

# ISO New England Load Forecast Methodology Review

Planning Advisory Committee  
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# Overview

- Benchmark Presentation
- ISO-NE Comments
- Next Steps
- Comments and Questions

# Electricity Demand Forecasting at ISO New England

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# Project Goals

- Provide an independent evaluation of ISO-NE's energy and peak demand forecasting models
- Compare ISO-NE's methodology and process with industry norms
- Recommendations for improving models and forecasts

# Evaluation Criterion

- Do the forecast methods and accuracy compare favorably with ISO-NE's peers?
- Can users replicate and test the models and forecasts for themselves?
- Have the forecasts improved over time?
- Are the models theoretically well specified and estimated?
- Are forecast errors within expected bounds?
- Are the models stable?

# Benchmark's Approach

- Compare and contrast ISO-NE's models and forecast accuracy with peers
- Interview staff regarding model development practices
- Review documentation for completeness and accuracy
- Reproduce key ISO-NE's models estimated parameters and forecasts
- Conduct in-depth analysis of the ISO-NE models
- Make recommendations

# Organization of Presentation

- Model Development Process
  - Comparison with Peers
  - Documentation
  - Replication
  - Forecast Improvement Over Time
  - Recommendations 1-6
- Technical Issues
  - Model Specification and Estimation
  - Recommendations 7-11

# Model Development Process

Comparison with Peers

# How Does ISO-NE Compare with Other ISOs?

- ISO-NE conducted a survey of 31 utilities and ISOs asking detailed questions
  - Forecasting Methods,
  - Data, Models, Forecasts, and
  - Forecast Performance or Forecast Errors
- ISO-NE provided Benchmark the raw survey data under a confidentiality agreement
- Benchmark provided results for five ISOs

# Comparison with Other ISOs

Forecasts					
	ISO#1	ISO#2	ISO#3	ISO#4	ISO-NE
<b>Energy</b>	Annual, 10 years	Annual, 20 years	Monthly, 11 years	Monthly, 5-10 years	Annual, 10 years
<b>Peaks</b>	Monthly	Winter, Summer	Monthly	Hourly	Winter, Summer
<b>Coverage</b>	Company	Sub-region	Sub-region	Region	State
<b>Sector</b>	Total	Total	Total	Total	Total

# Comparison with Other ISOs

Forecasting Methods					
	ISO#1	ISO#2	ISO#3	ISO#4	ISO-NE
<b>Method</b>	Econometric	Econometric	Econometric	Econometric Time Series	Econometric
<b>Data</b>	Economy.com	Economy.com	Economy.com	Global Insight	Economy.com
<b>Software</b>	MetrixND	MetrixND	MetrixND	SAS	MetrixND

# Comparison with Other ISOs

Energy and Economic Drivers in Forecast					
	ISO#1	ISO#2	ISO#3	ISO#4	ISO-NE
Population		Yes		Yes	
Households		Yes	Yes	Yes	Yes
Income	Yes	Yes	Yes		Yes
Employment		Yes	Yes	Yes	
Electric Prices	No	Annual	No	No	Yes
Sector Output	No	No	Industrial	No	No
Weather	Yes	Yes	Yes	Yes	Yes

# Comparison with Other ISOs

Price Elasticity and MAPE for Energy, Documentation Publicly Available					
	ISO#1	ISO#2	ISO#3	ISO#4	ISO-NE
<b>Price Elasticity</b>	Na.	-.1 to -1.2%	Na	Na	-1.1 to -2%
<b>MAPE</b>					
<b>1 Year</b>	Unknown	1-2%	1-2%	1-2%	<1%
<b>5 Year</b>	Unknown	3-5%	Unknown	Unknown	<3%
<b>10 year</b>	Unknown	3-5%	Unknown	Unknown	Unknown
<b>Documents Public?</b>	Not yet	“Yes”	“Yes”	No	YES

# Summary of Comparisons

- ISO-NE uses the same general approach (econometric) as other ISOs
- ISO-NE is using similar economic data and software as other Eastern ISOs
- ISO-NE is experiencing similar, if not smaller, forecasting errors as measured by MAPE
- ISO-NE's documentation and forecasts are accessible on the web: [http://www.iso-ne.com/trans/celt/fsct\\_detail/index.html](http://www.iso-ne.com/trans/celt/fsct_detail/index.html)

# Model Development Process

Documentation

# Are the Energy Forecasting Models Clearly Described in the Documentation?

- The equations for the short- and long-term models are exhibited
- Data sources are identified and most are obtainable from the web
- The estimation results, some diagnostics and some forecast errors are reported
- The general approach to merging the short- and long-term models is described

# Assessment of ISO-NE Energy Model Documentation

- In our experience, ISO-NE has done more than most forecasters to document their methods and make them accessible
- The content (models, data, estimation, error experience, etc.) is good but not complete
- Certain transformations to splice the short- and long-term forecasts are not fully explained

# Model Development Process

Replication

# Replication: Why it's Important?

- Opens the “black box”
  - Everyone can see precisely what is done
- Builds user confidence by allowing independent sensitivity, “what if” and other testing
- Starting point for improving model specification and performance
- Verifies documentation and archives

# Replication: Annual Short-Run and Long-Run Models

- Benchmark's slope parameters, estimated using public documentation, were generally close
  - In a few cases ISO-NE staff had to provide information not elsewhere available
- In several cases Benchmark's estimates of the levels (constant term), autoregressive and moving average corrections were much different than the ISO's due to software differences

# Replication: Summer and Winter Peak Models

- Benchmark's parameter estimates of the Summer models are effectively identical to ISO-NE's
- Benchmark's estimates of the winter model's energy trend, temperature, Monday and Friday parameters are the same as ISO-NE's

# Model Development Process

Forecast Improvement Over Time

# Forecast Improvement Over Time

- While ISO-NE knows its recent forecasting accuracy, there is not a track record of model forecasting performance over time
- Expected forecast error bounds are not calculated and compared with experience
- Model development and forecast analysis is hampered by the difficulty of using multiple software packages

# Model Development Process

Recommendations 1-6

# Process Recommendations: 1-2

1. Document the models, data and forecasts so that they can be replicated, tested and used by all stakeholders
2. Archive the model data, data transformations, models, residuals and forecast inputs on the ISO-NE web

## Process Recommendations: 3-4

3. Track and report forecasting errors, both weather-adjusted and not weather-adjusted
4. Obtain a single state-of-the art software package for data management, model specification, estimation, forecasting, and forecast evaluation

# Process Recommendations: 5-6

5. Sponsor an annual one-day meeting where demand forecasters and model users from the ISOs companies and research institutions share their experiences and innovations
6. Encourage and support staff in their professional development

# Technical Issues

Model Specification and Estimation

# Annual Forecasting Models

- ISO-NE's practice of splicing the short-term and long-term forecasts is labor intensive and may miss trends in the data
- Corrections for serial correlation in four of the state models impose arbitrary restrictions that can negatively impact the one-to-five year forecasts
- (Stochastic) Trends in the demand and economic data imply that standard ordinary least squares (OLS) estimation methods are not appropriate when analyzing time series data

# Summer Peak Demand

- The peak and three-day weighted indexes at the time of the daily peak do not have a normal distribution
  - Outliers have too much effect on estimates
  - Standard errors and t-statistics not valid
- Additional data required to support structural explanations of increasing peak demand (more air conditioning and electrical appliances, lack of price response)

# Technical Issues

Recommendations 7-11

# Technical Recommendations: 7

7. The current approach to estimating the short-run annual demand model should be tested and compared against one that estimates ISO total demand for the first three years by summing forecasts from quarterly state models

## Technical Recommendations: 8-9

8. The ISO should evaluate re-specifying the models to capture the time-series relationships among the variables in a less restrictive fashion
9. The ISO should evaluate the dynamic modeling of the data series to explicitly address the issues of integration, co-integration, and error correction

# Technical Recommendations: 10-11

10. The ISO should evaluate re-specifying the summer peak demand models in natural logarithms of peak demand and humidity (index)
11. The ISO, stakeholders and the major load-serving entities should jointly assess the value and cost of compiling historical data on the extent and use of air conditioners

# ISO New England Initial Comments

# Process Recommendations

- Document & Archive
  - ISO plans to implement recommendation
- Track & Report Errors
  - See 1/3/5-year error exhibits
- Software
  - ISO plans to implement recommendation
- Meetings & Training
  - ISO plans to participate in Market Operator Summit in May
- Staff
  - ISO is pursuing an econometrician with appropriate skills

# Technical Recommendations

- New England vs. States and Annual vs. Quarterly
  - ISO plans to investigate this recommendation
- Econometric
  - ISO recognizes limitations and is consulting with University of Massachusetts econometrician
- Peak Models
  - Forecasts based on re-specifying the models in logarithms results in significant under-forecasting
- Air Conditioning Saturation
  - ISO plans to undertake evaluation of air-conditioning penetration data and possible modeling approaches

# Next Steps

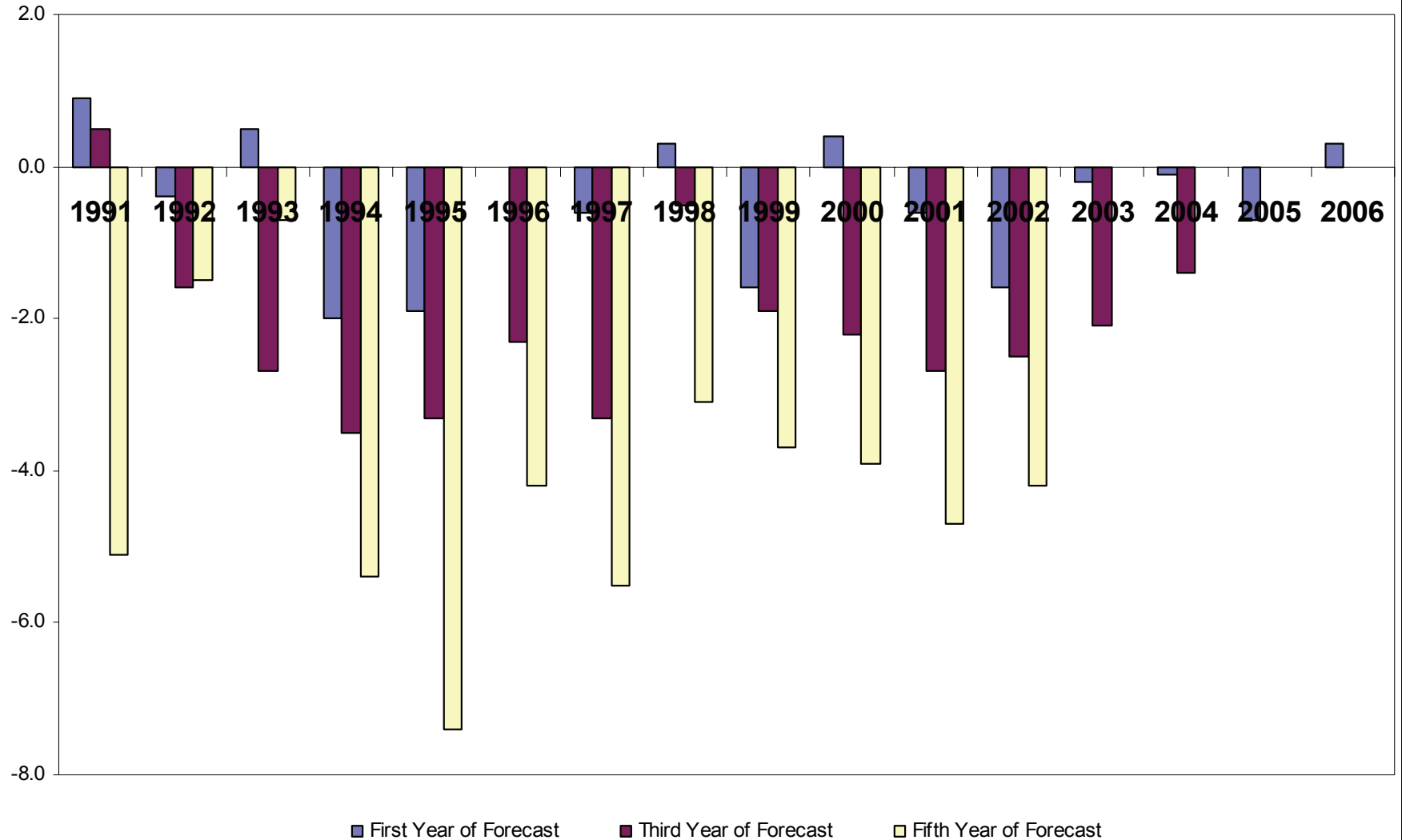
- PAC 17 in March
  - Opportunity for stakeholder comments and presentations
  - Update on ISO-NE methodology and forecast
- PAC 18 in April
  - Opportunity for stakeholder comments
  - ISO-NE presentation of methodology and long-run forecast of energy and peaks for New England and States
    - To be used for CELT, RSP, and FCM
- Develop subarea forecasts by June for RSP and FCM

# Forecast Methodology for RSP07

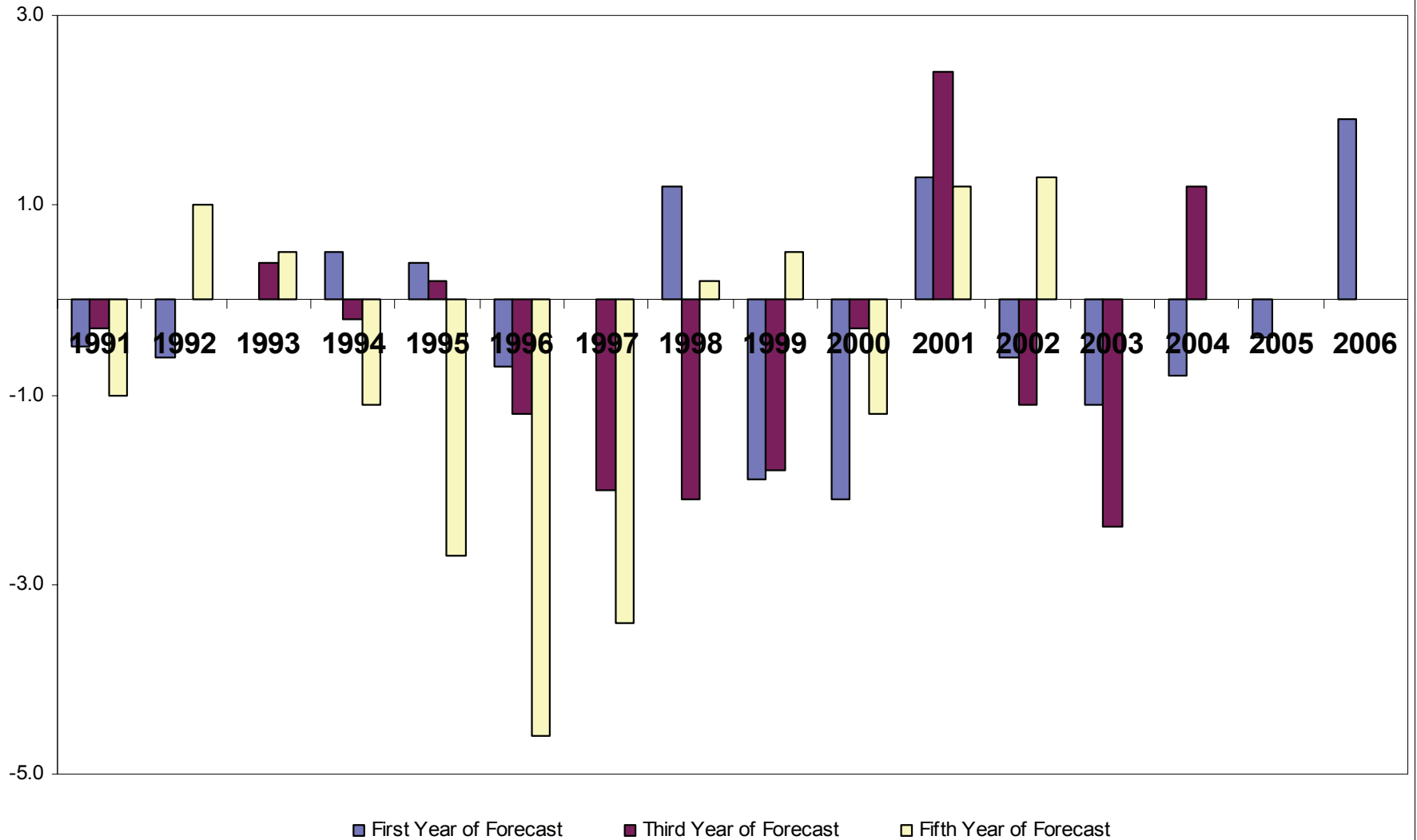
- Anticipate using current methodology for this forecast cycle
  - ISO plans to incorporate PAC suggestions and econometric improvements where feasible
- Forecast of retail electricity prices to include costs of:
  - Capacity market
  - Transmission projects
- Plan to explore alternative load-factor adjustments
  - Size and timing

# Comments and Questions

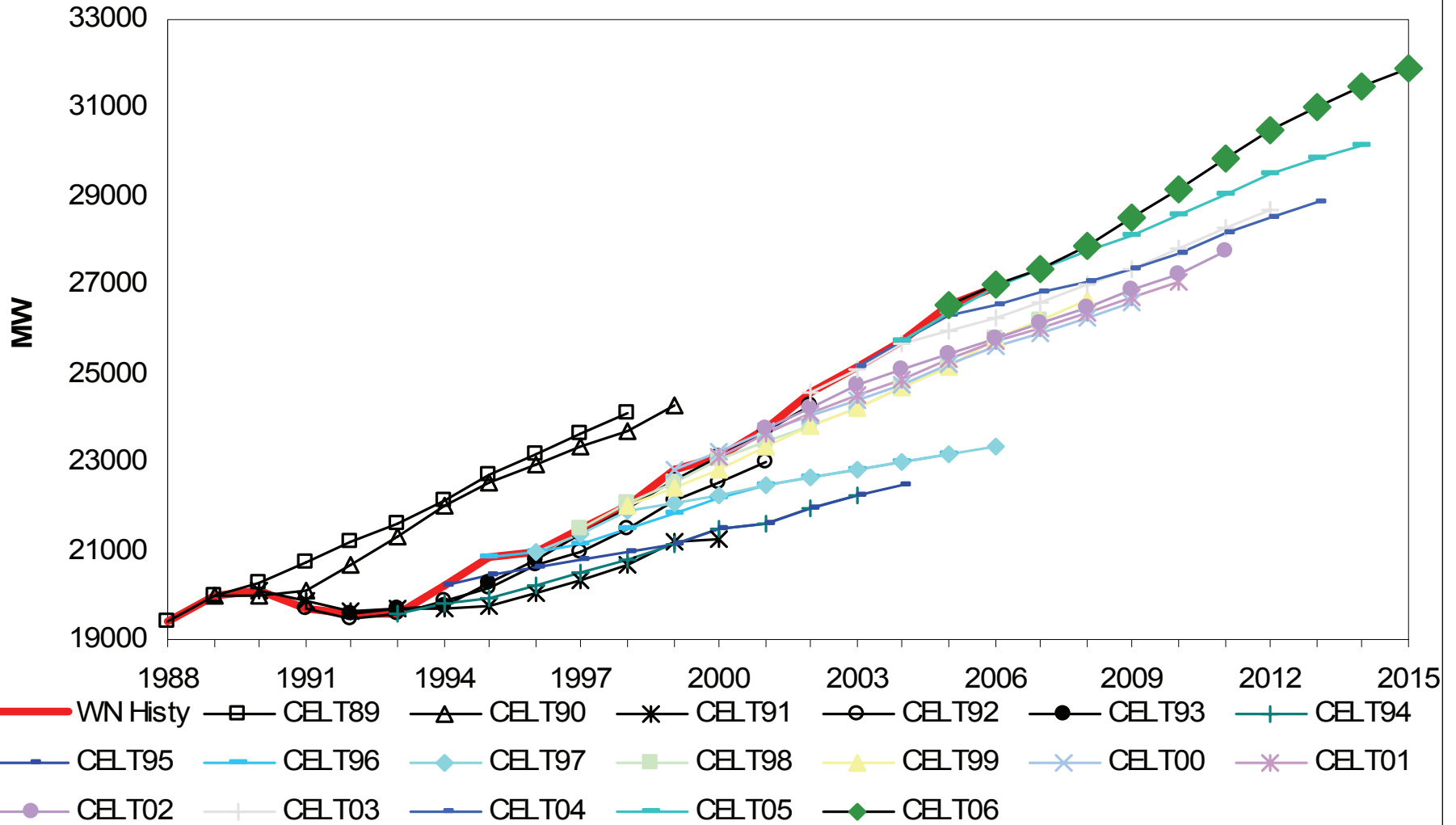
**ISO-NE 1991 to 2006 CELT Reports: Weather Normal Summer Peak Forecast Error**  
**Average Error (Abs Val): First Year 0.8%, Third Year 2.2%, Fifth Year 4.2%**



**ISO-NE 1991 to 2006 CELT Reports: Weather Normal Annual Energy Forecast Error**  
**Average Error (Abs Val): First Year 0.9%, Third Year 1.1%, Fifth Year 1.6%**



**1989-2006 CELT Reports: 10 Year Summer Peak Load Forecasts**  
**1989-02 Forecasts by End-Use Models, 2002-2006 by Econometric**



## 1989-2006 CELT Reports: 10 Year Summer Peak Load Factor Forecasts 1989-02 Forecasts by End-Use Models, 2002-06 by Econometric

