SECTION 3.1

FORECAST SUMMARY

INTRODUCTION

Twenty-year forecasts of energy demand and prices for electricity, natural gas, petroleum, and coal were developed for the State Energy Plan. The base year for forecasting is 2000. Forecasts include: (1) an Outlook Case bounded by (2) a High Economic Growth Case and (3) a Low Economic Growth Case for a total of three forecast scenarios. Forecasting methodologies and more detailed forecast information are provided in the Forecast Appendix, which is available on request.

The Energy Plan forecasts are consistent with and derived from the Energy Information Administration's (EIA) *Annual Energy Outlook (AEO) 2002*. The Mid-Atlantic *AEO 2002* forecast, which includes the states of New York, Pennsylvania, and New Jersey, serves as the basis for the Energy Plan forecasts. Electricity demand projections were derived in part from the *AEO 2002* electricity forecast developed specifically for the New York Control Area (NYCA). This forecast was adjusted to reflect energy efficiency and demand reductions in New York not factored into the AEO forecast. This adjusted forecast was an input the NYCA Market Assessment and Portfolio Strategies (MAPS) electricity market model, which then calculated the specific primary fossil fuel mix required to meet electricity demand. Fossil fuel use projected from the MAPS model was added to the AEO 2002-based forecasts of other sector fossil fuel use to derive total fossil fuel demand.

FORECAST METHODOLOGY

New York projections were derived from the EIA Mid-Atlantic Region all fuels demand and price forecasts and the NYCA Electricity Market Module demand and price forecasts. EIA produces regional forecasts under various economic and price scenarios. EIA uses the National Energy Modeling System (NEMS)[1] energy market projections of the *AEO 2002*.

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[1] NEMS is a computer-based, energy-economy modeling system for U.S. energy markets, using an integrated modular approach to represent macroeconomic activity, international energy supply availability, and end-use consumption sectors. For each fuel and consuming sector, the model balances energy supply and demand while accounting for competition among various energy fuels and sources. NEMS projects the production, importation, conversion, consumption, and consumer prices of energy based on macroeconomic and financial factors, world energy markets, resource availability and costs, market behavior, cost and performance of technologies, and demographic assumptions.

The Energy Plan forecasts represent a reasonable range of possible future energy demand and prices as a basis for assessing energy markets and future market needs.[2] Macroeconomic variables, used by EIA for its Outlook, High, and Low Economic Growth Cases, affect predictions of future capital investment, productivity gains, and technology and market development to name a few. Growth rates for key economic variables determine energy demand growth in both the EIA national and New York's forecasts. The primary growth rates for determining economic activity are provided in Table 1.

Table 1

Annual Average U.S. EIA Growth Rates (2000-2020) of Economic Variables			
	High Case	Outlook Case	Low Case
Productivity	2.4%	2.2%	1.9%
Labor Force	1.0%	0.8%	0.6%
GDP	3.4%	3.0%	2.4%
World Oil Price	0.4%	-0.5%	-2.3%

These economic variables are measured by EIA at a national level, but interact differently with regional variables in the ten census division (NEMS) economic modules. The High Economic Growth Case incorporates population, labor force, and productivity growth rates that are higher than the Outlook Case. Productivity gains result in lower inflation and interest rates. The Low Economic Growth Case assumes lower population, labor force, and productivity gains than the Outlook Case, with higher interest and inflation rates.[3]

Method Overview

The New York forecasts were derived from EIA's regional fuel demand and price forecasts, by determining the historic relationships between fuel demand and prices in New York and those of the Mid-Atlantic region. New York's energy use as a percentage of Mid-Atlantic energy use has remained fairly stable over the last three to four decades. Thirty-nine years (1960-1999) of New York fuel use, expressed as a percentage of the

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[2] Of the many scenarios simulated by NEMS, three forecasts, each featuring a different rate of economic growth, were chosen. These scenarios included the EIA Outlook Case forecast and projections based on high and low economic growth to reflect the uncertainties inherent in forecasting future economic activity.

[3] EIA Assumptions to the Annual Energy Outlook 2002, pg 58

Mid-Atlantic region's fuel use, defines the historic relationship between the two, by end-use sector. Twenty nine years (1970-1999) of New York fuel prices, expressed as a percentage of Mid-Atlantic prices, by sector, define the historic relationship used to modify the Mid-Atlantic forecasts. These demand and price relationships were projected into the future using linear regression and a univariate time series forecast. The forecasted percentages were then applied to the EIA Mid-Atlantic regional forecasts to obtain 20-year New York forecasts. The 2000 New York forecasted data were then replaced with actual 2000 data reported in New York State Energy Research and Devlopment Authority's (NYSERDA) *Patterns and Trends 2000*.

SYSTAT® 9.0 for Windows® was used to generate year-to-year New York forecasts. Regression analysis and univariate time-series metholodgies were used. The regression analysis model produces a more dynamic forecasted ratio of New York to Mid-Atlantic, but in the cases where the historical trend flucuates and history is determined to not be an accurate predictor of the future, the time-series model is used. The time-series model is preferred in this case because it weighs recent years more heavily than years past.

To predict New York as a percentage of the Mid-Atlantic using regression analysis, the SYSTAT® program fits an equation into to a set of data in order to best describe the relationship between the variables. In this case, the relationship established between the ratio of New York data to Mid-Atlantic for a given fuel and over a specified period of time, was linear. The relationship between New York and Mid-Atlantic was fairly stable for most fuel prices and demands by sector. Test statistics revealed the historical ratio was a positive predictor of the future, and therefore acceptable.

The SYSTAT® program ran a time-series projection using an Auto Regressive Integrated Moving Average (ARIMA) model[4] to determine New York's growth trend in relation to that of the Mid-Atlantic region. The historical data series used to generate New York demand and price forecasts for electricity, natural gas, petroleum, and coal satisfied standard statistical tests, and were deemed to sufficiently capture the

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[4] ARIMA models use either past values (the autoregressive model), past errors (the moving average model), or combinations of past values and past errors to create an accurate projection. A Box-Jenkins univariate time series model is the specific ARIMA model used. The Box-Jenkins ARIMA modeling process occurs in three stages: Identification, Estimation, and Diagnosis. With SYSTAT®, models are identified with Transform, Case series plot, ACF –Autocorrelation plot, and PACF Partial Autocorrelation plot functions, differenced to create a stationary data series, estimated with ARIMA and diagnosed to determine their adequacy with more plots.

relationship between all of the New York energy demand and prices and those of the Mid-Atlantic region.[5] Table 2 shows New York forecasts by sector and fuel. Forecasts for each of the listed fuel sectors can be found in the Forecast Appendix.

Table 2

New York State Forecasts (2000-2021)						
	Residential	**Commercial**	**Industrial**	**Electric Generation**	**Transportation**	**Total**
Petroleum tBtu	Distillate, Propane Demand and Price	Distillate, Residual Demand and Price	Distillate, Residual, Propane, Demand and Price	Distillate, Residual Demand and Price	Distillate, Motor Gasoline Demand and Price	Demand and Price
Electricity GWh	Demand and Price	Demand and Price	Demand and Price		Demand and Price	Peak(MW) Energy
Natural Gas mmdt	Demand and Price	Demand and Price	Demand and Price	Demand and Price		Demand and Price
Coal tBtu	Demand	Demand	Demand	Demand		Demand

NEW YORK STATE ENERGY DEMAND

A summary of Statewide energy demand forecasts is shown in Table 3. The forecasts highlight the demand for electricity, total and residential natural gas, total petroleum, home heating oil, gasoline, and coal over the forecast period for the Outlook Case. The Outlook Case assume 3.0% average annual economic growth over the period. The electricity forecasts represent the electricity requirements for retail customers. Using a weather-adjusted base, an average annual growth rate of 1% for total electricity requirements, measured in gigawatt-hours (GWh), is predicted over the forecast period.

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[5] The autoregressive (AR) model addresses serial correlation of errors. For example, a residual from our model reveals an autocorrelation statistic of .953. Correlation coefficients can be squared to reveal the proportion of variance, or in this case, the variation in error terms. This means that over 89% of the variation in error from predicting New York's percentage of Mid-Atlantic in one year can be accounted for by the error in predicting the previous year's percentage. Where serial correlation was found in plotted residuals, the appropriate number of AR parameters were added to eliminate their influence on the forecast.

Table 3

Energy Demand in New York State							
	Actual	**Outlook**	**Outlook**	**Average Annual Growth**			**Total Growth**
	2000	**2006**	**2021**	**2000-2006**	**2006-2021**	**2000-2021**	**2000-2021**
Electricity, Gwh	155,681	167,490	191,401	1.23%	0.89%	0.99%	22.94%
Peak, MW	30,200	32,319	36,568	1.14%	0.83%	0.92%	21.09%
Natural Gas, tBtu	1,135.1	1,346	1,555.5	2.77%	0.97%	1.51%	37.03%
Residential	362	420	443	2.50%	0.36%	0.97%	22.50%
Petroleum, tBtu	1,725	1,614.9	1,875.1	-0.07%	0.89%	0.40%	8.70%
Home Heating Oil, tBtu	197	167	140	-2.68	-1.18%	-1.61%	-28.88%
Gasoline, tBtu	697	757	853	1.40%	0.79%	0.97%	22.41%
Coal, tBtu	311	218	251	-5.76%	0.93%	-1.03%	-19.52%

The Outlook Case is bounded by Low and High Economic Growth Case forecast rates ranging from 0.8% to 1.3% per year. Peak demand growth, measured in megawatts (MW), lags behind projected growth in total electricity requirements. A variety of demand-side management programs reduces peak demand on extreme-weather days. Peak electricity demand is expected to grow at an average annual rate of 0.9%. The Low and High peak demand forecasted growth rates are 0.8% and 1.2% per year, respectively, over the forecast period.

Total natural gas demand is expected to increase at an average annual rate of 1.5% in the Outlook Case, over the forecast period. The Low and High Economic Growth Case forecasted rates for total natural gas are 1.3% and 1.7% per year, respectively. All sectors, electric generation, residential, commercial, and industrial, exhibit projected increases in demand for natural gas. Despite a recent trend of contracting demand, downstate[6] demand for natural gas has historically been stronger than upstate[7] demand, particularly in the residential sector. Forecasted downstate growth

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[6] Downstate comprises these utility areas: Central Hudson Gas & Electric Corp., Consolidated Edison Co. of N.Y., Inc., Keyspan New York, Keyspan Long Island, and Orange & Rockland Utilities, Inc.

[7] Upstate comprises these utility areas: Corning Natural Gas Corp., National Fuel Distribution Corp., New York State Electric and Gas Corp., Niagara Mohawk Power Corp., Rochester Gas & Electric Corp., and St. Lawrence Gas Company, Inc.

may be further slowed due to the World Trade Center disaster.[8] The increases in total gas demand are largely attributable to projected fuel requirements for electricity generation.

The predicted downturn in demand for petroleum (-0.07% average annual growth from 2000-2006) and a predicted slow 0.9% average annual growth from 2006 to 2021 is largely driven by declining use of distillate and residual oil for electric generation. In the Outlook Case, residual oil-fired generation decreases by 64.2% and distillate oil-fired generation declines by 90.44% over the forecast period. Home heating oil use decreases 28.9% over the forecast period. Home Heating oil price declines hold steady at about 1.6% per year in the both the Low and High Economic Growth Cases. The Energy Plan forecast results indicate growth in distillate requirements for the industrial and transportation sectors, increasing an average of 0.9% and 1.8% per year over the forecast period, respectively.

Average distillate use is projected to decrease in the residential, commercial, and electric generation sectors, by 1.6%, 0.2%, and 10.6% per year, respectively, over the forecast period. Average annual residual oil requirements are forecasted to decline 0.6% in the commercial sector, 0.9% in the industrial sector, and 4.8% in the electric generation sector over the forecast period. Demand for motor gasoline is expected to increase 22.4% over the forecast period. Demand for motor gasoline in the transportation sector is expected to grow between 0.7% and 1.2% per year, with most of the growth projected over the first ten years of the forecast. In the Outlook Case, propane demand rises 16.7% or 0.7% annually. Residential propane demand rises 24.0% in the Outlook Case, 1.0% annually. In the Low and High Economic Cases, propane demand rises 1.0% and 1.1% respectively.

Total coal use in New York is expected to decline over the forecast period. Average annual decline in the Outlook Case is forecasted at 1.0% and total decline is projected at 19.5% over the forecast period. Coal use in the electric generation sector is forecasted to decline sharply from 265 tBtu in 2004 to 160 tBtu in 2005. After this slowdown, growth is predicted to rebound to 197 tBtu in 2021, as rising natural gas wellhead prices and nuclear power plant retirements are projected to cause increasing demand for coal-fired baseload capacity in the electric generation sector. Coal demand is forecasted to decline 1.3% annually in the Low Economic Growth Case and 0.7% annually in the High Economic Growth Case. The High Economic Growth Case favors

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[8] The loss of load in New York City resulting from the terrorist attack on the World Trade Center is not factored into the forecast. This load is expected to be restored gradually during rebuilding efforts and completely restored once rebuilding is finished. Load is expected to be fully restored sometime in the early half of the forecast period.

coal burning in the electric generation sector. In that case, total coal use is projected to decline only 12.3% over the forecast period.

NEW YORK STATE ENERGY PRICES

Statewide average end-use electricity prices (including those of the New York Power Authority) are projected to decrease at an average annual rate of approximately 0.5% in constant 2000 dollars over the forecast period. An implicit assumption of the price forecasts is that New York will be able to meet it's energy demands during the forecast period. The MAPS electricity market model is used to analyze several scenarios including high demand. Should demand outstrip supply, prices would rise. Programs exist in the State designed to mitigate that problem. These emergency demand response and peak load reduction programs help mitigate price volatility, particularly at the time of peak demand. The Low and High Economic Growth Case price forecasts project that electricity prices will decrease an average of 0.7% and 0.3% per year, respectively, over the forecast period. In the Outlook Case, Statewide average natural gas prices for the residential sector are projected to decrease at an average annual rate of approximately 0.2% from 2000 to 2021. In the Low Economic Growth Case, the average prices for the residential sector are projected to decrease at an annual rate of 0.4%, while in the High Economic Growth Case, an average annual price decrease of 0.03% is projected.

The price to all natural gas users is forecasted to drop 10.4% over the forecast period, 0.5% annually. In the Low Economic Growth Case, the average prices are projected to decrease at an annual rate of 0.8%, while in the High Economic Growth Case, an average annual price decrease of 0.2% is projected. Home heating oil prices Statewide are projected to decrease for the residential sector by 16.0% over the forecast period. The Outlook Case, which projects moderate demand, predicts the smallest average price decline, about 0.8% per year. This is higher than the High Economic Growth Case, which predicts abundant supply and slackened residential demand, resulting in a 0.7% annual decrease in prices. The Statewide utility coal price is projected to decline at an average annual rate of approximately 0.7%, or a total of 14.4% over the forecast period. Both the Low and High Economic Growth Cases predict an average decline in coal price over the forecast period of 0.8% and 0.5% per year, respectively. Projected Statewide energy prices are shown in Table 4 in constant 2000 dollars.

Average prices for each fuel (shaded) are weighted by demand within their respective customer sectors.

Table 4

	Actual	Outlook	Outlook	Average Annual Growth			Total Growth
Energy Prices in New York State ($2000)							
	2000	**2006**	**2021**	**2000-2006**	**2006-2021**	**2000-2021**	**2000-2021**
Electricity, cents/kWh	10.7	9	9.6	-5.03%	0.41%	-0.51%	-10.13%
Residential, cents/kWh	13.4	11.7	12.1	-2.16%	0.19%	-0.49%	-9.78%
Commercial, cents/kWh	11.2	8.7	9.5	-4.03%	0.54%	-0.79%	-15.35%
Natural Gas, $/dt	6.95	6.42	6.23	-1.31%	0.20%	-0.52%	-10.36%
Residential, $/dt	9.59	9.96	9.14	0.65%	-0.57%	-0.23%	-4.71%
Petroleum, $/gal	1.24	1.09	1.12	-2.10%	0.18%	-0.48%	-9.54%
Home Heating Oil, cents/gal	152.56	116.51	128.22	-4.39%	0.64%	-0.82%	-15.96%
Motor Gasoline, $/gal	1.59	1.43	1.41	-1.76%	-0.10%	-0.58%	-11.42%
Electric Generation Residual Oil, $bbl	27.19	24.28	26.29	-1.87%	0.53%	-0.16%	-3.30%
Utility Coal, $/ton	39.11	36.33	33.46	-1.22%	-0.55%	-0.74%	-14.44%

FINDINGS AND CONCLUSIONS

- Demand and nominal prices for most fuels are forecast to increase at different rates over the forecast period; however, real prices (accounting for inflation) decline for most fuels over the forecast period.

- New York's aggregate demand for petroleum products is projected to rise moderately over the forecast period, with increases projected for motor gasoline and decreases for residential heating oil. Increased world demand is expected to exert upward pressure on prices, even given stable supplies. Over the forecast period, demand for motor gasoline is projected to increase 22.4%. Year 2000 prices were unusually high, $1.59 per gallon, so real prices are expected to drop 11.4% from this level, to $1.41 per gallon in 2021. Propane use rises 16.7% over the forecast period.

- Natural gas supply availability, being predominately domestic, is expected to be fairly stable. Natural gas prices rose sharply in 2000. This increase was due to tight natural gas supplies, both in production and storage. A result of this price

increase was greater U.S. exploration and drilling, increases in inventory levels, and hence, lower real prices over the forecast period. Demand growth will be strong in New York, with 37.0% growth over the forecast period. This is primarily due to a 61.0% increase in natural gas demand for electric power generation. Real natural gas prices are expected to decrease an average of 0.5% annually, from $6.95 per dekatherm in 2001 to $6.23 per dekatherm in 2021.

- Total electricity use in New York is expected to grow 22.9% over the forecast period, while prices in real terms decline. Real electricity prices are forecast to decline 10.1% over the forecast period due to increased competition among suppliers and lower fuel prices. Peak megawatt demand is forecast to grow at a slightly slower rate than total electricity requirements (21.1% versus 22.9%) over the forecast period.

- Coal demand is expected to decline, by a total of 19.5% over the forecast period. Customer coal prices decline over the forecast period along with mine-mouth coal prices. Productivity increases continue to result from technology enhancements, economies of scale, and better mine design. As a result, real utility coal prices are forecasted to decline 14.4% over the forecast period.