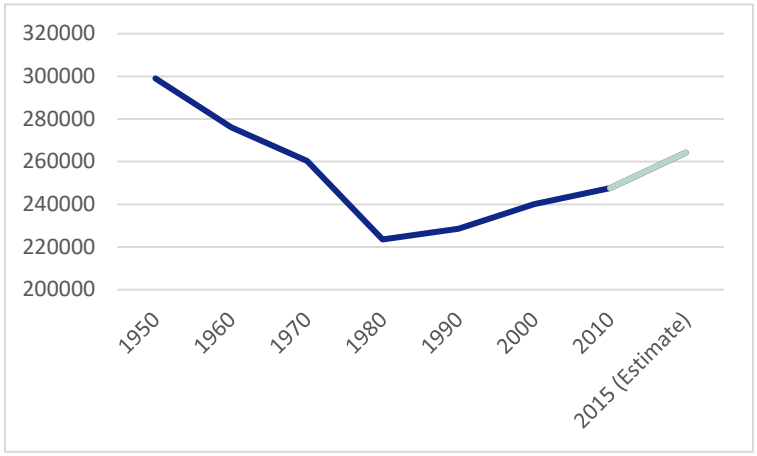


Figure 5: Jersey City Population 1950-2015 (Source: United States Census)

What Does the Future Hold? Possible Trends

The NCHRP identified 8 socio-demographic trends that will almost certainly affect travel demand and transportation habits in the years to come. If the shifting preferences for urban settings, combined with New Jersey's prominent strategic setting, are any indicators, then New Jersey is likely to experience these trends in an increasingly accelerated manner.

Trend 1: Reduced Population Growth Due to Declining Fertility Rates

THE TREND

No longer fertile, the baby-boomer generation is aging, while female labor participation rates are increasing

FOR NEW JERSEY THIS MAY MEAN

- Reduced demand for peak travel as more people retire.
- Increased reliance on public transportation.

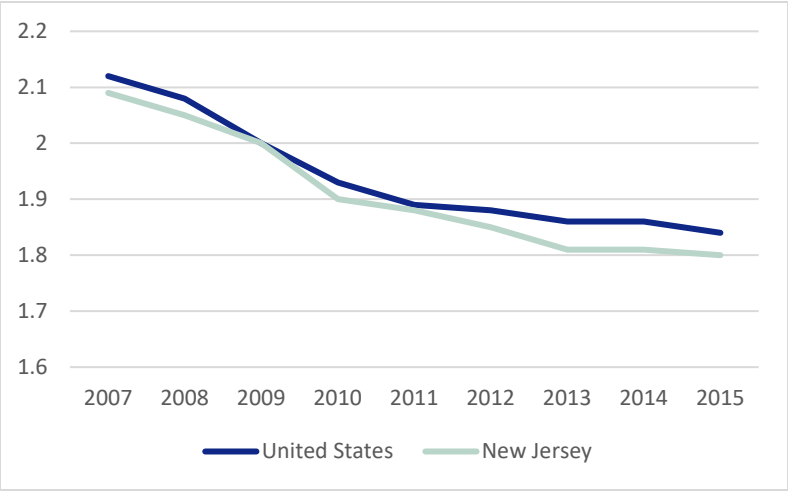


Figure 6: United States & New Jersey Fertility Rates 2007-2015 (Source: United States Center for Disease Control

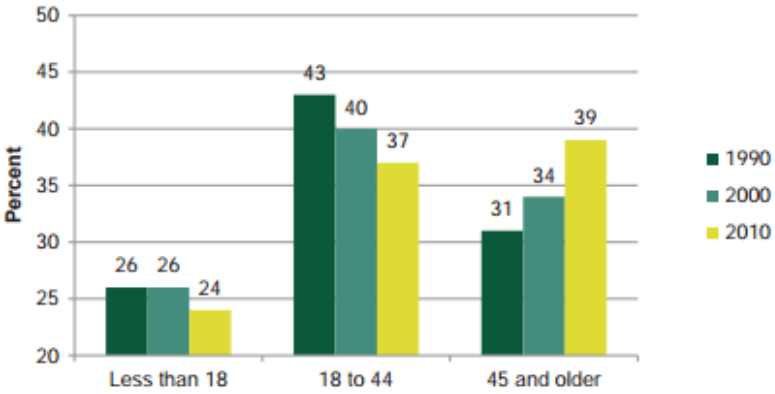


Figure 7: Proportion of U.S. Population by Age Group (Taken From NCHRP Report)

Trend 2: Graying of America

THE TREND

Americans are getting older. Between 2000 and 2010, the proportion of Americans over 45 surpassed the proportion of Americans between 18 and 45

FOR NEW JERSEY THIS MAY MEAN

- Increased VMTs in the short-run if older and retired Americans stay put in low-density areas.
- Reduced VMTs in the long-run as older Americans cease driving.

Trend 3: The Browning of America

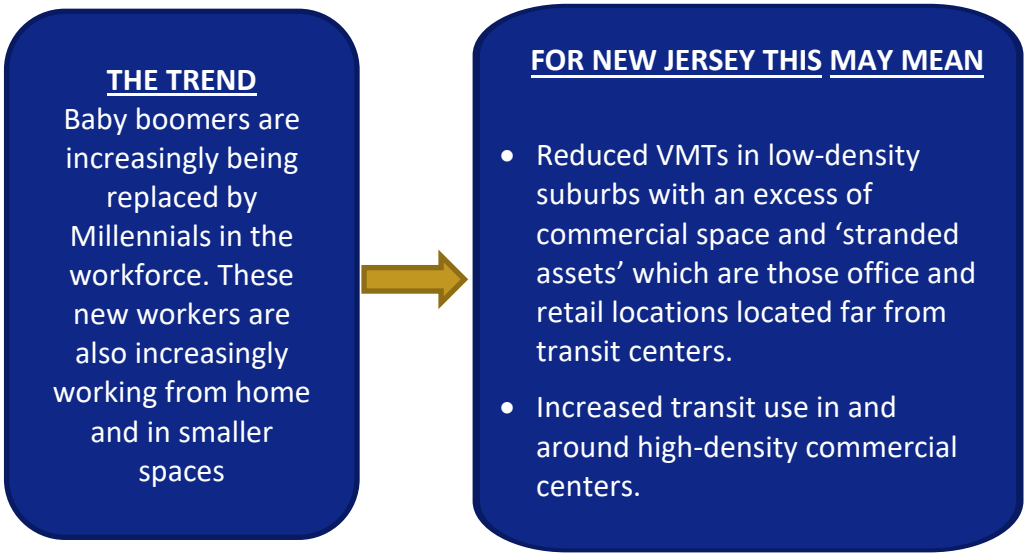
THE TREND

Owning to the proximity to major global centers, New Jersey will continue to see growing populations of Asian, Hispanic, Middle Easter and Afro-Caribbean populations of all socioeconomic statuses

FOR NEW JERSEY THIS MAY MEAN

- Increased public transit use in urban areas with large immigrant populations.
- Increased VMTs in suburban and low-density areas with wealthy immigrant populations.

Trend 4: Changing American Workforce



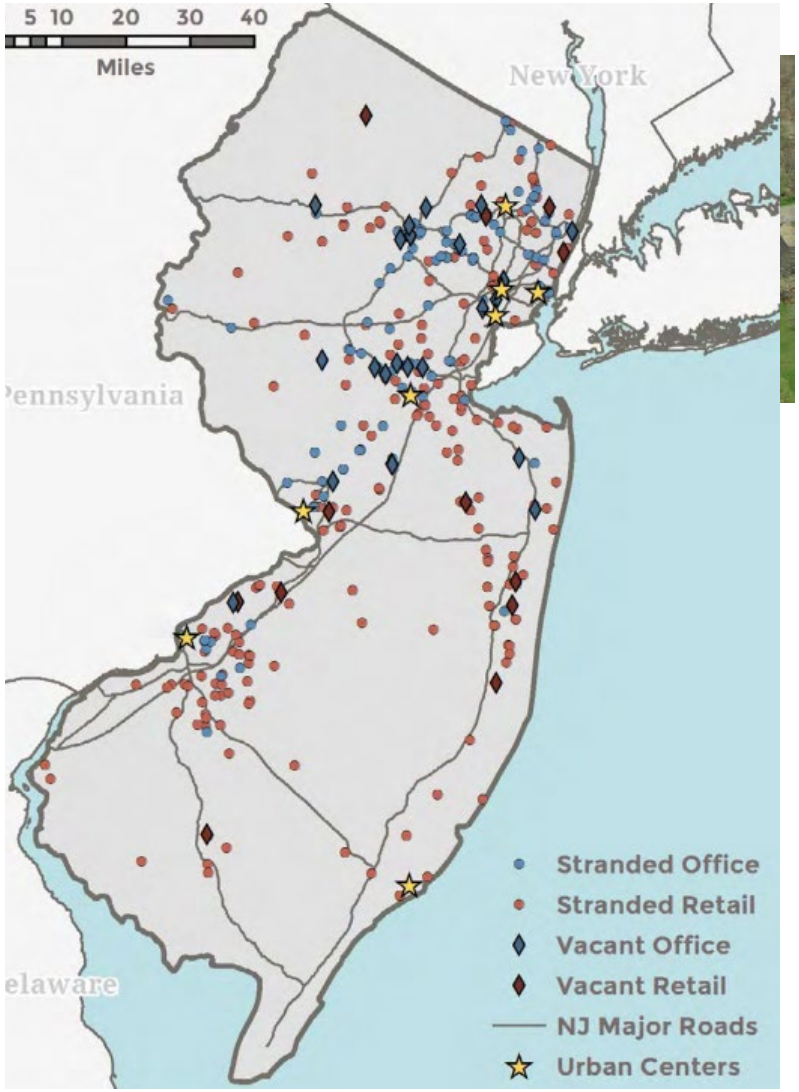


Figure 10: Map of Vacant and 'Stranded' Office & Retail Sites in New Jersey (Source: Plan Smart New Jersey

Trend 5: The Blurring of City and Suburb

THE TREND

Inner-ring urban-style suburbs with walkable downtowns, street grids and access to public transportation are becoming increasingly desirable

FOR NEW JERSEY THIS MAY MEAN

- Increased demand for public transportation in inner-ring suburbs.
- Increased demand for bicycling infrastructure.
- Potential for increased demand for public transportation in adjacent locales as existing residents are priced out of particularly strong mixed-use suburban real estate markets.

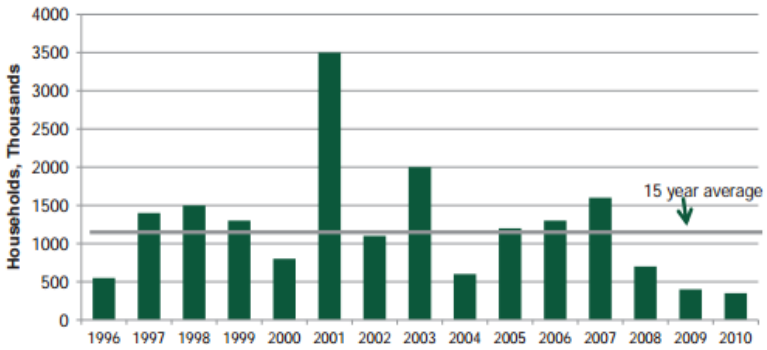


Figure 11: Net New Households, 1996-2010 (Taken from NCHRP Report)

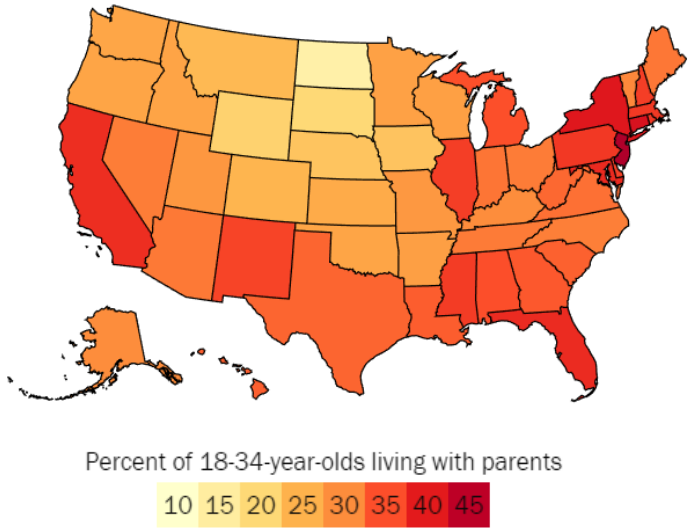


Figure 12: Percent of 18-34 Year Olds Living with Their Parents

Trend 6: Generation C

THE TREND

Generation C refers to the increasingly technology-driver and connected lifestyle more and more people are living.

FOR NEW JERSEY THIS MAY MEAN

- Reduced VMTs on commercial corridors with potentials for large retail vacancies given the rise of internet shopping.
- Increased truck VMTs around growing logistics hubs.

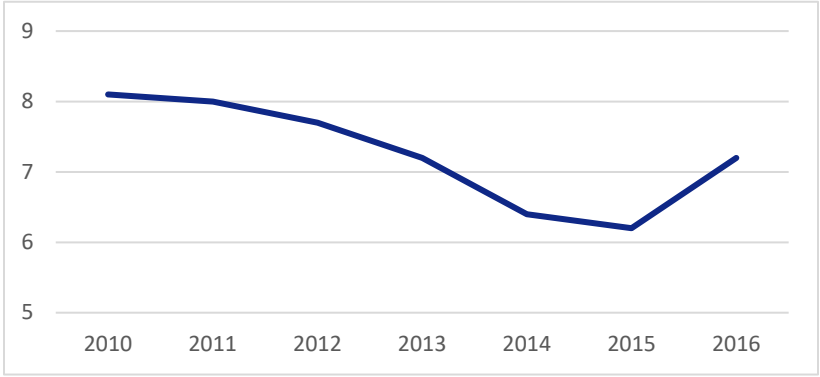


Figure 13: New Jersey Vacancy Percentage Rates (Source: Goldstein Group)

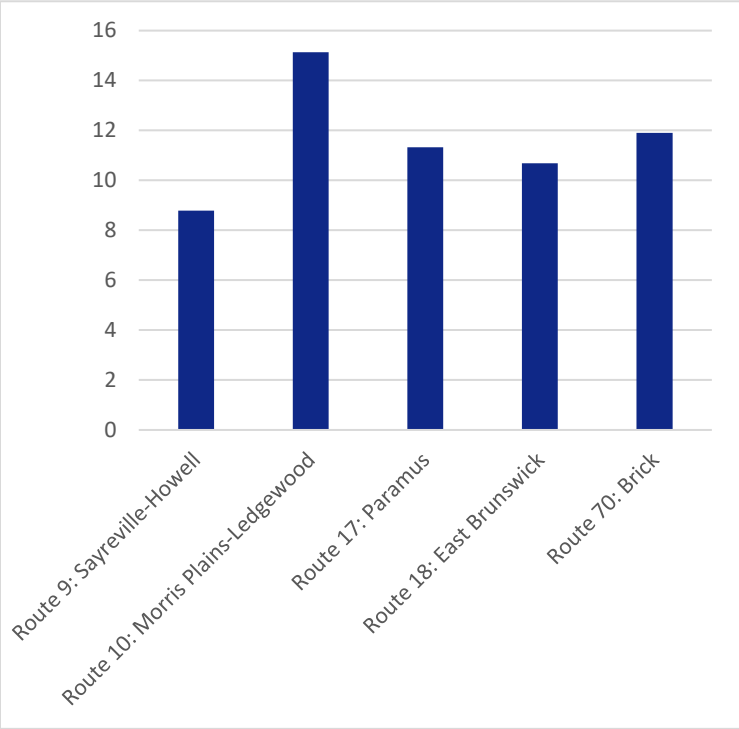


Figure 10: Vacancy Rates on Select Commercial Corridors (Source: Goldstein Group)

Trend 7: Salience of Environmental Concerns

THE TREND

Americans' stark differences with regards to environmental issues, by generation, may decrease over time. This is especially with regards to transportation and environmental consciousness.

FOR NEW JERSEY THIS MAY MEAN

- Increased use of more sustainable forms of transportation including walking and bicycling.
- Potentially reduced automobile ownership.
- Increased market share of hybrid and electric-powered vehicles resulting in reduced gasoline consumption and gasoline tax revenue.

Sustainability

Introduction

Across the United States, DOTs are embracing sustainability initiatives throughout transportation planning decision-making processes. The term 'sustainability' has gained extensive popularity, especially among millennials who have become increasingly concerned with issues of social justice, climate change and economic opportunity. The World Commission on Environment and Development defines sustainability as development that meets the needs of the present without compromising the ability of future generations to meet their own needs and considers economic, environmental and social aspects of society. Applied to transportation, sustainable planning aims to effectively move both people and goods in a manner that is socially and economically responsible, and provides as little impact to the surrounding environment as possible. Sustainable transportation planning applied to people and communities is achieved through a focus on bicycle/pedestrian and public transportation as opposed to the private automobile. Public transportation reduces reliance on bulk surface parking, a socially, economically and environmentally unsustainable land use, and functions more efficiently given the ability to transport more people in less space. Although the private automobile dominated transportation decision making throughout the latter half of the 20th century, there is a renewed emphasis on developing public transit-friendly communities, more conducive to economic development and community welfare.

Perhaps now more than ever, sustainability is an important aspect of long-range planning in New Jersey, given its centralized, but climate change-prone location within the Mid-Atlantic and Northeast Corridor. As the previous volumes indicate, transportation plays an integral role in all aspects of sustainability and opportunity in New Jersey. The NCHRP's 'Sustainability as an Organizing Principle for Transportation Agencies' is meant to provide guidance to stakeholders and decision makers in understanding and applying measures and concepts of sustainability.

Where Are We Now? Trends & Conditions

- The Present day transportation habits, characterized primarily by automobile dominance, are significantly shaped by the highway construction boom that took place in the post-World War II era.

Figure 1: Aerial View of the Interstate 280-Garden State Parkway Interchange in East Orange (Source: Google Maps)

- Between 1920 and 2010, total public road mileage in the United States increased five-fold, providing significant mobility for automobiles but causing equally significant disruption to existing neighborhoods, especially in urban areas.

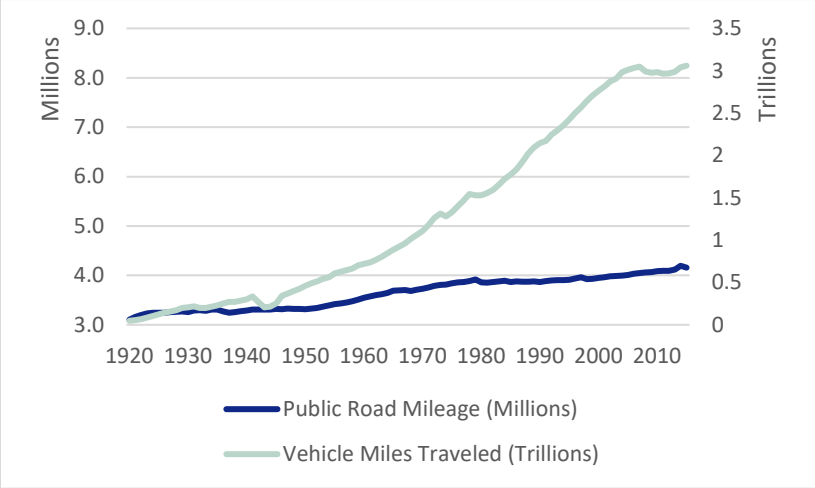


Figure 2: United States Vehicle Miles of Travel & Public Road Mileage: 1920-2015 (Source: Federal Highway Administration)

- In addition to the neighborhood disruption from an emphasis on highway infrastructure, our local, state and federal governments struggle to develop a sustainable fiscal approach for maintenance and new constriction.

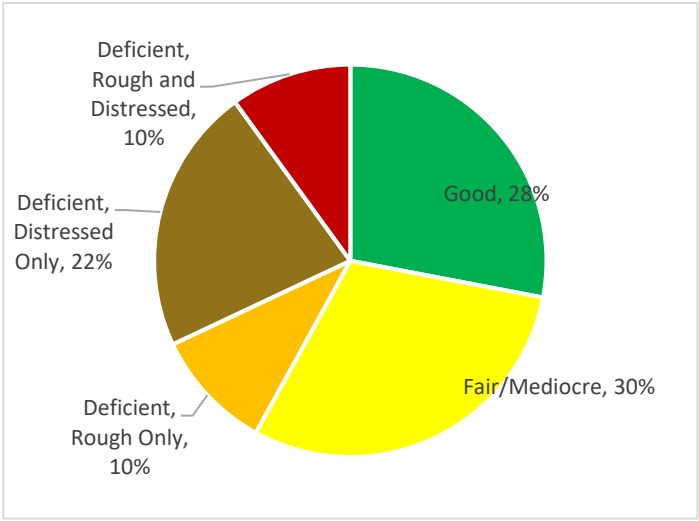


Figure 3: Functional Adequacy of the New Jersey State Highway System (Source: American Society of Civil Engineers)

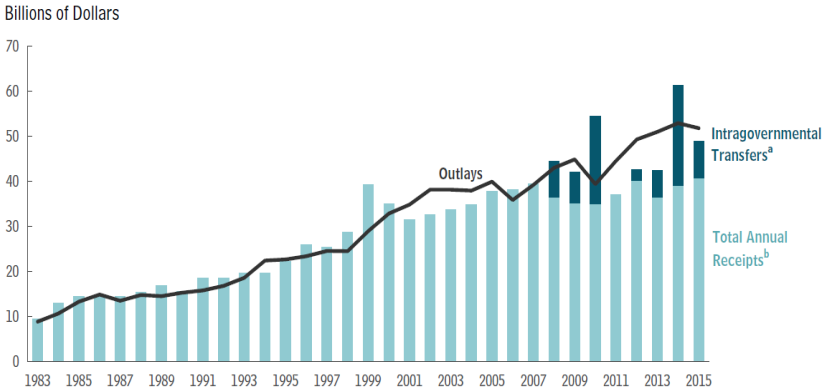


Figure 4: Highway Trust Fund's Outlays, Receipts, and Transfers (Source: Congressional Budget Office)

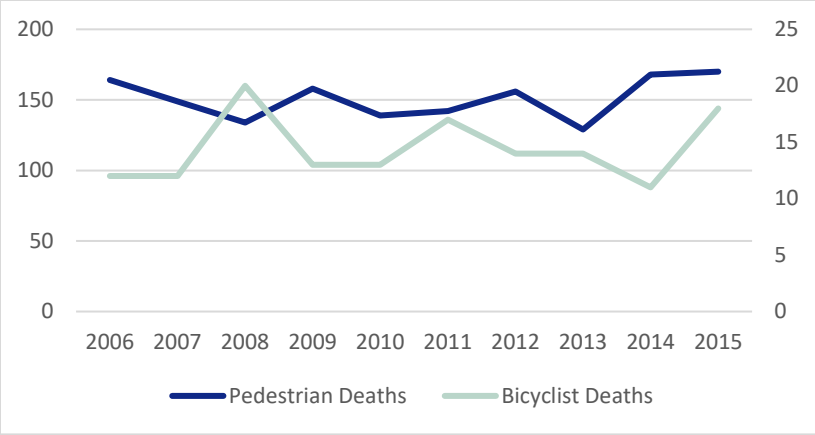


Figure 5: New Jersey Pedestrian Deaths: 2006-2015 (Source: National Highway Traffic Safety Administration)

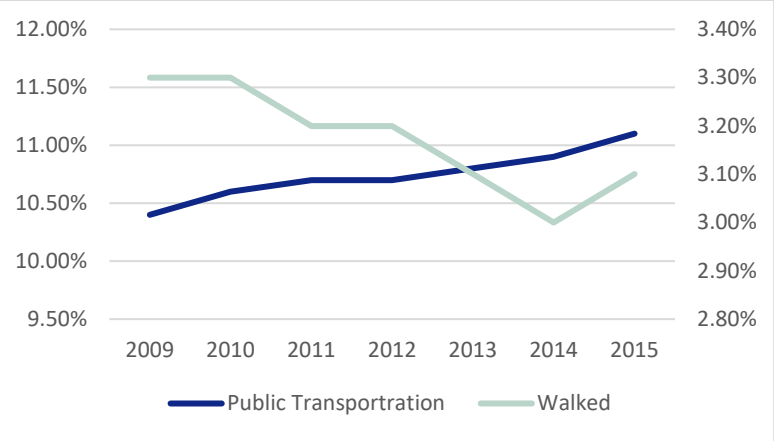


Figure 6: Proportion of New Jersey Residents Utilizing Public Transportation or walking to get to Work (Source: United States Census)

- Within New Jersey, pedestrian deaths have remained stubbornly stagnant at around 150 annual fatalities, even with decreases in total VMT. Despite relatively low figures, bicyclist deaths have also remained stagnant or have even risen slightly in recent years.

- Although public transit usage as a means of commuting to and from work has risen in recent years, the proportion of residents walking to work has actually decreased slightly.

- Despite the stagnant trends associated with sustainable transportation, inner-ring suburbs with walkable, vibrant downtowns have grown in popularity, due in part to extremely expensive rents in urban centers such as New York, Philadelphia and Jersey City.

- In recent years, many lower income residents of traditionally urban and transit-served locations have been displaced into less dense suburbs, as a result of gentrification and demand amongst wealthier residents for urban living.

- The displacement of working and lower class residents presents a challenge on how to best provide transportation to those residents who may need it the most, despite living in dispersed, hard-to-reach areas.

What Does the Future Hold? Possible Trends

Although sustainability issues are highlighted in various sections of the previous NCHRP reports, certain related issues warrant further examination, especially within the diverse context of New Jersey. Based on NCHRP's sustainability volume, multiple sustainability-related trends are identified, which will significantly affect the State in the upcoming years.

Trend 1: Continued Volatility in Petroleum Prices

THE TREND

Despite recent trends, much of the State's new development will occur in dispersed areas not necessarily conducive to public transit.

FOR NEW JERSEY THIS MAY MEAN

- Increased automobile VMT.
- Increased demand for public transit in suburban, exurban and rural areas where demand did not previously exist.
- Increased infrastructure ware on roadways not previously designed to handle increased development.

Trend 2: Continued Embrace of Sustainability Initiatives at the Local & Municipal Level

THE TREND

Increased coordination between NJDOT and local governments to provide transportation options that encourage sustainable development patterns.

FOR NEW JERSEY THIS MAY MEAN

- Increased undertaking of 'transit village' projects.
- Increased re-use of existing building and housing stocks, especially in transit-friendly neighborhoods.
- Increased development of walkable, dense communities, especially in traditionally low-density neighborhoods.

Trend 3: Increased Attention to Public Health Initiatives

THE TREND

Increased awareness and recognition of public health iniatives will result in municipalities undertaking grants and projects aimed at promoting healthy lifestyles.

FOR NEW JERSEY THIS MAY MEAN

- Increased awareness of active and sustainable mobility needs.
- Increased awareness and demand for elderly and disabled persons' transportation needs.
- Increased bicycle and pedestrian activity.
- Increased development of green and sustainable infrastructure.

Figure 7: All Purpose Trail in Cherry Hill
(Source: New Jersey Bicycle and Pedestrian Resource Center)

Trend 4: Increased Awareness of the Role of Food Systems in New Jersey Municipalities

THE TREND

New Jersey municipalities will see a greater emphasis placed on access to healthy and sustainable food systems.

FOR NEW JERSEY THIS MAY MEAN

- Increased emphasis on local transportation and paratransit for elderly and disabled residents to allow better access to groceries.
- Increased emphasis on local transportation connecting low income residents with grocery stores, farmers markets and commercial centers.

Trend 5: Increased Housing & Transportation Costs

THE TREND

Given New Jersey's centralized setting between New York City and Philadelphia, high taxes and aging transportation system, residents will need to dedicate an increasingly larger share of their total income to housing and transportation costs

FOR NEW JERSEY THIS MAY MEAN

- A decrease in non-essential trips on all transportation modes.
- An increase in poverty throughout the State, as urban neighborhoods continue to gentrify.
- Increased transportation demands in rural and low-density areas.
- Increased transportation demands from elderly and disabled populations.
- The development of affordable shared mobility transportation that aims to offset housing and transportation costs.

Climate Change

Introduction

On October 29, 2012, Superstorm Sandy made landfall just north of Brigantine and Atlantic City. Originally expected to move away from the Mid-Atlantic Coast, Superstorm Sandy, (weakened slightly from a hurricane in terms of wind speeds) made a sudden veer towards the New Jersey coast. The Barnegat Peninsula, located between Point Pleasant Beach and Seaside Heights sustained the most damage with entire portions of the peninsula becoming completely washed away by the Atlantic Ocean. In all, Superstorm Sandy cost the United States economy an estimated $50 billion.

With ocean temperatures increasing across the entire world, both the number and frequency of storms, the likes of and even worse than Superstorm Sandy, are expected to increase. With 129 miles of densely populated coast line and critical transportation infrastructure only a few miles inland, New Jersey is especially vulnerable to the effects climate change, both in the future and present time. As a result, there is a strong need for risk-based transportation planning that responds to the ever increasing uncertainty associated with short- and long-term weather events. The NCHRP's 'Climate Change, Extreme Weather Events, and the Highway System' provides a framework for climate change-based adaptation based on the identification of critical transportation assets.

Where Are We Now? Trends & Conditions

- Average temperatures in New Jersey have risen 3 degrees between 1895 and 2015, with 9 of the 10 warmest years having occurred after 1988.

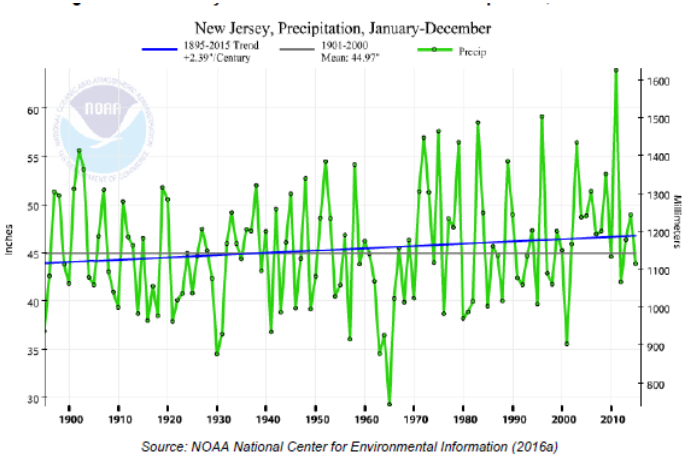


Figure 1: 1895-2015 New Jersey Average Temperature (Source: NJ Climate Adaptation Alliance

- Precipitation rates in New Jersey have risen slightly between 1895 and 2015, but with significant variability.

- Since 1900, sea levels have risen 1.5 feet along the New Jersey coast, at a rate of 1.5 inches per decade.

- Sea levels have risen at a higher rate along New Jersey coasts than the global average, due to factors of increased ground water depletion and subsidence brought about from melting glaciers.

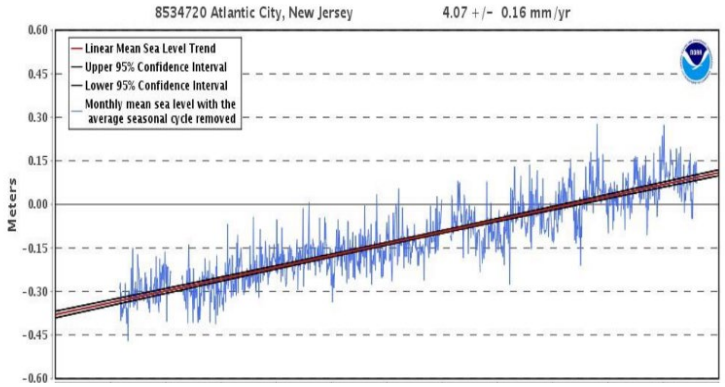


Figure 2: 1895-2015 New Jersey Annual Precipitation (Source: NJ Climate Alliance

- Increased development, especially in urban areas closer to New York City and Philadelphia have resulted in reduced natural habitat, contributing to the intensity of summer heat waves and increased flooding in certain areas.

- As of 2017, many residents of New Jersey are still recovering from the effects of Hurricane Sandy, while also taking various measures to better prepare for future events.

What Does the Future Hold? Possible Scenarios

New Jersey's combination of proximity to New York City and Philadelphia, population density and low-lying elevation make it particularly vulnerable to the effects of climate change. Based on the NCHRP's climate change volume, multiple related trends are identified which will significantly affect New Jersey and statewide transportation planning.

Trend 1: Changes in Extreme Temperatures

THE TREND	FOR NEW JERSEY THIS MAY MEAN
Increased duration, intensity and frequency of summer heatwaves & Warmer, wetter winters.	• Premature and accelerated multimodal infrastructure degradation. • Increased heat-related pauses in construction & maintenance. • Smaller snow & ice removal budgets. • Reduced infrastructure. degradation due to salt application.

Trend 2: Increased Frequency of Rain Storms and Natural Disasters

THE TREND	FOR NEW JERSEY THIS MAY MEAN
Strong storms and natural disasters such as Superstorm Sandy could occur more frequently.	• Increased erosion, flooding and saltwater intrusion. • More damage and disruption to infrastructure and services. • Increased disruption to flood-prone communities.

3Trend 3: Reductions in Year-Round Coastal Population

THE TREND

Damage and disruption from natural disasters may impact low-income communities disproportionately.

FOR NEW JERSEY THIS MAY MEAN

- Decreased coastal vehicular traffic during non-Summer months
- Reduced access to jobs and daily needs for people in lower-income coastal towns.

Trend 4: Increased Sea Level Rise

THE TREND

Sea-level rise is expected to continue and possibly intensify.

FOR NEW JERSEY THIS MAY MEAN

- Extensive damage to multi-modal coastal infrastructure.
- Increased infrastructure burdens for communities adjacent to, but not directly affected by sea-level rise.

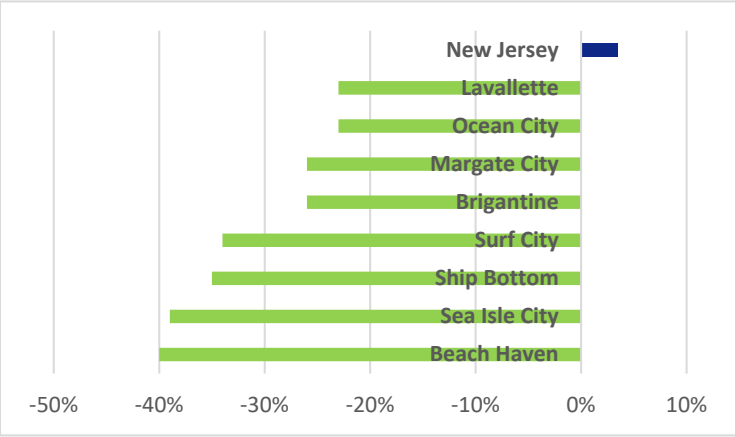


Figure 3: Change in Population in Select New Jersey Coastal Towns since the Economic Recession