

Petroleum Assessment
New York State Energy Plan 2009

December 2009

1 Overview

This Assessment describes the use of petroleum products, the origin of crude oil used to manufacture these various fuels, sources of refined products, adequacy of critical infrastructure and transportation components, price impacts and market fundamentals, and the introduction of biofuels as significant blending components for various fuels at the global, national, and state level.

New York is a major consumer of petroleum fuels such as motor gasoline, home heating oil, diesel fuel, propane, and residual fuel oil. The State is the fifth largest petroleum fuel market in the United States, exceeded only by Texas, California, Florida, and Louisiana.¹ In 2007, total statewide expenditures on all petroleum fuels by all economic sectors equaled \$32.6 billion.² The transportation sector accounted for \$24.6 billion, or 75 percent of the total. As crude oil prices have escalated in recent years, petroleum expenditures have increased with total annual petroleum expenditures increasing by \$15.0 billion, or 89 percent, from 2003 to 2007.

To meet this demand, numerous multi-national, national, and independent energy companies supply refined petroleum products to the State through an extensive distribution system. The Port of New York, with large petroleum storage terminals located on both the New York and New Jersey sides of the harbor, is an important component of this system. These deep water terminals receive a steady flow of refined petroleum products and crude oil into the New York area from domestic and foreign sources.

New York also receives petroleum products from several pipeline systems that connect terminals located throughout the State to the major refining centers located along the U.S. Gulf and East Coasts. Crude oil is also delivered into the harbor area and is used by refineries located in the Mid-Atlantic region to produce refined products for the northeastern United States. Once refined fuels arrive at these terminal facilities or are produced at the regional refineries, they are distributed by pipeline, barge, and truck transport to smaller coastal and inland terminals for further distribution to users.

The Assessment concludes that there is expected to be adequate supplies of the various fuels to meet demand throughout the forecast period. Storage capacity and infrastructure component capabilities will need to be monitored and reassessed on a regular basis as fuel types and blends evolve, supply sources change, and demand patterns evolve to meet user needs.

¹ U.S. Energy Information Administration (EIA). *State Energy Consumption Estimates: Table S2*. 2007. http://www.eia.doe.gov/emeu/states/sep_sum/plain_html/sum_use_tot.html

² New York State Energy Research and Development Authority (NYSERDA). *Patterns and Trends - New York State Energy Profiles 1993-2007*. 2009. http://www.nyserd.org/energy_information/patterns%20&%20trends%201993-2007.pdf

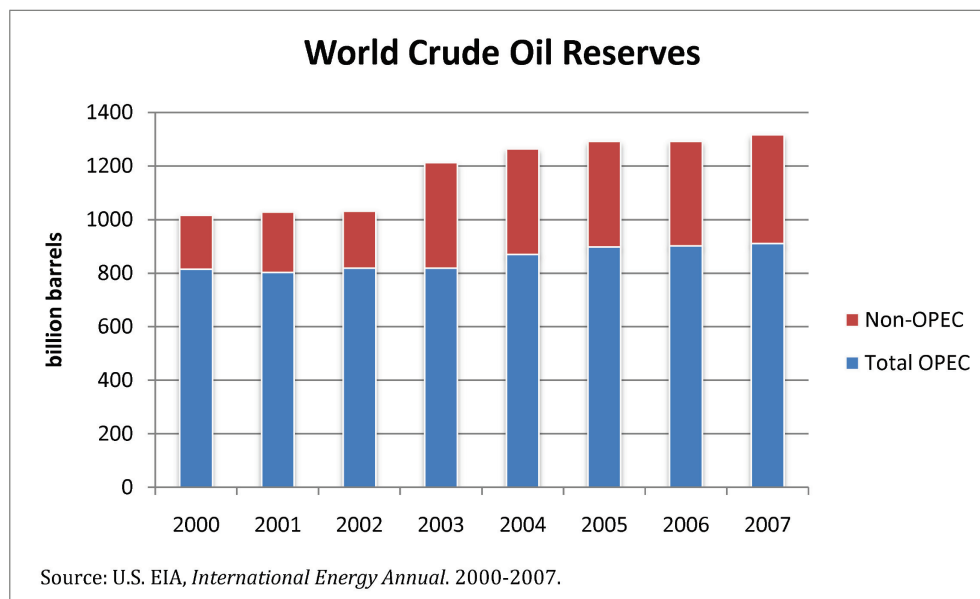
2 World and U.S. Markets

2.1 World Crude Oil Reserves

The geographic location of crude oil is as important a consideration as its quantity and quality. While there are a number of important crude oil producing regions around the world, one of the most vital is the Middle East, home to many member nations of the Organization of Petroleum Exporting Countries (OPEC).³ OPEC crude oil reserves equaled approximately 910 billion barrels in 2007 and accounted for 69 percent of total world reserves. As a comparison, U.S. crude oil reserves in 2007 equaled about 21 billion barrels and accounted for 1.6 percent of the worldwide total.

The amount of proven world crude oil reserves varies annually depending on the rate of consumption, the addition of reserves from new discoveries, and improved extraction techniques for existing production areas. In recent years, world crude oil reserves have remained relatively stable as new discoveries have effectively offset depletion of existing reserves. As shown in Figure 1, between 2000 and 2007, estimated worldwide reserves increased from approximately 1.0 to 1.3 trillion barrels and significant reserve additions were recorded in Iran, Libya, Nigeria, and Russia.

Figure 1. World Crude Oil Reserves



³ Member nations include Algeria, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, and Venezuela. Ecuador withdrew in 1992 and rejoined in October 2007 and Gabon withdrew in 1994. Angola joined in 2007.

2.2 World Production Trends

In general, world crude oil production has increased steadily to meet growing world demand. This gradual upward trend has been occasionally interrupted by periods of production declines in response to reduced economic activity, price induced consumer demand declines, and gains in efficiency. As shown in Figure 2, world crude oil production increased from 60.5 million barrels per day (mmb/d) in 1990 to 73.0 mmb/d in 2007, an increase of 12.5 mmb/d, or 20.7 percent; the highest production level, 73.7 mmb/d, occurred in 2005.

Production by OPEC member nations has dominated world output for many years. On a percentage basis, world crude oil production attributed to OPEC member nations has increased from 39.6 percent in 1990 to 44.1 percent in 2007. In 2007, the OPEC percentage share of world supply was only slightly below the most recent high of 44.7 percent in 2005. OPEC’s all-time highest percentage share of 55.7 percent occurred in 1973.

Figure 2. World Crude Oil Production

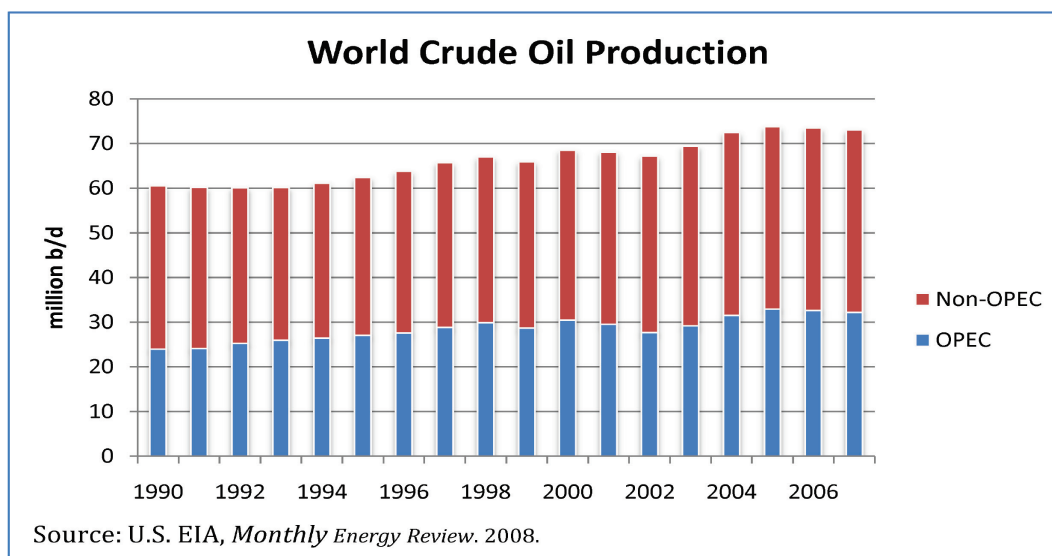
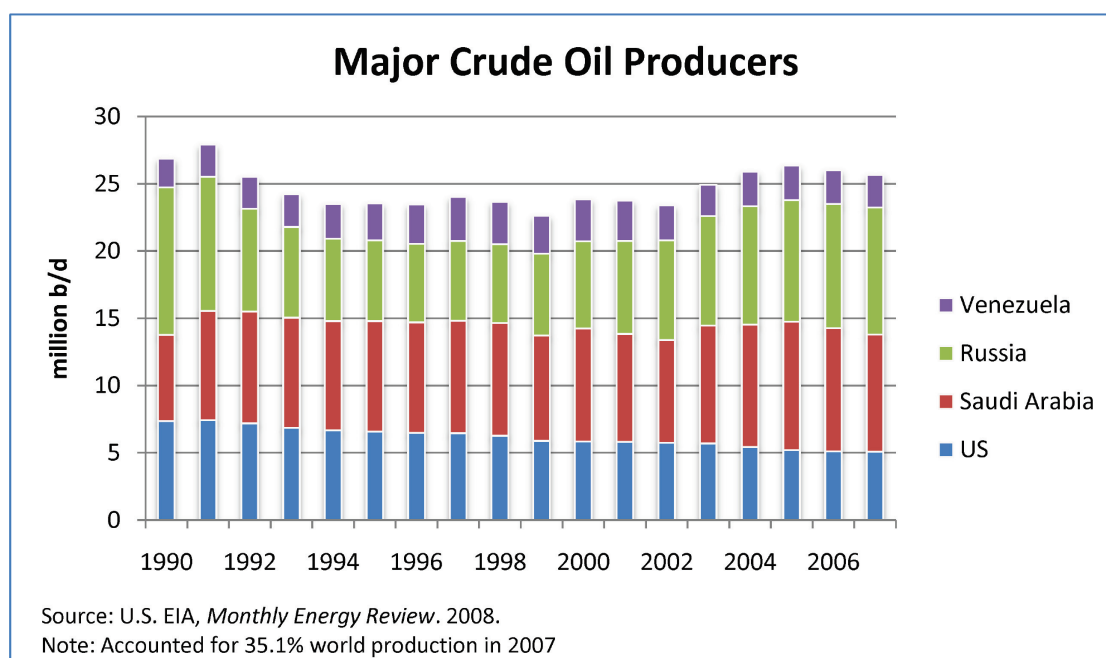


Figure 3 presents the annual crude oil production volumes of several major producing countries between 1990 and 2007. The four countries, Venezuela, Russia, Saudi Arabia, and the United States, accounted for 35.1 percent of world production in 2007, down from 44.4 percent in 1990. The reduction in combined market share by these countries is primarily the result of the production decline in the United States and Russia; although, since reaching a low point in 1996, Russian production has steadily increased.

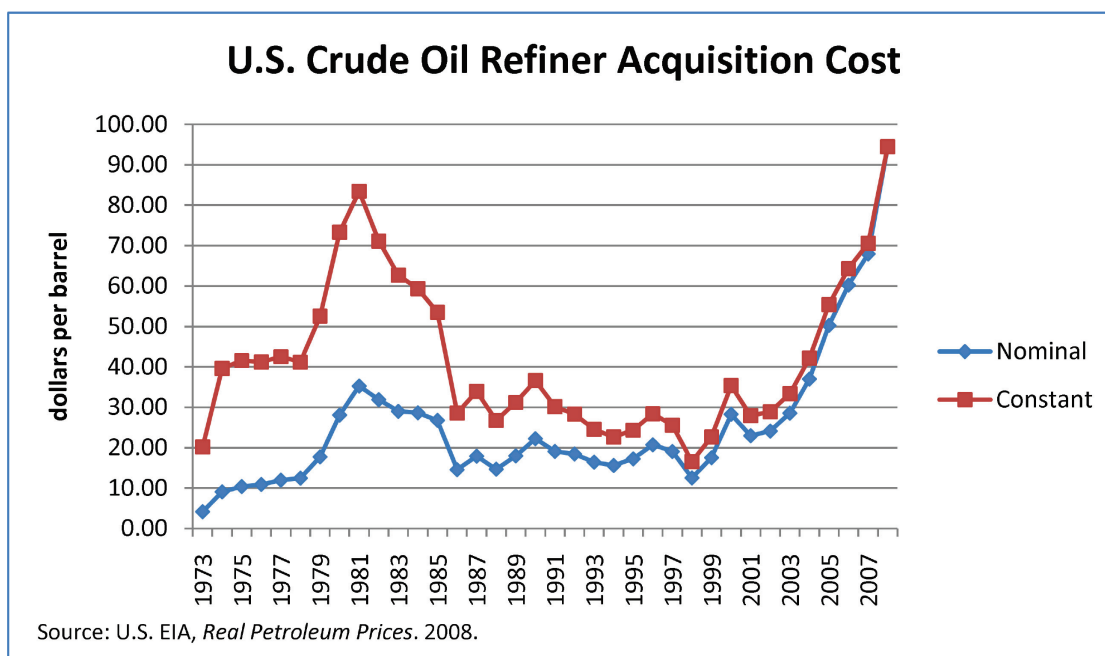
Figure 3. Major Crude Oil Producers

U.S. crude oil production fell from 7.4 mmb/d in 1990 to 5.1 mmb/d by 2007, a decline of 31.1 percent, as major portions of the U.S. Outer Continental Shelf remained off-limits to exploration activities. While U.S. production continues on a downward trend, production in Russia has increased in recent years from a low of 5.9 mmb/d in 1996 to 9.4 mmb/d in 2007, an increase of 59.3 percent. In Saudi Arabia, production climbed from 6.4 mmb/d to 8.7 mmb/d between 1990 and 2007, a 35.9 percent increase. Again, over the 15 year period, production in Venezuela rose from 2.1 mmb/d to 2.4 mmb/d, a gain of 14.2 percent.

2.3 U.S. Petroleum Price Review

A review of the refiner acquisition cost (RAC) of crude oil, the average price paid by U.S. refiners for all grades of crude oil processed at domestic refineries, in both nominal and real dollars (constant year-2007), is presented in Figure 4. The nominal dollar line shows the average price paid by a U.S. refiner for a barrel of crude oil in that particular year. The constant dollar line indicates the price that a refiner would have paid in year-2007 dollars during each historic year. For example, in 1981, on a nominal basis, RAC prices reached a high of \$35.24 per barrel (bbl) as the Iranian revolution disrupted the world petroleum markets. In terms of constant year-2007 dollars, the price of crude oil actually reached an estimated \$80.38/bbl that year, higher than year 2007 RAC prices.

Figure 4. U.S. Crude Oil Refiner Acquisition Cost



From the mid-1980s through the 1990s, nominal RAC prices generally remained within the \$15/bbl to \$25/bbl range. Even significant events, such as the Persian Gulf War in 1990 when Iraq invaded Kuwait, only temporarily interrupted the relative stability of crude oil prices. However, beginning in 2003 and continuing into 2007, numerous global events such as rising tensions in the Middle East, a general strike in Venezuela, military action in Iraq, increased world demand, particularly by China, and hurricane damage in the U.S. Gulf of Mexico in 2005, all contributed to force RAC prices upward to the 2007 average of \$67.94/bbl from a recent low of \$12.98/bbl in 1998. This is an increase of \$54.98/bbl or 423 percent. The historic low nominal price on the graph is the 1973 price of \$4.15/bbl.

The upward price movement continued into 2008 with the RAC crude oil price averaging \$86.48/bbl for the month of January. World events, coupled with speculative financial market activity, pushed the monthly average price to an all-time high of \$129.03/bbl in July 2008. From this point crude oil prices began to moderate and fell to \$37.45/bbl by January 2009, a decline of \$91.58/bbl or 71.0 percent. More recently, early summer 2009 prices show that June RAC crude oil prices have once again begun to climb higher. As of June 2009, RAC prices equaled an estimated \$65.00/bbl.

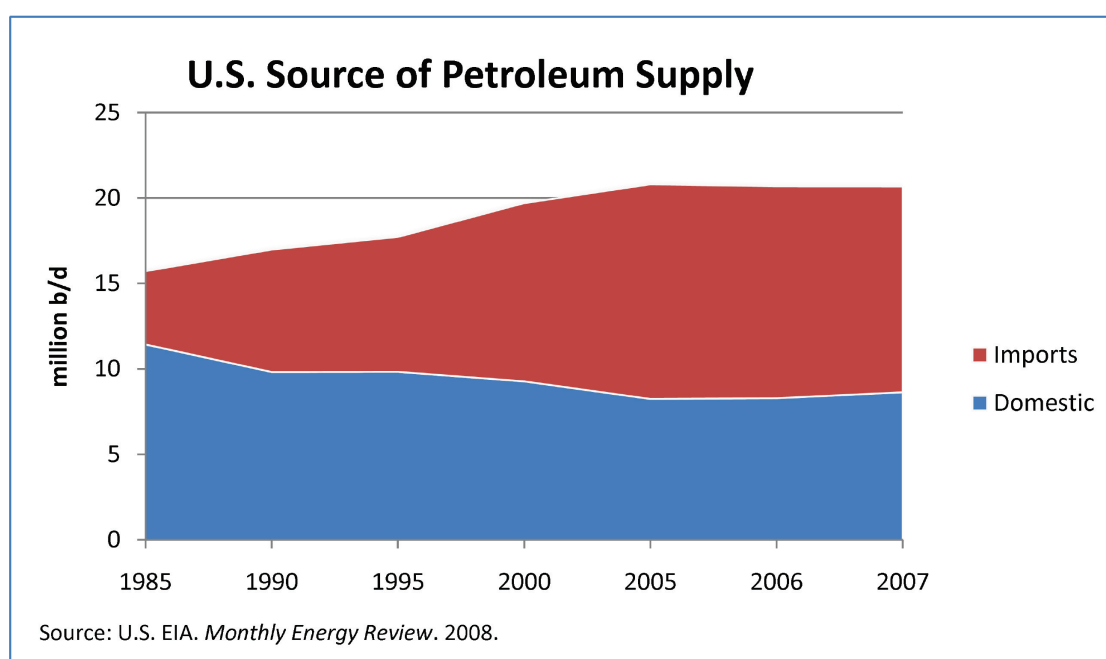
2.4 U.S. Petroleum Supply and Demand

In the United States, demand for petroleum products has grown steadily since 1985, as illustrated in Figure 5. During the 1985 to 2007 period, U.S. petroleum demand increased from 15.7 mmb/d to 20.7 mmb/d, a rise of 5.0 mmb/d, or 31.8 percent. Conversely, over this same period, total domestic production declined from 11.4 mmb/d to 8.6 mmb/d, a decrease of 2.8 mmb/d, or 24.6 percent. Consequently, to meet the rise in domestic consumption as U.S. production was falling, net imports of crude oil and refined petroleum products rose from 4.3 mmb/d in 1985 to 12.0 mmb/d in 2007, a gain of 7.7mmb/d, or 179 percent. On the percentage of total supply basis, imports of crude oil and refined products passed the 50 percent level for the first time in 1998 and equaled 51.6 percent that year. For the

most recent year, 2007, U.S. dependency on imports equaled 58.2 percent. For comparison, the 1990 import share was 42.2 percent and in 1980 it was 37.3 percent. The highest level of import dependency was 60.3 percent in 2005.

OPEC's share of total U.S. petroleum product imports exceeded 50 percent for the first time in 1974 when the member countries supplied 55.7 percent of total imports. The percentage share moved steadily higher until 1977, when an all-time high of 72.3 percent of total imports were supplied by OPEC members. Beginning in 1978, the Arab oil embargo and sharply higher world crude oil prices pushed the OPEC share downward, reaching a low of 42.7 percent by 1985, as crude oil production capacity increased in non-OPEC countries. From 1986 to 2001, OPEC's share of the U.S. market remained between 50 and 60 percent. Since 2002, the share has fallen into the mid-40s percentage range and for the most recent year, 2007, equaled 49.7 percent.

Figure 5. U.S. Source of Petroleum Supply



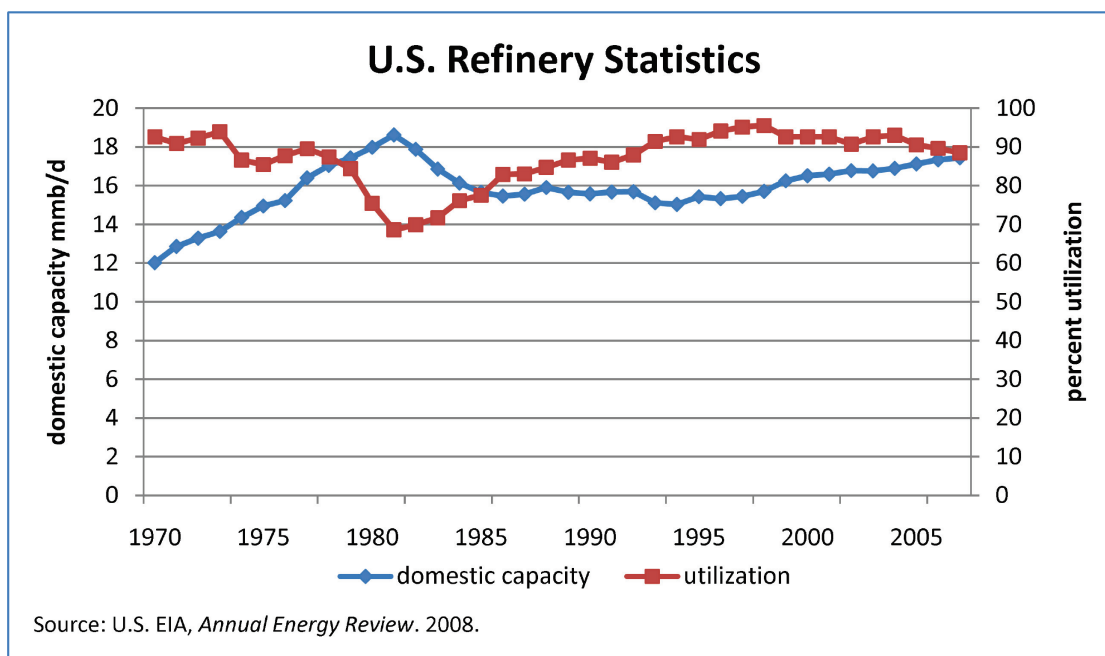
2.5 U.S. Refining Industry Profile

The domestic refining industry has undergone significant change since the early 1970s. During the 1970s and early 1980s, domestic refining capacity climbed from approximately 12 mmb/d to the then historic peak of 18.6 mmb/d by 1981, a 55 percent gain. Correspondingly, the total number of refineries increased from 276 to 324 by 1981. This increase in refinery capacity occurred in response to rising domestic demand. However, by 1978, U.S. petroleum demand had reached a peak of 18.8 mmb/d, and with higher energy prices stimulating conservation initiatives, demand began to decline. It was not until 20 years later in 1998 that U.S. demand once again reached and then surpassed the 18.8 mmb/d level. The most recent U.S. demand peak of 20.8 mmb/d occurred in 2005.

As illustrated in Figure 6, during the 1970s as domestic refining capacity increased, the percentage utilization rate for domestic refineries began to fall from the 1973 peak of 93.9 percent. In effect, capacity additions were occurring at a faster rate than the growth in petroleum demand, causing utilization

rates to decline. The combination of rising capacity and falling demand pushed refinery utilization rates sharply downward, falling to a low of 68.6 percent in 1981. In response to these low utilization levels the domestic refining industry began a period of consolidation resulting in the closure of many small and less efficient refineries. Between 1981 and 2003, the number of domestic refineries fell from 324 to 149, a 54 percent decline, while the corresponding reduction in capacity from 18.6 mmb/d to 16.8 mmb/d was only a 9.7 percent decrease.

Figure 6. U.S. Refinery Statistics



Since 2003, the number of operating refineries in the United States has held steady at 149. However, while the number of refineries has remained constant, the total capacity of these units has grown from 16.8 mmb/d to 17.4 mmb/d, a gain of 600,000 b/d, roughly the equivalent of two large capacity refineries. Since 1993, the consolidation effort has increased the utilization rate of the remaining refineries to above 90 percent. It was only in the most recent two years, for which data is available, 2006 and 2007, that utilization rates have slipped below 90 percent as small capacity expansions continue. While financial, environmental, and legal considerations make it difficult for new refineries to be built in the United States, many facilities have added capacity as various existing processing units are upgraded or expanded. Refiners are also altering processing units to maximize the production of higher value “light products” and middle distillates such as gasoline, diesel, jet fuel, and liquefied petroleum gases at the expense of residual fuel, which has seen its market share decline for many years.

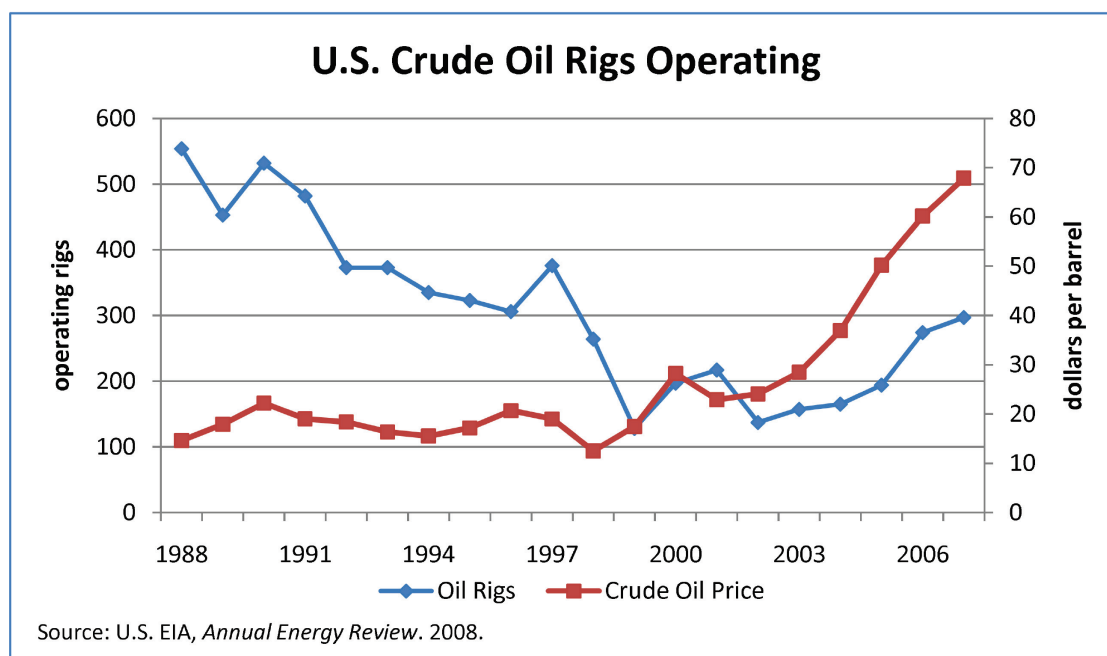
This higher level of utilization has made the industry more susceptible to equipment breakdowns and outages as facilities have been required to operate closer to the maximum design capacity over longer durations. One result of this consolidation effort is that many regions of the country, once served by a number of different companies and facilities, are now dependent on fewer refineries. When operational problems occur at one of the remaining facilities, a region may experience supply disruptions and price surges until adequate replacement volumes find their way to the affected markets.

Another important aspect of this consolidation of refining capacity is that many of the remaining refineries are geographically clustered together in a limited number of areas. During August and September 2005, Hurricanes Katrina and Rita made landfall in the Louisiana, Mississippi, and Texas Gulf Coast region, an area with a high percentage of U.S. refining capacity. At the peak, the combined impact of these two hurricane events resulted in the closing of 16 refineries with combined production capacity of almost 5 mmb/d, fully 30 percent of total U.S. refining capacity. The net effect was a surge in prices and substantial concern of the ability of the remaining refineries and import sources to meet U.S. demand. Three years later in September 2008, a similar event occurred as Hurricanes Gustav and Ike made landfall in the Gulf Coast region. Again, extensive damage was incurred by U.S. refineries and crude oil and natural gas production facilities. For this 2008 hurricane event, at the peak, approximately 4 mmb/d of refinery production capacity was closed. Also shut-in was 7.3 billion cubic feet per day of natural gas production and 1.3 mmb/d of crude oil production capacity.⁴

2.6 U.S. Crude Oil Exploration Industry Profile

The amount of exploratory and development drilling undertaken by industry is strongly dependent on the price of crude oil and access to attractive exploration targets. Data showing the number of rotary rigs operating in the United States involved with crude oil exploration since 1988 is presented in Figure 7. Since peaking at 554 rigs in 1988, the number of crude oil exploratory rigs operating in the United States steadily declined until reaching a low of 128 rigs in 1999. Since that time, the number of rigs in operation has grown to 297 nationally as higher crude oil prices stimulated exploration activity.

Figure 7. U.S. Crude Oil Rigs Operating



⁴ DOE. *Comparing the Impacts of 2005 and 2008 Hurricanes On U.S. Energy Infrastructure: Table ES-1*. 2009. <http://www.oe.netl.doe.gov/docs/HurricaneComp0508r2.pdf>

As important as the price of crude oil and land access are to drilling activity, the productivity of drilling operations is also critical. As the cost of operations and activities, such as data acquisition and processing, and the display and integration of seismic data with geologic data, continue to fall, the costs of drilling becomes more affordable, efficient, and productive. Additional factors, such as ever more powerful computers and the general increase in knowledge and experience, continues to exert downward pressure on drilling costs and helps stimulate exploration activities. The net effect of all the technological innovation and expanded knowledge is that the exploration industry is more likely to drill a successful well and, overall, have a lower number of wells drilled.

3 New York State Petroleum Markets

3.1 Infrastructure and Distribution Network

Meeting New York's future petroleum demands requires both an adequate supply of refined products and an efficient distribution network to transport the various fuels from refining centers and terminals to end users statewide. However, the reliability and efficiency of the petroleum distribution system is continually challenged by changing circumstances, such as stricter environmental requirements, land use issues, the general aging of infrastructure, and adequate finance to make the necessary investments to adequately maintain and expand facilities where necessary.

The petroleum supply and distribution industry in New York has evolved over time in response to ever greater volumes of refined petroleum products. As domestic sources of crude oil and refined products became less plentiful, the Port of New York developed into a ready entry point for petroleum products. As tanker shipments of petroleum products from foreign sources and distant Gulf Coast refineries increased, many terminal companies established large supply operations along the New York and New Jersey sides of the Port. Today, these primary oil storage facilities act as vital mechanisms to redirecting bulk deliveries of imported and domestic refined products to end users across New York and throughout the Northeast.

Over the years, a diverse distribution network has developed to transport petroleum products into and throughout New York. Several pipeline systems connect New York consumers to the major refining centers located along the U.S. Gulf and East Coasts. Waterways, consisting of coastal channels, rivers, and canals, allow barges and coastal tankers to move supplies of refined products to end users statewide. These water routes also provide an alternative means to ship fuels from domestic refineries located outside New York. Highway transport vehicles deliver supplies from New Jersey, Pennsylvania, and Canada across the Southern and Northern regions of the State. Rail shipments, while not as common as other modes of petroleum fuel transportation, are generally confined to interstate movements of bulk quantities of fuel. In recent years ethanol producers, many located in the Mid-Western United States, have used railcars to move large volumes of ethanol to gasoline terminal and distribution areas such as the Port of Albany and New York Harbor. Refined products, including gasoline with ethanol, are often placed in interim locations, such as major regional terminal centers, for later truck or barge distribution to retail outlets and end users.

3.2 Statewide Storage Capacity

In the 1990s, many petroleum product distribution companies throughout the State expressed concern over the decline in the number of storage terminals and associated storage capacity. They argued that the capacity reduction has increased the risk of impairing the operational flexibility needed to satisfy consumer oil demand. Petroleum storage terminal facilities face many of the same environmental, land use, and economic pressures that affect the refining sector. Operators note the high costs associated with meeting environmental regulations, insurance costs, greater carrying costs associated with holding higher priced petroleum products, and the lack of market incentives to build new facilities as impediments to adding storage capacity in the State. However, beginning in 2007, the amount of New York State storage

capacity dedicated to distillate fuels has increased. In certain parts of the State, including Long Island, the petroleum distribution industry has responded to market signals and added tank capacity to meet demand.

During the 1994 to 2008 period, total New York storage capacity for all fuels declined from 2.74 billion gallons to 2.28 billion gallons, a decline of 462 million gallons (mmgals), or 16.9 percent.⁵ However, since 2004, the total capacity has held relatively steady at about 2.4 billion gallons. Within this capacity range, individual fuel storage capacities have changed as the distribution industry makes adjustments in response to consumer demand, changing fuel types, specifications, and blends, including biofuels.

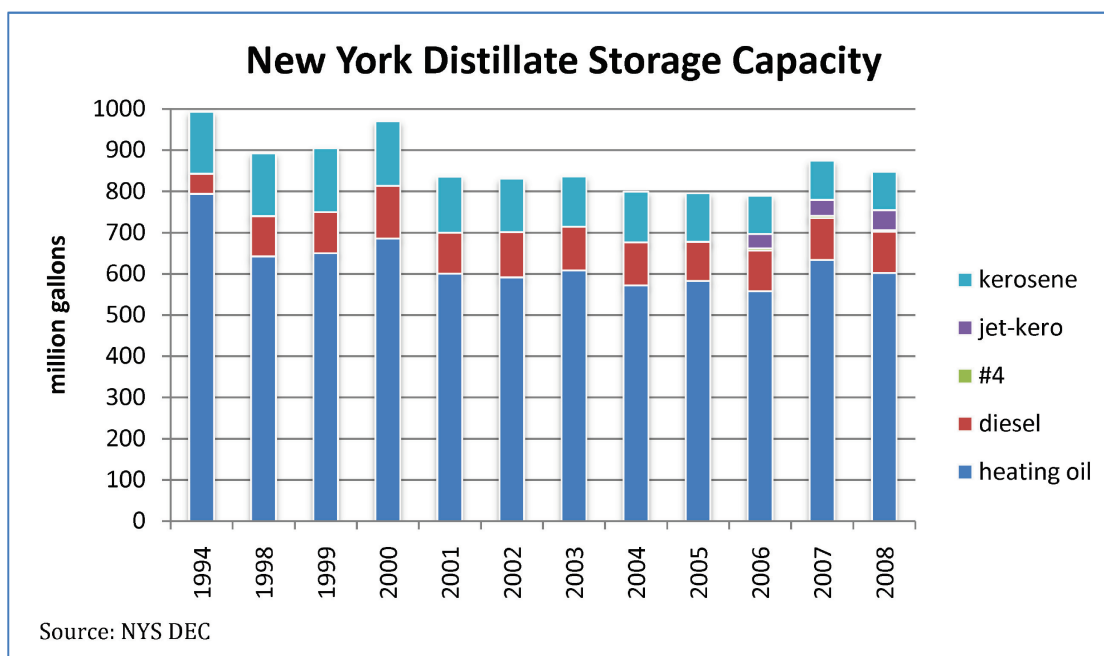
Statewide distillate fuel storage capacity, which includes volumes of No.2 home heating oil, kerosene, diesel fuel, No.4 fuel, and jet-kerosene, is shown in Figure 8.⁶ This grouping of fuels is presented together because it is relatively easy for terminal operators to convert tanks to hold one fuel or another depending on demand or as market events dictate. The total State storage capacity for all these fuels has fallen from 993 mmgals in 1994 to 847 mmgals in 2008, a decline of 146 mmgals, or 14.7 percent. However, over the same period, statewide demand for all these fuels increased 3.6 percent.⁷ This indicates that while terminal capacity is being used more efficiently to meet normal everyday demand, there may be less capacity available to meet atypical demand surges by the heating and electric generation sectors during periods of colder than normal temperatures. This may create marketplace supply uncertainty and contribute to greater short-term price volatility. In effect, consumers are becoming more dependent on the ability of the petroleum transport industry (tugboats, barges, pipelines, tankers, and trucks) to resupply the remaining terminals and distribute the various fuels during peak demand periods.⁸

⁵ Department of Environmental Conservation (DEC). Major Oil Storage Facility data file.

⁶ Storage capacity of No.4 fuel equals approximately 5 mmgals, and while included, is too small to see on the chart.

⁷ DEC. Major Oil Storage Facility data file.

⁸ For a more complete analysis of the State's distillate and residual fuel storage capacity, see ICF Consulting LLC (prepared for NYSERDA). *Petroleum Infrastructure Study*. 2006.

Figure 8. New York Distillate Storage Capacity

Of all the distillate fuels, home heating oil has the highest demand. It is primarily used by the residential sector for heating and hot water, but it may also be used by the electric generation sector as a secondary backup fuel by dual-fueled facilities and in peaking turbines. In New York, operational storage capacity of home heating oil declined from 794 mmgals in 1994 to a low of 558 mmgals by 2006. However, since the 2006 capacity low, storage has increased to 602 mmgals in 2008. Even with this recent increase, there is still an overall reduction in capacity of 192 mmgals, or 24.2 percent, from the 1994 peak.

Kerosene is an important fuel used to meet heating needs and as a blending agent to prevent cold temperature gelling in both diesel fuel and home heating oil. This fuel can also be used as a secondary backup fuel by many dual fueled electricity generating facilities that use natural gas as their primary fuel. It may also be used in peaking turbines. Statewide storage capacity of this fuel has fallen from 151 mmgals in 1994 to 93 mmgals in 2008, a decrease of 58 mmgals, or 38.4 percent.

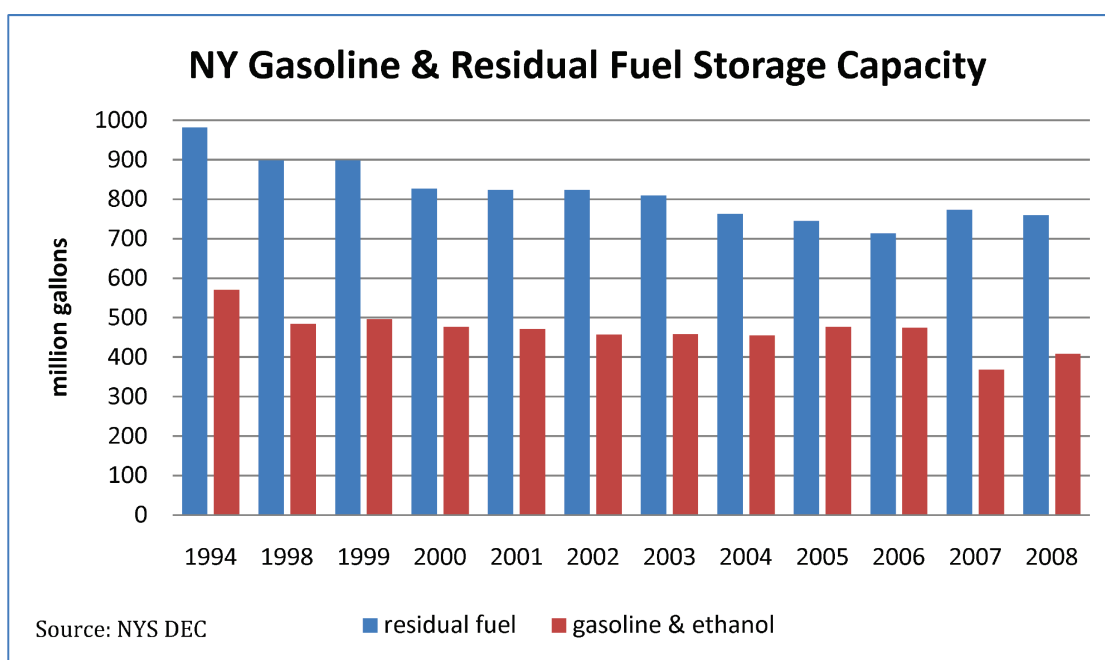
Diesel fuel is primarily used by the transportation sector although it may also be used in heating application and for electric generation. Diesel fuel, like gasoline, has steady, everyday, supply/demand fundamentals unlike heating fuels, which are subject to sharp demand spikes. As such, diesel fuel requires less storage capacity to maintain adequate supply because demand is more constant and predictable. In New York, storage capacity of diesel fuel increased steadily from 49 mmgals in 1994 to 127 mmgals by 2000, a gain of 78 mmgals, or 159 percent. However, a significant decline in capacity occurred in 2001 as the total statewide volume decreased to 99 mmgals, a fall of 28 mmgals, or 22 percent. Since 2001, capacity has remained relatively steady, and in 2008 equaled 100 mmgals, 27 mmgals less than the 2000 peak.

Jet fuel capacities have only been available from the Department of Environmental Conservation (DEC) data files since 2006. Prior to that year, these capacities were included in one of the other distillate fuels. In 2008, total State capacity equaled 48.6 mmgals, 13.5 mmgals, or 38.5 percent, more than the initial year of data availability, 2006. Most of the jet fuel storage capacity is located at airport facilities,

particularly the large downstate airports. Only a limited number of petroleum distribution terminals have any jet fuel capacity, and what they do have is generally dedicated to local airport service. Jet fuel may also be used as a backup fuel to natural gas by the electric generation sector.

As shown in Figure 9, statewide motor gasoline and residual fuel storage capacities indicate the same declining capacity trend discussed for distillate fuels. Between 1994 and 2008, gasoline capacity fell from 571 mmgals to 372 mmgal, a drop of 199 mmgals, or 34.9 percent. Again, while capacity declined, demand for gasoline over the 1994 to 2007 period increased from 5.4 billion gallons to 5.8 billion gallons, a gain of 7.4 percent.⁹ Somewhat enhancing gasoline storage capacity is the addition of 37 mmgals of ethanol and ethanol blended gasoline capacity. Ethanol is required to be blended into the reformulated gasoline (RFG) used in the downstate area. Additionally, ethanol is beginning to be added on an optional basis by some distributors to conventional gasoline used in the upstate area. It is expected that additional ethanol storage capacity will be added in the coming years; however, it is not known if this will include new tanks or simple be existing gasoline tanks converted to ethanol storage.

Figure 9. New York Gasoline & Residual Fuel Storage Capacity



Residual fuel oil, a fuel primarily used by the electricity generation sector and in large industrial, commercial, and residential boilers, saw statewide capacity decline from the 1994 peak of 981 mmgals to 755 mmgals in 2008, a reduction of 226 mmgals, or 23 percent. From the 1960s to the late 1970s, the New York electric generation sector was dominated by residual fuel powered capacity. By the 1970s, however, concern about environmental emissions and oil dependency, stimulated the conversion of generation capacity away from residual fuel to natural gas. In response to this lower demand, the terminal industry has eliminated large amounts of residual fuel storage capacity.

⁹ NYSERDA. *Patterns and Trends - New York State Energy Profiles 1993-2007: Table 2-2a*. 2009. http://www.nyscrda.org/energy_information/patterns%20&%20trends%201993-2007.pdf

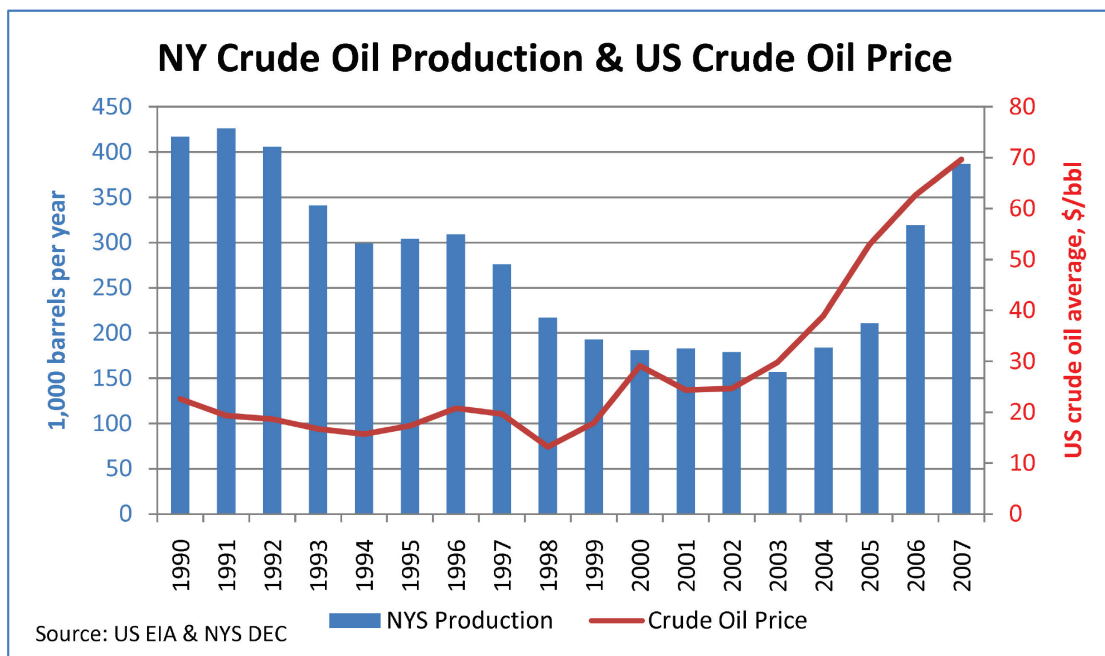
3.3 Crude Oil Production

New York's first commercial oil well began production in year 1865, and statewide production peaked in 1882 at 6.8 million barrels per year. This initial oil boom was short-lived, and by 1893 production was down to one million barrels per year. New York's second oil boom occurred with the advent of water flooding, the first enhanced oil recovery technique. This technique led to a second peak of 5.4 million barrels in 1943. The Bass Island Trend in Chautauqua County, brought on line in 1981, was the last major oil discovery in New York.

According to the U.S. Energy Information Administration (EIA), New York ranked 25th out of 31 oil producing states in 2007. New York's oil production comes from two distinct regions: 1) the historic areas of Allegany, Cattaraugus, and Steuben counties, and 2) from the Bass Island Trend in Chautauqua County. As shown in Figure 10, oil production in 2007 totaled 387,000 barrels, about 0.1 percent of annual statewide petroleum product demand. While the 2007 production total is 9.2 percent less than the 1991 peak of 426,000 barrels, it is 146 percent greater than the 2003 low of 157,000 barrels.

Crude oil exploration and production activities, whether in New York or nationally, are very dependent on the market price of oil for support. In recent years, sharply higher crude oil prices have stimulated exploration activities in the State. As shown in Figure 10, between 1990 and 2003, U.S. domestic crude oil prices averaged \$20.69/bbl, an insufficient level to support extensive exploration efforts in the State. Consequently, by 2003, crude oil production in New York had dropped to a low of 157,000 barrels per year. By 2007, the average price for U.S. domestic crude oil had increased to \$69.65/bbl, a gain of \$39.83/bbl, or 133 percent from the 2003 level of \$29.82/bbl. Beginning in 2003, these significant crude oil price increases acted to stimulate new interest in New York's historic oil fields. As indicated by the production total presented in Figure 10, the long decline of the State's crude production volumes reversed in 2004 and continued to trend higher through 2007. From the historic low in 2003, New York production has risen to 387,000 barrels per year, a gain of 230,000 barrels, or 146 percent, and the highest since 1992. In 2008, U.S. domestic crude oil prices averaged \$98.44/bbl and continued to stimulate New York exploration activities. During 2008, permits for new oil wells totaled 249, up 75 percent from 142 in 2007. This is compared with just 22 oil well permits and 17 well completions in 2002, when prices averaged \$24.65/bbl.

Figure 10. New York Crude Oil Production & U.S. Crude Oil Price



Even after 144 years of production, the remaining resource base is substantial. In an extensive geological study of New York’s resource base completed in the 1980s, original oil-in-place was estimated at 1.118 billion barrels.¹⁰ Cumulative production through 2007 totaled approximately 246 million barrels. This represents an estimated recovery rate of approximately 22 percent. Primary production usually can recover a maximum of 30 percent, with another 15 percent possible from enhanced oil recovery methods. Using a 45 percent maximum recovery factor, total New York production from primary and enhanced methods may total 600 million barrels with 355 million barrels yet to be recovered.

As crude oil prices have increased over the past few years, there has been new interest in improving the recovery rate from domestic oil fields. The University at Buffalo developed a geological model of sand deposition to help identify bypassed crude oil pay zones. This study is now helping operators identify new primary production zones and develop potential enhanced oil recovery projects.

Through the Stripper Well Consortium, a program funded by the U.S. Department of Energy (DOE) and NYSERDA, Pennsylvania State University and East Resources Inc. are examining the use of a nitrogen/carbon dioxide mixture injection for enhanced oil recovery in the Chipmonk Field in Cattaraugus County, New York. The laboratory work is complete and the project is now looking to move on to field demonstration. Application of this type of technology promises to significantly increase oil production.

As a means to mitigate anthropogenic carbon dioxide (CO₂) emissions into the atmosphere, there is increasing interest in enhanced oil recovery (EOR) using CO₂. Rather than cycle out the CO₂ as done in a typical EOR project, the CO₂ is left in the voided pore space. Though the opportunity for CO₂ EOR with carbon sequestration in New York is limited, there is the potential that a small EOR/sequestration program could be implemented in New York’s oil fields, particularly in the “Bass Island Trend” in Chautauqua County.

¹⁰ DEC, Division of Mineral Resources. *New York State Oil and Gas Drilling and Production*: p.59. 1988.

Due to the improved business conditions, higher crude oil prices, and the development of better recovery techniques, there is renewed interest in applying technologies, such as enhanced oil recovery and horizontal drilling, to New York's oil fields. Should the current high crude oil price trend hold, it is possible production may continue to trend upward for the foreseeable future.

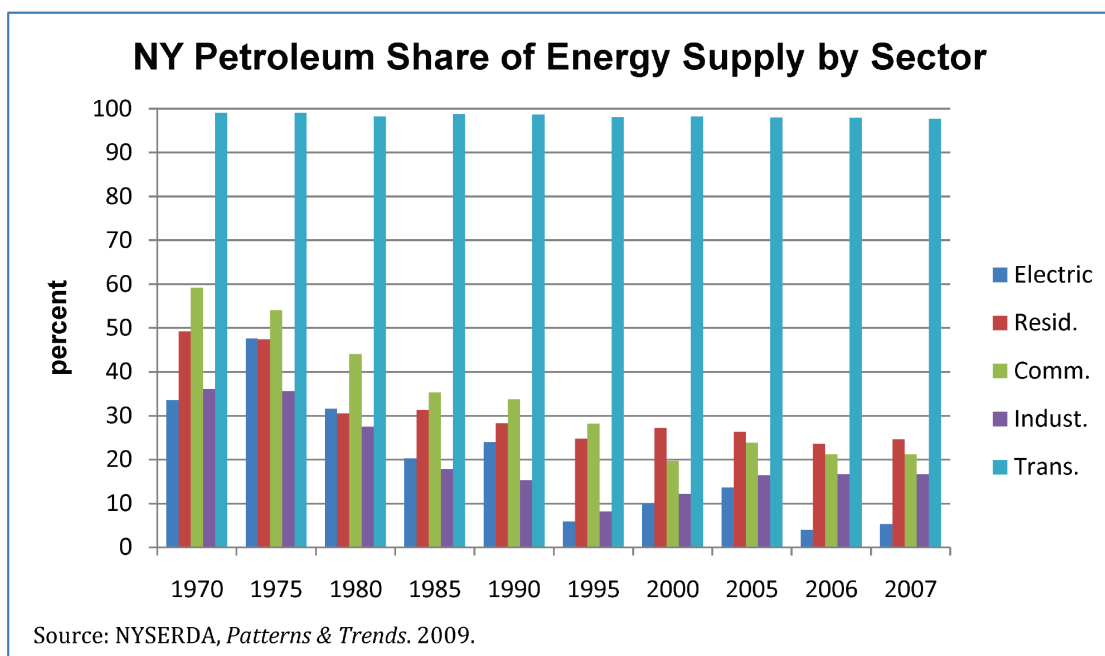
3.4 Petroleum Share of New York Economic Sector Demand

Petroleum fuels are vital to New York's economy and remain the single largest source of energy consumed in the State. In 2007, petroleum fuels accounted for approximately 40 percent of New York's total energy demand. This is well below the 66.8 percent record high recorded in 1972.¹¹ While the total petroleum share of energy demand continues to gradually decrease, a review of each economic sector, as shown in Figure 11, indicates that there has been an increase in the industrial sector since 1995 and in the commercial sector since 2000.

On a historical basis, the electric sector has posted the sharpest decline, falling from about 48 percent in 1975 to only 5.3 percent by 2007. Beginning in the mid-1970s, the electricity sector steadily turned to natural gas to satisfy the State's increased electricity demand. Even with the trend to natural gas powered facilities, petroleum products, such as residual fuel, continue to supply a number of large baseload generating units. Additionally, distillate fuels, such as diesel, kerosene, jet fuel, and home heating oil, power electricity generation peaking units and provide essential backup fuel capability at dual-fueled interruptible natural gas powered baseload generation facilities. Dual-fuel equipment allows end-users the option to switch between natural gas and distillate or residual fuels when the price for one fuel makes it an economic advantage to do so. As a result, if a sufficient amount of fuel switching occurs, petroleum use may increase or decrease from year to year. Finally, in the transportation sector, petroleum fuels such as gasoline and diesel fuel, account for approximately 98 percent of energy supplies.

¹¹ EIA. *State Energy Data System: Table 7*. 2009.
http://www.eia.doe.gov/emeu/states/hf.jsp?incfile=sep_use/total/use_tot_ny.html&mstate=NEW%20YORK

Figure 11. New York Petroleum Share of Energy Supply by Sector



In the residential sector, demand for all petroleum fuels, including home heating oil, kerosene, and propane fuel, declined as higher prices and environmental considerations encouraged homeowners to convert to natural gas, increase home insulation, lower thermostats, and purchase high efficiency furnaces. The total of all petroleum fuels’ share of energy supply to the residential sector has fallen from 49.1 percent in 1962¹² to 24.6 percent by 2007. Similar end-user sentiment in both the commercial and industrial sectors acts to reduce petroleum’s share of total energy supply. A limited amount of dual-fuel capability exists in large apartment buildings in the residential sector and in both the commercial and industrial sectors.

¹² EIA. *State Energy Data System: Table 8*. 2009.
http://www.eia.doe.gov/emeu/states/hf.jsp?incfile=sep_use/res/use_res_ny.html&mstate=NEW%20YORK

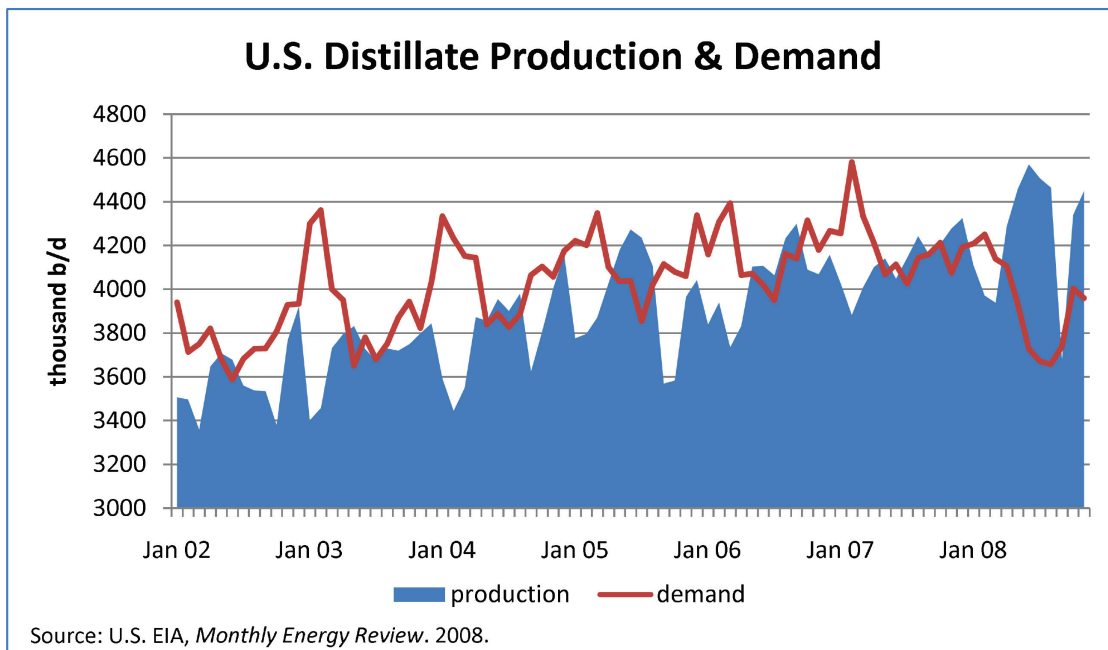
4 Refined Products

4.1 Distillate

4.1.1 U.S. Distillate Supply and Demand

As Figure 12 illustrates, there are months during the winter period when demand for distillate fuel outstrips the production capacity of domestic refineries. It is during these periods that inventories and product imports become critical supply enhancements to meet consumer needs. During the October 2002 through March 2003 winter period, the demand over production spread averaged 445,000 b/d, the largest differential of the study period. By the winter season of October 2006 to March 2007, the spread had decreased to 283,000 b/d, a decline of 172,000 b/d, or 38 percent. This reduction was the result of the U.S. refining industry increasing the production of distillate fuels and a series of warmer than normal winters limiting heating oil demand. For the winter season, October 2007 to March 2008, one of the warmest winters in many years, the spread equaled only 41,000 b/d, 91 percent less than the 2002 to 2003 heating season. Late 2008 data shows the first sustained period of significant U.S. distillate fuel production capacity in excess of demand. Reasons for this include reduced domestic demand, particularly for on-road diesel fuel, caused by lower economic activity, increased domestic production capacity, and higher foreign demand for diesel fuel.

Figure 12. U.S. Distillate Production & Demand



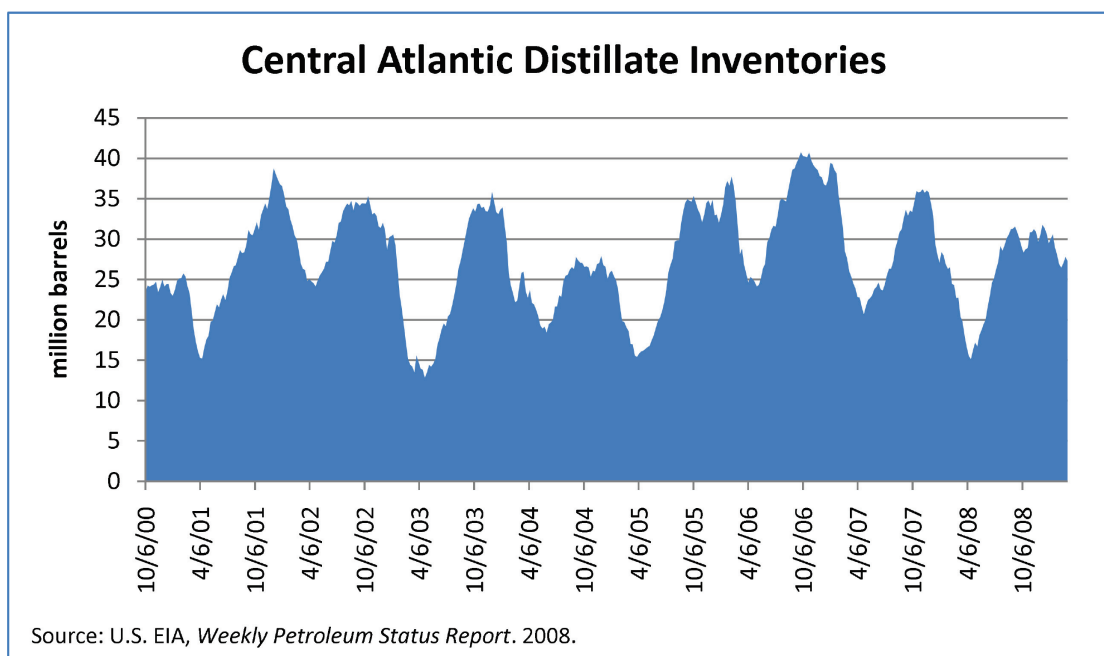
4.1.2 Central Atlantic Distillate Inventory Trends

Inventory volumes are important components of the distillate fuel supply system and at the regional level, act as critical buffers to meeting demand spikes during the winter months. Monthly distillate fuel quantities for the Central Atlantic Region of the United States are presented in Figure 13.¹³ Regional analysis is important because New York's fuel needs, as well as those of neighboring northeast states, are met from terminals located both within and outside the State. Correspondingly, some fuel inventories held at terminals in the New York Harbor area and northward along the Hudson River, supply neighboring New England and other Central Atlantic states.

Beginning in the 1970s, the petroleum distribution industry began to move away from the practice of building large volumes of heating fuels in the summer months to one that reflected a pattern of limited inventories and "just-in-time" resupply. "Just-in-time" inventory practices reflect the desire of petroleum terminal operators and distributors to lower costs. The industry now relies on the petroleum supply chain to deliver fuel to satisfy market requirements more promptly. While this management practice reduces inventory carrying costs, it exposes the petroleum distribution chain to a greater level of potential volatility and vulnerability should supply disruptions occur anywhere, or for any reason, along the distribution chain.

As illustrated in Figure 13, inventory volume levels may vary significantly depending on both the specific year and the time of year. Volumes are universally lower in the warm early summer months when there is limited demand for heating applications other than hot water. As winter approaches, the industry begins to increase inventory levels in anticipation of high, cold weather induced demand. In Figure 13, the first week in October, the traditional start of the heating season, is indicated. Ideally, the petroleum industry will have placed substantial volumes of fuel in storage by this time of year. Even with the knowledge of oncoming cold temperatures, inventory levels at the start of the heating season may vary widely. For example, October 2006 stocks equaled 35.2 million barrels (mmbbls), 11.8 mmbbls, or 50.4 percent, greater than the 23.4 mmbbl level of October 2000. Depending on demand and resupply efforts, low inventories may result in upward price pressure later in the season, while high stock volumes may help mitigate price pressure, particularly if average winter temperatures are higher than normal.

¹³ EIA sub-district 1B includes Delaware, District of Columbia, Maryland, New Jersey, New York, and Pennsylvania.

Figure 13. Central Atlantic Distillate Inventories

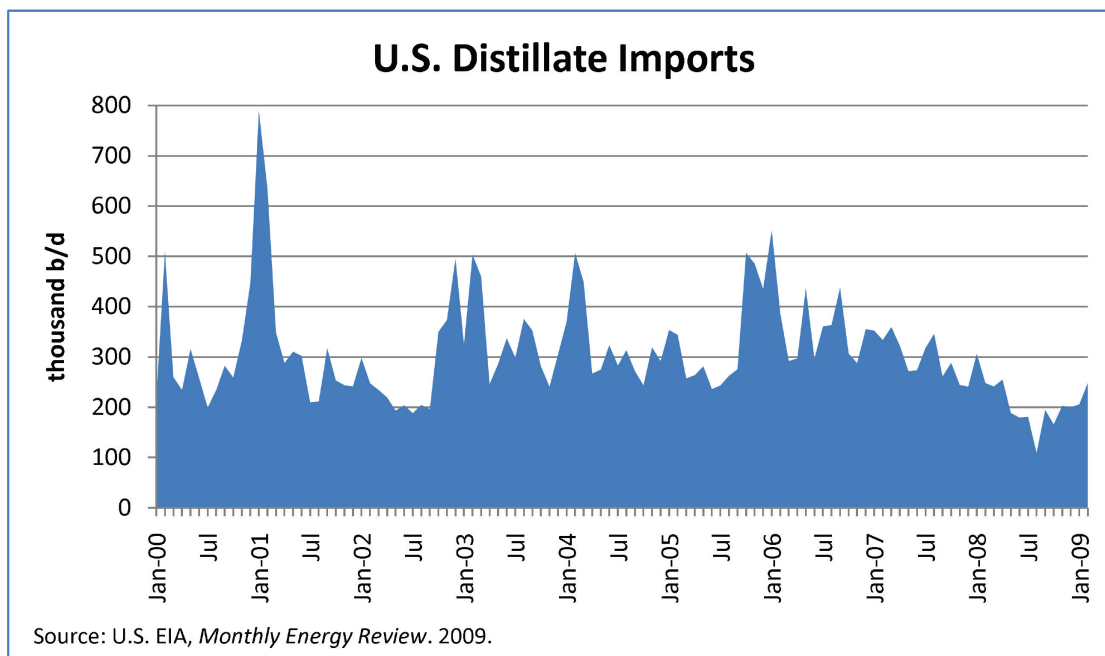
4.1.3 Northeast Home Heating Oil Reserve

As a result of the home heating oil shortfalls that occurred during the 1999-2000 winter season, DOE established the Northeast Home Heating Oil Reserve in the summer of 2000. This reserve consists of two mmbbls of government-owned heating oil. The reserve is intended to provide insurance against lower than normal inventories, supply shortfalls, and delivery interruptions. Reserves of one mmbbls are held at the Amerada Hess terminals in Perth Amboy, New Jersey, and 250,000 barrels at Groton, Connecticut, whereas in New Haven, Connecticut, the Morgan Stanley terminal holds 750,000 barrels. States covered by the reserve are New York, Connecticut, Maine, New Hampshire, Rhode Island, Vermont, Massachusetts, Pennsylvania, and New Jersey.

4.1.4 U.S. Distillate Imports

By the mid-2000s, in response to ever lower inventory levels and relatively flat domestic production trends, the petroleum industry turned to increased imports of distillate fuel to meet the surge in demand that may occur during peak winter periods. Figure 14 illustrates that as average inventory volumes declined over the years, the petroleum industry satisfied occasional demand spikes with increasingly larger quantities of imports. For example, in February 2000, the industry imported a high of 510,000 barrels per day (b/d). The following year, 2001, the petroleum industry imported record volumes for two consecutive months, 789,000 b/d and 635,000 b/d, respectively, for January and February. In the following three of the next four winter seasons, imports once again peaked in the 500,000 b/d range, even as several of these winters recorded warmer than normal temperatures. However, during the 2007 to 2009 winter seasons, imports have trended lower. While temperatures play an important part, conservation measures, the level of economic activity, and increased domestic production, have reduced the need for significant distillate fuel imports to meet demand.

Figure 14. U.S. Distillate Imports



With large import volumes being delivered within very short time periods, there is concern whether or not the distribution system, including barges, tankers, pipelines, and trucks can satisfy the future requirements of the region during severe weather conditions. Also, potentially significant increases in demand for distillate products, used as backup fuel for natural gas by the electricity generation sector, add to the concern. Lower storage tank capacities and quantity of fuel stored increase the potential that supply disruptions, caused by winter storms or heavy ice conditions, could adversely affect New York end-users in all economic sectors.

4.1.5 New York State Distillate Fuel Focus

New York is a major user of distillate fuel,¹⁴ accounting for 5.1 percent of total U.S. distillate fuel demand in 2007.¹⁵ The three distillate fuels are utilized in each of the economic sectors of the State and represent approximately 28 percent¹⁶ of total petroleum fuel used in New York in 2007. The residential and transportation sectors account for the greatest percent share of consumption of distillate fuel in the State in 2007, 39.6 percent and 35.3 percent, respectively. Home heating oil use in the residential sector is particularly important in New York State with an estimated 2.3 million households, representing about one-third of the New York housing stock, using home heating oil and kerosene to heat. New York uses

¹⁴ Distillate fuel is defined as home heating oil, kerosene, and diesel fuel.

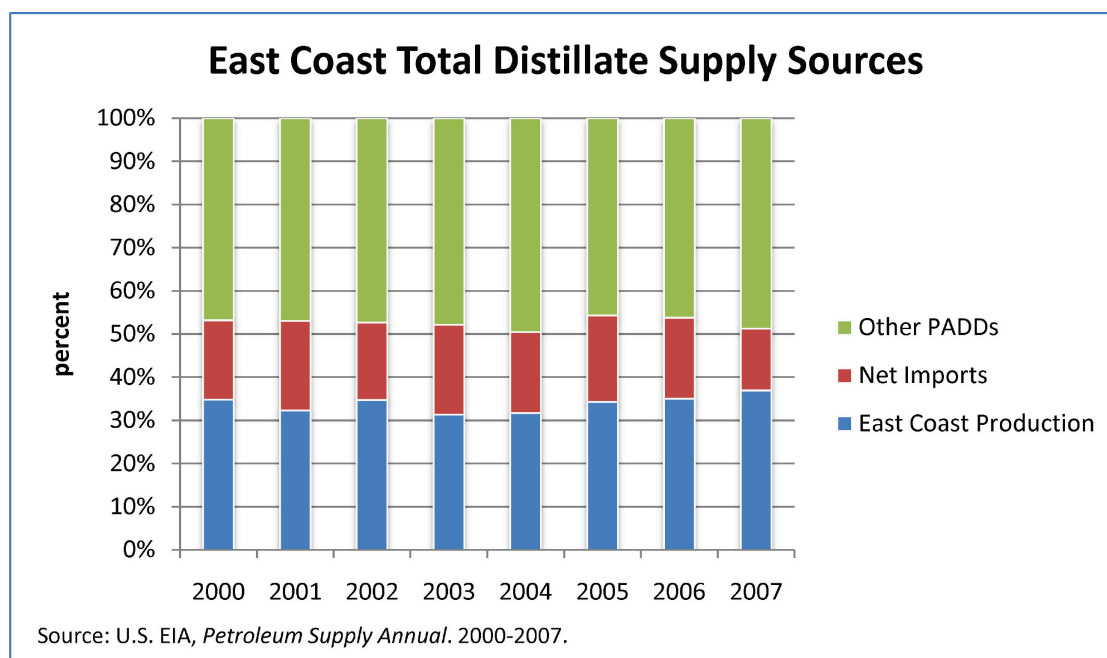
¹⁵ EIA. *State Energy Data System: Table F4a*. 2007. http://www.eia.doe.gov/emeu/states/sep_fuel/html/fuel_use_df.html

¹⁶ NYSERDA. *Patterns and Trends - New York State Energy Profiles 1993-2007*. 2009. Distillate fuel does not include jet fuel. http://www.nysERDA.org/energy_information/patterns%20&%20trends%201993-2007.pdf

more home heating oil in the residential sector than any other state in the nation, accounting for 24.5 percent of the nation’s total demand in 2007.¹⁷

New York-specific sources of supply data are not possible to calculate; however, EIA does calculate East Coast Petroleum Administration for Defense District (PADD) 1¹⁸ level refined product source data. In 2007, New York accounted for 14.8 percent of PADD 1 total distillate consumption. As shown in Figure 15, in 2007, the East Coast States received approximately 37 percent of their distillate supplies from refineries located within the East Coast PADD 1 region, almost 49 percent from other U.S. regions, and about 14 percent from direct foreign imports. For most of the study period, the percentage share of imports ranged from 18 percent to 20 percent. However, in 2007, the import share fell to 14 percent as a combination of reduced demand and increased domestic production limited import requirements. With the often immediate need for supply in response to cold temperature demand spikes, less reliance of distant imports and more production from close proximity East Coast refineries may be a critical factor to meeting short term demand spikes.

Figure 15. East Coast Total Distillate Supply Sources



¹⁷ EIA. *Fuel Oil and Kerosene Sales 2007: Table 7*. 2008.

http://www.eia.doe.gov/oil_gas/petroleum/data_publications/fuel_oil_and_kerosene_sales/foks.html

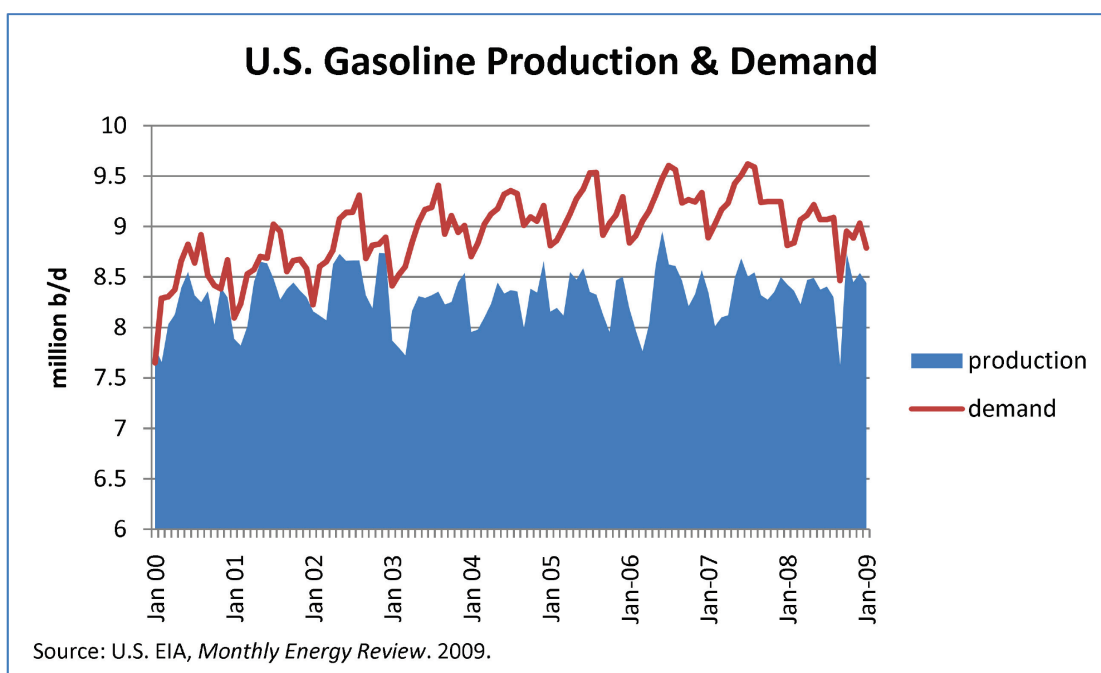
¹⁸ Petroleum Administration for Defense Districts (PADD) are geographic aggregations of the 50 States and District of Columbia. PADD 1 includes 17 States from Maine to Florida, including New York.

4.2 Gasoline

4.2.1 U.S. Gasoline Supply and Demand

Monthly total U.S. gasoline production and demand data beginning in January 2000 are presented in Figure 16. The clear pattern that emerges from the data is that the United States is becoming more dependent on imported gasoline to meet the increasing volume of everyday demand. This is particularly true during the summer months and again highlights the importance of maintaining adequate storage capacity and inventory volumes. On an annual basis, the data indicate that from 2000 to 2007 the difference between domestic production and demand increased from 521,000 b/d to 947,000 b/d, a gain of 407,000 b/d, or about 78 percent. Beginning in 2008, gasoline prices in excess of \$4.00 per gallon for many months and reduced economic activity acted to exert downward pressure on gasoline demand as consumers restricted purchases. The second half of 2008 production and demand drop-offs are clearly seen in Figure 16. The net effect of this price induced conservation was to reduce the production to demand differential for 2008 to 606,000 b/d. Even as prices moderated in early 2009, demand remains well below the mid-2000s volumes.

Figure 16. U.S. Gasoline Production & Demand

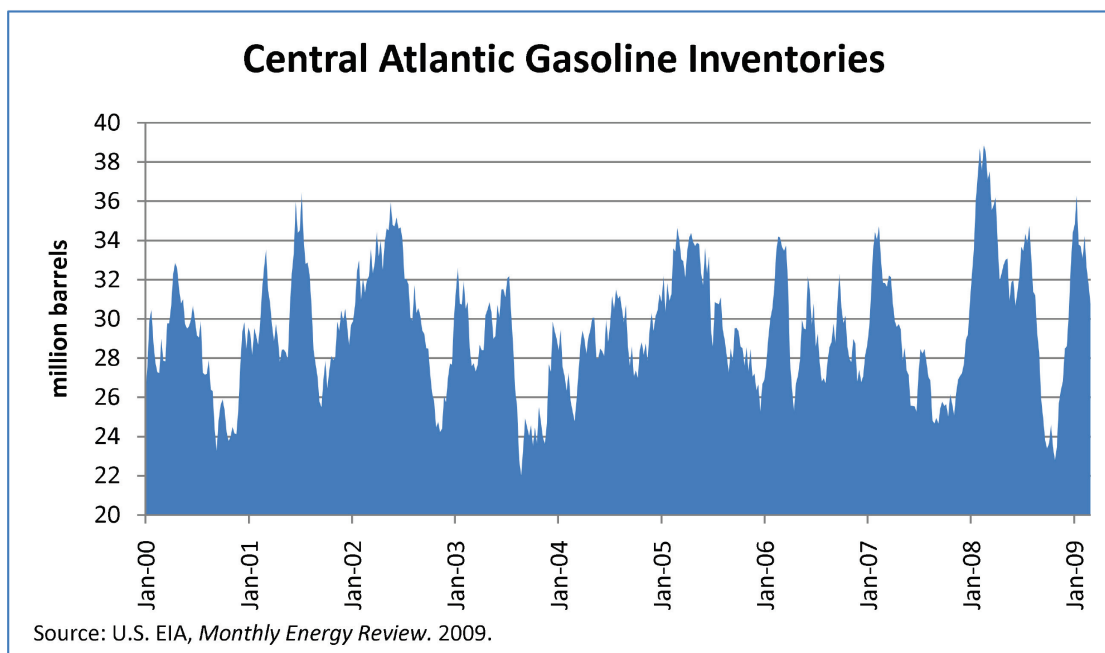


4.2.2 Central Atlantic Gasoline Inventory Trends

Like distillate fuel inventories, gasoline inventories play a critical role ensuring adequate supplies of motor gasoline, particularly during the peak summer driving season. Total gasoline inventories for the Central Atlantic Region, which includes New York, for both conventional and reformulated types of gasoline are presented in Figure 17. Motor gasoline stocks are subject to large fluctuations depending on time of year and demand. Generally, inventories show builds in the late winter and spring periods as suppliers prepare for the high demand summer season. Stocks are then drawn down to meet the peak

demand period and reach their traditional low quantities in the fall. Over the study period, inventories ranged from a low of 22.0 to a high of 38.8 mmbbls, a differential of 16.8 mmbbls, or 76 percent. In 2008, high gasoline prices caused a reduction in demand resulting in a buildup in inventories during the traditional high demand summer months. In response to this lower demand, suppliers reduced both domestic production and imports to bring supply fundamentals back into balance. By the late fall, inventories had returned to a more traditional level. Early 2009 data indicates the industry is once again increasing stocks in preparation for the summer period.

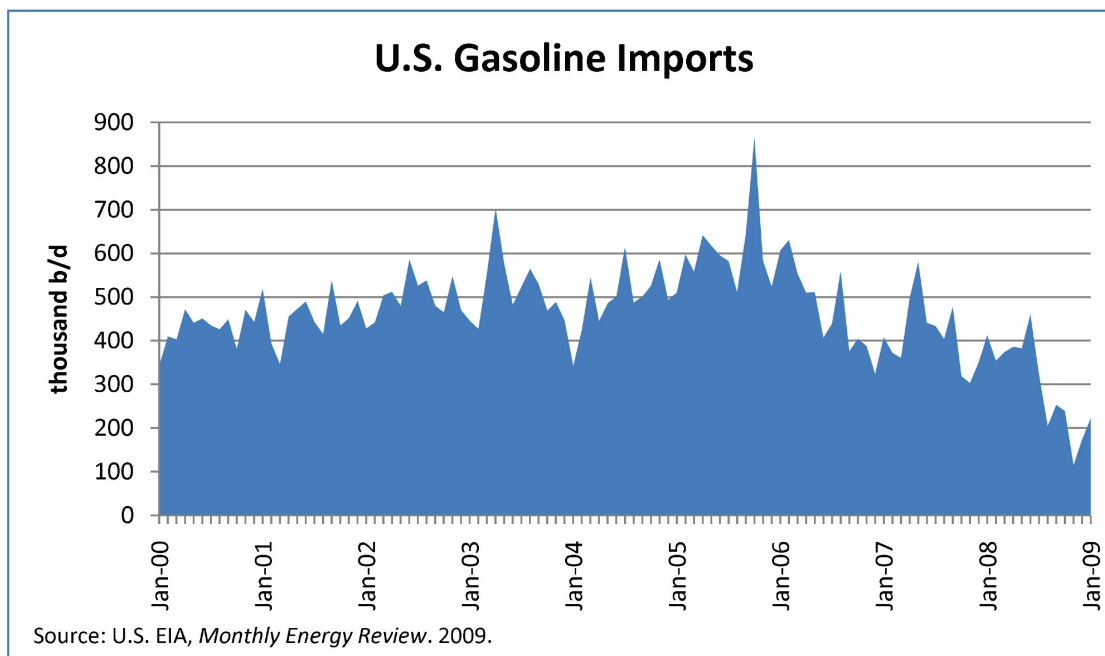
Figure 17. Central Atlantic Gasoline Inventories



4.2.3 U.S. Gasoline Imports

Since domestic gasoline production did not keep pace with the rise in demand during much of the 2000s, increased volumes of imported fuel were required to make up the difference. Monthly total U.S. gasoline imports for all grades of fuel are shown in Figure 18. The chart illustrates that between 2000 and 2005 the quantity of gasoline imports increased steadily. It should be noted that the sharp spike in imports in the fall 2005 period on the chart is the result of extensive hurricane damage to U.S. Gulf Coast refineries and the temporary loss of a large percentage of their fuel production capabilities. To offset this lost production, the United States imported record levels of gasoline to meet demand. In 2000, imports averaged 427,000 b/d and by 2005, the volume had risen to 603,000 b/d, an increase of 176,000 b/d, or 41.2 percent. However, during the 2006 to 2008 period, average annual import volumes began to drop off, falling to a low of 306,000 b/d in 2008. This reduction is the result of several factors including expanded domestic production capacity, high gasoline price-induced conservation activity, and the beginning of a change in domestic vehicle choice to higher fuel economy models.

Figure 18. U.S. Gasoline Imports



4.2.4 New York Gasoline Focus

New York gasoline consumption equaled approximately 5.8 billion gallons in 2007, 4.1 percent of total U.S. and 11.3 percent of PADD 1 demand.¹⁹ The State’s gasoline requirements are satisfied by either conventional grade fuel or U.S. Environmental Protection Agency (U.S. EPA) mandated reformulated (RFG) gasoline. Gasoline retailers are required to sell the RFG grade gasoline throughout the year in New York City, Long Island, and in the counties of Westchester, Putnam, Orange, Dutchess, and Rockland. In 2007, this region of the State used an estimated 2.9 billion gallons, or approximately 50.4 percent of New York’s annual gasoline demand.²⁰

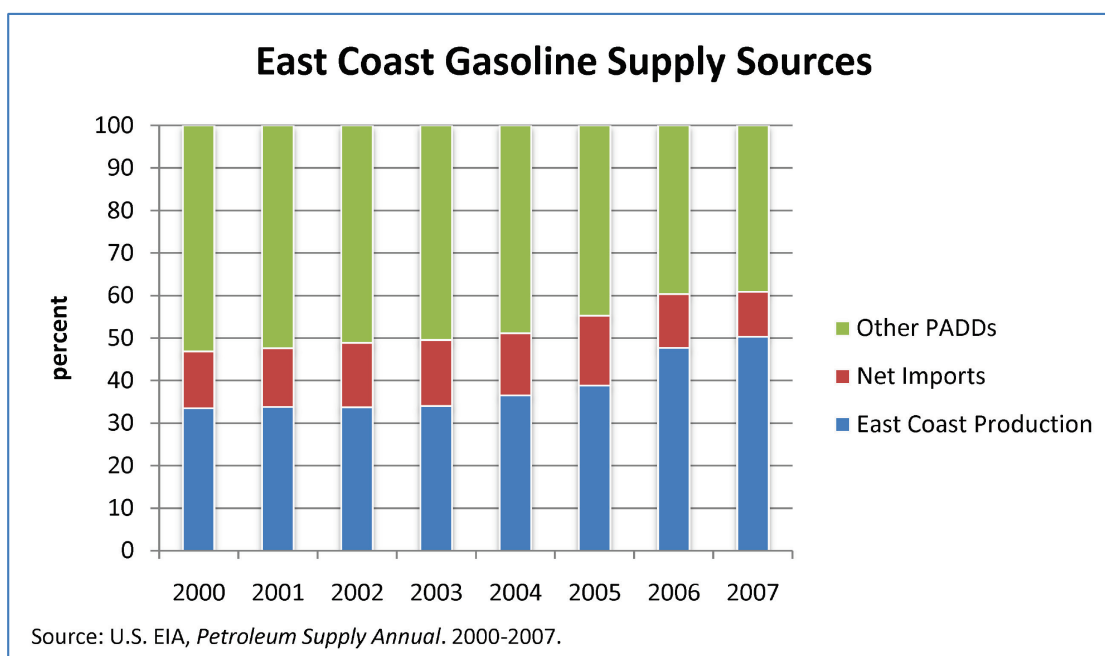
Beginning in 2004, New York banned the use of the gasoline additive methyl tertiary-butyl ether (MTBE) because of pollution concerns during fuel spills and leaks. This additive had been used in gasoline since 1979. Initially it was used as an octane enhancer to replace lead as an additive, and later, as an oxygenate to reduce ozone, carbon monoxide, and other air pollutants. In New York, MTBE was replaced by ethanol to meet the oxygenate requirements in place at that time. By 2005, many other states and gasoline producing companies also began to remove MTBE from their gasoline. In December 2007, the Energy Independence and Security Act of 2007 (EISA) was signed into law. EISA amends the Renewable Fuel Standard, which was signed into law in 2005, and includes provisions mandating the use of renewable fuels such as ethanol in RFG. It also requires 11.1 billion gallons of renewable fuels be mixed with gasoline for 2009. The quantity of renewable fuel mandated increases each year until 2022 when 36 billion gallons will be required. By early 2009, ethanol was also being added to conventional gasoline marketed in the upstate New York area on a limited basis.

¹⁹ EIA. *State Energy Data System: Table F1*. 2007. http://www.eia.doe.gov/emeu/states/sep_fuel/html/fuel_mg.html

²⁰ NYSERDA. *Patterns and Trends - New York State Energy Profiles 1993-2007*. 2009. http://www.nysERDA.org/energy_information/patterns%20&%20trends%201993-2007.pdf

Once again, as shown in Figure 19, while New York-specific data is not available, East Coast PADD 1 information indicates that in 2007 approximately 39 percent of all gasoline delivered to New York was produced in other PADDs, particularly at Gulf Coast region refineries, down from the 53 percent level in 2000. Most of this fuel is shipped by pipeline to storage terminals in the New York Harbor area. Additionally, a small volume of this Gulf Coast supply is transported by coastal tanker and barge to New York Harbor. By 2007, approximately 50 percent of the gasoline consumed on the East Coast was produced at Mid-Atlantic refineries, an increase from the 34 percent rate in 2000. These facilities are located primarily in New Jersey, Delaware, and Pennsylvania, and the fuel they produce is moved into New York Harbor and Long Island terminals by barge and truck, and by pipelines to central and western New York. Gasoline reaching New York Harbor is also barged to regional terminals along the Hudson River, as far north as Port of Albany and east to Long Island. The remaining 10.5 percent of 2007 East Coast gasoline supply is imported from foreign sources, a slight decline from the 13 percent rate in 2000. The majority of this fuel originates in the Caribbean area, largely from Virgin Islands’ and Venezuelan refineries or from Canada. Tanker trucks then move the gasoline from these regional terminals to neighborhood retail outlets.

Figure 19. East Coast Gasoline Supply Sources



4.3 Propane

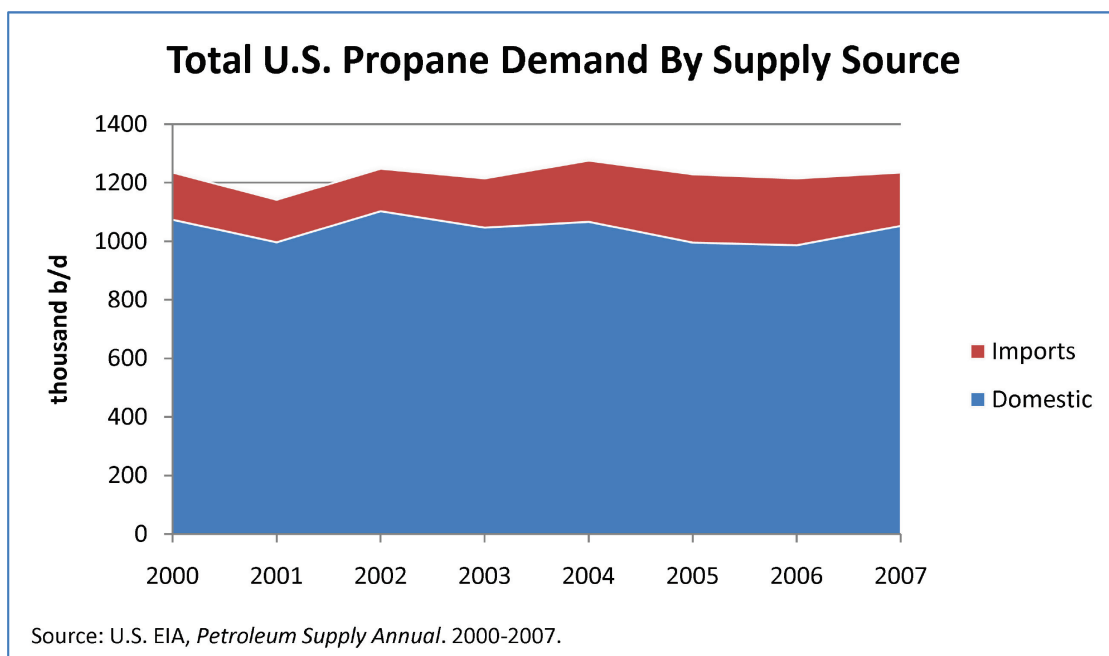
4.3.1 U.S. Propane Supply and Demand

Propane fuel is a small volume, essential source of energy for New York residents and business owners. Propane, often referred to as “bottled gas” or “LP-gas,” is used in the residential sector for heating homes and water, cooking, drying clothes, and fueling fireplaces. In the commercial and industrial sectors, it is used for heating and to drive manufacturing processes. In the transportation sector, both off-highway and on-highway applications continue to grow. Finally, in the agriculture sector, propane is used for heating,

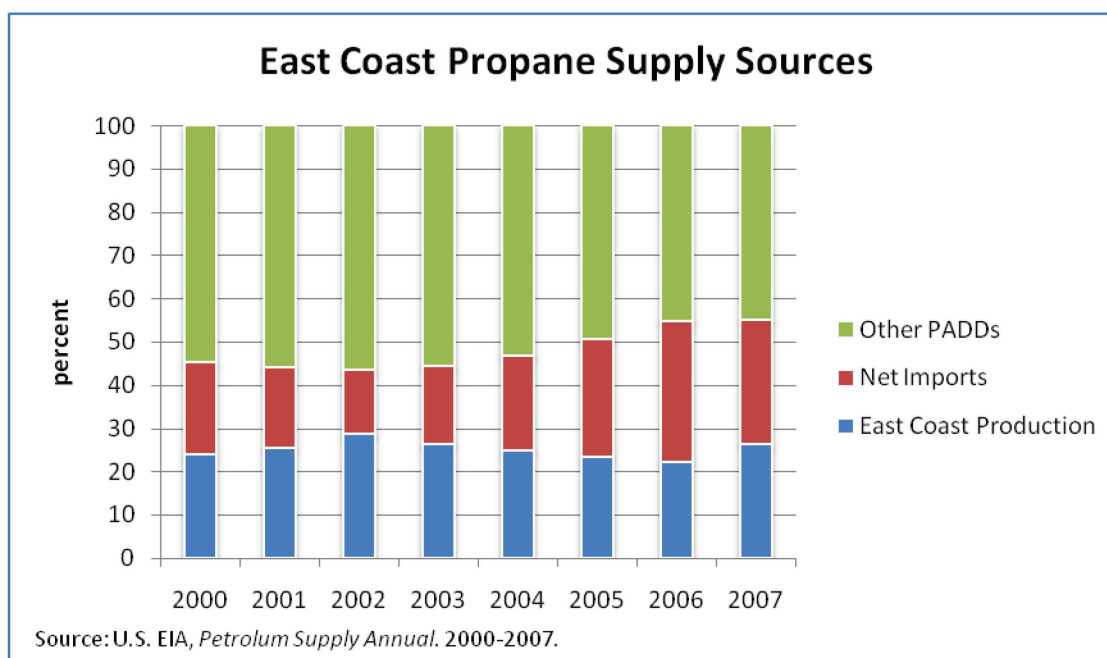
crop drying, and weed control. At the national level, propane is an important feedstock for the petrochemical industry, particularly in the U.S. Gulf Coast area.

Propane is produced both as a by-product of natural gas processing and petroleum refining. Domestically, propane is shipped to New York via the Texas Eastern Products Pipeline (TEPPCO), which originates in the U.S. Gulf Coast, and by rail car and by truck. Propane is also imported from Canada by rail car and truck, as well as, from foreign sources by ocean going tankers. As shown in Figure 20, over the study period, U.S. propane demand has ranged from a low of 987,000 b/d in 2006 to a high of 1.1 million b/d in 2002. Much of this variation may be attributed to winter temperatures, crop drying needs, and petrochemical demand. During this same period, propane imports ranged from a low of 145,000 b/d in both 2001 and 2002 to a high of 233,000 b/d in 2005.

Figure 20. Total U.S. Propane Demand by Supply Source



As illustrated in Figure 21, in 2007, the East Coast states received 45 percent of their propane supplies from other parts of the country, primarily the U.S. Gulf Coast region. This percentage share has steadily declined over the past five years from 56 percent in 2002. Supplies from the East Coast PADD 1 area, which equaled 26.3 percent in 2007, have ranged from 22.2 percent to 28.7 percent since 2000. Finally, imports to PADD 1 ranged from a low of 14.9 percent in 2002 to a high of 32.5 percent in 2006.

Figure 21. East Coast Propane Supply Sources

4.3.2 East Coast Propane Storage

The pre-winter season build up of propane inventories is a critical supply component to New York consumers. Winter season cold temperature induced demand often exceeds the resupply capacity of the propane distribution system. For example, rail car deliveries from distant refineries and natural gas processing plants, and truck transport from distant primary terminals, may be delayed due to severe cold and snowy weather conditions. These resupply delays often have the effect of severely reducing available local market area inventories, resulting in immediate local supply shortfalls and upward price pressure as the distribution industry struggles with delays.

Propane inventory capacity is generally classified by three levels of storage capacity: primary, secondary, and tertiary. At the primary level, in central New York, there are several underground storage caverns constructed in salt beds that hold large volumes of propane. These caverns are emptied as the heating season unfolds to meet regional demand. Many of these caverns are connected to the TEPPCO pipeline or have railcar capacity for distribution of fuel to terminals located across the northeast region. Propane is injected into these caverns during the summer and early fall period in anticipation of high demand during the winter months. The fuel held in these storage caverns is not dedicated exclusively for New York users. Companies supplying propane to users in other northeast states may also choose to store fuel in these facilities. Similarly, New York users often receive propane from two separate ocean import terminals located in New England.

At the secondary level, there are many large-scale, pressurized above-ground tanks located at terminals and retail dealers around the State. Again, some of this fuel may be destined for consumers in neighboring states. These facilities may include any number of 90,000 gallon tanks grouped together at one location or as little as one 30,000 gallon tank located in a local community. During the heating season, these secondary tanks are repeatedly refilled with fuel from primary storage facilities to meet local demand.

These smaller, secondary storage facilities play a critical role ensuring adequate local fuel supply during high demand periods. They are the last line of supply for a locality before a distributor must send large transport trucks to distant terminals to secure resupply. This resupply effort is time consuming and significant costs may be incurred. During the normal average cold 2008-09 winter season, strong season-long demand, an early drawdown of primary level storage cavern inventories, and resupply delays at the New England ocean terminals forced many northeast companies to send transport trucks to distant supply sources as far away as Indiana, Kansas, and Michigan to secure fuel. The added transport costs of this effort resulted in higher retail prices for many New York consumers as distribution companies passed along the additional costs.²¹ Finally, end user storage tanks, including residential homeowners, represent final tertiary storage capacity.

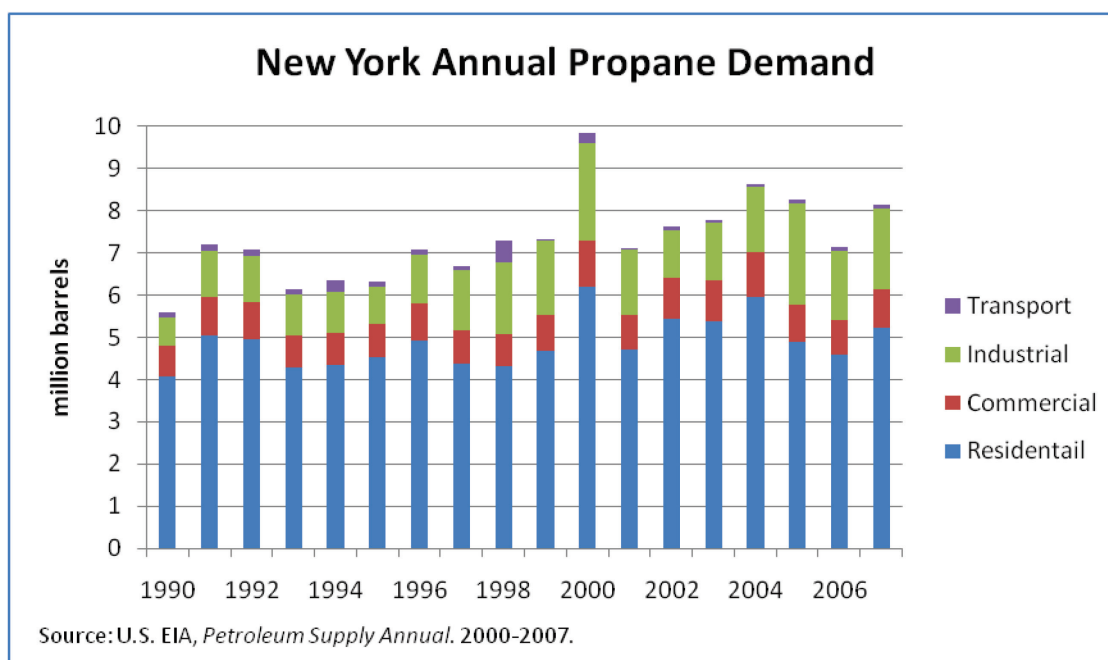
4.3.3 New York State Propane Fuel Focus

On a national scale, New York's percentage share of propane use is small, 1.0 percent of total U.S. demand.²² However, when compared to the East Coast PADD 1 region, the State accounts for 9.2 percent of demand, the third largest market behind North Carolina and Pennsylvania. As shown in Figure 22, demand for propane fuel in New York is on a general upward trend. Much of the individual year demand fluctuations are explained by winter season temperature variations impacting the residential sector. Between 1990 and 2007, annual propane demand increased from 5.6 to 8.2 million barrels, a gain of 2.6 million barrels, or 46.4 percent. In 2000, propane demand spiked at 9.8 million barrels on strong residential demand. In 2007, the residential sector accounted for 64 percent of total State demand, the commercial sector 11.3 percent, industrial 23.2 percent, and the transportation 1.4 percent.²³

²¹ Additional information is included in the Energy Infrastructure Issue Brief.

²² EIA. *State Energy Consumption Estimates: Table S2*. 2007
http://www.eia.doe.gov/emeu/states/sep_sum/plain_html/sum_use_tot.html

²³ NYSERDA. *Patterns and Trends- New York State Energy Profiles 1993-2007*. 2009.
http://www.nysERDA.org/energy_information/patterns%20&%20trends%201993-2007.pdf

Figure 22. New York Annual Propane Demand

4.4 Residual Fuel

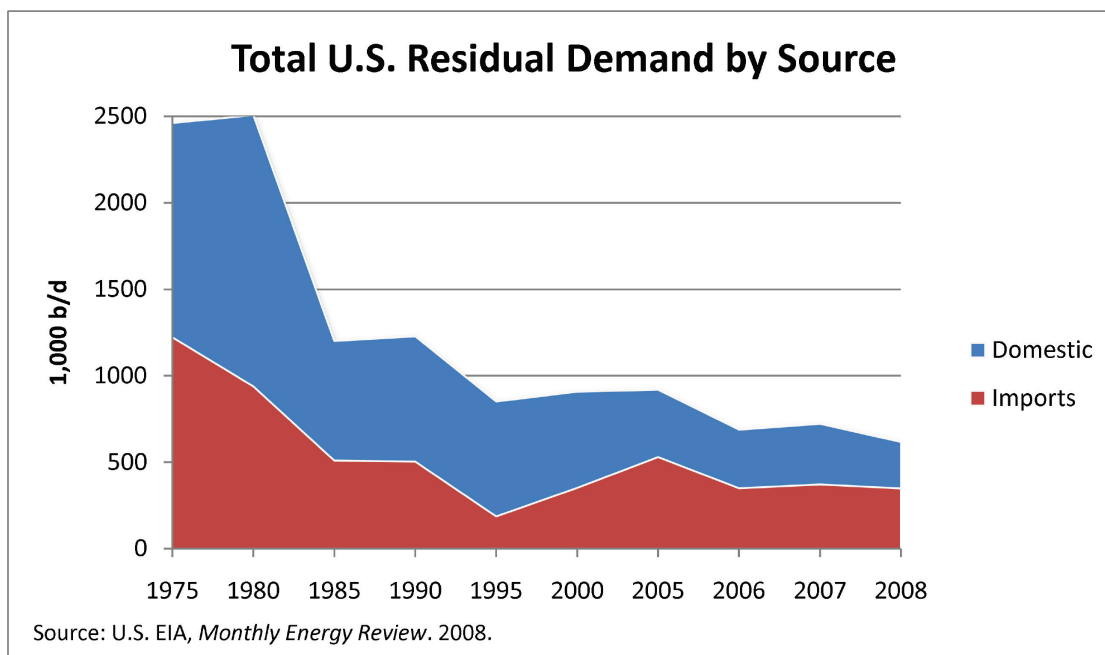
4.4.1 U.S. Residual Fuel Supply and Demand

Since 1991, consumption of residual fuel oil has ranked as the third largest petroleum fuel used in New York on a volumetric basis, trailing gasoline and distillate fuel oil. The fuel is traditionally refined and blended to different sulfur content levels to meet varying air emission standards across the State. These sulfur contents are measured as a percentage by weight. The allowable sulfur content in New York ranges from a low of 0.3 percent to over 2.0 percent. The fuel is blended at terminals and refineries to meet different local sulfur requirements. In New York City, residual fuel is required to have a sulfur content of no greater than 0.3 percent. Residual oil is not shipped in pipelines because of its high viscosity. Rather, it is transported by tanker, barge, and for local delivery, by truck. It is traditionally used in large boiler applications such as electric power generation, space heating in large apartment and commercial buildings, vessel bunkering, and industrial facilities.

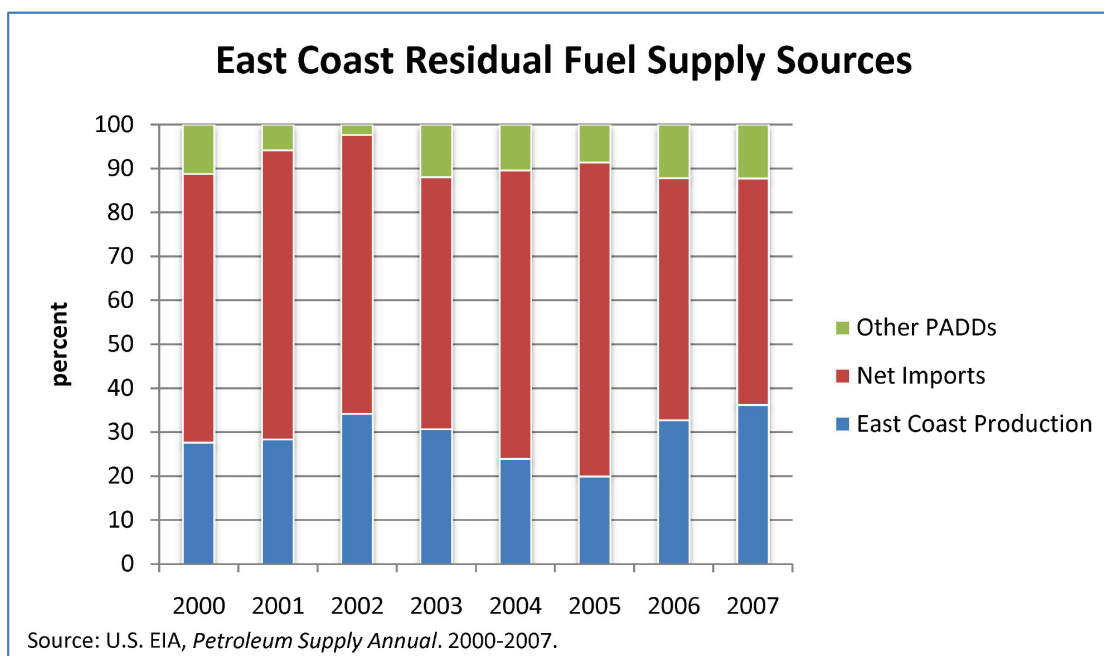
U.S. demand for residual fuel oil has fallen steadily since 1980 when the market for this fuel began to erode. Beginning in the late 1970s, many residual fuel oil use applications converted to natural gas because of the cleaner emission characteristics of that fuel and the price advantages at that time. This was particularly true for electric power generation. Another consideration at that time was the effort to reduce U.S. dependency on imported petroleum fuels. As depicted in Figure 23, U.S. total annual residual fuel oil demand peaked at 2.5 mmb/d in 1980 and declined steadily to 852,000 b/d by 1995, a 66.0 percent reduction. Since 1995, demand has ranged from a high of 920,000 b/d in 2005 to a low of 618,000 b/d in 2008. The demand fluctuation in recent years is primarily the result of high natural gas prices. Many residual fuel users have dual-fuel capability. The dual-fuel option allows users to select between residual fuel and natural gas on an economic basis and fuel supply availability. Therefore, when the price of natural gas exceeds residual fuel, users are likely to switch to the lower cost residual fuel. Conversely, in 2008, record high crude oil and refined petroleum product prices, including residual fuel, pushed demand

to an all-time low as users switched to natural gas. Also, facilities relying on interruptible natural gas delivery service may have gas supply restricted during high demand periods. These users are then required to use back-up residual fuel capacity.

Figure 23. U.S. Residual Fuel Demand & Imports



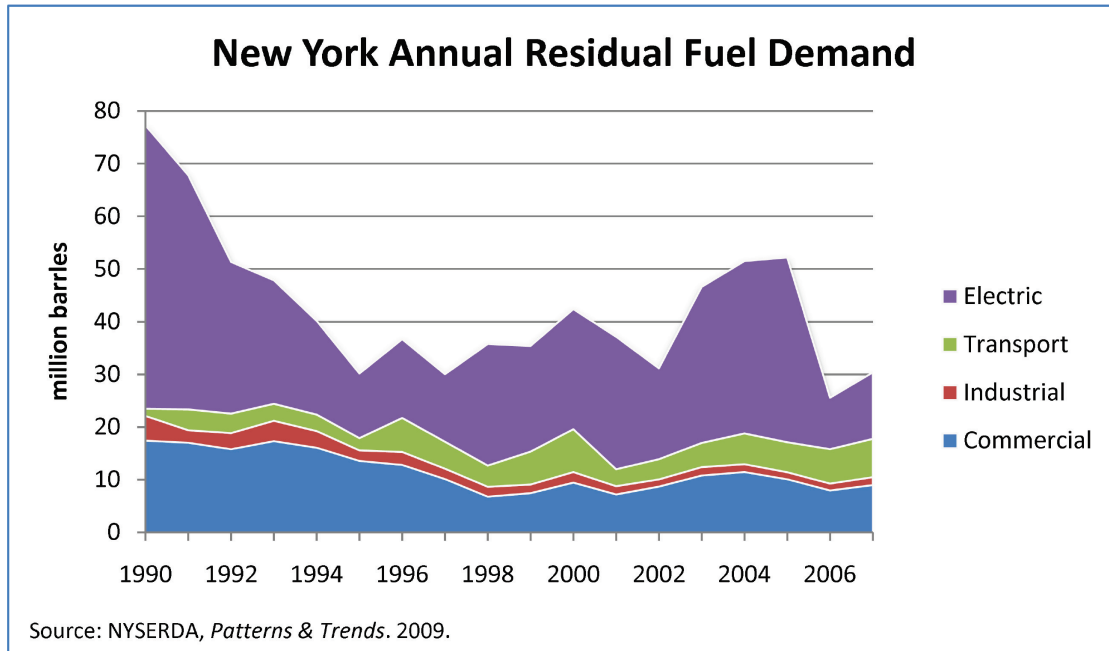
The United States used approximately 264 million barrels of residual fuel oil in 2007. Almost half of this total was consumed in PADD 1 states, with Florida and New York being the largest users. In 2007, New York used about 30 million barrels, approximately 11 percent of total U.S. demand and 24 percent of PADD 1 demand. While it is not possible to determine state specific sources of residual fuel, Figure 24 shows that in 2007 the majority of residual fuel used on the East Coast, 51.6 percent, originated from foreign sources. During 2006 and 2007, East Coast refineries expanded their market share and supplied 33 percent and 36 percent, respectively. Finally, over the past five years the U.S. Gulf Coast area has generally accounted for about 10 percent of supply. For many years, U.S. refiners have acted to reduce residual fuel production capacity in favor of more profitable gasoline and distillate fuels. Consequently, the trend toward higher import dependence for residual fuel is likely to continue as refiners continue to eliminate residual fuel production capacity.

Figure 24. East Coast Residual Fuel Supply Sources

4.4.2 New York State Residual Fuel Focus

Matching the national trend, New York residual fuel demand has fallen very sharply since 1990, as illustrated in Figure 25. Between 1990 and 2007 statewide demand declined from 77.2 to 30.3 million barrels, a reduction of 60.8 percent. The State's electric sector has traditionally been the largest user of residual fuel. During the 1990 to 2007 study period, electric sector residual fuel demand was exceeded only once, in 1995, by commercial sector demand. In 2007, the electric sector accounted for 41.6 percent of total residual fuel demand, much lower than the 1990 level of 66.7 percent. In 2007, the commercial sector, which includes large apartment buildings common in New York City, accounted for 29.6 percent of residual demand, the transportation sector equaled 23.9 percent, and the industrial sector equaled 4.9 percent. The sharp reduction in electric sector residual fuel demand in 2006 is partially explained by favorable natural gas prices compared to residual fuel and inflated 2005 electric sector demand as a result of disruptive hurricane activity that year. In the late summer of 2005, hurricanes damaged substantial system components of the U.S. Gulf Coast natural gas production and processing infrastructure. In response to reduced natural gas supplies, prices moved sharply higher. This resulted in most dual-fueled facilities in New York switching to residual fuel for much of the fall and early winter 2005 period.

Figure 25. New York Annual Residual Fuel Demand



4.4.3 New York Petroleum Demand and Price Forecast Summary

New York’s residential distillate fuel (home heating oil) demand, as shown in Table 1, is projected to decrease 2.3 percent annually over the next 10 years, while motor gasoline demand is projected to decline by 0.2 percent. The total decline in residential distillate is calculated to be 35.1 trillion Btus (TBtu), from 172.0 TBtu in 2009 to 136.9 TBtu in 2018. The total decrease in motor gasoline demand is calculated to be 12.8 TBtu, from 710.0 TBtu in 2009 to 697.2 TBtu in 2018. Over the 2009 to 2018 forecast period, residential distillate fuel price is projected to increase 2.8 percent annually, and motor gasoline price is expected to increase 2.8 percent. The total increase in residential distillate price is \$4.63/MMBtu in constant 2009 dollars, from \$14.72/MMBtu in 2009 to \$19.35/MMBtu in 2018. The total increase in motor gasoline price is \$4.84/MMBtu in constant 2009 dollars, from \$17.36/MMBtu in 2009 to \$22.20/MMBtu in 2018. A fuel price projection in constant 2009 dollar units removes the natural rate of inflation within the State’s economy and allows for analysis of real changes in the future relative to current prices.

For a more detailed discussion of the various forecast assumptions and a description of the forecast methodology, see the Energy Demand and Price Forecasts Assessment.

Table 1. New York Petroleum Demand and Price Forecast

New York Petroleum Demand and Price Forecast				
Year	Residential Distillate		Motor Gasoline	
	Demand (TBtu)	Price 2009\$/MMBtu	Demand (TBtu)	Price 2009\$/MMBtu
2009	172.0	14.72	710.0	17.36
2012	154.1	17.51	708.9	20.28
2015	143.6	18.63	700.8	21.46
2018	136.9	19.35	697.2	22.2
Annual Growth Rate (2009-2018)	-2.3%	2.8%	-0.2%	2.8%

