Long Island Regional Planning Council

Long Island 2035 Regional Comprehensive Sustainability Plan

Technical Report-Infrastructure and Transportation

Long Island
Regional Planning Council

Long Island Regional
Planning Council

Long Island 2035 Regional Comprehensive Sustainability Plan

Infrastructure & Transportation

This report takes into account the particular instructions and requirements of our client.
It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party

Ove Arup & Partners PC
155 Avenue of the Americas, New York NY 10013
Tel +1 212 229 2669 Fax +1 212 229 1056
www.arup.com

Contents

Tables

Figures

1 Introduction

Long Island faces many challenges between now and 2035. Its infrastructure is aging and in need of repair. In some cases, infrastructure expansion will be required to meet the growing and changing needs of Long Island residents and businesses. Moving from status quo to adaptation will help Long Island as all Long Islanders work to engage in the 21st century economy and society. While infrastructure needs are pressing, demographic shifts, higher gasoline prices, and changing attitudes about suburban life and amenities are creating a new dynamic in how people make choices about housing, transportation, and lifestyle. This report seeks to assess the current and future challenges facing Long Island and propose some initial high-level recommendations for improving the state of infrastructure on Long Island.

Section 2 of this report presents an overview of Long Island's existing infrastructure system based on research of numerous studies performed by federal, state and local governments and organizations. This, data is supplemented with Long Island's infrastructure and resource use, and interviews with organizations linked to infrastructure and resource use in Long Island.

Sections 3 through 5 describe the methodology, inputs, and results of a forecasting exercise that was undertaken by the project team to examine and evaluate key trends in resource use and transportation. The exercise uses a model that builds upon the scenarios and findings developed in the Land Use Technical Report. This model uses the projected land use outcomes from the 2010 Baseline and 2035 Business-as-Usual cases as inputs into an analysis of the demands on Long Island's infrastructure today and in the future. These sections also include an assessment of future transportation conditions based on forecasts conducted by the New York Metropolitan Transportation Council (NYMTC) as part of their regional travel demand model.

Section 6 includes a discussion on what these goals might be, and how they could be developed into actionable strategies in the next stage of the Long Island 2035 Sustainability Plan. These goals will guide discussions about sustainable infrastructure and inform potential strategies for implementing changes to Long Island to address the needs of a sustainable future.

2 Baseline Infrastructure Assessment

2.1 Waste Overview

Summary: Long Island's waste governance is highly decentralized, it has high waste generation rates (above national average), low recycling rates (below national average) and not enough capacity in its waste-to-energy plants to handle all of the waste (waste is transported off-island)[1].

Waste management on Long Island is governed by the regulations of the New York State Department of Environmental Conservation (NYSDEC). Each town (and incorporated City) is required to report its waste to the NYSDEC (See *Figure 1*). Long Island consists of 13 towns and 2 incorporated cities, however, the actual management of the waste materials varies across the island. There are approximately 50 residential waste managers in Long Island[2] and additional waste haulers for commercial waste. Waste is collected and disposed of on Long Island in the following ways:

- Residential waste and small commercial waste is collected by Towns, either directly by the villages and hamlets or through a contracted private hauler.
- Commercial and industrial waste is usually handled by private haulers.
- Most of the waste is taken to an on-island transfer station and depending on the town's disposal method is either incinerated at a waste-to-energy incinerator or transported off-island.

Long Island is above a sole source aquifer (discussed in Section 2.2.1) which caused the Environmental Protection Agency (EPA) in 1990 to close all Municipal Solid Waste (MSW) Landfills due to potential groundwater contamination[3]. As a result, each town's MSW is either incinerated at one of the four waste-to-energy incinerators on Long Island or sent out of state via long haul truck. Waste from construction & demolition (C&D) debris and clean fill (soils and fill materials) is still permitted to be landfilled.

[1] Waste generation rates, recycling percentage, waste governance and waste-to-energy capacity were observed from Stony Brook Waste Reduction and Management Institute's."Municipal Solid Waste Assessment Nassau and Suffolk Counties, Long Island, New York, 2006". ©August 2007,Suffolk County Government's "Suffolk County Solid Waste Management Report and Recommendations" ©2006, Malcolm Pernie Inc.'s "Consolidation Analysis and Implementation Plan: Solid Waste" ©2008, and Nassau County Office of Comptroller's "Cost Disparities in Special Districts in Nassau County" ©2007

[2] Stony Brook Waste Reduction and Management Institute. "Municipal Solid Waste Assessment Nassau and Suffolk Counties, Long Island, New York, 2006. ©August 2007 pg 2, pg 78.

[3] Liptak, B. *Municipal waste disposal in the 1990s*. Radnor: Chilton. ©1991.pg 26

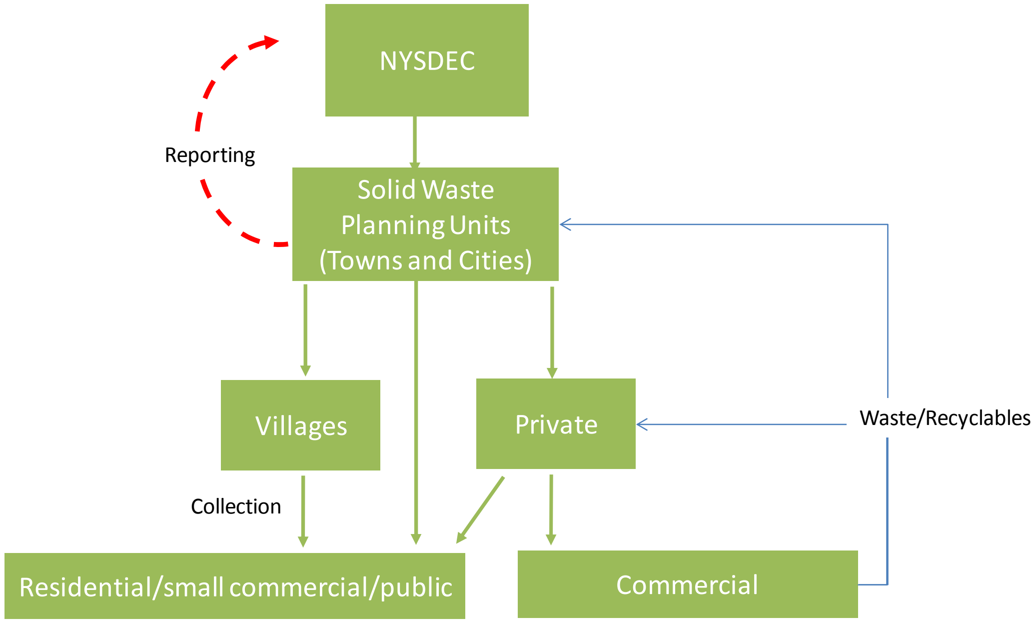


Figure 1: Long Island waste hierarchy

The existing waste management approach in Long Island creates the following issues:

- Higher cost and variability in waste collection
- Less incentive to sell recyclables due to lack of economies of scale
- Minimal recycling goals (if any) – There are no specific targets that are being attempted nor any long term goals, ie, many cities and countries have joined the "zero-waste" goal

2.1.1 Waste Generation

Ultimately, the amount of waste generated determines the operations for each Town and City's waste management. Long Island's waste generation rate at six (6) pounds per person per day is above the national average of 4.6 pounds per person per day[4]. Shelter Island, Southampton, and Southold are towns that are trying to encourage recycling habits by requiring residents to purchase non-recyclables bags via a pay-as-you-throw (PAYT) program. This system has the potential to reduce the average waste generation rates across Long Island and has become popular in many areas of the United States.

[4] EPA. "Municipal Solid Waste Generation, Recycling and Disposal in the United States: Facts and Figures for 2007" ©2008 pg. 3

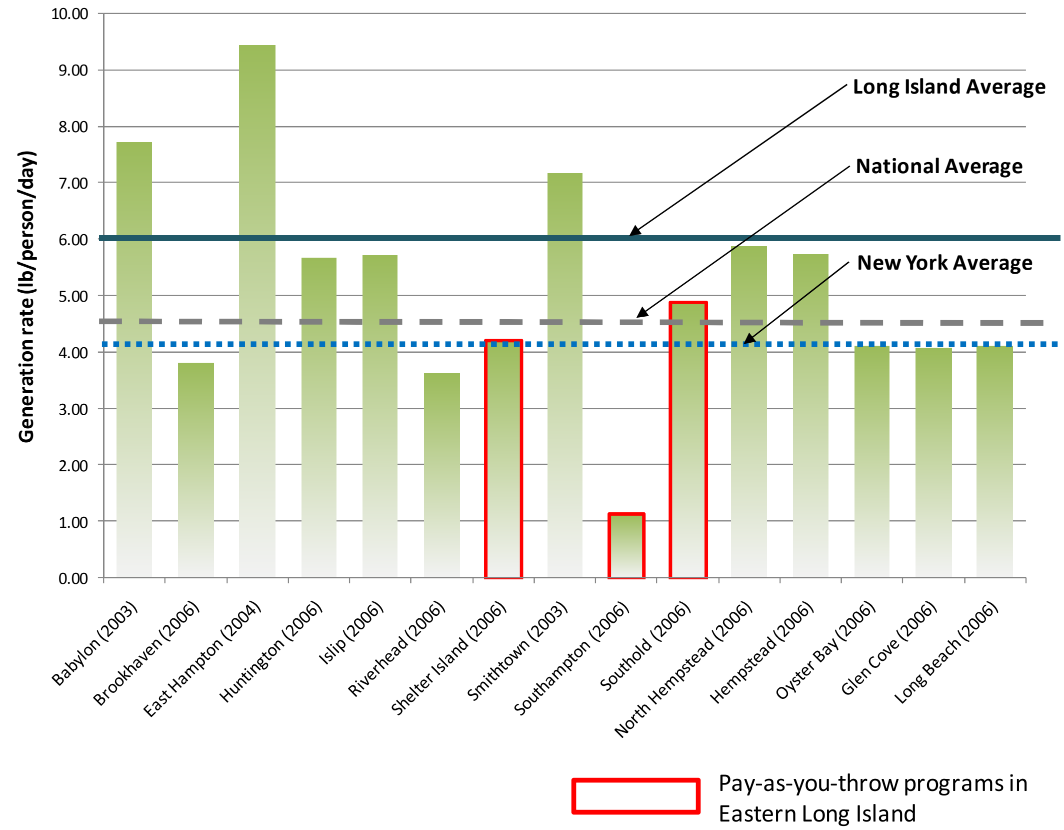


Figure 2: Long Island waste generation rates[5] (towns with pay-as-you-throw programs outlined in red)

As shown above, town waste generation rates per person vary widely. Babylon, East Hampton, and Smithtown have the highest rates while Southampton, Brookhaven, and Riverhead have the lowest. All the towns with pay-as-you-throw programs have waste generation rates well below the Long Island average.

Since reporting differs from town to town and commercial waste is not reported, there is no official estimate of total waste generated on Long Island. To determine the total waste for Long Island an estimate of the potential waste generation rates for each town was determined using the Arup model for 2009. This exercise yielded an estimate of approximately 3.5 million tons of waste generated per year on Long Island[6]. Of that waste generated approximately, 22% to 25% or 814,000 tons of waste is transported off-island.

Waste generation rates are habitual and reflect ingrained behaviors. The high generation rates in Long Island may be due to the following:

- Cost signals do not encourage recycling or reducing waste generation
- Little incentive to recycle – only three towns have fee based non-recyclable pick-up and only one town recycled organic waste
- Waste issues are not well-publicized – Do residents know where their waste is actually going or what the impact of their habits is?

To change these rates, it would be necessary to understand the behaviors of people in the community and what is needed to help them make better choices about recycling and resource use.

[5] "Suffolk County Solid Waste Management Report and Recommendations" and "Consolidation Analysis and Implementation Plan: Solid Waste"

[6] Stony Brook Waste Reduction and Management Institute. "Municipal Solid Waste Assessment Nassau and Suffolk Counties, Long Island, New York, 2006. ©August 2007 pg 2, pg 78.

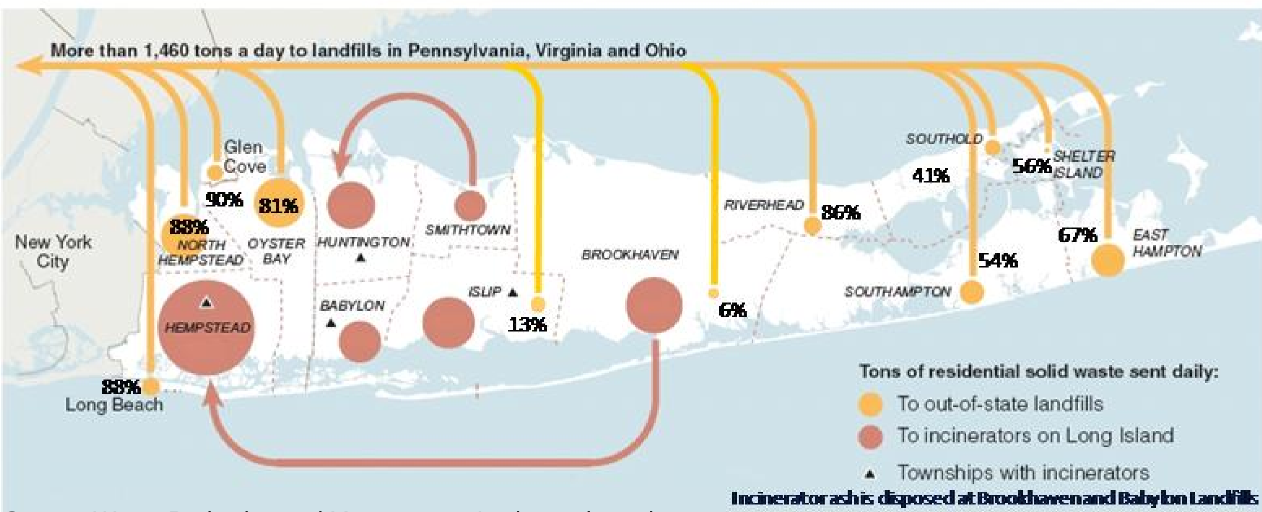
2.1.2 Waste to Energy

There are currently four waste-to-energy facilities on Long Island and they produce about 6% of the electricity generated[7]. Residential and a portion of commercial waste from certain areas of Long Island are taken to one of these facilities:

- Covanta waste-to-energy facility in Hempstead (from Brookhaven and the Town of Hempstead)
- Covanta waste-to-energy facility in Huntington (from Huntington and Smithtown)
- Islip municipal waste-to-energy facility (from Islip)
- Babylon waste-to-energy facility (from Babylon)

2.1.3 Out-of-State Waste Management

Waste from all other towns and incorporated cities is hauled via truck to out-of-state landfills in Virginia, Pennsylvania and Ohio, etc. In addition, due to limited capacity at the waste-to-energy facilities, excess waste from Islip and Brookhaven is transported out-of-state. This means that long haul trucks must use available capacity on the region's roadway systems to move waste to other facilities. It also means that Long Island is exporting a potential energy resource. Each town's waste disposal methods and the approximate disposal percentage that is beyond permitted capacity and transported off-island are shown in *Figure **3***. The dots on the diagram are relative in size and are intended to show the relative degree to which waste must be disposed of on the island or transported to other locations. Not included in Figure 3 is waste from large commercial, institutional and industrial users that is typically taken out-of-state.



Source: Waste Reduction and Management Institute; city estimates

Figure 3: Long Island's waste disposal[8]

2.1.4 Recycling

Recycling is a proven strategy for reducing waste generation, and recycling programs can be very effective at changing people's behavior. Recycling rates for Long Island are below the national average of 34% of total waste generated[9] (Suffolk – 33%, Nassau – 20%).

[7] LIPA

[8] Rather, J. "A Long, Long Haul From the Curb". 12/4/2005. New York Times. 10/20/2009

[9] "Suffolk County Solid Waste Management Report and Recommendations" and "Consolidation Analysis and Implementation Plan: Solid Waste"

*Table **1*** lists each town's recycling rate. The higher recycling rates in Eastern Long Island (Shelter Island, Southampton and Southold) could be contributed to pay-as-you-throw programs enacted by these Towns. These programs charge residents for Town garbage bags used for non-recyclables encouraging residents to recycle, which is free for disposal. Furthermore, Islip collects organic waste, which contributes to higher recycling rates. Note that these recycling rates are only for residential, public and small commercial facilities and do not include all large commercial/ industrial recycling rates that are hauled privately[10]

Table 1: Long Island recycling percentages[11]

Town/Incorporated City	Recycling %
Babylon	29.3%
Brookhaven	31.9%
East Hampton	32.6%
Huntington	33.3%
Islip	40.0%
Riverhead	13.6%
Shelter Island	44.0%
Smithtown	24.2%
Southampton	45.6%
Southold	56.4%
North Hempstead	11.9%
Hempstead	21.0%
Oyster Bay	19.0%
Glen Cove	10.0%
Long Beach	12.0%

Additionally, the recycling percentages in *Table 1* do not include all of the yard waste separated during pickup. Yard waste in the western half of Long Island is transported off-island to composting facilities in Pennsylvania. The Town of Southold, Brookhaven, Riverhead, Islip, East Hampton, Southampton and Shelter Island compost their organic waste at site within their town boundaries.

2.2 Water and Wastewater Overview

Summary: Long Island's potable water use has increased over the last two decades (in a period of time where water usage rates have remained constant across the United States), Suffolk County has a well distributed potable water infrastructure and poorly distributed wastewater infrastructure, whereas Nassau County has a well distributed wastewater infrastructure and poorly distributed water infrastructure, and Long Island Sound is being polluted by New York City/Long Island sewage treatment plants.

Water usage rates on Long Island are some of the highest in the country. Part of this could be attributed to some of the lowest water bills in the nation. The low cost is primarily due to the abundance of water in Long Island's groundwater system. It is also due to the low level of water treatment, which varies from well to well. Treatment costs are low in comparison to the surface water treatment systems located throughout the United States. Additionally, the high consumption rates could be attributed to innovations in automatic

[10] Waste is reported differently in each Town. Most residential waste is reported but large commercial and institutional waste carted by private companies is usually not accounted for. In addition, construction and demolition waste and yard waste generation is not consistent for all Towns and Incorporated Cities. As a result, the recycling rates and disposal rates in the report do not include all the waste generated.

[11] Recycling percentages as of 2006

sprinkler systems[12], making it easier to water large lawns more frequently. *Figure 4* shows the high levels of water consumption during the summer season. Although water conservation techniques such as EPA Energy Policy Act of 1992[13] for plumbing fixtures and leak detection equipment have been implemented over the past 20 years in Long Island, water consumption has increased.

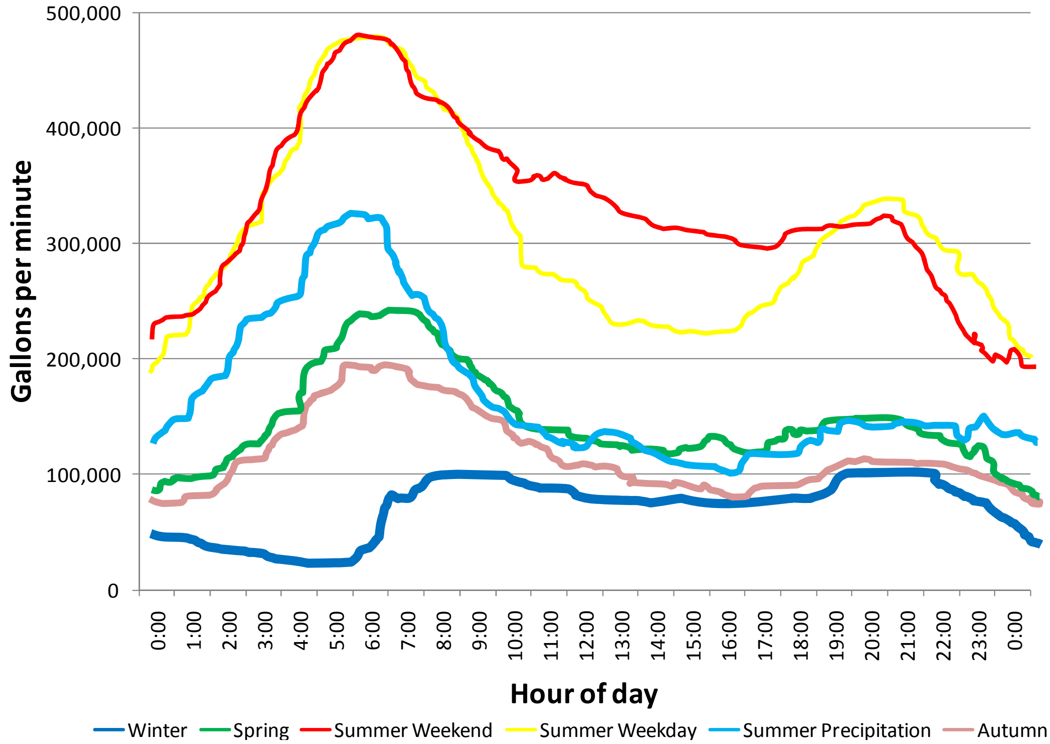


Figure 4: Suffolk County Daily Pumping Patterns from Suffolk County Water Authority Distribution Systems[14]

[12] As per teleconference and email correspondence with the Suffolk County Water Authority (September 2009)
[13] The Energy Policy Act (EPAct) of 1992 was a US government act that addressed energy and water use in commercial, institutional and residential facilities.
[14] Information from Suffolk County Water Authority (September 2009)

2.2.1 Aquifers

Long Island is located above an Environmental Protection Agency (EPA) designated sole source aquifer[15]. While some agricultural and industrial users draw from surface water sources for non-potable uses, groundwater is the sole source of potable water for Long Island. The Long Island aquifer system consists of the upper Glacial, which has the greatest risk of contamination; the Magothy, which is the most abundant water source; and the Lloyd aquifer, the oldest aquifer, which is used in areas with limited or contaminated access to the Glacial or Magothy aquifers (*Figure 5*). The use of the Lloyd aquifer is a controversial topic. The aquifer is the oldest and thought to be only used sparingly to preserve Long Island's future groundwater source. However, due to contaminated groundwater or lack of access to the Glacial or Magothy aquifers, the Lloyd aquifer has been used for pumping, especially in Nassau County.

The number of water supply wells in Suffolk and Nassau County are shown in *Table 2*. It is important to note that although perceived as the future water source, the Lloyd does not have as much volume as the Magothy and requires more treatment in some cases due to high iron and manganese levels. Therefore, preserving and keeping the Magothy aquifer clean provides a viable future for Long Island groundwater.

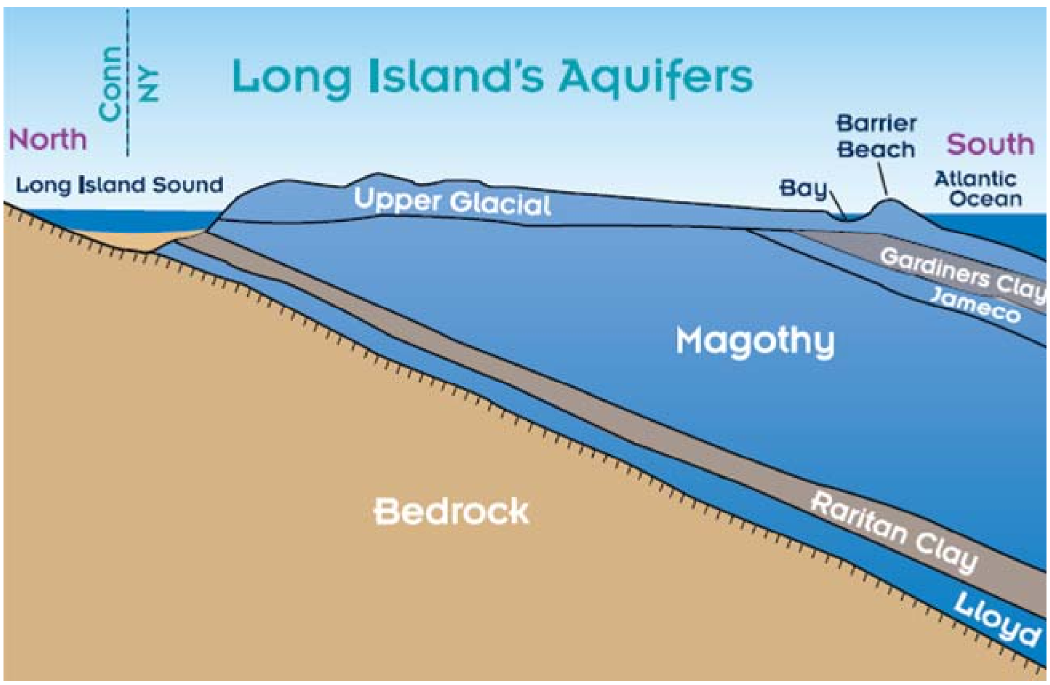


Figure 5: Long Island aquifer system

Table 2: Number of water supply wells and type at the county level

Aquifer level	Supply wells	
	Nassau[16]	Suffolk[12]
Glacial	366	259
Magothy	167	323
Lloyd	66	4

[15] Sole source aquifers are regions that are a minimum 50% dependent on the groundwater as its potable source of water, and there is no alternative drinking source. In Long Island about 100% of drinking water comes from groundwater.

[16] "Nassau County Groundwater Report" 2005. http://www.nassaucountyny.gov/agencies/DPW/Docs/PDF/Groundwater03ReportSections23.pd

2.2.2 Water Distribution and Use

Approximately 85% of potable water in Suffolk County is distributed by the Suffolk County Water Authority (SCWA)[12] The remaining water supply is distributed by smaller public systems in South Huntington, Riverhead, Greenlawn, Dix Hills, Hampton Bays and East Farmingdale, and other private systems (~8%). The water quality in Suffolk County is monitored and reported by the Suffolk County Department of Health. The NYSDEC regulates the water source on Long Island (the Water Districts and the Department of Health both report to the NYSDEC).

Water in Nassau County is significantly less consolidated with 19 municipal and village owned systems and 56 individually owned water corporations. Water quality in Nassau County is monitored and reported by the Nassau County Department of Health. Water districts report to the Nassau County Department of Public Works (DPW) and the NYSDEC.

SCWA's ownership of most of the water distribution in Suffolk County allows a single entity to control the infrastructure. This gives them the following advantages over a less distributed system in Nassau County:

- Greater chance to be awarded funding from state or federal government due to reduction in administrative burden and maximizing technical resources
- Allows for resource sharing in emergencies through SCWA's distribution network, i.e., if a villages' water supply is contaminated, water can be pumped from a neighboring village
- Institutional knowledge

Water use per capita has increased in both Suffolk County and Nassau County over the past 10 years, with Suffolk County increasing at a higher rate, possibly due to lower density development (*Figure 6*). As previously discussed, household irrigation significantly contributes to increased water use rates on Long Island.

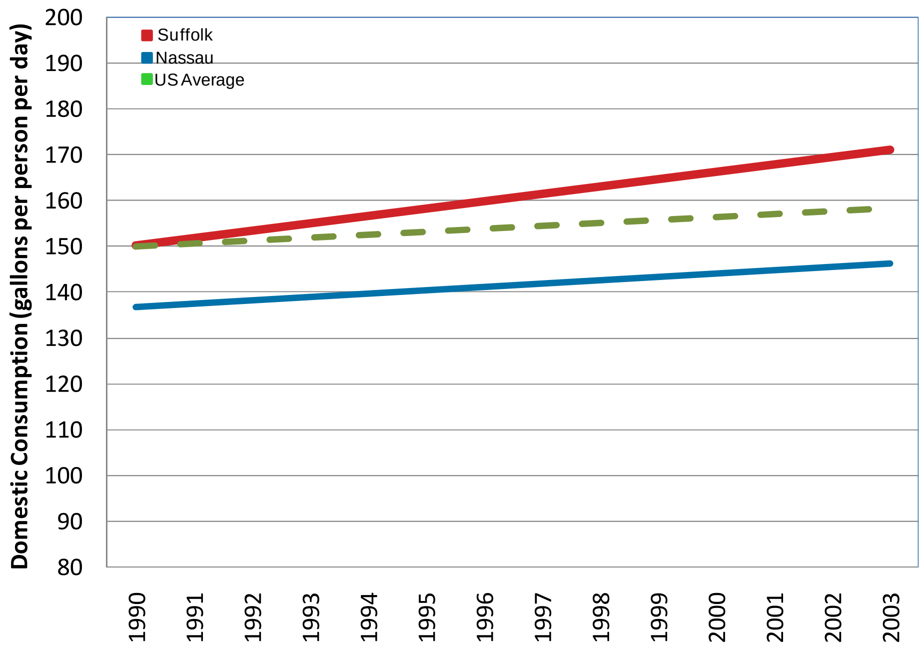


Figure 6: Long Island water consumption trends[17]

[17] Data for Nassau County was derived from Nassau County Department of Public Works, "Nassau County Groundwater Report" 2005. Data for Suffolk County was derived from "Long Island Index 2005".

2.2.3 Wastewater

Suffolk County Wastewater infrastructure is made up of 24 public treatment plants (managed by the Suffolk County Department of Public Works) and 190 private treatment plants. The largest of the public treatment plants is Bergen Point and smaller public and private treatment plants are needed for sewer districts along town centers and major corridors (see *Figure 7*). The remaining areas are without wastewater pipelines and treat wastewater using septic systems.

Nassau County has a more robust wastewater treatment network, a result of more dense development and the possibility of contaminating the groundwater source. There are 13 public treatment plants in Nassau County, the three main treatment plants are Bay Park, Cedar Creek and Glen Cove which treat approximately 80% to 90% of Nassau County's wastewater. *Figure 7* shows the wastewater treatment facilities in Nassau County.

Most biosolids, which are a product of wastewater treatment, are transported off-island to out-of-state facilities.

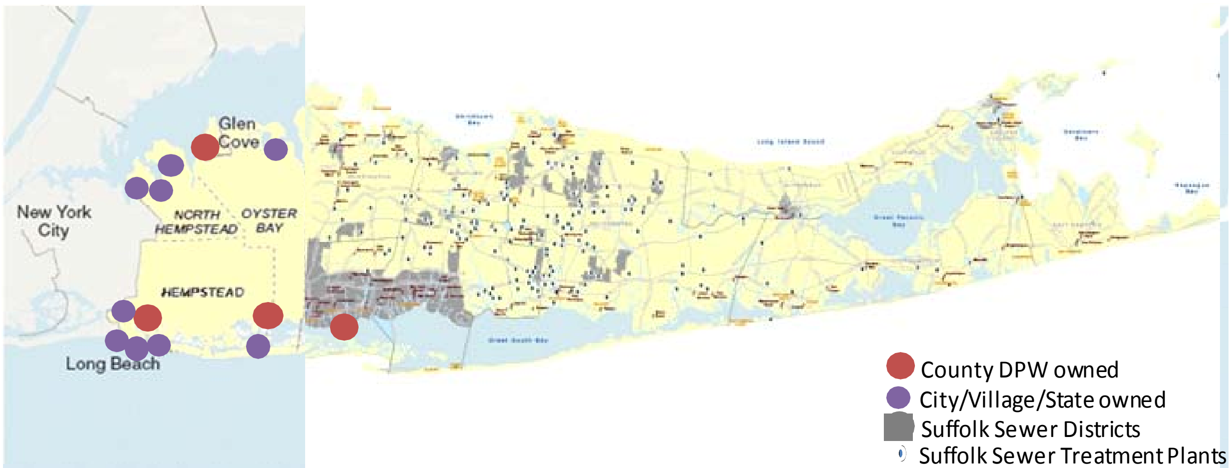


Figure 7: Long Island wastewater infrastructure

Much like Suffolk County's water distribution ownership, Nassau County has advantages due to its wastewater distribution infrastructure such as:

- Greater chance to be awarded funding from state or federal government due to reduction in administrative burden and maximizing technical resources
- Less chance of groundwater contamination because wastewater is discharged to surface waters as opposed to septic systems and leach fields
- Well-developed institutional knowledge
- Ability to accommodate compact development – since a wastewater infrastructure is in place, there are fewer septic systems which can limit density

2.2.4 Water Pollution

The main contributors to groundwater contamination are septic systems (nitrates, ammonia, etc.), saltwater intrusion, fertilizers (from agriculture/golf courses), dry cleaners (PCE and TCE) and leaking underground storage tanks. Nitrate contamination in the groundwater has decreased in Nassau County due to increasing sewage treatment infrastructure, although sewage contamination is still possible in dense areas without pipelines. Since Suffolk County has less wastewater infrastructure, septic system nitrate contamination occurs, especially in areas with high groundwater levels such as the North Shore and South Shore. Contamination is also likely in regions with high densities, as there is less area for appropriately sized septic system and leaching fields. Another current groundwater contaminant which may continue to be problematic is methyl-tertiary-butyl ether (MTBE) from discontinued underground gasoline storage tanks. Policy and health codes have limited contamination from dry cleaners (reducing PCE and TCE contamination) and old industrial practices in Long Island (reducing solvent and heavy metal contamination). Nitrate loading has increased in the Long Island Sound due to discharge from the wastewater treatment plants and surface water runoff. This has led to eutrophication which causes a decrease in dissolved oxygen (hypoxia) in the water, which suffocates aquatic species and destroys wetlands, and elevated pathogen levels causing shellfishing restrictions. State and Federal authorities are continuing to restrict the amount of nitrate and phosphates in sewage effluent discharge.

2.3 Energy Overview

Summary: Electricity rates on Long Island are among the highest in the country, much of the energy supply comes from off-island resources, less than 5% of the energy supply of Long Island is derived from local renewable energy sources, and residential and commercial buildings are energy inefficient.

2.3.1 Energy Providers

Electricity is generated from and provided by the following sources:[18]

- National Grid power plants,
- LIPA owned power plants (18% of the Nine Mile 2 Nuclear plant),
- Individual generators,
- Tie-in connections with Con-Edison and NYPA,
- Interconnections with the New England Cross-Sound Cable, and
- The PJM ISO (Neptune Cable).

The majority of the electricity is delivered to Long Island customers through the Long Island Power Authority (LIPA). Exceptions include facilities operated by some State of New York government agencies receiving electricity via New York Power Authority (NYPA) as well as private turbines at industrial and institutional facilities. Gas is delivered to the island via Iroquois interconnection pipeline to the National Grid gas distribution system. An overview of the energy infrastructure is illustrated in *Figure 8*.

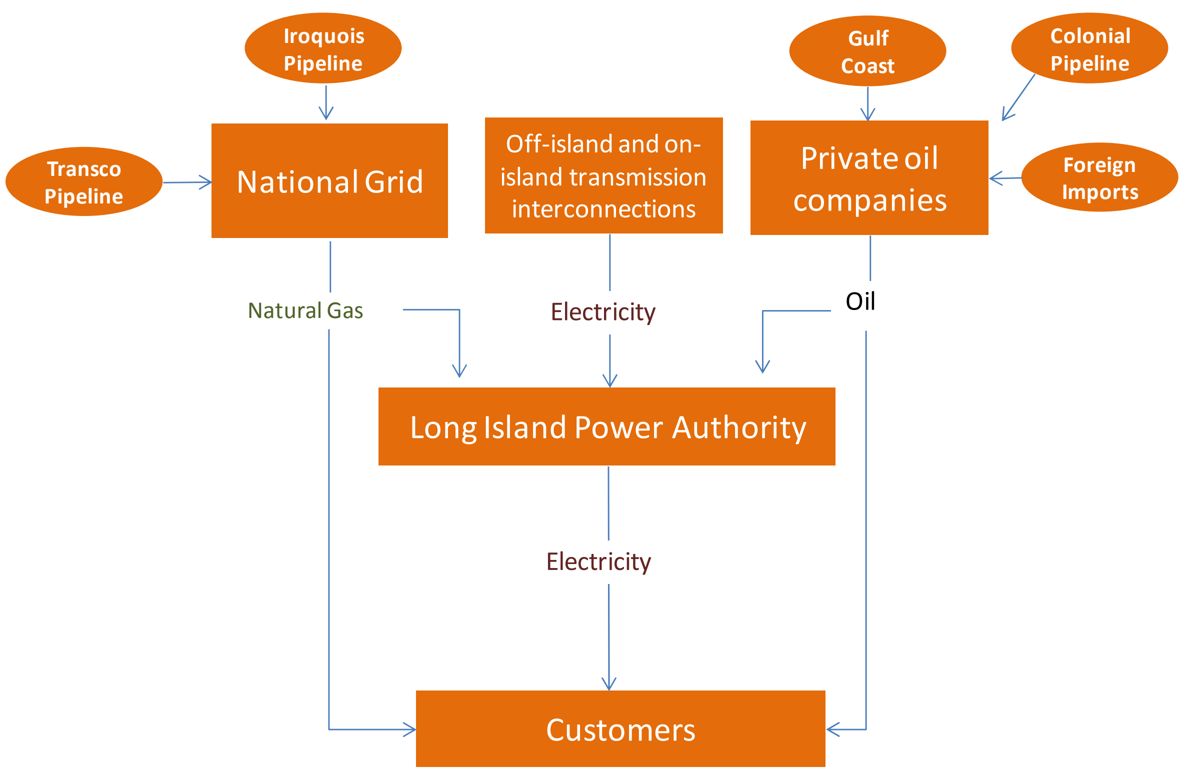


Figure 8: Long Island's energy infrastructure hierarchy

[18] Source: Long Island Power Authority Draft Electric Resource Plan 2009-2018, Appendix B, Energy Primer. March 18, 2009 pg 2-9

LIPA's power supply sources are shown in *Figure 9*. A majority of the power (57%) is supplied by National Grid's power plants. Private sector power plants (fast track units) are tied into the grid to provide approximately 9% of the power supply. LIPA's On-Island power plants provide approximately 4% of the power. Off-Island resources such as the Nine Mile 2 Nuclear power plant (of which LIPA is an 18% owner) provide 4%. Tie-in to the PJM and ISO-New England markets, as well as contracts with the NYPA and Con-Edison make up the remaining 26% of tie-in capability.

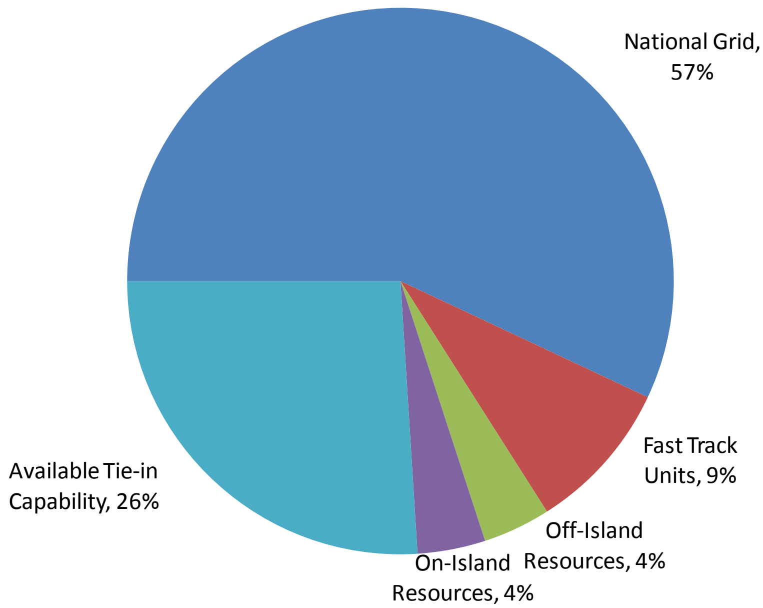


Figure 9: Generation and Transmission Resources

2.3.2 Electricity Rates

Long Island has some of the highest electricity rates in the country. This is largely due to high state and local taxes (property taxes), operations and maintenance, fuel prices[19], and approximately 15% of Long Island residents' electric bills are attributed to LIPA's debt. About half of the $7 billion debt is attributed to the construction and decommissioning of the Shoreham Nuclear Power Plant[20]. Currently, there is federal legislation to reduce the interest rates on this debt. .

2.3.3 Fuel Sources

The LIPA grid sources for electricity, heating, and cooling as of 2008 are presented in *Figure 10*. Note that this data does not include the power mix from coal fired powerplants, as reported in the Neptune power purchase agreement (the value was not reported), or sources of fuel for transportation.

Renewable energy provides approximately 9% of the power mix from pumped storage hydroelectric purchases and waste-to-energy and landfill gas to energy purchases. This is well below the amount of the 30% renewable energy portfolio that LIPA is trying to achieve by 2015.

[19] LIPA. ":Long Island Power Authority 2010 Proposed Operating and Capital Budget Presentation" November 2, 2009 & Newsday. "LIPA looks to reduce 'tax' bill". September 2009.
[20] Long Island Assembly Minority Delegation. "Long Island Ratepayer Rescue Plan". Page 4. "$3.8 Billion of $6.6 Billion debt". May 2009

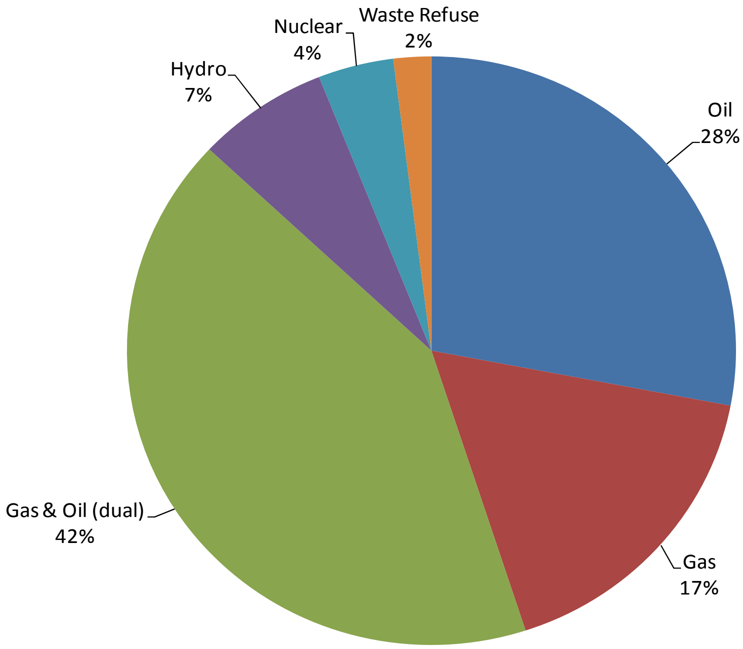


Figure 10: Electricity supply mix to LIPA[18]

2.3.4 Heating Fuels

The majority of residential heating is fueled by heating oil (approximately 65%) and natural gas[21]. However, there are some areas that use liquid petroleum gas (LPG) and wood.

Oil sources are supplied by refineries in New Jersey and Pennsylvania, by the Colonial Pipeline from the Gulf Coast, and through foreign imports[18]. Heating oil is delivered by numerous private oil companies via oil truck to individual oil tanks.

Natural gas is supplied to the island mainly through the Iroquois Pipeline (*Figure 11*) and procured by National Grid. The remaining is delivered via Transco pipeline. Natural gas is distributed to households, commercial, institutional and industrial sites by National Grid.

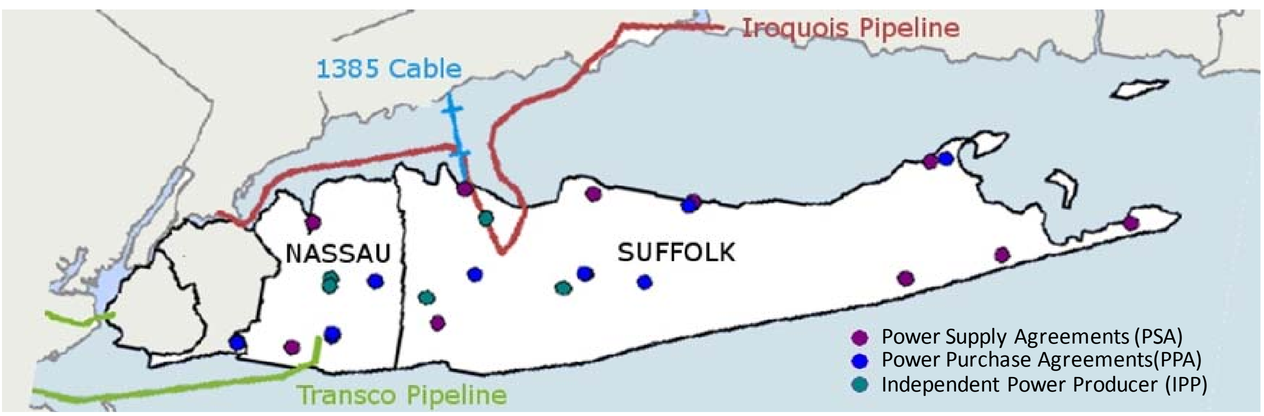


Figure 11: Long Island purchased energy (electricity and gas)[7]

Figure 9 and *Figure 11* show that Long Island's energy relies heavily on out of state sources (gas, oil and electric). If, for example, a catastrophe was to occur causing the Iroquois or Transco pipelines to fail, residents and businesses will be without an important source of gas used for electricity generation and heating.

[21] "LI heating oil dealers shying from price locks". 8/21/2009. http://www.newsday.com/long-island/nassau/li-heating-oil-dealers-shying-from-price-locks-1.1385594. 10/20/2009

2.3.5 Electricity Demand

In 2008, Long Islanders consumed approximately 21,000 GWh of electricity or 7,700 kWh per resident. These figures exclude electricity consumed by facilities which generate their own electricity and institutions receiving electricity through NYPA[18]. If these facilities were included, the figures would be approximately 9,875 kWh per person per year[22]. Both of these values are below the national average of 13,635.7 kWh per person per year[23]. This could be the result of relatively high electric bills in the region, although this correlation has not been confirmed. *Figure 12* shows the increase in electricity use by Long Islanders from 2000 to 2007. Both commercial and residential electricity use increased over this period.

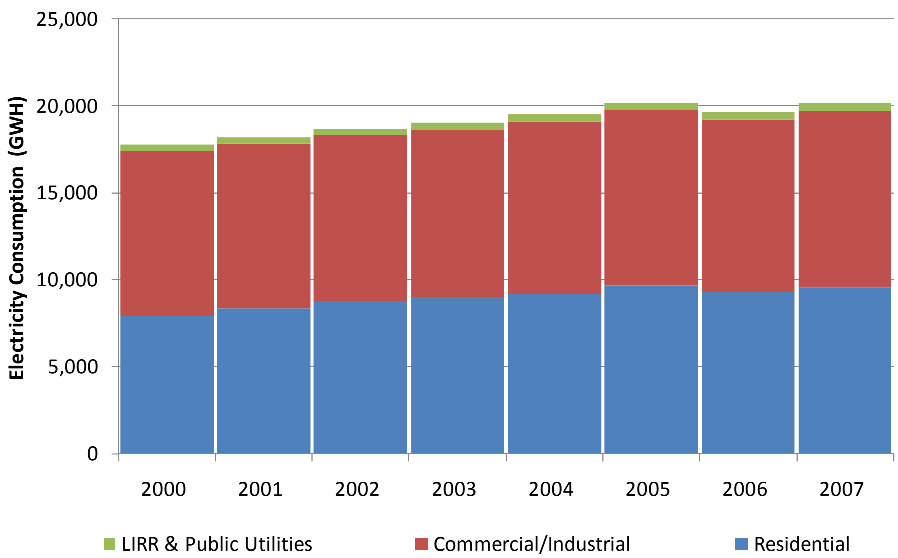


Figure 12: Electricity Consumption from 2000 to 2007

2.4 Climate Change Overview

Summary: Long Island relies mainly on fossil fuel combustion for electricity generation. Residential heating is disproportionally dependant on heating oil and transportation relies heavily on gasoline. All three of these factors make the region a large contributor to CO_2 emitted into the atmosphere. Long Island is also vulnerable to climate change and natural disaster due to its long shorelines and susceptibility to catastrophic weather events.

2.4.1 Climate Change Mitigation

Carbon dioxide is an important Greenhouse Gas (GHG) because while it transmits visible light it also absorbs infrared radiation, trapping heat within the surface to the troposphere. CO_2 is produced by animals, plants, and micro organisms; it is used during photosynthesis and is a major component of the Carbon Cycle. Five-hundred million years ago it was 20 times more prevalent than it is today. Inorganic CO_2 is also emitted naturally (e.g. by volcanoes and hot springs) but emissions from human activities including the combustion of fossil fuels are currently far more significant. The global average atmospheric concentration of CO_2 is about 375-385 ppm by volume but varies with location, urban areas tending to be higher. Levels indoors can be up to 10 times the atmospheric concentration. Human activities such as burning fossil fuels and cutting down forests have increased atmospheric carbon dioxide by about 35% since the industrial

[22] Based on calculations from Arup's model
[23] International Energy Agency (IEA) Statistics Division. 2007. *Energy Balances of OECD Countries (2008 edition)--Economic Indicators* and *Energy Balances of Non-OECD Countries (2007 edition)--Economic Indicators*. Paris: IEA. Available at http://data.iea.org/ieastore/default.asp.

revolution. Globally, scientists are concerned that the increase in GHGs is causing a rise in temperatures, and ultimately climate change.

Carbon footprint is a measure of greenhouse gas emissions and CO_2 from all activities associated with a region, expressed as carbon dioxide equivalents. It is a measure of human activity impacts upon the environment. The carbon footprint for a city or region is calculated by taking into account two aspects:

- The direct (or primary) footprint – this is a measure of direct emissions of CO_2 from energy consumption, transportation, waste disposal and water consumption
- Carbon offsets – this refers to investments in projects that either prevent the emission of an equivalent amount of CO_2 elsewhere or remove it from the atmosphere directly.

The United States carbon footprint in 2006 was approximately 5.752 billion metric tons CO_2 per year at a rate of 19 metric tons/person/year[24].

The 2009 carbon footprint for Long Island was approximately 60.5 million metric tons of CO_2 per year at a rate of 21.2 metric tons of CO_2 per person per year, which is higher than the national average.

2.4.2 Climate Change Adaptation

Long Island is vulnerable to rising sea levels due to the length of its coastline (approximately 400 miles). From 1971 to 2000, flood heights were approximately 6.3 feet for 1 in 10-year storms, 8.6 feet for 1 in 100-year storms, and 10.7 feet for 1 in 500-year storms[25]. The increased frequency of intense storms and increased precipitation due to climate change are likely to increase coastal flood events in the future[25]. This vulnerability is increased by the lack of a consensus for an Emergency Evacuation Plan for all of Long Island. The last evacuation plan written for Long Island was developed during the permitting process for the now decommissioned Shoreham Nuclear Power Plant (Evacuation Plan's were developed by Nassau and Suffolk County, separately). Although it was approved by FEMA, it was not approved by New York State and Local officials. There continues to be a need for a comprehensive evacuation plan for Long Island.

2.5 Transportation Overview

2.5.1 Summary:

Long Island has a mature transportation network of roads, highways, and railways. The low density development pattern means that transportation needs are predominantly served by private cars and goods are moved by truck. However, transit serves an important role for commuters to Manhattan during the week, some reverse commuting to Long Island and transportation to Long Island vacation destinations in the summer months. Limited access to rail and bus services and low density development means there is a reliance on the private car for all travel needs which leads to high levels of congestion throughout the day. Mobility options for a wide range of income groups are limited by lack of suitable alternatives to the automobile, and bicycle and pedestrian infrastructure is lacking. Finally, Long Island has limited connections to the greater region and nearly all transportation modes must pass through the most congested jurisdiction in the region, New York City, to reach destinations in the tri-state area and beyond.

2.5.2 Roadways

Auto travel is the primary mode of transportation in Long Island with very high mode shares across the island, particularly in Suffolk County. In most areas, over 90% of trips are taken by automobile. As the population of the island grows, the majority of trips are being accommodated by the Island's roadway network. The result is that the current state of roadway travel in Long Island is characterized by congestion where lengthy delays present a burden to Island residents and a drain on local businesses.

[24] World Bank, World Development Indicators: CO2 emissions per capita (2009)
[25] York City Panel on Climate Change. "Climate Risk Information." 17 February 2009. Table: p. 3 and p. 20.

The highway system is focused on east-west travel, with the Long Island Expressway, Southern State Parkway, Northern State Parkway, and the Sunrise Highway providing a large amount of roadway capacity for travel the length of the Island. However, roadway capacity for north-south trips across the Island is limited. As a result, several of the key north-south roadways such as the Sagtikos Parkway and Route 110 exhibit very high levels of congestion and low travel speeds, not only during daily peak hour periods but at many other times during the day as well. The high volume of trucks on the region's roadways and highways increases this traffic congestion. (See Section 2.5.5 on freight.)

Figure 13: Long Island Highways[26]

In addition to the major through routes, congestion is experienced in most downtown and commercial centers on Long Island. In order to continue to support growth without worsening congestion, Long Island will need to adopt a comprehensive strategy for improving land use and transportation integration.

[26] Source: Google Maps

2.5.3 Rail Transit

Like the highway system on Long Island, the regional rail transit was originally built for the primary purpose of carrying people into and out of New York City. The Long Island Railroad (LIRR), a part of the Metropolitan Transit Authority (MTA), continues to serve this function well today. The LIRR is the largest commuter railroad in the United States, operating eleven rail lines on almost 600 miles of track. The system carried an average weekday ridership of over 300,000 travelers in 2009. The LIRR system has 124 stations, including 57 in Nassau County and 41 in Suffolk County.

Figure 14: LIRR System Map[27]

According to the Long Island Index 2009 Report, ridership on the LIRR system grew at 2% between 2000 and 2007, a much slower rate than other regional commuter rail systems over the same period, such as Metro North (12% growth) and New Jersey Transit (20% growth). Some of the growth enjoyed by Metro North and New Jersey Transit is likely due to faster population growth in their respective service areas. Another factor that may cause growth in LIRR ridership to lag behind is that the LIRR has not added the types of services these other systems have since 2000, such as Metro North's third track and New Jersey Transit's increased commuter rail service[28]. However, the LIRR has begun to adapt to changing conditions on Long Island. The LIRR has made several service improvements in recent years to augment its reverse-commute and off-peak services to accommodate this growing market.

2.5.4 Bus Transit

Bus transit represents a small but growing part of the transportation mode share on Long Island. The two major operators, the MTA Long Island Bus system and Suffolk County Transit, help supplement the LIRR rail system in several ways: by connecting travelers to LIRR stations, by providing limited coverage of north-south trips and other intra-island segments that are underserved by the LIRR today, and by serving shorter routes between stations and areas that are outside of the LIRR catchment area.

The MTA Long Island Bus system serves Nassau County as well as parts of western Suffolk County and eastern Queens in New York City. This system connects 96 communities, 47 LIRR train stations, five New York City Transit subway stations, and numerous job centers throughout the region. Almost 110,000

[27] Metropolitan Transit Authority (http://www.mta.info/lirr/html/lirrmap.htm)
[28] Long Island Index 2009 Report

passengers per day are carried on 54 routes representing 954 route miles. In addition, the Long Island Bus system operates the largest fleet of all natural-gas-fueled buses in the country.

Suffolk County Transit is a county agency that oversees the funding and operational planning for several privately run bus companies in Suffolk County and southeastern Nassau County. This public-private partnership operates 53 bus routes and carried over 6.4 million passengers in 2008, for an average of around 17,500 riders daily. The Town of Huntington operates its own bus system, called Huntington Area Rapid Transit, or HART, as do the villages of Patchogue and Port Jefferson.

Ridership on the two major bus systems on Long Island has enjoyed growth over the last decade. According to the Long Island Index, the MTA Long Island Bus service experienced an 8% growth in ridership since 2000, while the Suffolk County Transit has seen growth of 35% in the same time period. The Suffolk County Transit system added nearly 500,000 riders between 2007 and 2008, a one-year increase of 7.5%. This indicates that the rate of growth has increased in recent years. This difference in growth rate of the two systems is likely due in part to faster population growth in Suffolk County, but it may also indicate that service increases to the Suffolk County Transit system at the beginning of the decade are paying dividends.

2.5.5 Air

Long Island's residents and businesses have convenient access to some of the best-served domestic and international commercial airports in the world in New York's LaGuardia and JFK, which had a combined 725,000 commercial flights in 2008[29]. Long Island MacArthur Airport in the Town of Islip is the only facility in the two counties that is served by major commercial carriers. In 2008, MacArthur Airport served over 178,000 airplane operations, of which over 23,000 were scheduled commercial flights[30]. Other airports on Long Island such as Republic Airport, Brookhaven Airport, and Spadaro Airports in Suffolk County serve the general aviation market and help alleviate congestion at the region's major hubs. According to the NYMTC 2010-2035 Regional Transportation Plan, these three are designated as general aviation reliever airports by the Federal Aviation Administration.

2.5.6 Freight

The majority of freight in Long Island is carried by truck on the region's highways and local roads. According to the NYMTC 2010-2035 Regional Transportation Plan, the New York metropolitan area as a whole ranks lower than 23rd of the 25 largest urban areas in the country in the percentage of freight carried by rail, at around 1% of the regional total. This is due to several factors, including the lack of connections to the national rail network, the predominance of passenger service on the regions rails, physical limitations in terms of vertical and lateral clearance along the older rail lines, and lack of space for rail yards and intermodal facilities.

Freight carried by trucks to and from Long Island must pass through the congested core of New York City. The New York City Department of Transportation (NYCDOT) requires that all vehicles defined as trucks by Section 4-13 of the New York City Traffic Rules (vehicles with two axles and six tires, or three or more axles) must follow the designated Truck Route Network.[31] This consists of Local Truck Routes and Through Truck Routes, shown in *Figure 15* with blue and red lines, respectively. This limited number of routes for truck freight onto and off of Long Island includes only the following designated Through Truck Routes:

- Northern Boulevard
- I-495 Long Island Expressway
- Hillside Avenue

[29] From: GCR & Associates, Inc. derived from the FAA's Aeronautical Information Services. (http://www.gcr1.com/5010web/default.cfm)
[30] From: GCR & Associates, Inc. derived from the FAA's Aeronautical Information Services. (http://www.gcr1.com/5010web/default.cfm)

[31] NYCDOT (http://www.nyc.gov/html/dot/html/motorist/truckrouting.shtml)

- Jamaica Avenue
- Hempstead Avenue
- North and South Conduit Avenue
- Rockaway Boulevard

Figure 15: NYCDOT Designated Truck Routes

While Long Island is particularly constrained by the congestion and physical barriers that New York City provides, there are a small number of rail freight lines in the region. The New York & Atlantic Railway (NYAR) has operated freight service on tracks and facilities owned by the LIRR since 1997. It currently carries around 20,000 carloads annually[32] over 269 route miles of track. While most of the routes operated by NYAR share tracks with commuter trains, there are a few lines that are used for freight only. These include the Bushwick Branch that splits from the Montauk Branch at Maspeth, and the Bay Ridge Branch that splits from the Montauk Branch at Fresh Pond and connects with a CSX route that runs over the Hell Gate Bridge to points north.

The result of such a high truck freight mode share in the Long Island region is increased congestion on the area's roadways and a higher than average regional carbon footprint from transportation sources. Developing strategies to move freight from trucks to rail could help mitigate both of these issues in the future.

[32] Anacostia & Pacific Co, Inc. New York and Atlantic Railway (http://www.anacostia.com/nyar/nyar.html)

3 Resource Use Forecasting Methodology

3.1 Arup Modeling Approach

In addition to understanding the existing conditions on Long Island today, the purpose of the Infrastructure Report is to forecast current consumption rates over a given period of time to understand what future demands will be and the environmental implications that result from those demands. Arup's modeling approach allows our team to streamline the analysis of significant amounts of data related to resource use, land use, and economic growth on Long Island. The model developed for this exercise builds up a baseline scenario based on existing performance data for Long Island such as housing density, waste generation, resource use, etc. This baseline model is calibrated using regional baseline data for resources such as energy, transport, water, waste and carbon. Planning assumptions and technical data are applied so that the baseline results match the observed existing conditions. Baseline 2008 land use assumptions and methodology are described in detail in the Land Use Technical Report.

The 2008 baseline model of land-use and development patterns for the towns of Nassau and Suffolk County used in this analysis was developed using calculations of gross floor area by built program type based on residential population, household and housing unit information from the US Census Bureau's 2008 American Community Survey, the Regional Plan Association's parcel-level land use database, and employment figures presented by HR&A.

From this baseline platform, future scenarios are forecast by adjusting the values for variables related to land use, economic growth and changes in major infrastructure. These adjustments are based on observed trends and assumptions related to future conditions that were developed by the modeling team. The forecast model outputs include predictions for energy demand, water demand, waste generated, and carbon emitted.

3.1.1 Forecasting Assumptions

For this analysis, the purpose of the forecast is to extrapolate the baseline case using current trends with zero policy change to determine the amount of resource consumption in the future scenario. This forecast represents an approximation of future conditions based on the best available current knowledge. As events unfold, new initiatives, new technologies and new options will be grasped to minimize resource consumption and transportation. At this point in the Sustainability Plan's development it is difficult to predict these policy changes and their resulting rates of change and implementation timeframe for resource consumption and transportation. Therefore, for the purposes of this report they have been excluded.

The following assumptions were used for the waste, water and wastewater and energy using Arup's model:

- Land-use assumptions for present (2008) and 2035.
- Waste generation rates and recycling rates remain unchanged from 2009 to 2035.
- Water use and wastewater generation rates remain unchanged from 2009 and 2035.
- Energy consumption and intensity rates remain unchanged between 2009 and 2035.
- Changes in transportation assumptions reflect the NYMTC projection model.

3.1.2 Land Use Scenarios

In conjunction with the Land Use Technical Report, Arup developed an analytical model which combines Census American Community Survey data from 2008 and the Regional Plan Association's parcel database, employment and demographic projections from NYMTC and HR&A, and a set of quantitative algorithms developed by the Arup team to estimate and project land-use patterns by Long Island town. This approach and its principle findings are detailed in the Land Use Technical Report. This exercise of forecasting infrastructure and resource needs uses the 2035 Business-as-Usual scenario as the comparator for existing conditions.

In the 2035 Business-as-Usual scenario ("Business-as-Usual"), land-use and development patterns for 2035 were projected for Long Island towns in a scenario where growth occurs and the development typologies and demographic characteristics are consistent with current zoning *and* the expressed future land-use intentions of the towns. This means that current trends were used, as opposed to historical ones, in forecasting the demand for real estate product types. In addition, demographic characteristics in the forecast reflect emerging instead of purely historical patterns. Top-line population growth projections for the two counties are consistent with the other scenarios in the Land Use Technical Report, which used modified NYMTC projections as a basis. Changes in developed land-use are based on the 2008 baseline characterization. This scenario assumes smaller household sizes and thus more total households.

The 2035 Business-as-Usual Case represents our best estimate as to what Long Island's future will look like from a land-use perspective based on current realities, all other factors being equal and without significant changes in both markets and current policies. This represents a case that makes use of those smart growth and TOD strategies either adopted by or under consideration by Long Island towns. This scenario does not reflect strategies that the Long Island Sustainability Plan may suggest or any policy changes which may result from those strategies. The projection of outcomes with such strategies taken into account will occur in a subsequent stage of the LISP process.

3.2 Transportation Methodology

In order to assess future transportation trends on Long Island, Arup coordinated with the New York Metropolitan Transportation Council (NYMTC), the agency responsible for developing the long-range transportation plan for the New York metropolitan region. A summary of NYMTC's findings and recommendations can be found in the 2010-2035 Regional Transportation Plan (RTP). The relevance of these findings for the Long Island region is discussed in Section 5.6 below.

In addition, to understand the current state of transportation on Long Island and likely future trends in greater detail, the Arup team examined a large set of existing and projected travel data developed by NYMTC. As MPO for the local region, NYMTC creates and maintains a regional travel demand forecast model that is used to predict future travel patterns. This Best Practices Model (BPM) has many planning and policy applications, from generating regional emissions and air quality forecasts to evaluating proposed new transportation infrastructure projects. As a part of their travel demand forecast, NYMTC conducts detailed demographic forecasts of households and employment that serve as inputs to the transportation model. The analysis in this report examines data from the NYMTC BPM in order to assess the effects of projected travel patterns on Long Island.

NYMTC provided Arup with data from the 2009 existing conditions model and projected travel data from the 2035 proposed model. This data came in the form of model inputs including demographic information, and model outputs including origin/destination matrices for the entire MPO region. NYMTC breaks the entire MPO region into transportation analysis zones (TAZs). Demographic data such as total population, number and size of households, and number of jobs is compiled by TAZ in order to calculate the number of trip ends – origins and destinations – for each TAZ. Our team sorted and filtered this data to examine how three key metrics can give insight into the future of transportation on Long Island:

- Vehicle miles traveled (VMT) for automobiles
- Average vehicle trip length for automobiles
- Auto mode share percentage

These data were examined for the baseline year of 2009 and the forecast year of 2035. The change in data values between 2009 and 2035 was also examined to provide additional understanding of the projected travel trends over time in the business as usual scenario. For each of the following metrics, the base data has been analyzed by TAZ, town and county. This provides a range of comparisons in order to examine and understand trends at different levels of detail.

3.2.1.1 Vehicle Miles Traveled (VMT)

One of the most important measures of existing and future travel is vehicle miles traveled in automobiles. VMT data provides an analog for the amount of emissions associated with transportation. Our team calculated VMT by multiplying the trip distance between each origin-destination zone pair by the number of trips between each pair. These distances were then summed up by origin zone and destination zone to provide a measure for each TAZ, town, and county.

3.2.1.2 Average Auto Trip Length

This metric was examined to gain insight into how far people in certain areas are willing to travel – or are required to travel – on a daily basis. Areas where this measure is high can suggest inefficient transportation infrastructure or land uses that are not coordinated with demand. One of the ways to reduce VMT, and therefore emissions, is to coordinate development and transportation infrastructure in a way that reduces and shortens auto trips. Our team calculated this measure by dividing VMT by the total number of auto trips for each TAZ, town, and county.

3.2.1.3 Auto Mode Share

The percentage of trips that use automobile as the primary mode is useful in assessing the amount of choice people have in their daily travel. Areas where auto mode share is very high generally correspond to areas where viable transportation choices are low. Shifting people from cars to transit is another way to reduce congestion and emissions from travel. Our team calculated auto mode share by dividing the number of vehicular trips by the total number of trips for each TAZ, town, and county.

4 Baseline Model Inputs

4.1 Waste Inputs

The following information was used for the baseline:

- Waste generation rates for residential households in pounds/unit/day in Suffolk County and pounds/unit/day in Nassau County (determined from existing waste management practices in Long Island) are shown in Table 3.

Table 3: Waste generation rates used for projection

Town/City	Single-family lb/unit/day	Multi-family lb/unit/day
Babylon	19.50	10.83
Brookhaven	13.00	7.22
East Hampton	18.00	10.00
Huntington	16.50	9.17
Islip	19.00	10.56
Riverhead	11.00	6.11
Shelter Island	11.00	6.11
Smithtown	24.00	13.33
Southampton	7.00	3.89
Southold	11.00	6.11
North Hempstead	17.00	9.44
Hempstead	20.00	11.11
Oyster Bay	14.00	7.78
Glen Cove	14.00	7.78
Long Beach	13.00	7.22

- Waste generation rates and composition percentages for commercial and institutional waste were determined using the California Integrated Waste Management Board (CIWMB) “Targeted Statewide Waste Characterization Study: Waste Disposal and Diversion Findings for Selected Industry Groups ©2006”. These rates and the characterization of this waste rarely deviate from region to region across the United States.
- Waste generation rates for industrial uses were determined using the CIWMB’s Estimated Solid Waste Generation Rates for Industrial Establishments (0.006 lbs/sqft/day)
- Waste recycling, off-island disposal and incineration percentages were determined using the following reports:
  - Suffolk County. “Suffolk County Solid Waste Management Report and Recommendations” ©2007
  - Malcolm Pirnie, Inc. “Consolidation Analysis and Implementation Plan: Solid Waste”. June 2008
  - O’Connell, C., Cahill, M., Heil, J. and Swanson, L. “Long Island Waste Index” ©2004
  - Stony Brook Waste Reduction and Management Institute. “Municipal Solid Waste Assessment Nassau and Suffolk Counties, Long Island, New York, 2006. ©August 2007

4.2 Water and Wastewater Inputs

The following assumptions were used for the water projections using Arup's model:

- Suffolk County DPW Manual for On-site Sewage was used to estimate indoor water use and wastewater generation for residential, commercial, industrial and institutional spaces. *Table 4* shows the interior water consumption rates used.
-

Table 4: Internal water use rates

Land-use Type	Unit	Value
Single Family	gpd/unit	300
Multi-Family	gpd/unit	225
Commercial[33]	gpd/sf	0.045
Industrial	gpd/sf	0.04
Institutional	gpd/sf + gpd/job	0.03 + 2.5

gpd = gallons per day; sf = square foot

- Interviews with Suffolk County Water Authority and the Nassau County DPW revealed that the amount of water used for irrigation has increased over the past two decades. Today, approximately 40% of residential water use is used for irrigation.
- A ratio was determined for Nassau and Suffolk County based on the percentage of building footprint per lot area data developed by HR&A and Arup's land use model.

These values were then calibrated to determine the potable water use and the wastewater discharge.

4.3 Energy Inputs

- Single family residential use energy intensity values were determined using *Residential Energy Consumption Survey (*RECS) data for different home types in New York.
- Commercial and institutional electricity and heat (gas or oil) intensity values were determined by Trane Trace energy model for a constant air volume heating and cooling a four-story office building.
- Utility consumption (LIPA, LIRR, etc.) remained approximately 2% of the electricity requirements.

[33] Average of Office = 0.06 gpd/sf and Retail = 0.03 gpd/sf

4.4 Climate Change Inputs

The following assumptions were used in the climate change projections.

- Sea-level rise based upon Niels Bohr Institute 100-year projection
- Electricity from water treatment, distribution and wastewater treatment is included in the Carbon Footprint.Table 5 presents the emission factor used for oil and gas consumption. The electricity emission factor was calculated using the 2008 grid mix.
-

Table 5 : Emission factors

Fuel Type	Emission factor $kgCO_2eq/kWh$
Oil	0.758
Gas	0.1848
Electricity	0.443

- Waste emission rates were sourced from the ICLEI CACP model for landfilling and incinerating waste (long-haul transportation emission rates were not included in the analysis). These rates include emissions and sequestration associated with paper, food, yard waste, wood/textiles, and residual waste.
- Water electricity rates for distribution and treatment were sourced from the report "Water-Related Use in California" reported by the Assembly Committee on Water, Parks and Wildlife, February 20, 2007.
- Transportation emissions assumed a light truck mix of 50% gas and 50% diesel. Emission factors are shown in *Table 6* below.
-

Table 6: Transportation emission factors

Fuel Type	Gasoline kg/mi	Diesel -	Source
Light Auto	0.489	-	
Light Truck	0.647	0.543	USEPA Technical Guidance on the Use of MOBILE 6.2 for Emission Inventory Preparation, August 2004
Heavy Truck	-	1.614	"
Urban bus	-	2.151	EMFAC, Urban Bus

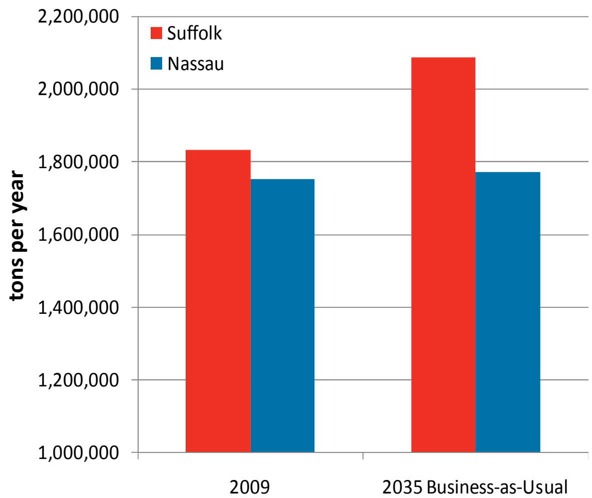
5 2035 Forecast Analysis

5.1 Waste Forecast

The waste generation rates per capita in Nassau County indicate a decrease in 2035 compared to 2009, as shown in Figure 16. This is due to a projected increase in multi-family homes compared to single family homes. Generally, multi-family, or more densely populated neighborhoods generate less waste than single family neighborhoods.

Figure 16 illustrates that generation rates in Suffolk County are higher than Nassau County in 2035 for both cases. This is a result of an increase in the number of residential units (both single family and multifamily) in Suffolk compared to Nassau.

In 2009 the results show, at least 815,000 tons per year, or approximately 22% - 25% of waste generated is transported off-island (9% Suffolk and 33% Nassau). If recycling rates remain the same and the existing waste-to-energy plants do not increase capacity or no additional waste-to-energy technology is introduced, then approximately 1 million tons of waste will need to be transported off-island in 2035 (the high scenario is about 39,000 more tons of waste per year off-island).



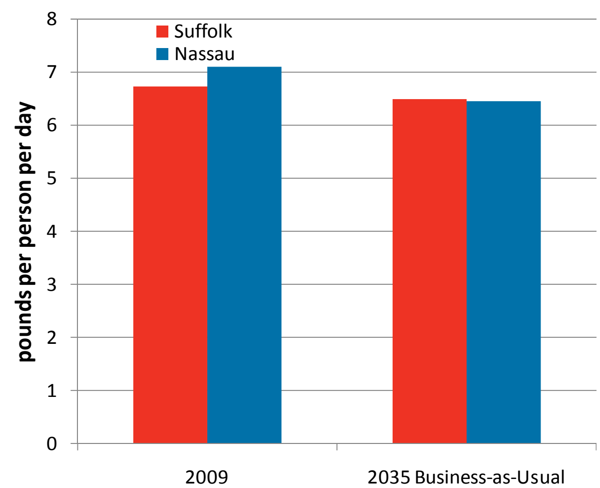


Figure 16: Projected waste generation (left) and per capita waste generation (right)

5.2 Water

As shown in *Figure 17*, Long Island water consumption will increase in the next 26 years. If trends continue, consumption rates may increase as they have in the last decade (this trend was not taken into account in the projection study). The top priority, as per discussion with the SCWA, is to reduce water consumed as a result of automated sprinkler systems. Regionally, Long Island has a surplus of water; however, if total water use increases, as *Figure 17*suggests, then less water will be available. Reduced water availability will have the secondary effect of increasing energy use due to increased treatment and distribution for water that previously needed less treatment. In addition, if impervious hardscapes increase due to development or precipitation rates decrease due to climate change, the groundwater recharge could potentially be less than that consumed. Increased development may also increase the potential for contamination (if adequate sewage infrastructure is not developed).

Due to increased building footprints and build out area in Suffolk County for the 2035 Business-as-Usual scenario, irrigation water use decreases in Suffolk County.

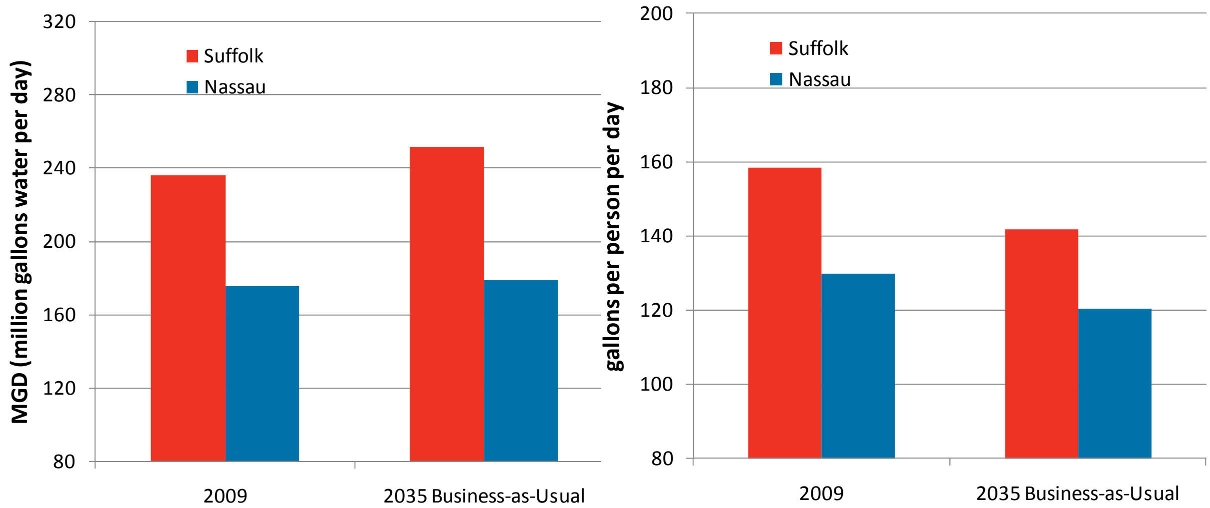


Figure 17: Projected potable water use total (top) and potable water use per person per day (bottom)

5.3 Wastewater Forecast

The projected water increase will require additional water treatment systems and additional wastewater treatment plants. Currently, the capacity of the Nassau County wastewater treatment system is approximately 150 MGD (Suffolk County is more difficult to predict due to septic system treatment). If this is exceeded then additional wastewater treatment plants will be necessary. In Suffolk County, the additional wastewater generation (Figure 18) from increases in density will potentially increase the risk of groundwater contamination if septic systems continue to be used.

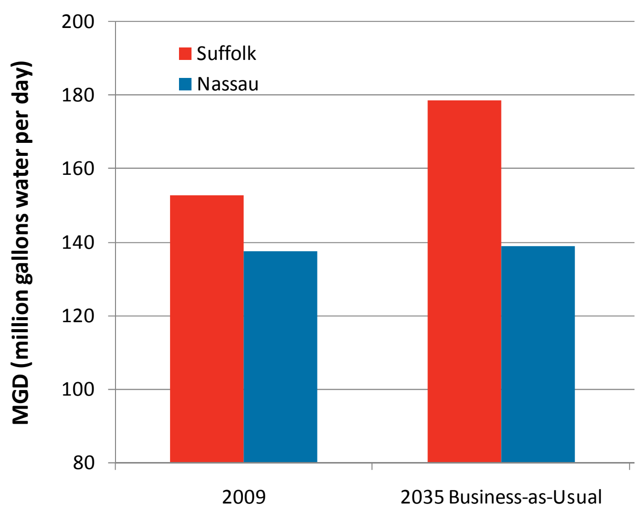


Figure 18: Projected wastewater generation volumes

5.4 Energy Forecast

As shown in Figure 19, energy consumption per capita decreases in the future scenario. This is predominantly due to increased density in Long Island. The higher density scenario (2035 Business-as-Usual) has lower per capita energy consumption than the 2009 scenario. As expected, the total energy consumption increases in both scenarios. It is important to note that electricity and gas/oil intensity rates are stagnant in this projection, which is not necessarily the case in some future scenarios. For example, LIPA's electricity projection included a 3.6% in total electricity consumption increase per year.

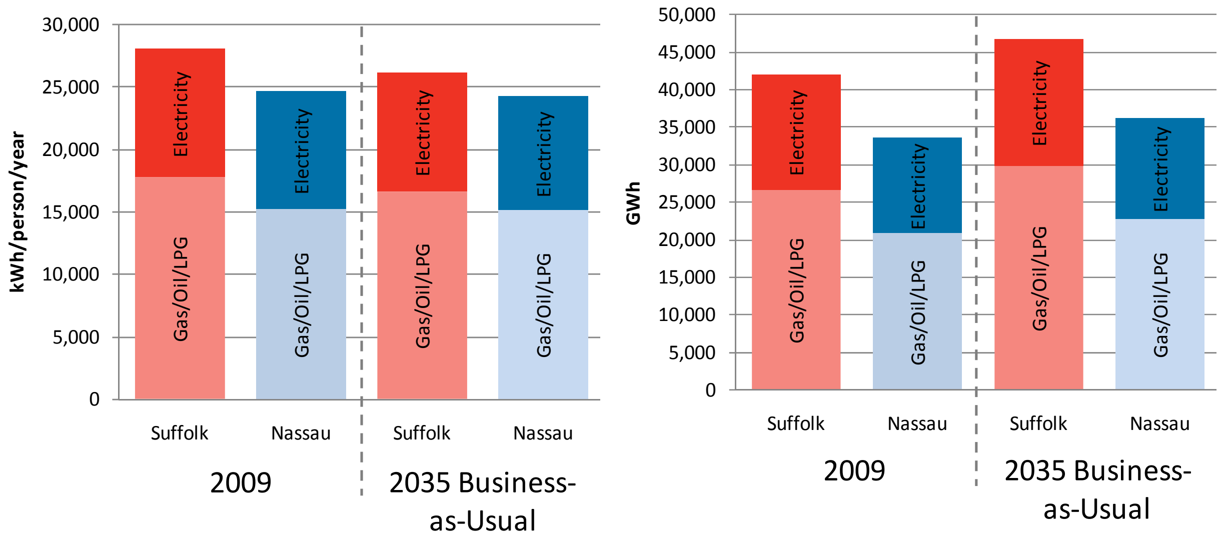


Figure 19: Projected per capita energy consumption (top) rates and total energy consumption (bottom)

5.5 Climate change

The estimated and projected carbon footprints for Long Island are illustrated in *Figure 20*. By 2035, Long Island will have a larger impact on the planet with a projected 12% increase in carbon emission from today.

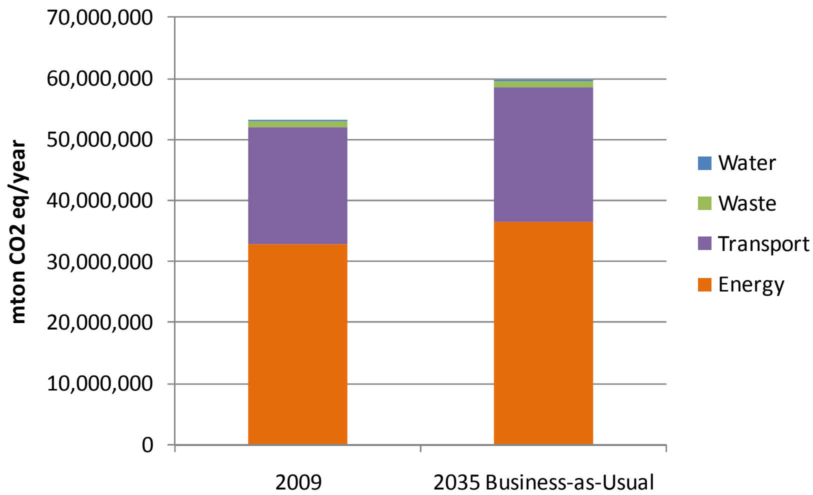


Figure 20: Long Island's Carbon footprint

Using the Niels Bohr Institute 100-year projection, it is expected that sea level rise is one meter by 2035. The areas potentially affected by this level of rise are indicated in red on the figure below.

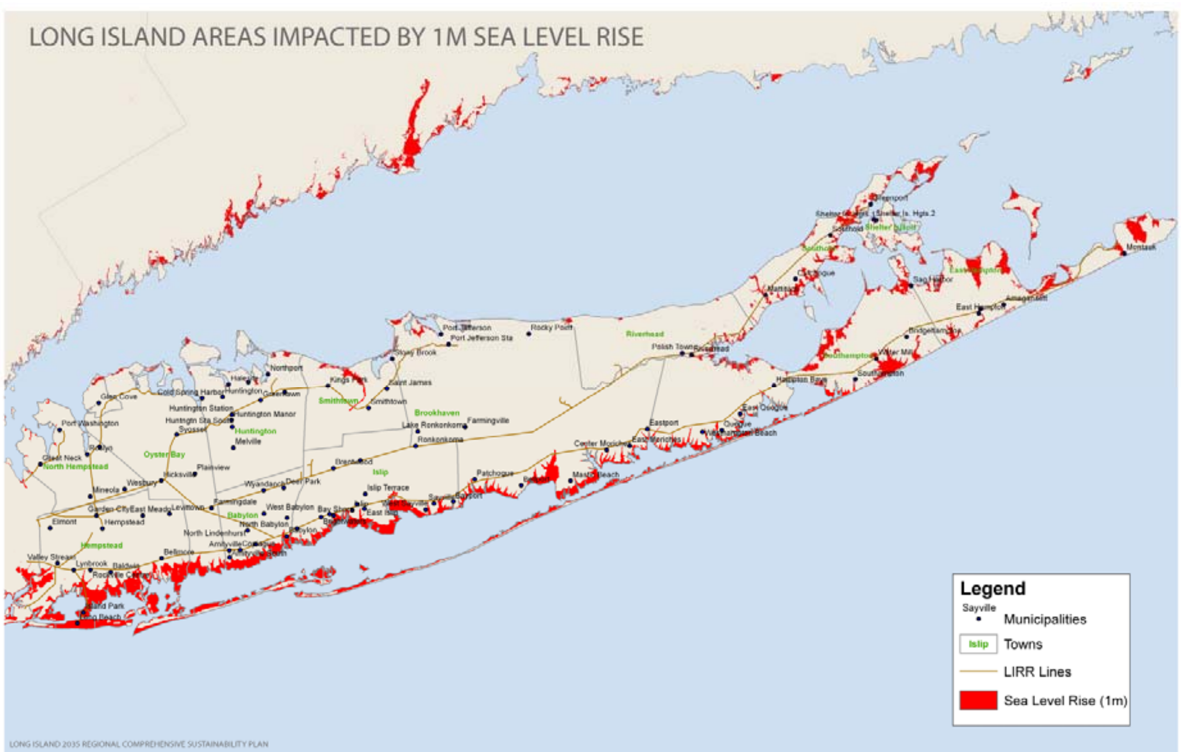


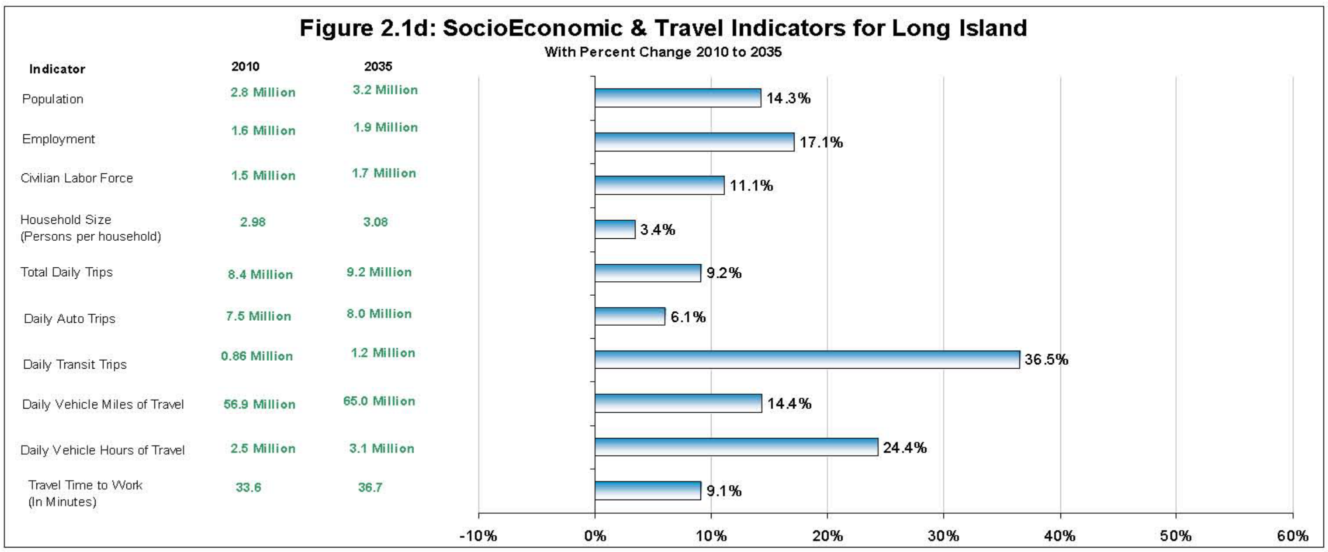
Figure 21: Long Island's potential sea level rise

5.6 Transportation Forecast

The demographic and transportation forecasts developed by NYMTC as part of the Regional Transportation Plan present a future for Long Island characterized by a few sobering trends as well as some positive signs.

For example, the total number of vehicle miles traveled (VMT) is projected to increase 14.4%, also faster than the number of auto trips. This means that people who do drive will be traveling even further on average than they are today. And the projected increase of daily vehicle hours of travel is projected to rise by an even greater amount, at 24.4%. This extra time spent in vehicles likely means that left unchecked, congestion could be even worse in the future than it is today.

There are some positive signs however. One is that the number of total trips is increasing more slowly than total population. This suggests that people are projected to be generally more efficient with the number of trips they take in 2035 than they are today. In addition, while daily auto trips and daily transit trips are both on the rise, the number of transit trips is projected to increase by 36.5% - far higher than the projected 6.1% increase in auto trips.



Source: “2010-2035 NYMTC Regional Transportation Plan: A Shared Vision for a Shared Future”

Figure 22: NYMTC Demographic Predictions for Long Island

In order to examine these trends in greater detail, the NYMTC trip data for the 2009 and 2035 was aggregated at the county and town level in order to examine the localized changes in VMT, average trip length, and mode share data. The results of this assessment are discussed in the following sections.

5.6.1 Vehicle Miles Traveled (VMT)

According to the NYMTC projections, VMT is expected to increase in both Nassau and Suffolk Counties by 2035. The examination of the model data at the town level suggests that this increase will occur relatively evenly across the island. This means that other measures such as average trip length and auto mode share can inform where strategies to reduce auto travel and encourage transit will have the greatest impact.

Table 7: 2009 Trip Data Sorted by Town

Town	Trips			Auto Mode Share	VMT	Avg Trip Length
	Auto	Transit	Total			
Babylon	540,894	66,170	607,064	89%	3,909,495	7.2
Brookhaven	1,186,858	57,912	1,244,770	95%	10,225,198	8.6
East Hampton	62,706	1,580	64,285	98%	517,133	8.2
Glen Cove	56,107	4,254	60,361	93%	524,974	9.4
Hempstead	1,652,411	339,260	1,991,671	83%	11,059,941	6.7
Huntington	661,090	43,570	704,659	94%	4,913,502	7.4
Islip	836,754	71,479	908,233	92%	6,693,086	8.0
Long Beach	45,597	13,844	59,441	77%	438,503	9.6
North Hempstead	559,374	95,830	655,204	85%	4,256,295	7.6
Oyster Bay	779,763	63,783	843,545	92%	6,078,247	7.8
Riverhead	98,078	2,615	100,693	97%	1,039,411	10.6
Shelter Island	6,157	68	6,225	99%	60,391	9.8
Smithtown	334,472	17,546	352,018	95%	2,619,498	7.8
Southampton	175,144	4,094	179,238	98%	1,677,652	9.6
Southold	55,956	998	56,954	98%	544,760	9.7

Table 8: 2035 Trip Data Sorted by Town

Town	Trips			Auto Mode Share	VMT	Avg Trip Length
	Auto	Transit	Total			
Babylon	590,698	69,212	659,910	90%	4,264,982	7.2
Brookhaven	1,465,379	67,993	1,533,371	96%	12,267,472	8.4
East Hampton	84,419	2,050	86,468	98%	700,010	8.3
Glen Cove	59,606	4,650	64,255	93%	538,599	9.0
Hempstead	1,671,375	335,001	2,006,376	83%	11,318,858	6.8
Huntington	706,439	44,361	750,800	94%	5,449,048	7.7
Islip	921,948	73,655	995,603	93%	7,426,058	8.1
Long Beach	48,281	14,223	62,504	77%	458,820	9.5
North Hempstead	581,672	102,656	684,327	85%	5,148,951	8.9
Oyster Bay	810,468	64,778	875,246	93%	6,636,537	8.2
Riverhead	136,234	3,704	139,937	97%	1,374,337	10.1
Shelter Island	8,713	192	8,904	98%	81,724	9.4
Smithtown	380,609	19,866	400,474	95%	3,209,522	8.4
Southampton	225,799	5,571	231,370	98%	2,169,572	9.6
Southold	75,742	1,570	77,311	98%	700,288	9.2

5.6.2 Average Trip Length

When viewed at the town and TAZ level, the projected pattern for average trip lengths in 2035 is largely the same as in 2009. In both the existing and future scenarios, when people drive in Suffolk County they travel roughly one mile further on average than those in Nassau County. The average trip length in most areas remained relatively constant, with most towns experiencing only an increase or decrease of less than a half-mile per trip.

In general, zones in central and western Suffolk County, where transit service is relatively limited and development densities are lower, tended to exhibit the highest average trip length. Other clusters of high average trip lengths also occurred along both the north and south shores of Nassau County, which likely reflects the longer distances between these zones and the main east-west LIRR transit corridors. This suggests that improving north-south connections across the island, through more direct and frequent transit service and additional street connections, could help reduce overall VMT and the associated fuel costs and carbon emissions.

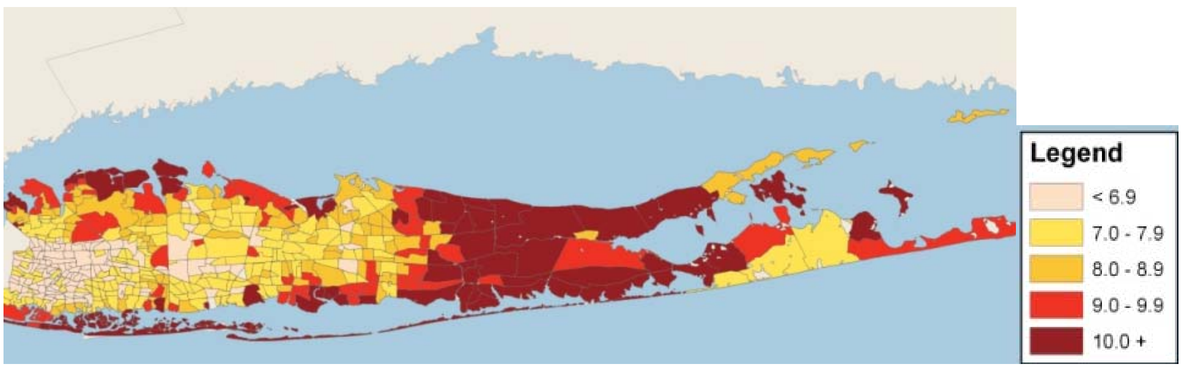


Figure 23 - 2009 Average Trip Length by Origin TAZ

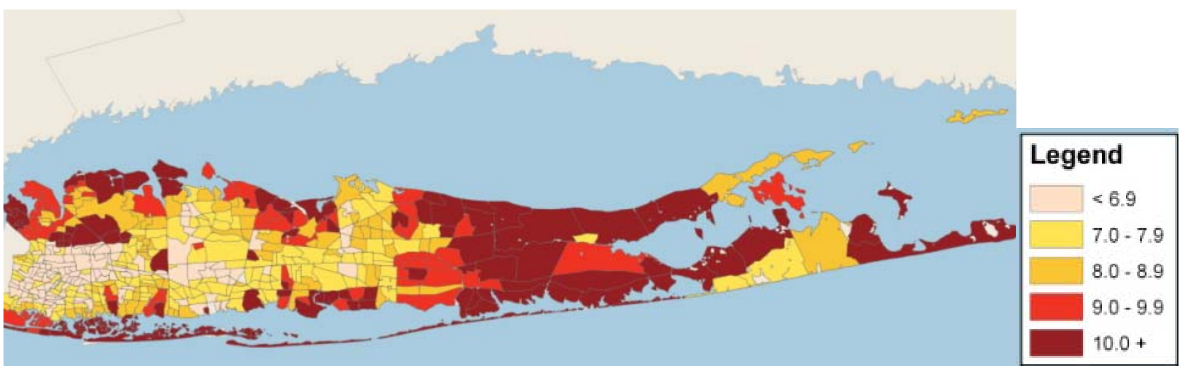


Figure 24 - 2035 Average Trip Length by Origin TAZ

5.6.3 Auto Mode Share

The NYMTC projections suggest that auto mode shares in both Nassau and Suffolk County will remain relatively constant between 2009 and 2035, at 94% for Suffolk County and 86% for Nassau County. A breakdown of the model data at the town and zone level again suggests that the more detailed pattern is also expected to remain steady.

Overall, auto mode share patterns in the existing and future scenarios reflected a number of transportation infrastructure and demographic properties of Long Island. Areas with limited access to transit and long average trip lengths exhibited extremely high auto mode shares. These areas included most of Suffolk County and the north and south shores of Nassau County. The areas with the longest average trip lengths also tended to have the highest auto mode share, including Riverhead (97%), Shelter Island (99%), and

Southold (98%). This suggests that an opportunity exists in these areas to reduce trip length through a combination of land use changes, increased LIRR service, and new transit options. In the case of these three towns, this could mean encouraging more mixed-use development to bring more commercial and retail services to the northeast area of Long Island.

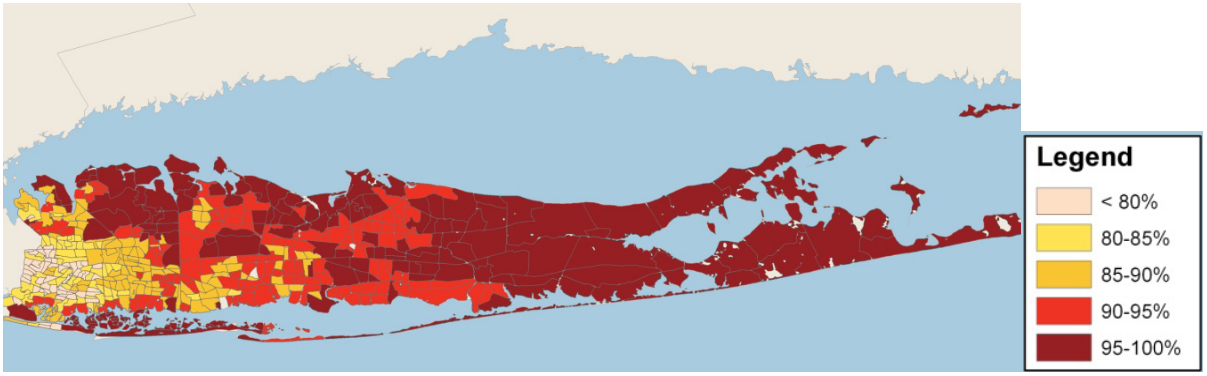


Figure 25 - 2009 Auto Mode Share by TAZ

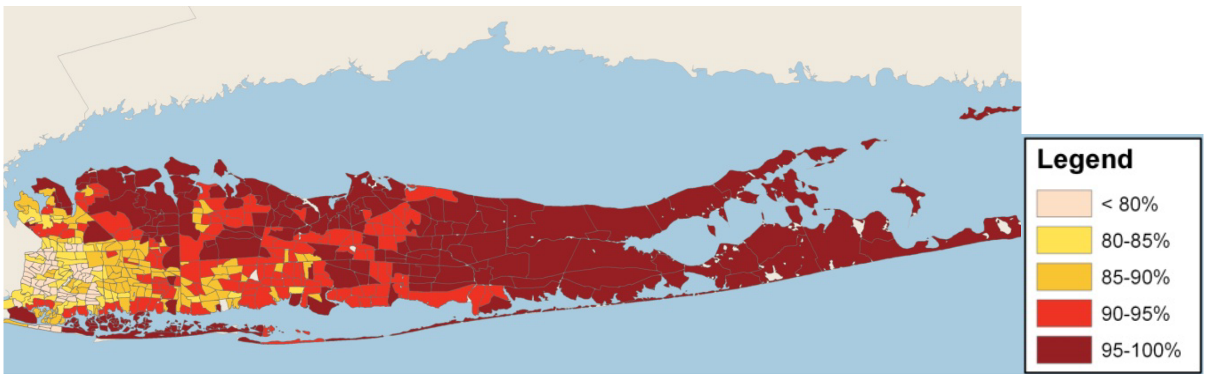


Figure 26 - 2035 Auto Mode Share by TAZ

One notable exception to the general pattern of auto mode share was the City of Long Beach, which had a relatively low auto mode share (77%) but a high average trip length (9.6 miles/trip). The longer average trip length may be attributable to the town's relative isolation; all trips in and out must cross one of only three access bridges. However the reasons for the relatively low auto mode share are unclear. Further study would be necessary to determine if this value is due to conditions on the ground or exceptions in the data and calculations.

Another exception to the Island-wide mode share pattern was the relatively high auto mode share in the northern half of Nassau County. This area is relatively well served by transit, and closer to employment centers in New York City. This may reflect a reduced sensitivity to travel costs. In general, higher income travelers generally have lower sensitivities to differences between auto and transit travel time and cost, and therefore often produce higher auto mode shares even when transit options are present. Strategies that seize on the opportunity to promote realistic transportation choices will be most effective in reducing auto mode share.

6 Infrastructure Goals

6.1 Waste Goals

In order to improve the existing and future waste management in Long Island the following goals have been developed throughout the stakeholder process.

- *Reduce waste generation on Long Island*. The waste management in Long Island is not integrated. Each Town has a different waste strategy managed by various levels of government and private businesses. With additional waste streams arising, a unified waste strategy is necessary between each Town and the two counties. If waste management is fully integrated, recyclables and compost product markets become more economical, waste to energy plants could be shared when not at full capacity (instead of the waste going off-island).

- *Change behavior to manage waste generation at all levels* (production, distribution, and consumption). Behavioral changes through education, as well as other strategies will need to be considered to reduce the waste generation rates on Long Island.

- *Establish and implement cost effective methods for waste management.* Waste cost per household varies for each Town[5]. A single waste strategy could evenly distribute these costs and provide a more viable market for compost and recyclable products.

- *Manage 100% of solid waste on Long Island.* Managing waste on Long Island will reduce the environmental and cost impacts from transporting waste off the Island, as well as, reduce the burden that Long Island has on those States receiving Long Island waste. In addition, management of waste will have recognizable economic benefits to Long Island.

6.2 Water and Wastewater Goals

In order to improve the existing and future water management in Long Island the following goals have been developed. These will be updated throughout the Long Island Sustainability Plan development process.

- *Conserve water.* Developing building codes requiring low flow fixtures and time and seasonal limits to automatic sprinklers will decrease water consumption levels.

- *Adapt water supply and waste water systems for higher density development.* As areas become more developed and dense, the risk of septic system contamination increases. Potable water and sewage infrastructure will need to be further developed to prevent septic system contamination, or if there is contamination, alternate distribution lines could potentially be used.

- *Preserve and protect aquifers.* Educating Long Islanders on the importance of Long Island's sole source aquifer, a reduction in water consumption through codes and planning, use of low impact design practices, and potable water and wastewater pipeline distribution may reduce the impact on Long Island aquifers.

6.3 Energy Goals

- *Reduce energy demand.*

LIPA has the following initiatives to reduce energy consumption and supply a renewable energy source to Long Island:

  - Power supply CO_2 footprint reductions – reduce CO_2 emission to a level 10% below the 2005 emissions, levels by 2020 (20% by 2030)

  - Efficiency Long Island Plan – Reduce electrical peak demand and consumption

- Solar PV
- Regional Wind (off-shore)

LIPA is also aligning with New York State's "45 by 15" goal, which includes:

- 15 X 15 goal - 15% energy reduction by 2015
- Renewable portfolio standard program goal – 30% renewable portfolio by 2015

Energy reduction can be achieved through building codes requiring prescriptive energy efficiency measures and standards, upgrades to insulation and boiler systems in residential households, and a smarter electricity distribution grid. LIPA and National Grid may also work closer with all the municipalities across Long Island to reduce electricity and heating demands.

- *Achieve a safe, sustainable and secure energy supply.*

Long Island is dependent on energy sources off-island. This includes the gas from the Iroquois and Transco pipeline, and electricity transmission lines coming from New England or New Jersey. An increase in energy consumption will require additional off-island fuel resources for electricity generation and heating. Any disturbance to those fuel sources would affect Long Island's energy security. In addition, if LIPA's goal is to have a 30% renewable portfolio by 2015, an increase in energy consumed will require more renewable technologies, higher fuel costs and transmission and distribution upgrades, increasing the cost to LIPA and national grid, which potentially would be felt by the consumer.

6.4 Climate Change Goals

- *Reduce greenhouse gas emissions.*

Reducing energy demand and increasing renewable energy supply, reducing waste transport and the amount of waste incinerated, reducing water consumption in relation to energy used for distribution and treatment, use of public transportation, increase of freight train travel (as opposed to trucking materials) and reducing Long Islanders dependence on automobiles are methods to mitigate climate change.

- *Increase resilience to climate change*.

Protecting Long Island's water source, designing buildings and infrastructure by thinking about climate change and developing an evacuation plan are climate change adaptation methods.

6.5 Transportation Goals

The assessment of existing conditions and projected future conditions can offer insight into where the problem areas are and how the region can work towards its goal of sustainable mobility and better access to the region. Some transportation goals could include the following:

- *Plan for Vibrant, Walkable Downtowns*.

Concentrating development and cultural facilities in downtown areas and enhancing pedestrian and bicycle facilities serving those areas will create vibrant centers of activity where people can come to shop, dine, stroll, and meet other members of their community. By putting new development in walking distance of stores, cultural facilities, restaurants, shops and schools, walking, bicycle and transit are more attractive and convenient while these areas become more vibrant and sustainable. Improving options for walking, cycling and transit minimizes and reduces carbon emissions from auto-based transport, which also improves air quality and public health. Enhancements to the pedestrian (and bicycling) realm can promote social equity when improved streetscapes and quality community design remove barriers that bisect or fragment local neighborhoods. When trips are made by walking, cycling or transit instead of automobiles, carbon emissions from transportation are reduced.

- *Develop in LIRR Station Areas*.

Long Island's rail stations provide the opportunity to create a series of transit-oriented developments around the Island. With the station at its center, the focus of the rail can still be to carry residents into and out of New York City while also serving as an intra Long Island transit corridor with LIRR connecting these centers together. In response to new plans and additional transit service, as residential, cultural and business uses fill-in the gaps around the station new services for the residents will emerge, as well as the potential for a local high-density employment center. These conditions would allow people to abandon their cars in favor of walking, cycling, or taking other local transit modes to/from the station for commuting purposes.

- *Increase the Viability of Transit.*

Increasing the ease of access, efficiency of service, and number of destinations for transit will provide residents of Long Island with the choices they need to make efficient and sustainable transportation decisions. Through Eastside Access, LIRR third track, Bus Rapid Transit Systems, and better bicycle and pedestrian facilities, transit can play a meaningful role in the mobility for all Long Island residents. Improving the viability of transit and providing realistic travel options also promotes social equity by facilitating efficient and affordable travel choices. A shift towards transit can enhance economic prosperity by reducing congestion, improving the efficiency in the movement of people and goods, and increasing the affordabilityof transportation for all users

- *Improve Regional Connectivity*.

While Long Island enjoys a mature road and rail system, the infrastructure is aging and in need of updating. This includes making transit capacity and infrastructure improvements, many of which are underway today. Investing in the health of the region's roadways is vital to Long Island's transportation future. While Long Island should work actively to promote new and improved transit options, automobile travel is not going away and vehicular travel must continue to be accommodated in the future. Without building new facilities, the capacity of the existing roadway network can be improved through maintenance and technological improvements.

- *Avoid the Congestion of New York City*.

As long as all roads and transit systems leading to Long Island pass through the region's congested core, it will be difficult to sustain a healthy climate on Long Island for businesses and growth. While New York City provides enormous opportunities for Long Island residents, it also acts as a barrier between Long Island and the rest of the country. Providing more connections to get on and off Long Island will have multiple benefits for residents and businesses.

- *Improve North-South and Other Intra-Island Transportation Links*.

The existing road and rail network is set up in a predominantly east-west direction, reflecting a historical need to connect residents to New York City. Internal trips, especially along north-south corridors, are congested and difficult on many of Long Island's roads. Much of this congestion is due to inadequate capacity on roadways and a lack of viable transit options along these corridors. Creating and investing in new transit options along these north-south corridors will provide access to new job centers, connect Long Island's existing transit corridors, and serve as an essential improvement to transportation connectivity in Long Island.

- *Reduce Auto Dependency*.

As the data sections of this report showed, despite having the country's busiest commuter rail system, Long Island is still dominated by the automobile. The future of Long Island depends on investment in its existing transit network and a thoughtful expansion of the transit system. Projects to improve existing transit capacity, the construction of new transit links and corridors, and the development of transit-oriented development are important to reducing Long Island's auto dependency. Key metrics for improvement are reductions in vehicle miles traveled, trip length, and auto modal share.

- *Accommodate goods movement*.

Long Island is isolated from the rest of the Tri-State region given the only paths on and off the island are via the most densely populated city in the United States: New York City. With one of the most productive agricultural economies of the state and a healthy local economy, finding new ways to connect Long Island to the Tri-State area and beyond will have economic and mobility benefits for the region. This can be accommodated through a deep water port, expanding rail transport, and finding additional roadway links to Connecticut and New Jersey. Developing ways to resolve operational, physical and geometric freight bottlenecks, identifying locations for new intermodal facilities, and exploring public-private partnerships between freight haulers and track owners could all lead to fewer trucks on the road, less traffic congestion, improved safety for drivers, and reduced greenhouse gas emissions from transportation sources. In addition, connecting Long Island to the rest of the nation via freight infrastructure could help Long Island commercial and industrial businesses position themselves competitively, create new jobs, and inject much-needed financial support into the local economy.

7 Conclusion

The infrastructure challenges Long Island faces in the next twenty-five years are varied and complex. A decentralized system of waste collection faces high waste generation rates and inadequate capacity to dispose of it. The Island's sole source of potable water is being subjected to rising water usage rates. Much of the Island's energy is generated elsewhere while renewable sources make up less than 5% of the total. The region is a large contributor of CO_2, its coastlines remain especially vulnerable to the potential effects of climate change and transit choices are limited while congested roadways lead to lost time and inefficiency.

Solutions to these issues are within reach. The inter-related nature of the challenges identified in this report mean the opportunity exists to address them through a coordinated, multifaceted approach. Improvements in one realm will be most effective when there are supporting and complementary improvements in another realm. Energy strategies that promote efficiency will support efforts to improve affordability for residents and businesses. Enhancing transportation options and connections complements initiatives aimed at attracting jobs and population growth. Land use changes that support intensification of development also support housing affordability, improved access to jobs and initiatives that enhance the efficient transport of goods.

These solutions will require cooperation not only among the residents, governments, and leaders of Long Island, but also with agencies and stakeholders in New York City, New York State, and partners in the municipal services industries. .. Ideas such as moving to low-carbon energy sources, ensuring the security of water supplies, improving regional connectivity, increasing the viability of transit, and responding to the effects of climate change all will require investment and approval from a number of area government entities. The leaders of Long Island must work with other local leaders to address the infrastructural challenges Long Island faces, as a healthy and productive Long Island will have positive results for the region and the nation in the long term.

Long Island is a unique place in America, and has a history of serving as an example of progress for the rest of the nation. Only a coordinated approach to improving and maintaining Long Island's infrastructure, services and amenities will ensure that this tradition of leadership continues. Addressing the needs facing the region's infrastructure will support the wider goals for Long Island in 2035 – enhanced economic prosperity, expanded social equity and a healthy environment.