A General Discussion of the Forecast Model Structures of the ISO New England Short and Long Run Energy and Seasonal Peak Forecasts for the 2009 CELT Report and 2009 Regional System Plan

Table of Contents

Section 1
General Description of Forecast Model Structures

In the 2006-2008 timeframe, in anticipation of the upcoming implementation of the Forward Capacity Market, ISO-NE and NEPOOL initiated a review of the ISO-NE load forecast methodology. Since the load forecast would play an important role in establishing the Installed Capacity and Local Sourcing Requirements that would be used in the new Forward Capacity Market, it was felt that an independent review of the forecast methodology was warranted.

Through the larger review process, two independent forecasting experts were hired to review and comment on the ISO-NE load forecast methodology. Benchmark Forecasts completed its review in 2006, and Dr. Tim Mount completed his review in 2007. A summary of their recommendations may be found in Appendix A of this report. The current structure of the forecast models for both energy and peak load include the implementation of the recommendations suggested by these two reviewers. During this past year, the recommendations shown as 1, 2, 4, and 5 in Appendix A were implemented.

1.1 Energy Forecast Model

The 2009 long-run energy model is an annual model of projected total energy consumption within the ISO-NE control area and each of the six New England states. The goal of the model development process is to specify a forecast model with a sound economic structure so that the relationship between the input variables captures a genuine causal relationship and is able to accurately predict electric consumption. Thus, an autoregressive model[1], using lags on the dependent variable in conjunction with economic and weather variables is used. This dynamic specification allows for the gradual adjustment of energy consumption to changes in the explanatory variables over time. For example, this adjustment process includes consumer purchases of more efficient appliances in response to higher energy prices as existing appliances wear out or are scrapped. Even though the purchases are stimulated by higher energy prices, they do not all occur immediately. The models produce both short-run and long-run price and income elasticities.

Specifically, the model structure is as follows:

$$E_t = A\,\mathrm{E}_{t\text{-}1}^{\alpha_1}\, rp_t^{\alpha_2(t)}\, rpi_t^{\alpha_3}\, cdd_t^{\alpha_4(t)}\, hdd_t^{\alpha_5}\, \varepsilon_t \qquad (1)$$

Taking logarithmic,

$$\ln(E_t) = \alpha_0 + \alpha_1 \ln(E_{t-1}) + \alpha_{2,t} \ln(rp_t) + \alpha_3 \ln(rpi_t) + \alpha_{4,t} \ln(cdd_t) + \alpha_5 \ln(hdd_t) + e_t \qquad (2)$$

Where:

t	:is the year
E	:is the energy for load
rp	:is the real average retail electricity price
rpi	:is the real personal income
cdd	:is the cooling degree days

[1] The underlying theory is supported by the Partial Adjustment Model often used to model energy consumption. See *Learning and Practicing Econometrics* by William E. Griffiths, R. Carter Hill and George G. Judge; John Wiley & Sons, Inc, 1993.

hdd :is the heating degree days
e :is the stochastic residual

The estimated short-run price and income elasticities are derived from the model (2) as

$$\eta^{SR}{}_{p,E}\,(t) = \hat{\alpha}_{2,t} \quad \text{and} \quad \eta^{SR}{}_{rpi,E} = \hat{\alpha}_3 \tag{3}$$

The estimated long-run price and income elasticities are derived as follows:

$$\eta^{LR}{}_{p,E}\,(t) = \frac{\hat{\alpha}_{2,t}}{1-\hat{\alpha}_1} \quad \text{and} \quad \eta^{LR}{}_{rpi,E} = \frac{\hat{\alpha}_3}{1-\hat{\alpha}_1} \quad \text{where} \qquad 0 \le \hat{\alpha}_1 \le 1 \tag{4}$$

ISO-NE uses the sample size which provides the most stable estimates. Generally, most models use electric consumption from the 80's. The use of a shorter sample size is called "truncation of the sample." Truncations could be necessary under special circumstances. An example of truncation would be the case of Vermont's energy model[2]. During the first haft of the 80's, the electric price and electric consumption moved in opposite direction. The model could not identify a statistically significant negative price estimate for the entire sample. ISO-NE truncated the series and used a sample size of 1985-2008. By truncating the series, a statistically significant price elasticity was found[3].

ISO-NE state energy models include dummy variables to account for extraordinary events that affect the level of energy and are not caused by the explanatory variables in the model. For example, the energy model for Maine includes several dummies to account for the sudden increases in the level of energy for load corresponding to the incorporation of generation to the grid in response to the first market. Those increases of energy occurred at the end of the 1990's and at the beginning of the 2000's. The use of dummy variables is designed to reinforce the coefficient of the lagged dependent variable for 1999, 2000 and 2001. Regional and state energy models and their corresponding econometric outputs can be found in Forecast Energy Models 2009.xls at:
http://www.iso-ne.com/trans/celt/fsct_detail/index.html
.

1.2 Peak Forecast Model

The ISO-NE peak load model is a monthly model of the typical daily peak for each month, and produces forecasts of weekly, monthly, and seasonal peak loads over a 10-year time period. Daily peak loads are modeled as a function of energy consumption, weather, and intercepts and slope shifters for weekends and holidays. For the summer months, a trend-weather variable is included in the regression equation to capture the increasing sensitivity of peak load to weather due to the increasing cooling load.

[2] A relatively fixed electric price may be responsible for the low correlation between consumption and price.
[3] Difficulties in finding negative and significant price elasticities are not solely an ISO-NE issue. Most researchers find positive price elasticity emerging from energy models for the state of Vermont (see Technical Report: "Differences in the price-elasticity of demand for energy" by Mark A. Bernstain, James Griffin and prepared for the National Renewable Energy Laboratory). It appears that rigidity in the price of electricity may be the cause of the poor correlation between price and consumption in the state.

Specifically, the model structure is as follows:

$$PeakLoad_{t,d} = \gamma_0 + \gamma_1 E_t + \gamma_2 (wthi_{t,d} - 55)^2 + \gamma_3 trend_t * (wthi_{t,d} - 55)^2 + \\ + \gamma_4 w_{t,d} + \gamma_5 h_{t,d} + \gamma_6 w_{t,d} trend_t (wthi_{t,d} - 55)^2 + \gamma_7 h_{t,d} trend_t (wthi_{t,d} - 55)^2 + e_{t,d} \quad (5)$$

Where:

PeakLoad	:is the daily peak load
E	:is the annual energy for load
wthi	:is the weighted average temperature humidity index at the time of peak
w	:is a dummy variable taking value equal to one for weekends and zero otherwise
h	:is a dummy variable for holidays taking value of one for Holidays and zero otherwise
e	:is the stochastic residual

Regional and state peak models and their corresponding econometric outputs can be found in Forecast Energy Models 2009.xls at http://www.iso-ne.com/trans/celt/fsct_detail/index.html

1.3 Key Model Inputs and Drivers

The economic drivers used in the regional energy and peak forecast models are:

- New England personal income – derived from a forecasted nominal personal income and price deflator produced by Moody's Economy.com

- New England Real Retail Price of Electricity – derived from the Energy Information Administration's Current and Historical Monthly Sales, Revenue and Average Revenue per Kilowatt hour

- The weather concepts used in the energy model are: New England 8-city weighted annual heating degree days (HDD) representing winter weather, and an annual temperature-humidity index cooling degree days (CDD), constructed from both dry bulb and dew point temperatures for summer weather. The weather concepts used in the peak models are the New England 8-city weighted daily dry bulb for the winter and shoulder months and the New England 3-day weighted temperature-humidity index (WTHI) for the summer months. The forecasts assume normal weather.

1.4 Model Enhancements for 2009

For the 2009 forecast cycle, the ISO made several changes to the forecast methodology to better capture structural changes occurring during the historical period.

1.4.1 Changes in Energy Forecast Model and Forecast

A) The model incorporates flexible price elasticity to better account for structural changes over the historical period (e.g., increasing impact of price-induced energy conservation).

B) The model incorporates flexible Cooling Degree Day weather elasticity to better account for structural changes over the historical period (e.g., impact of greater penetration of air conditioners).

C) The forecast includes estimates of the impact of new Federal Electric Appliance Standards that would not be captured by the econometric models.

1.4.2 Changes in Peak Forecast Model and Forecast

Prior to 2009, the regional peak load forecast methodology involved the estimation of 120 equations. The forecast process was as follows: first, estimate the non-weather sensitive load (N-WSL) coefficients and the weather sensitive load (WSL) coefficients for each year and month; second, trend the N-WSL and the WSL coefficient's estimates; and third, forecast the peak load using weather and trended estimates of N-WSL and WSL coefficients that capture the impact of economics and weather on peak.

Specifically, in the first stage:

$$PeakLoad_d = \beta + \delta\ (wthi_d - 55)^2 + \phi_1 w_d + \phi_2 h_d + e_d \text{ by year} \tag{6}$$

Where β represents the N-WSL coefficient and δ describes the WSL coefficient

In the second stage:

$$\beta_t = \beta_0 + \beta_1 trend \tag{7}$$

$$\delta_t = \delta_0 + \delta_1 trend \tag{8}$$

Where the trend is time spanning 1992 though the present

In the final stage:

$$PeakLoad_{t,d} = \beta_0 + \beta_1 trend_t + (\delta_0 + \delta_1 trend_t) * (wthi_{t,d} - 55)^2 + \phi_1 w_{t,d} + \phi_2 h_{t,d} + \\ + \phi_3 w_{t,d} trend_t\ (wthi_{t,d} - 55)^2 + \phi_4 h_{t,d}\ trend_t\ (wthi_{t,d} - 55)^2 + e_{t,d} \tag{9}$$

Or

$$PeakLoad_{t,d} = \beta_o + \beta_1 trend_t + \delta_0 (wthi_{t,d} - 55)^2 + \delta_1 trend_t (wthi_{t,d} - 55)^2 + \phi_1 w_{t,d} + \phi_2 h_{t,d} + \\ + \phi_3 w_{t,d} trend_t\ (wthi_{t,d} - 55)^2 + \phi_4 h_{t,d}\ trend_t\ (wthi_{t,d} - 55)^2 + e_{t,d} \tag{10}$$

Where:

$$(N - WSL)_t = \beta_0 + \beta_1 trend_1 + \phi_1 w_{t,d} + \phi_2 h_{t,d} \tag{11}$$

$$WSL_{t,d} = \delta_0 (wthi_{t,d} - 55)^2 + \delta_1 trend_t (wthi_{t,d}\ 55)^2 + \phi_3 w_{t,d} trend_t\ (wthi_{t,d} - 55)^2 + \\ + \phi_4 h_{t,d}\ trend_t\ (wthi_{t,d} - 55)^2 \tag{12}$$

In the current 2009 forecast cycle, ISO-NE combined the previous three stages into one which incorporates the intercept and slope shifters for weekends and Holidays; see equation (5).

$$PeakLoad_{t,d} = \gamma_0 + \gamma_1 E_t + \gamma_2 (wthi_{t,d} - 55)^2 + \gamma_3 trend_t * (wthi_{t,d} - 55)^2 + \\ + \gamma_4\ w_{t,d} + \gamma_5\ h_{t,d} + \gamma_6\ w_{t,d}\ trend_t\ (wthi_{t,d} - 55)^2 + \gamma_7\ h_{t,d}\ trend_t (wthi_{t,d} - 55)^2 + e_{t,d} \tag{13}$$

By doing so, ISO-NE has reduced the number of equations to be estimated from 120 to 12, while preserving the basic structure of the model that distinguishes the contributions of the N-WSL and WSL to the peak load (Appendix A - recommendation 1and 2). In addition, the revised methodology includes:

1. N-WSL linked to energy and then to economic variables - not to a trend.
2. Better fit of historical data (or reduction in the standard error of the equation).[4]
3. Estimates of the impact of new Federal Electric Appliance Standards (2013 going forward).
4. Conversion of short-run peak model to a long-run model by allowing the growth in the Cooling Load Trend to diminish over time. This replaces the prior load factor methodology.

1.5 Economic Input Data – Real Personal Income

Real personal income is used as a surrogate for overall economic activity in the models. Figure 1.1 presents forecasted real personal income for New England used in the current load and peak forecast, as compared to the forecast of real personal income used in 2008. The 2009 forecast shows economic activity slowed in mid-2007, with a sharp decline in 2008. The decline is forecast to bottom out in late 2009, with a weak recovery beginning in 2010. Figure 1.2 presents historic and projected real personal income for New England, as compared to the United States as a whole.

[4] The in-sample MAE (Mean Absolute Error) has been reduced by 8.2% in the summer peak model and by 6% with the new methodology.

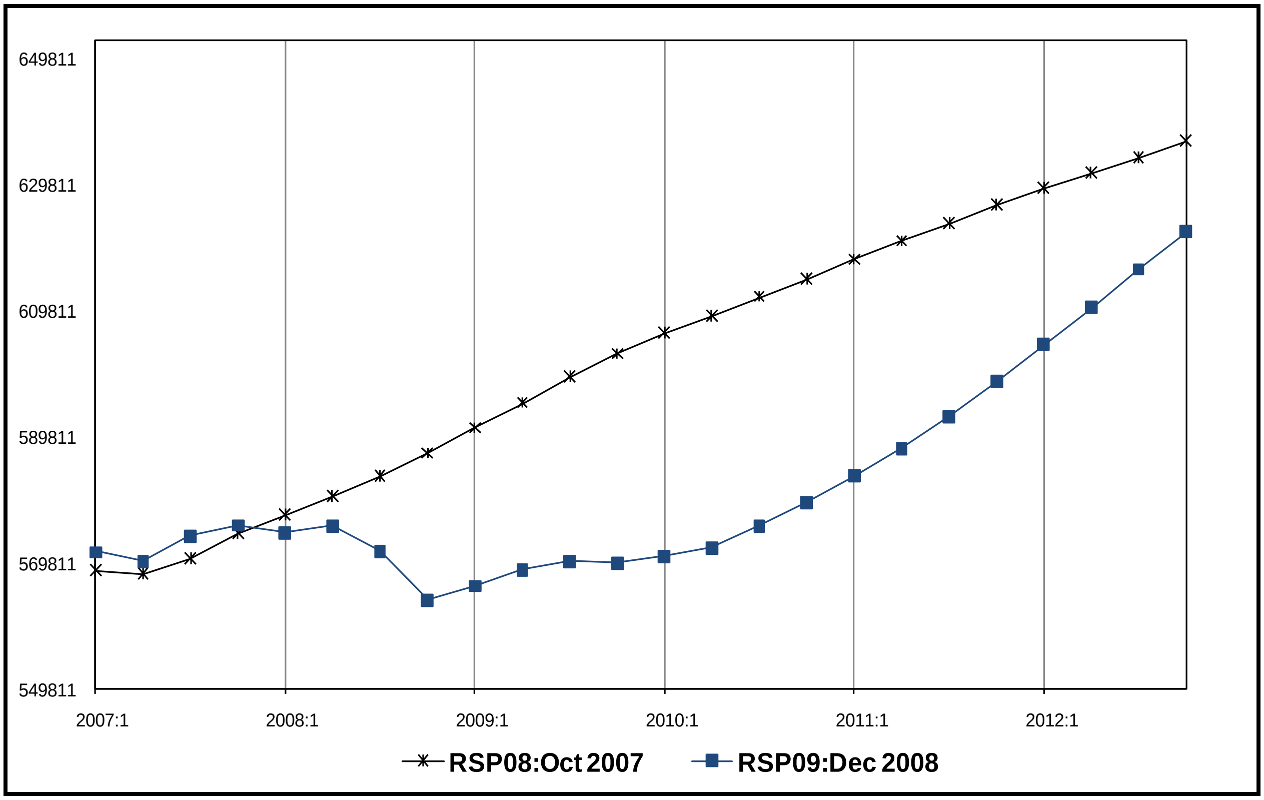

Figure 1–1: Forecasts of New England Quarterly Real Personal Income
Slowdown Starts Mid 2007, Recession Bottoms Late 2009, Weak Recovery in 2010

Source: Economy.com

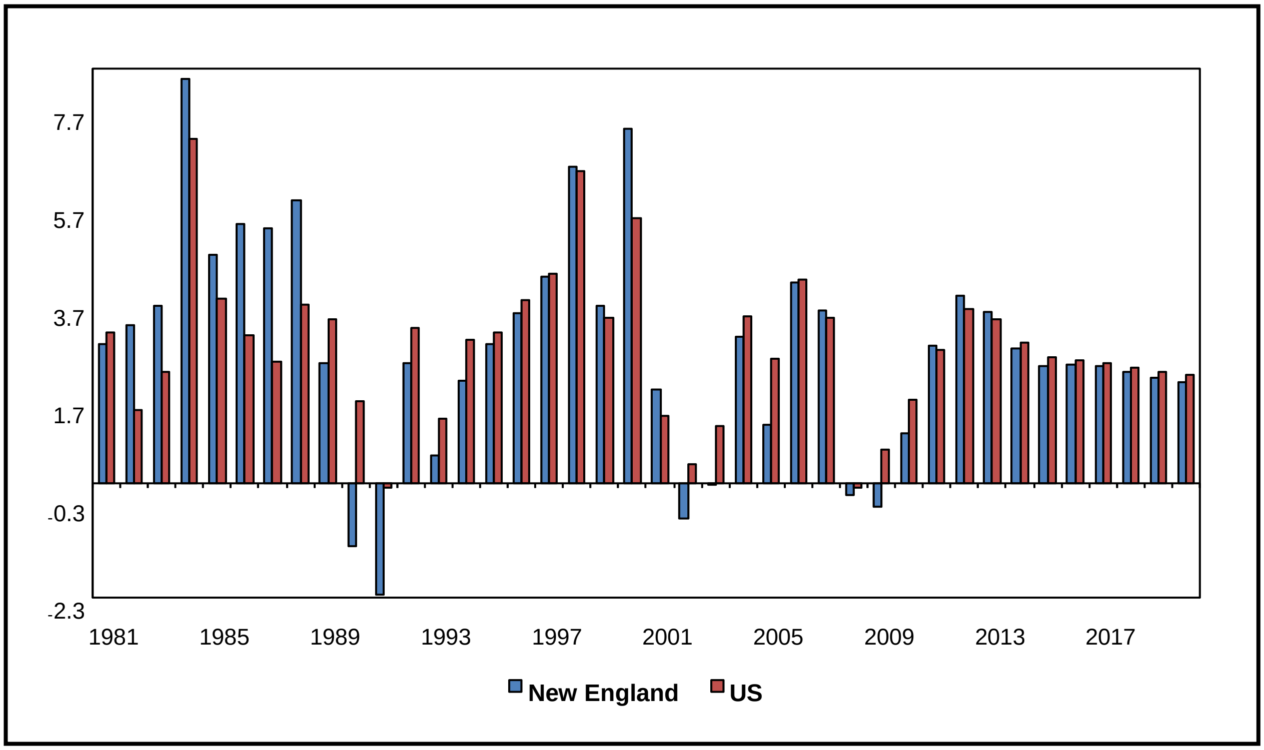

Figure 1–2: Real Personal Income: Annual Percent Changes
Early 1990s Severe Recession in New England
Stimulus Package Mitigates Current Recession

Source: Economy.com

Section 2
Projected Energy Consumption (2009-2018)

The Long-run forecast of the ISO-NE Control Area Net Energy for Load (NEL) is a forecast of ten years of energy growth by each of the six New England states. The sum of the states is totaled and reconciled to the NEL forecast for the ISO-NE Control Area.

The April 2009 or 4/09 Forecast refers to the date of the April 1, 2009 ISO-NE Control Area Forecast Report of Capacity, Energy, Loads and Transmission (CELT) for which this forecast is produced.

The 2009 energy forecast model includes enhancements which are described in Section 1.4.1. Table 2-1 shows the projected annual energy and annual growth rates for the long-run forecast for the ISO-NE Control Area. The projections include estimates of the impact of new Federal Electric Appliance Standards. The average annual growth rate is 0.9%.

Forecast values for annual energy by state can be found at:
http://www.iso-ne.com/trans/celt/fsct_detail/2009/index.html.

Table 2–1
Projected Regional Energy Growth

Year	Regional GWh	Annual Growth
2008	131500	-
2009	131315	-0.14%
2010	131330	0.01%
2011	132350	0.78%
2012	134015	1.26%
2013	134635	0.46%
2014	136085	1.08%
2015	137540	1.07%
2016	139025	1.08%
2017	140565	1.11%
2018	142125	1.11%

Figure 2.1 below shows the 2009 (RSP09) energy forecast versus RSP08 energy forecast. As would be expected, given the pessimistic forecast of economic activity, total annual demand for electricity in New England is projected to decline as the current recession progresses. Initially, this decline is driven by lost economic growth during the recessionary period, as well as by demand destruction which typically occurs during a recession. Following the recession, total demand would have been projected to return to the previous forecast level, less the consumption which would have been attributed to lost economic growth.

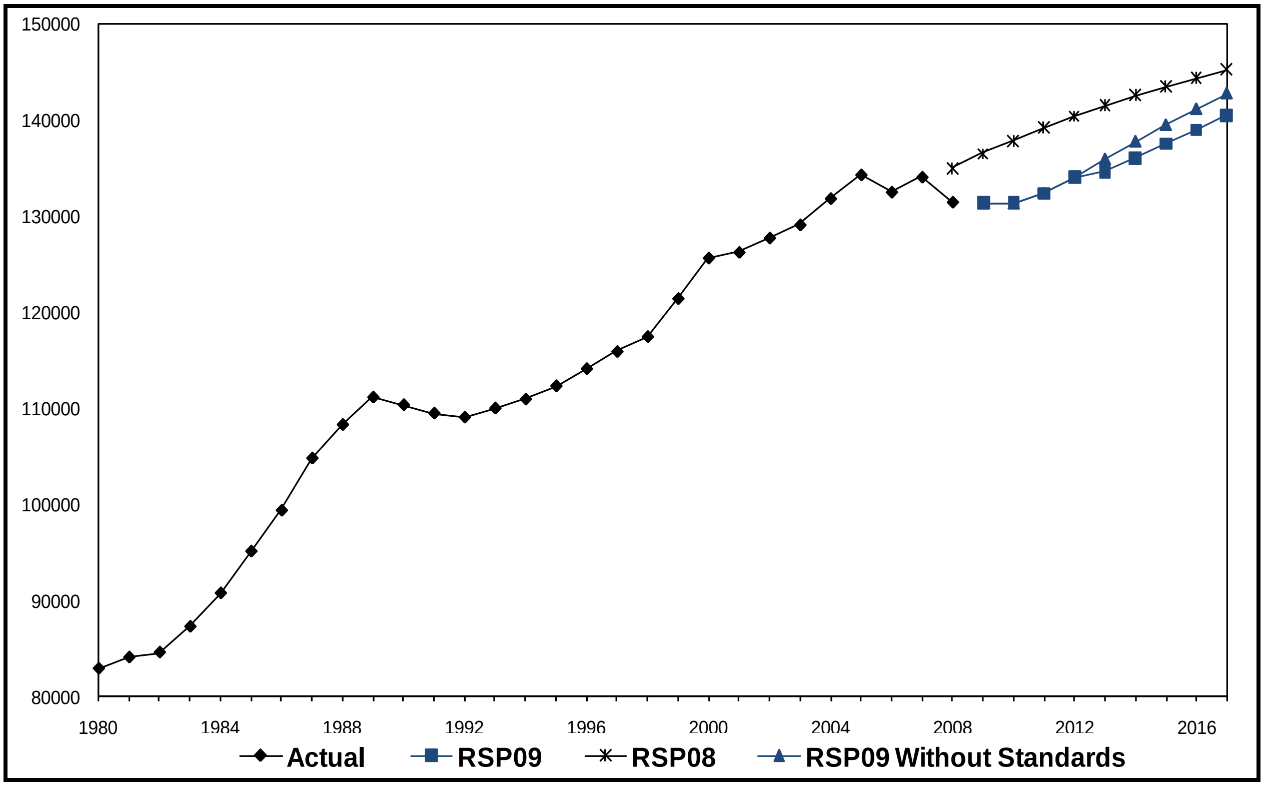

Figure 2–1: ISO-NE Net Energy for Load (GWh)
Federal Appliance Efficiency Standards Lower RSP09 Starting in 2013

However, the recent introduction of Federal Appliance Efficiency Standards, incorporated in the 2009 forecast, acts to depress projected consumption. The initial recession-driven decline in the forecast is projected to drop total consumption by 5200 GWhr, representing 4% of the total. By the end of the forecast period, projected consumption is still down by 4700 GWhr, or 3.4%. Nearly half that deficit, 1.6%, is attributed to the impact of the efficiency standards, with the remainder attributed to lost growth.

Section 3
Projected Peak Load (2009-2018)

The ISO-NE peak load forecast produces seasonal, monthly and weekly peak loads for a 10 year time period. Projected peak load forecast are developed at regional, state and load zone level. The April 2009 or 4/09 Forecast refers to the date of the April 1, 2009 ISO-NE Control Area Forecast Report of Capacity, Energy, Loads and Transmission (CELT) for which this forecast is produced.

The 2009 peak load forecast model includes enhancements which are described in Section 1.4.2. Table 3.1 below shows the projected summer and winter peak load growth rates for the long-run forecast for the ISO-NE Control Area. The projections include estimates of the impact of new Federal Electric Appliance Standards. For the forecast period, the average annual summer and winter growth rates are 1.2% and 0.4%, respectively. Forecast values for seasonal peak load at the 50/50 and at the 90/10 levels by state can be found at http://www.iso-ne.com/trans/celt/fsct_detail/2009/index.html

Table 3–1
Seasonal Peak Load Weather Normal History 2000-2008 and 50/50 Forecast 2009-2018

Year	Summer (MW)	Annual Growth	Year	Winter (MW)	Annual Growth
2000	23,150		2000/01	20,630	
2001	23,790	2.76%	2001/02	20,785	0.75%
2002	24,590	3.36%	2002/03	21,010	1.08%
2003	25,170	2.36%	2003/04	21,250	1.14%
2004	25,760	2.34%	2004/05	21,970	3.39%
2005	26,545	3.05%	2005/06	21,960	-0.05%
2006	26,940	1.49%	2006/07	21,870	-0.41%
2007	27,460	1.93%	2007/08	22,215	1.58%
2008	27,765	1.11%	2008/09	22,190	-0.11%
2009	27,875	0.40%	2009/10	22,100	-0.41%
2010	28,160	1.02%	2010/11	22,105	0.02%
2011	28,575	1.47%	2011/12	22,175	0.32%
2012	29,020	1.56%	2012/13	22,290	0.52%
2013	29,365	1.19%	2013/14	22,335	0.20%
2014	29,750	1.31%	2014/15	22,440	0.47%
2015	30,115	1.23%	2015/16	22,540	0.45%
2016	30,415	1.00%	2016/17	22,645	0.47%
2017	30,695	0.92%	2017/18	22,750	0.46%
2018	30960	0.86%	2018/19	22,860	0.48%

The 2009 forecast cycle projects a drop in the winter peak load in 2009 and a much lower growth rate over the next 10-year period than in last year's forecast. There are several reasons explaining this major change in the winter forecast:

1. The economic downturn significantly impacts the winter peak, much more than it impacts the summer peak, since 85% of the winter peak load is not weather-sensitive.
2. The weather trend portion of the winter peak has been eliminated. Analysis of the peak load equation (referred to as equation 2 elsewhere in this document) for the winter months revealed a non-statistically significant weather trend coefficient. Therefore, the weather trend coefficient was removed from the winter peak equation and its impact from the forecast (see Figure 3.1).
3. The impacts of Federal Electric Appliance Standards on peak demand have been incorporated into the model.

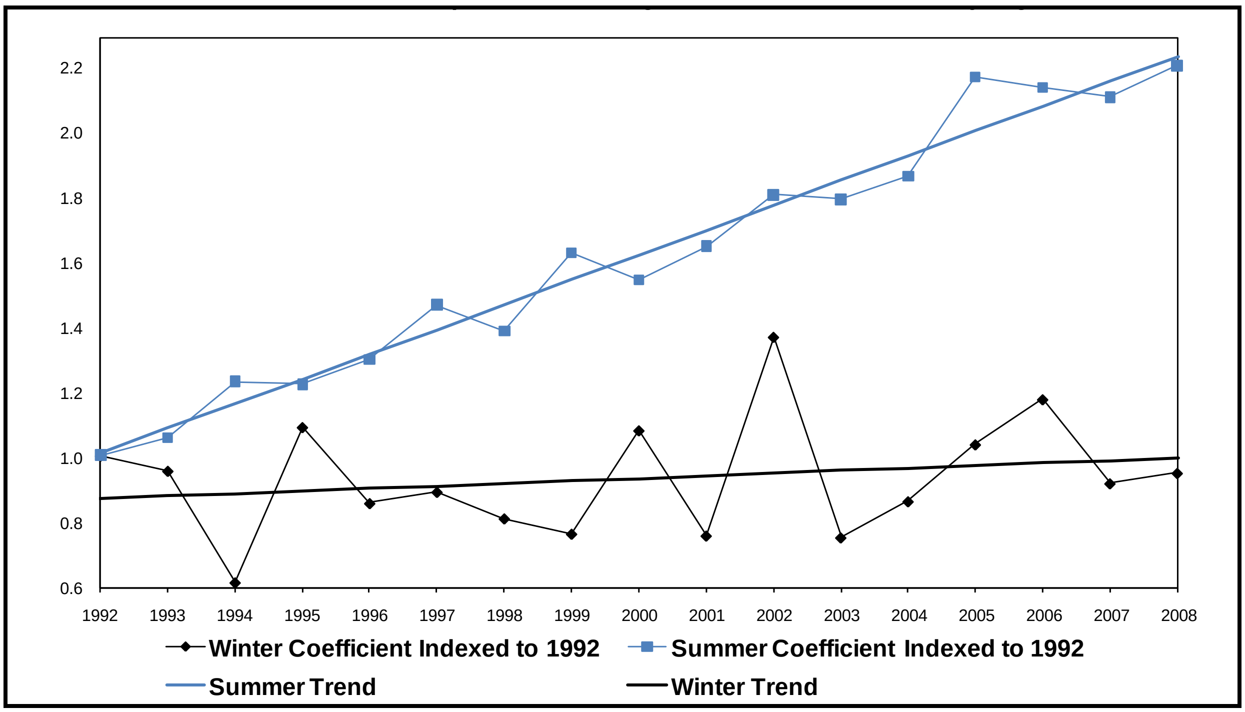

Figure 3–1: ISO-NE Summer and Winter Annual Peak Load to Weather Sensitivity Coefficients
Clear Increases in Summer Peak Load Response to Weather
Winter Peak Load Response Shows Slight Trend but not Statistically Significant

The impact of the recession and the Federal Appliance Efficiency Standards on the winter forecast was consistent with expectations. However, before making the change to eliminate the winter weather coefficient from the model, ISO-NE undertook further analysis to confirm the non-significance of the weather trend portion of the winter peak. ISO-NE estimated the weather sensitivity coefficients for the month of January for each year 1992-2008 and fitted them with different trends. None of the trends showed substantial growth over the period, and none were found to be statistically significant. In the summer months, the weather sensitivity coefficients have been increasing over the same time period due to the increased penetration of air conditioning.

The US Department of Energy – Energy Information Agency has developed residential appliance saturation estimates based on periodic surveys and the National Energy Modeling System. These estimates show electric heating saturations in New England to be slowly declining from 6.4% in 1980 to 4.5% in 2020, but central air conditioning saturations steadily increasing from 3.0% in 1980 to 21.3% in 2020 (see Figure 3.2).

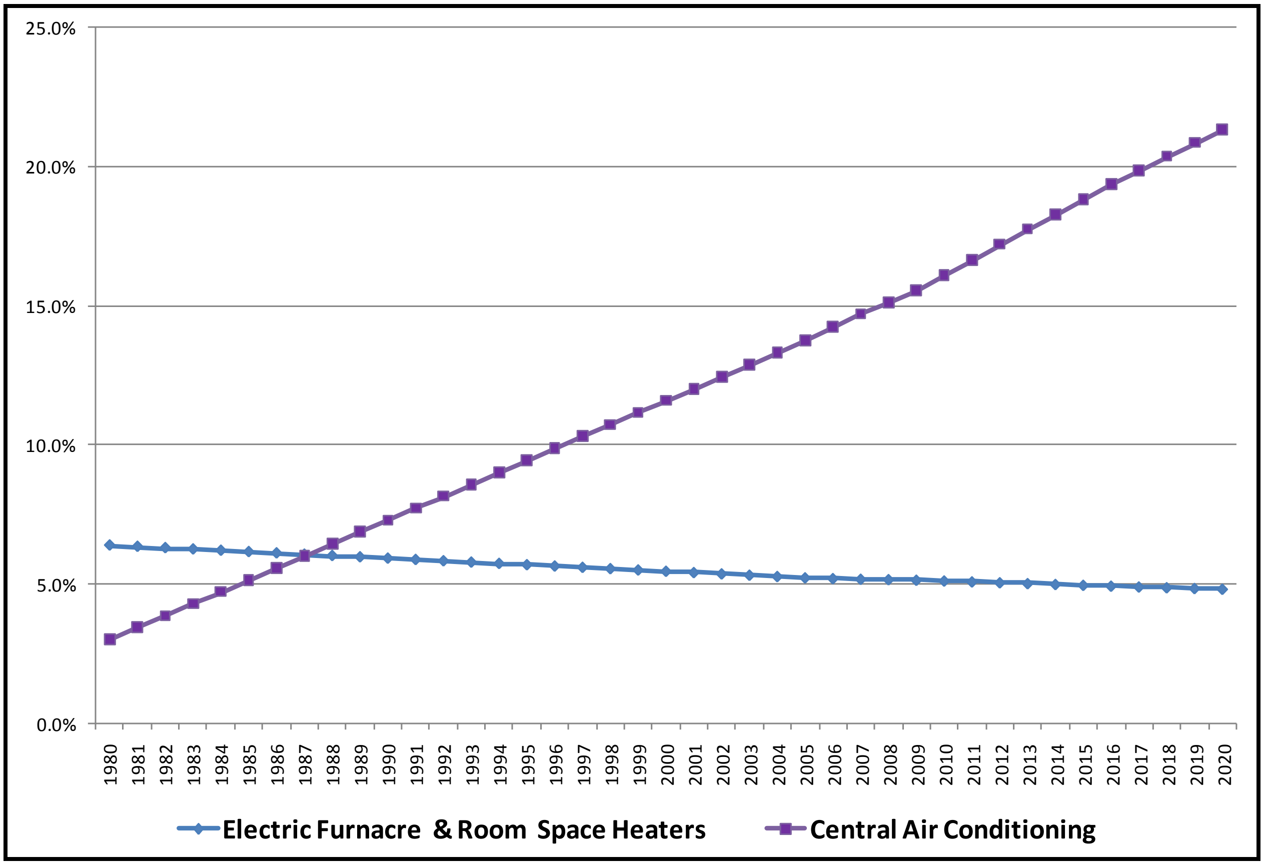

Figure 3–2: U.S. Department of Energy – Energy Information Agency
Estimates of New England Appliance Saturations
Slow Decline in Electric Heating/Continuing Growth in Air Conditioning

To further confirm the results, ISO-NE studied the historical load factor for the winter over time and revealed an increasing load factor for the region – meaning that annual energy grows faster than the winter peak (see Figure 3.3). The winter peak load forecast without the weather trend is a continuation of the increasing load factor experienced in history, while a winter peak load forecast with the weather trend would grow faster than the underlying energy forecast and break that long-term dynamic.

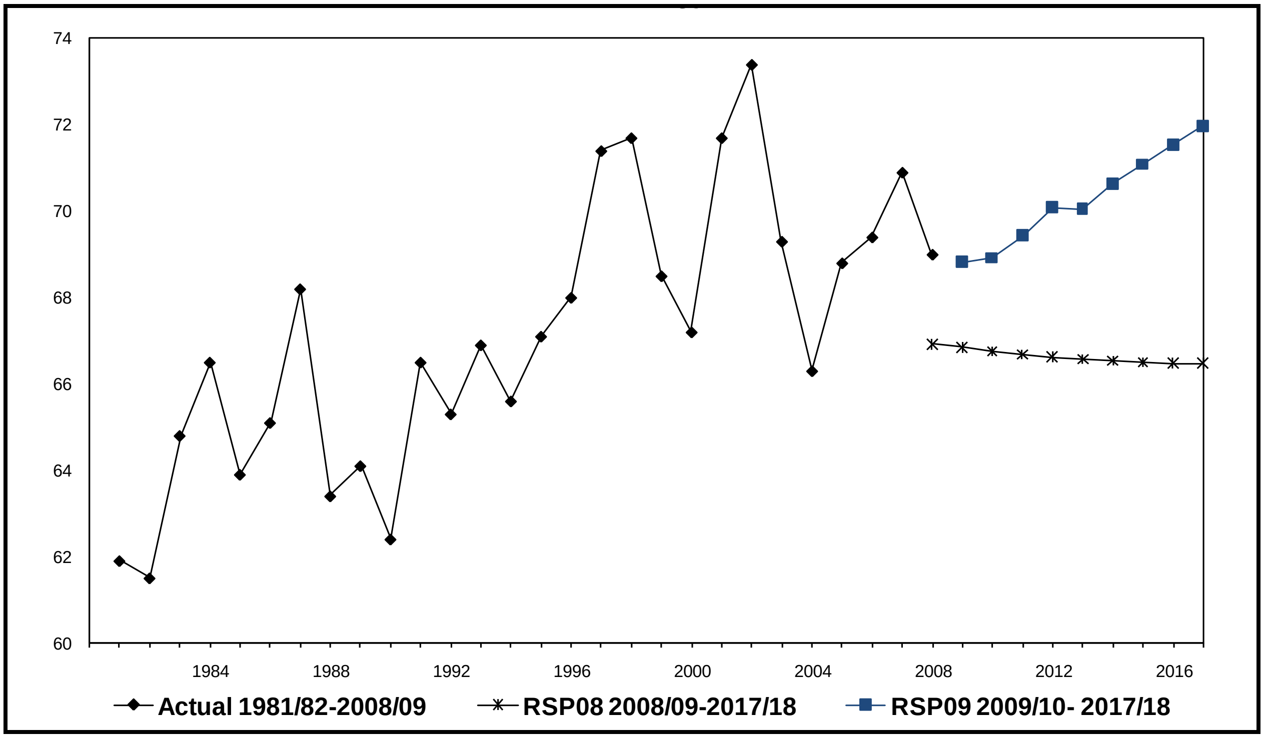

Figure 3–3: ISO-NE Winter Peak Load Factor (Percent)
Load Factor Increases because Energy Grows Faster than Winter Peak

The updates in methodology help to reveal that, while the growth trend on the weather sensitive peak load has been effective to forecast summer peak, it has not been as effective in describing the behavior of the winter peak.

Section 4
Projected Summer Peak

Given the input assumptions regarding economic activity, the summer peak forecast exhibits the expected pattern. During the depths of the recession, the growth in peak demand significantly slows down. Early in 2010 as the economy begins a weak recovery, growth resumes and the growth in projected peak demand begins to return to its prior trend. Essentially, the summer peak forecast exhibits a discontinuity at the point of the recession, resulting in the loss of approximately one to two years of growth from that point through the end of the forecast (see Figure 4.1).

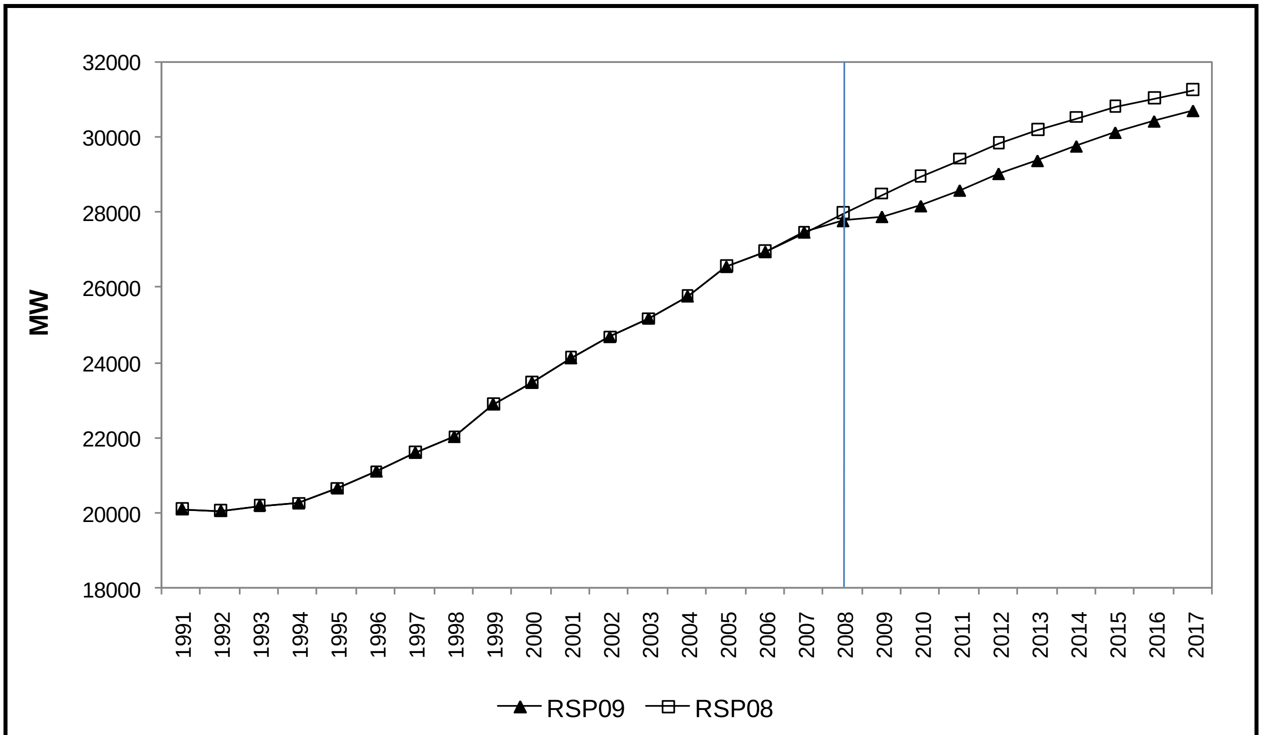

Figure 4–1: ISO-NE Summer Peak Loads: RSP09 and RSP08 (MW)
Weather Normal History 1991-2008 and 50/50 Forecast 2009-2017
2008 is a Forecast in RSP08 but Weather Normal Actual in RSP09

Section 5
High/Low Economic Bandwidths

High and low economic bandwidths are created for the long-run regional energy and peak forecast by using the personal income from a high and low economic forecast (Economy.com) and high and low electricity price forecasts with the models estimated for the reference forecast. To simulate systematic increases/reductions in energy costs, the low growth bandwidth increases the reference forecast electricity prices by the growth in the Consumer Price Index, and the high growth bandwidth decreases them by the growth in the CPI. Figures 5.1 illustrates the bandwidths for the ISO net energy for load while Figure 5.2 illustrates the bandwidths for the 50/50 summer peak.

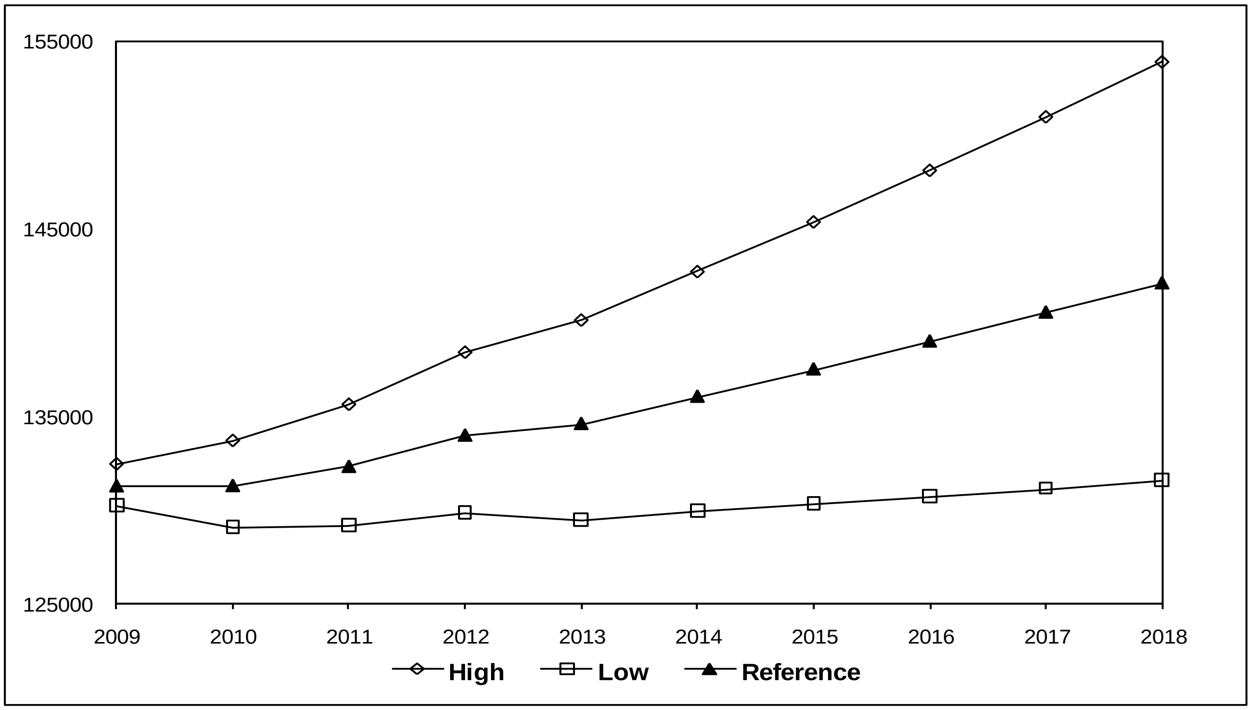

Figure 5–1: ISO-NE Net Energy for Load Bandwidths (GWh).

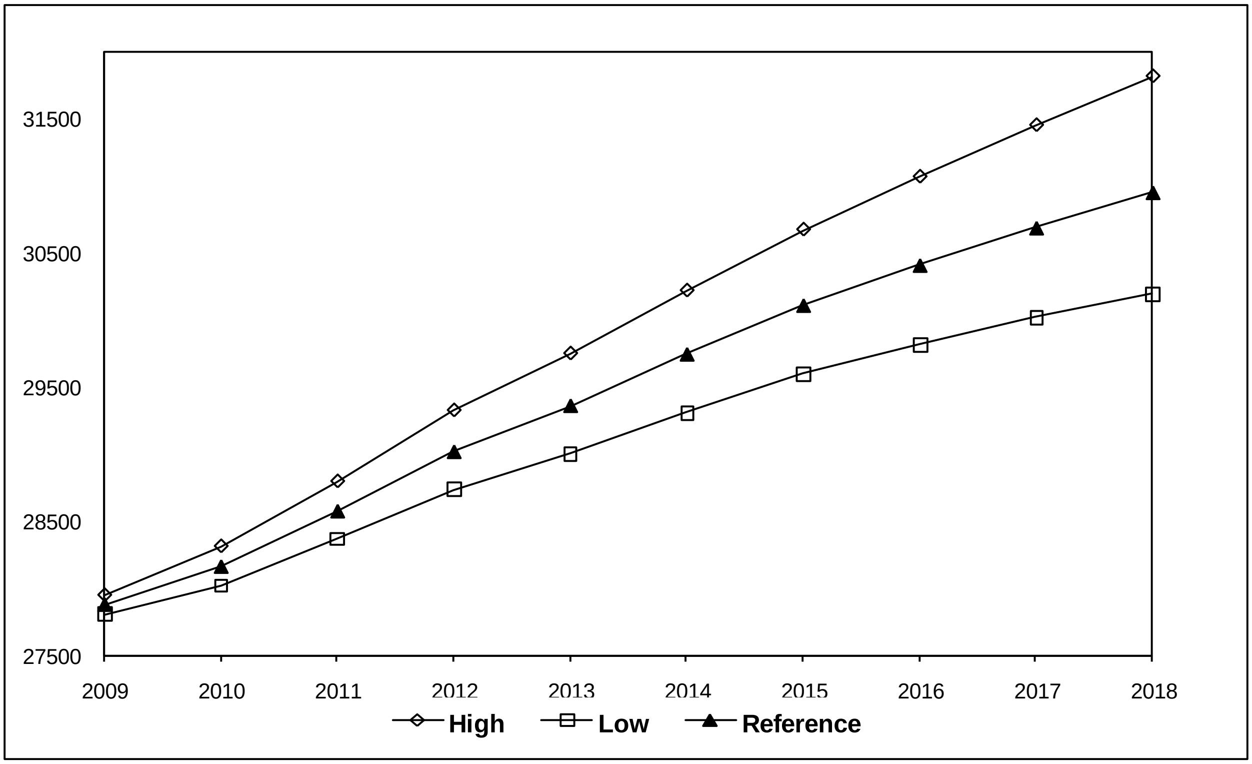

Figure 5–2: ISO-NE 50/50 Summer Peak Bandwidths (MW).

Appendix A: Summary of Enhancements Recommended by Benchmark Forecasts and Dr. Tim Mount

Recommendation 1: Keep the current linear structure of the model of peak load so that the ability to distinguish explicitly between temperature sensitive and non-temperature sensitive load is maintained.

Recommendation 2: Use a model specification for peak load that makes it feasible to estimate the short-run and long-run effects of economic (price and income) and physical (weather) factors simultaneously.

Recommendation 3: Statistical evidence should be presented in public reports to demonstrate that all time-series models are consistent with the basic econometric specifications such as white noise and the homoskedastic and non-stationarity characteristics of the residuals.

Recommendation 4: Use a statistical package that estimates time-series models correctly when there are gaps in the sequence of the observations. These gaps from one year to the next and from one state to another state are inevitable.

Recommendation 5: Incorporate weekend effects into the model to make it feasible to add weekend observations for estimation and eliminate many of the gaps in the time-series data.

Appendix B: Statistical Tests

EViews econometric software was used to estimate and forecast energy and system peak load. Linear Least Squared, Non-linear Least Squared or Restricted Least Squared Estimation techniques were used to estimate the majority of the models. A complete detail of the results of the tests can be found at http://www.iso-ne.com/trans/celt/fsct_detail/2009/index.html

Overall, the energy and system peak load models exhibit very good statistical properties. All the estimates of the explanatory variables have the expected signs and are statistically significant at a 1% critical level. The “goodness of fit” is represented by the high adjusted R-squared of approximately 0.97.

Following the recommendations of Benchmark Forecasts and Dr. Tim Mount (Appendix A – Recommendation 3), ISO-NE has paid particular attention to the statistical properties of each of the models used in the forecast process to make sure that the standard statistical assumptions are not violated, and to ensure that the forecast is unbiased and as efficient as possible.

As ISO-NE deals with time series data, the most typical statistical problem encountered in modeling is serial autocorrelation of order 1 or higher in the residuals. Having residuals of different periods correlated would indicate the failure of the model to fully explain the pattern in the data. In this case, the standard warning is that the regression estimates from an ordinary least squares regression are still unbiased, but the standard errors and confidence intervals estimated by conventional procedures will be too narrow, giving a false sense of precision.

Thus, ISO-NE modeled energy and system peak load with various techniques until the residuals from the equations exhibited no systematic pattern (indicative of white noise). Further, ISO-NE used the Breusch-Godfrey Lagrange multiplier test to test for serial autocorrelation of order 1. Correlograms of the residuals and Ljung-Box Q-statistics associated with them were used to test for "n" order serial autocorrelation (or "white noise"). As all the p-values are larger than 0.05, the tests fail to reject the null hypothesis of no serial autocorrelation at the 1% critical level (99% Confidence) for each of the forecast models used.

Homoskerasticity (versus heteroskedasticity) of the residuals is another of the statistical standard assumption that every forecast model should fulfill. Homoskerasticity is a statistical term which describes a modeling or measurement result where the degree of error is independent of the actual magnitude of the modeling result or measurement. By contrast, if the results of the model exhibit heteroskedasticity, the error of the prediction is correlated with the magnitude of the prediction.

Having models with homoskerastic residuals is extremely important for forecasting purposes and in particular for forecasting system summer peak. For instance, if this homoskedasticity property is not fulfilled and residuals are heteroskedastic, it would imply that as temperature and humidity levels increase, model's errors become larger. Thus, ISO-NE tested for heteroskedasticity using the White heteroskedasticity test. As all the p-values are larger than 0.05, the tests fail to reject the null hypothesis of homoskedasticity at the 1% critical level for each of the forecast models used.

Since the White Heteroskedasticity test assumes that the errors are both homoskedastic and independent of the explanatory variables, this test is generally used to test for model misspecification as well. Failure of any one of these conditions could lead to a significant test statistic and model rejection. Thus, the results of the tests also imply that the assumption that the models were correctly specified was not violated.

In addition, ISO-NE tested for autoregressive conditional heteroskedasticity in the residuals using and the ARCH Lagrange multiplier test. As all the p-values are larger than 0.05, the tests fail to reject the null hypothesis of homoskedasticity at the 1% critical level for each of the forecast models used.

Energy, income and prices are non-stationary series while weather variables are not. In an equation containing different non-stationary explanatory variables, the residuals must be stationary. If they are not, the equation is "spurious." Thus, ISO-NE tested the residuals for non-stationarity (or also called "unit roots") in the series using the Augmented Dickey-Fuller test. In each of the models, Augmented Dickey-Fuller test rejected the null hypothesis of unit root at 1% critical level.