

AESO Wind Power Forecasting Pilot Project

The Quantitative Analysis

ORTECH

presentation at the AESO pre-conference session

April 24, 2007

Calgary Alberta

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Purpose

Quantitative Analysis

- To provide evaluation of forecasting models at specific sites and on a regional bases
- To provide input into the development of recommendations by AESO on wind power forecast methods to be incorporated into the technical requirements of wind power facilities, operational procedures and policies &/or market design

Project Team

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- **Don McKay Ph.D MBA**

Requirements of the Quantitative Analysis

- the general accuracy of the forecasts,
- the accuracy of the forecasts at the different forecast horizons studied (T=1 hour to T=48 hours),
- the accuracy of the forecasts at different hours of the day and seasons of the year,
- comparing all the above between Alberta wind regions,

Requirements of the Quantitative Analysis Cont'd

- the accuracy of the forecasted met data before running through the power conversion models,
- the accuracy of the power conversion,
- potential co-variance from given data samples,
- the accuracy of the forecast at different wind speeds or different points of a wind power facility's power curve,

Requirements of the Quantitative Analysis Cont'd

- the relative comparison between forecasts
- the validity of the forecast methodologies used and their strengths and weaknesses.
- potential co-variance from given data samples,
- the relative comparison between forecasts.

Requirements of the Quantitative Analysis Cont'd

- the trend of the forecast performance through time.
- forecast accuracy for individual wind farms, aggregate forecast accuracy of all wind farms, which are in the same region, aggregate forecast accuracy of all wind farms
- how well the forecast predicts fast ramp up and ramp down times.

Methodologies

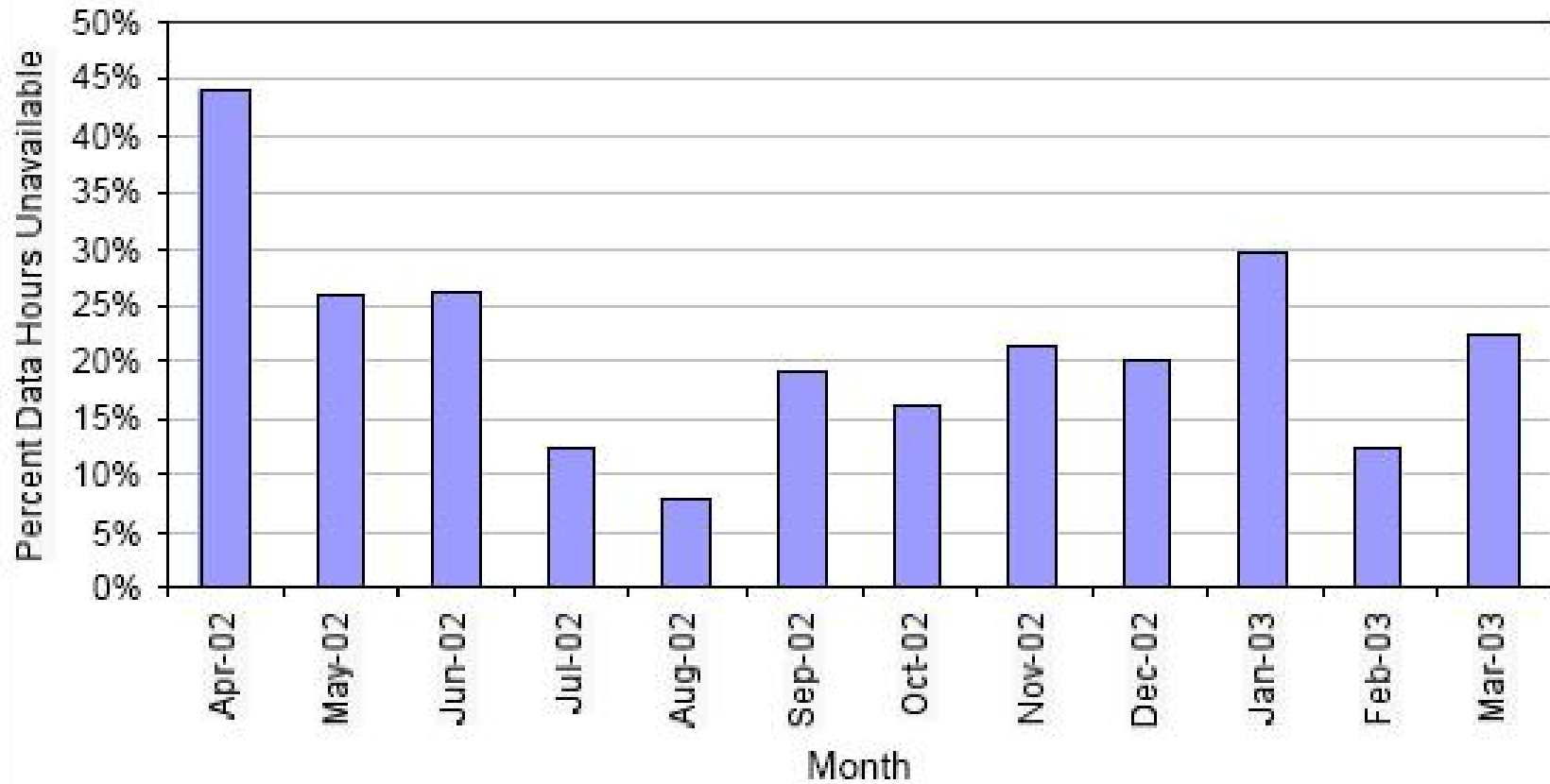
- Overall Error Measures
 - Root Mean Square Error (RMSE)
 - Mean Absolute Error (MAE)
- Wind Speed Dependent Prediction Error
- Ensemble of a region
- Principal Component Analysis
- Extreme and non-systematic errors
 - probability of detection
 - False alarm ratios

Methodologies Cont'd

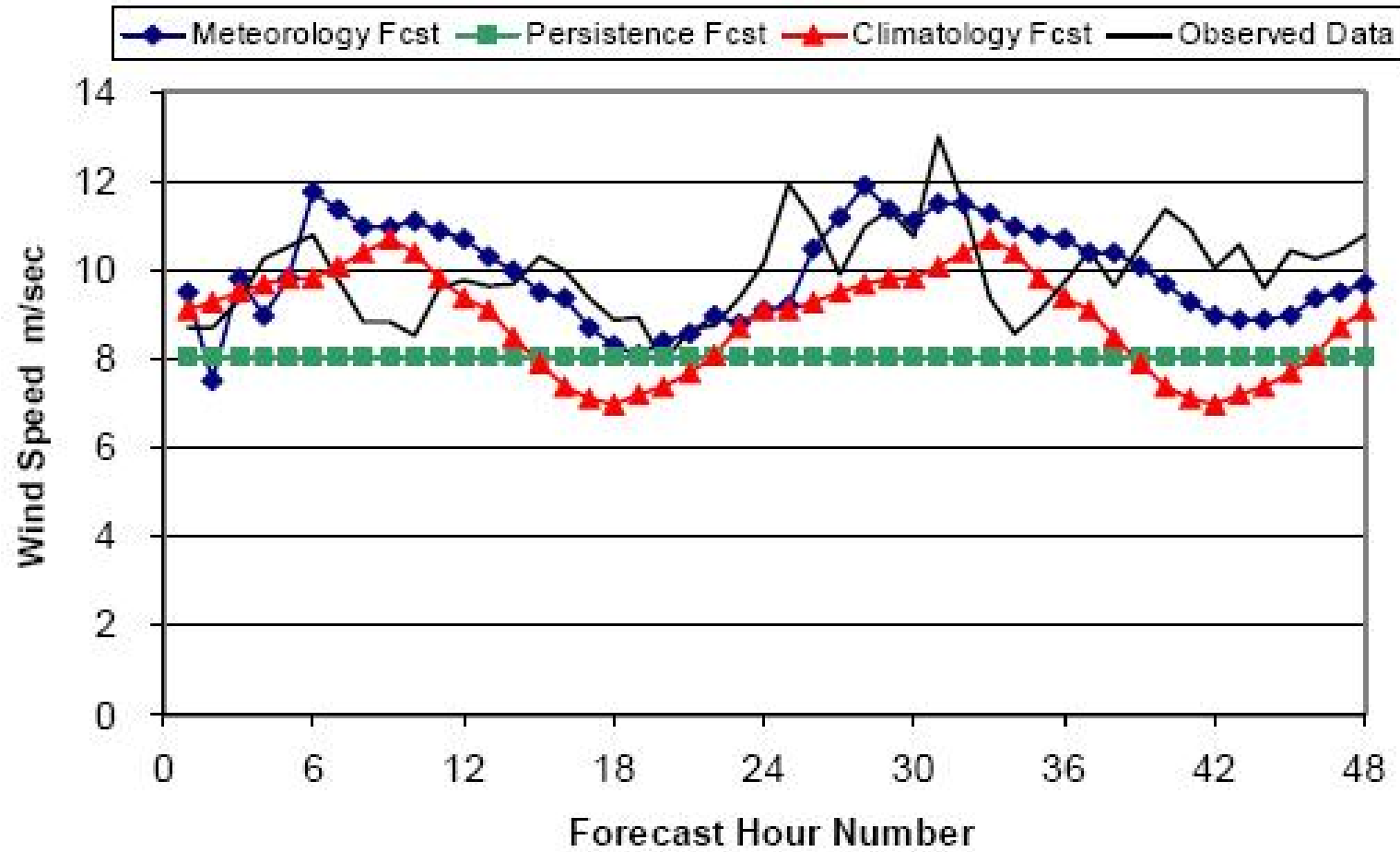
- Improvement on persistence
 - skill score
- Data completeness

Examples of Graphical Representations

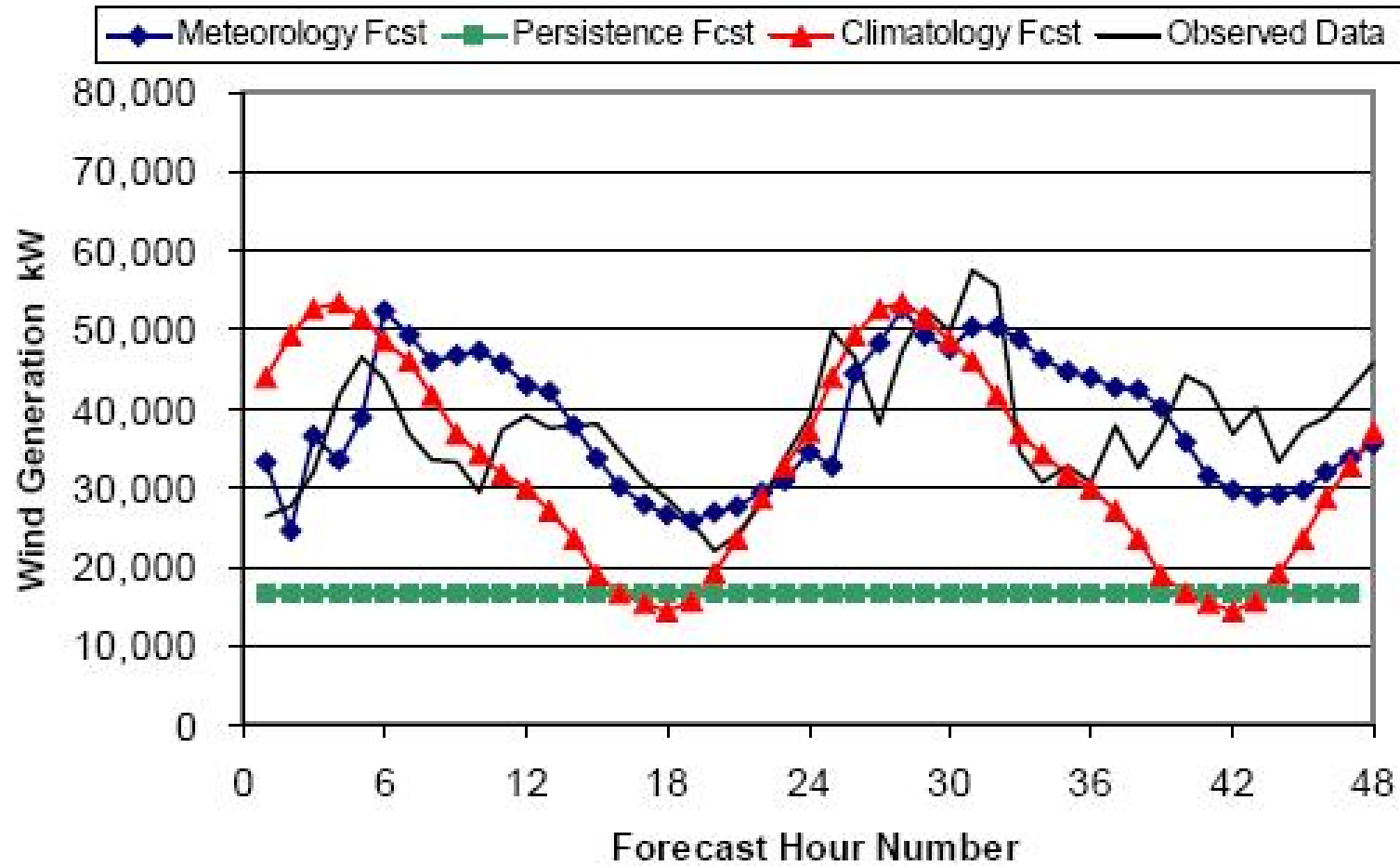
Unavailable Data Hours



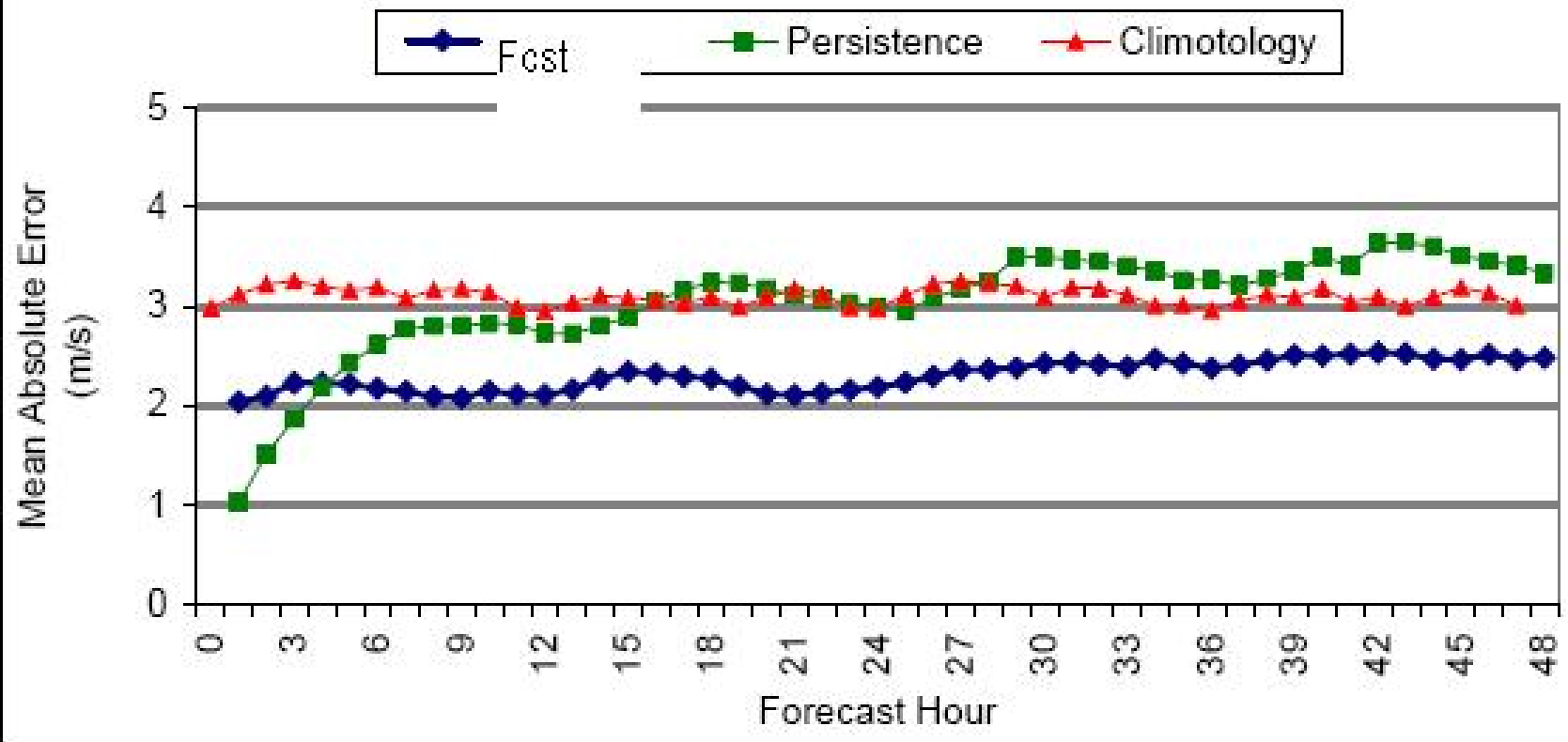
Wind Speed Forecasts



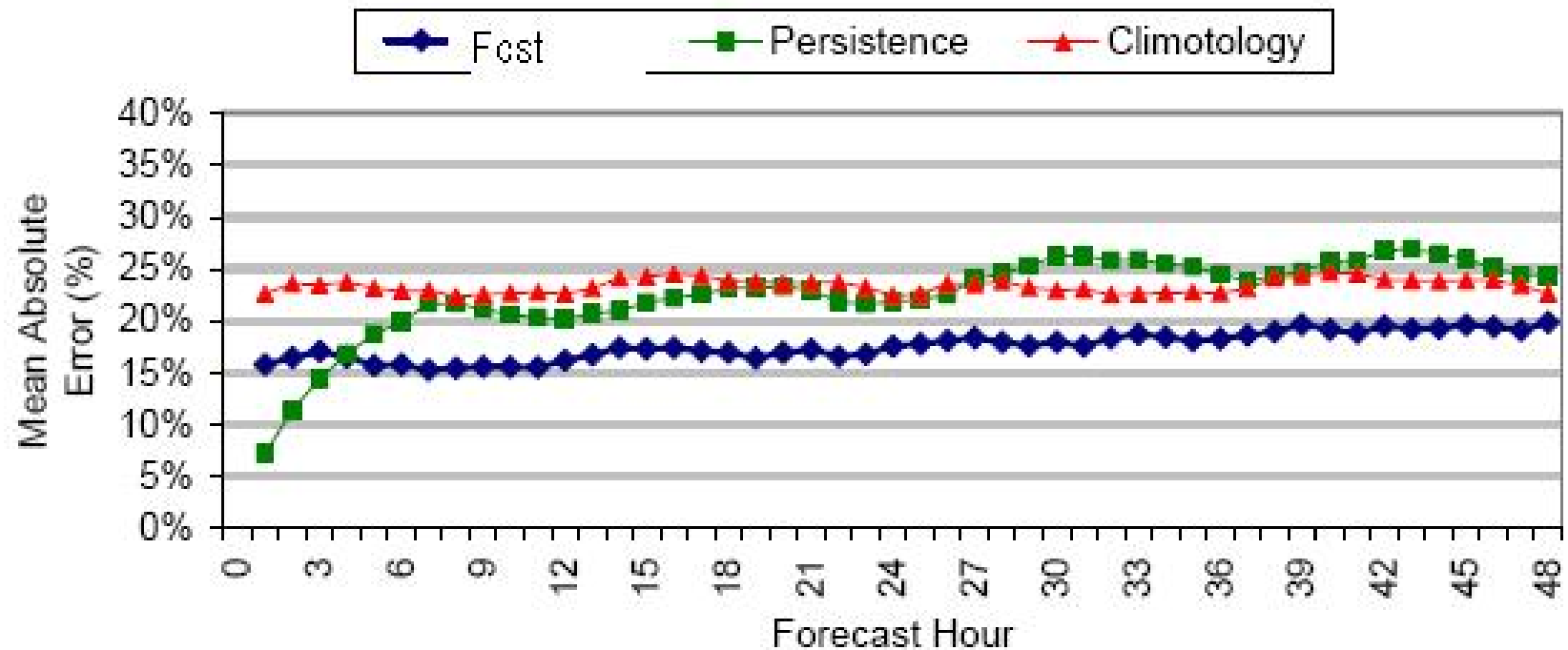
Wind Generation Forecasts



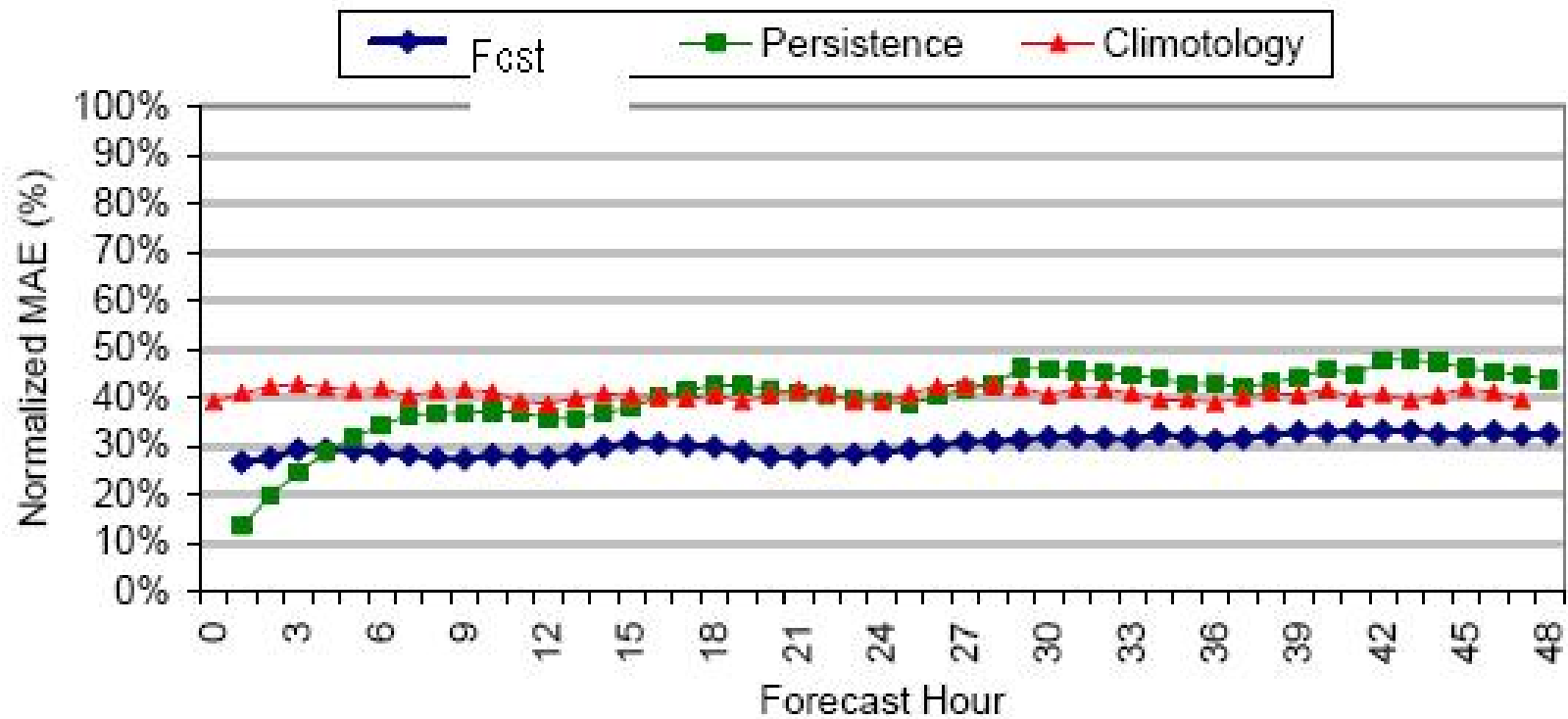
Mean Absolute Error Wind Speed Forecasts



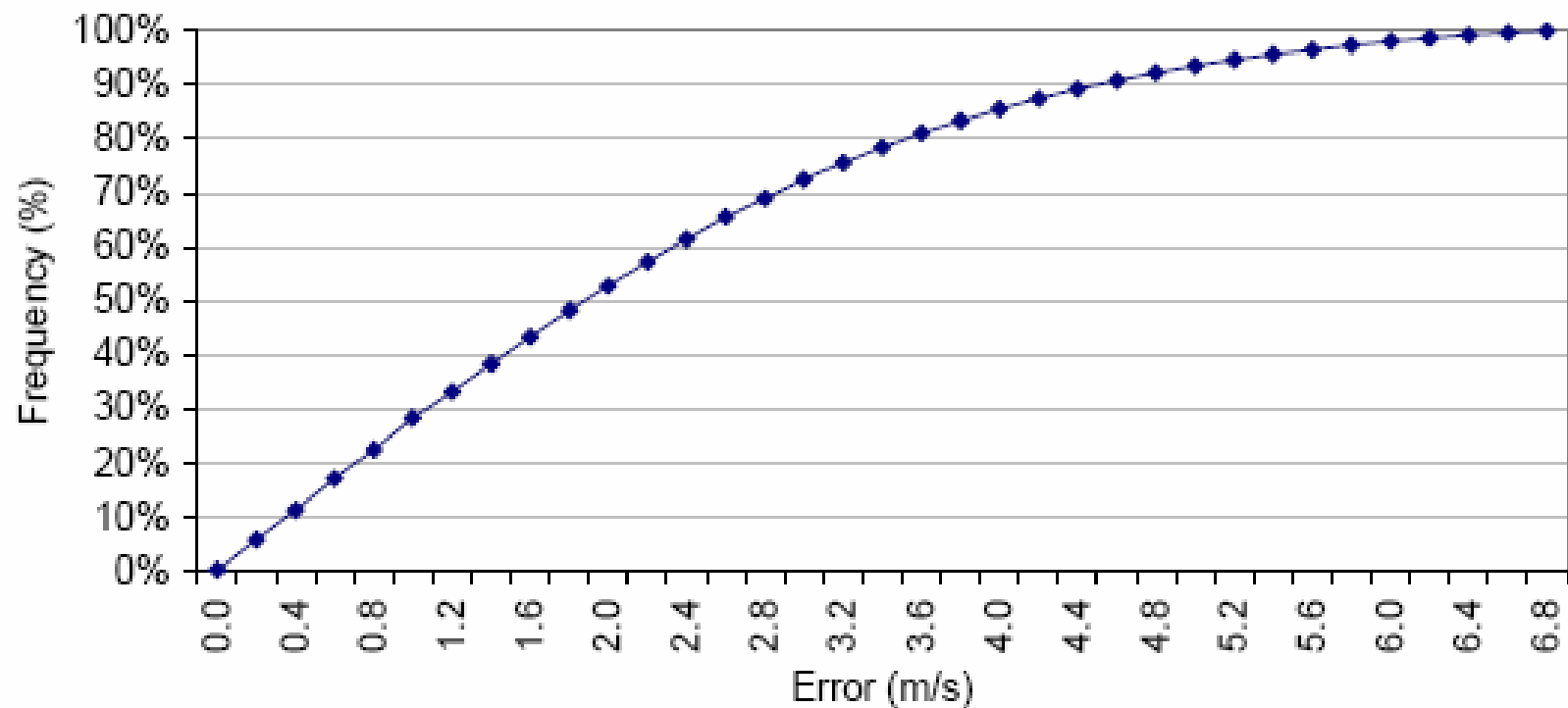
Mean Absolute Error as % of Installed Capacity for Wind Generation Forecasts



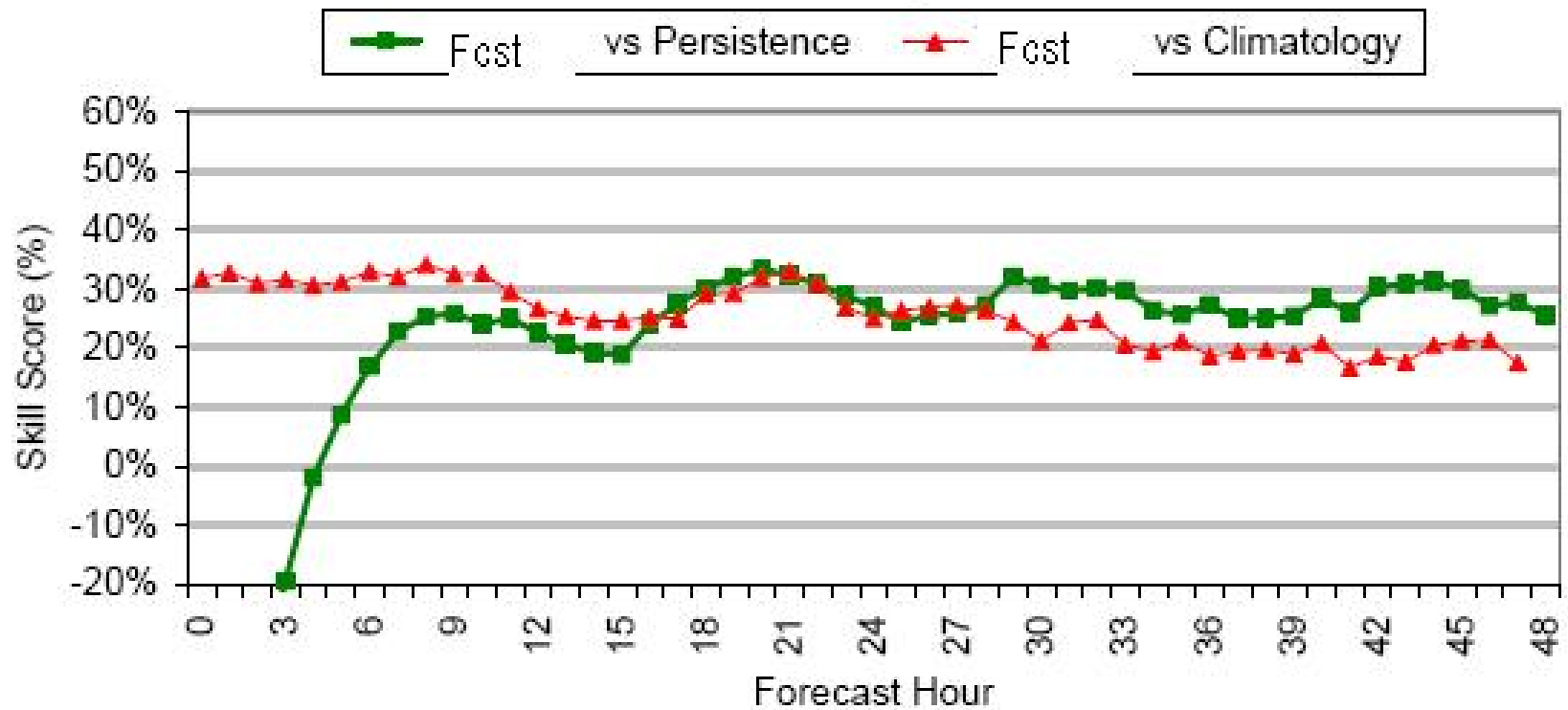
Normalized Mean Absolute Errors Wind Speed Forecasts



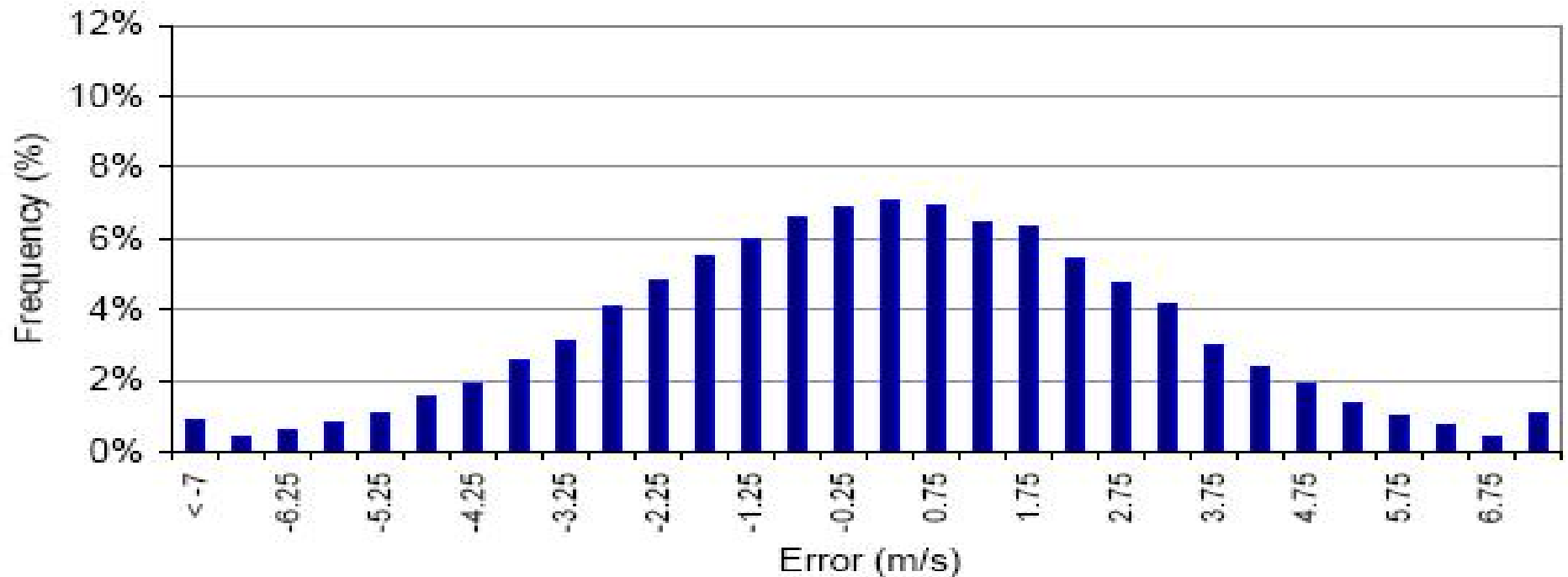
Cumulative Forecast Error Frequency Distribution Wind Speed Forecasts



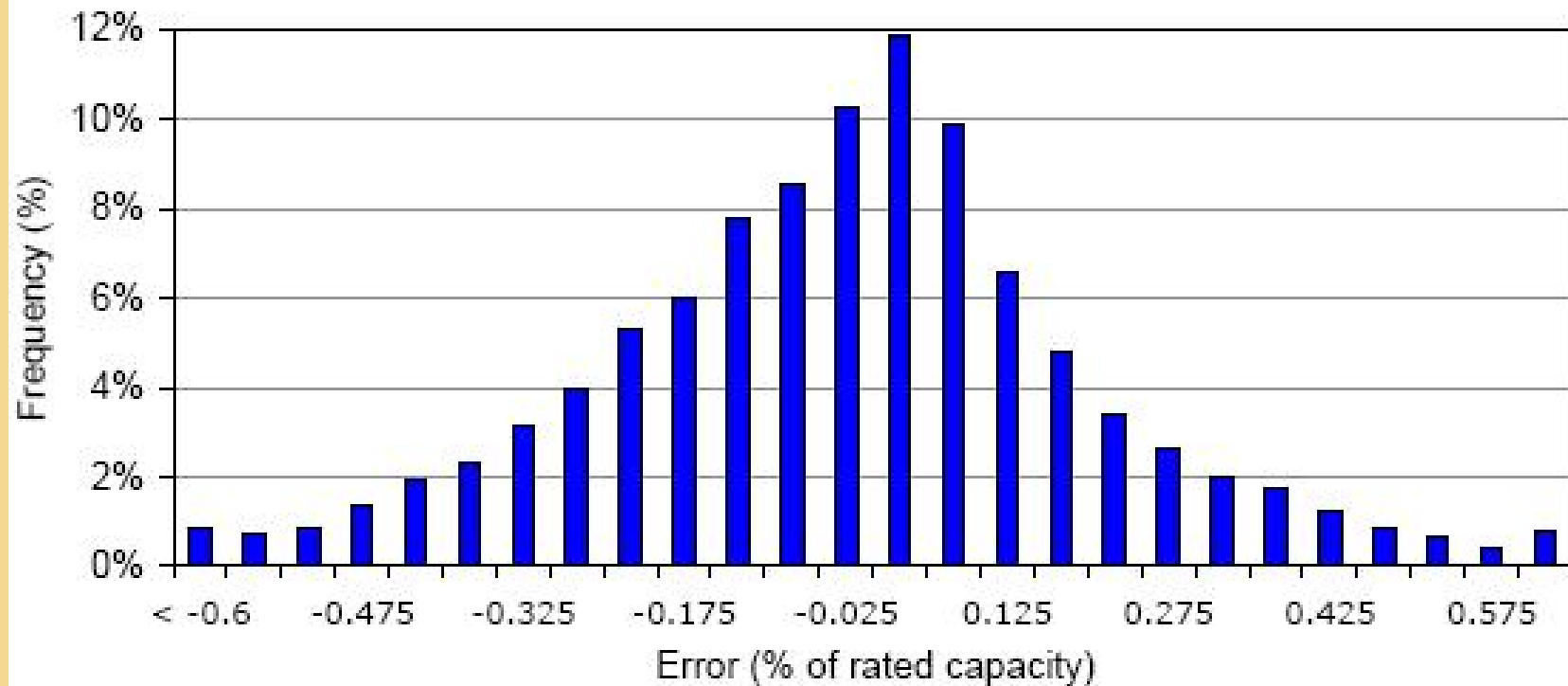
Skill Score Wind Speed Forecasts



Forecast Error Frequency Distribution - All Hours Wind Speed Forecasts

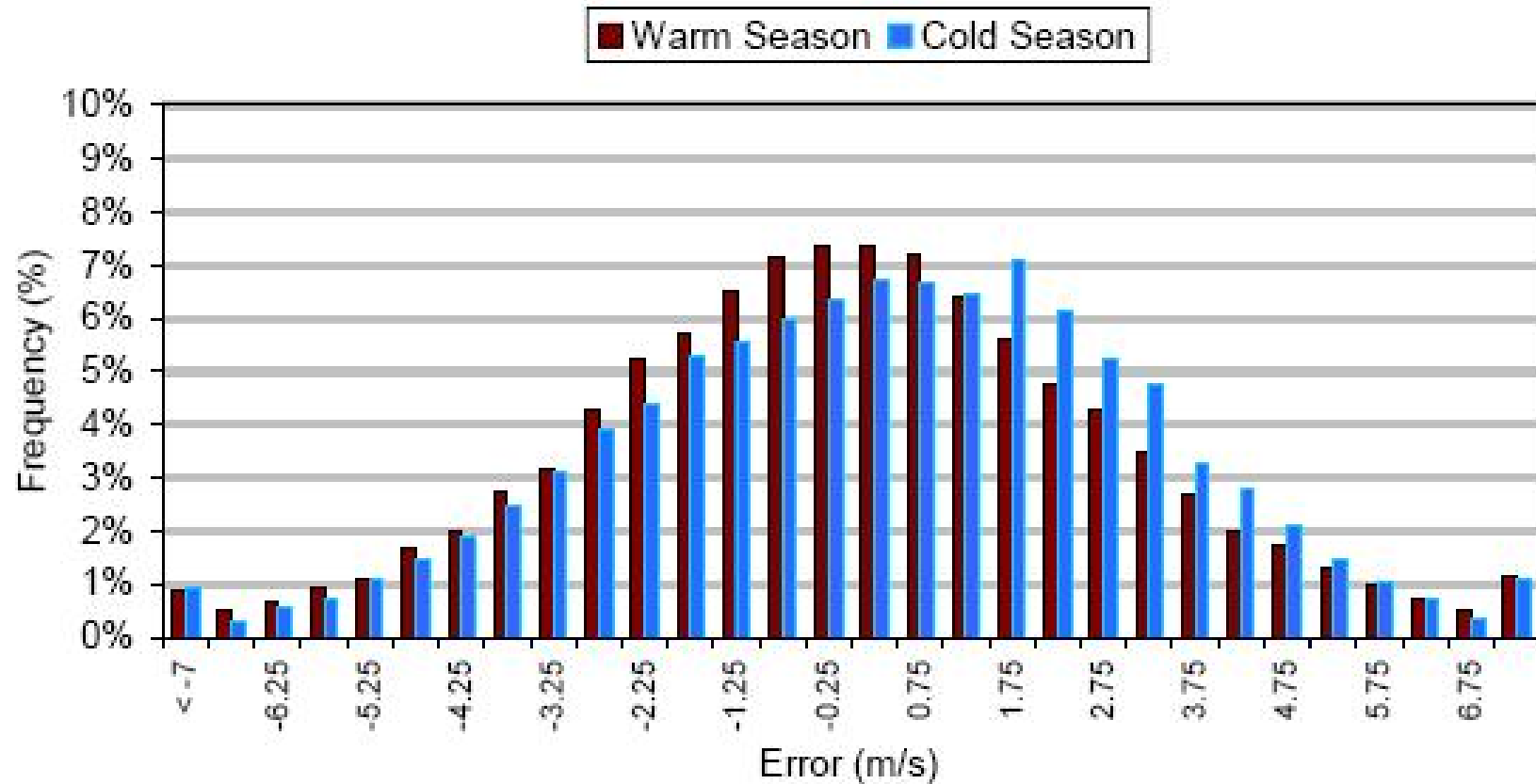


Forecast Error Frequency Distribution - All Hours Wind Generation Forecasts



Wind Speed Forecast Error Distribution

Warm vs Cold Season



Project Peroid	Wind Speed m/sec	Generation kW
Forecast Error		
Annual ME (m/sec)	0.2	-1,822
Annual MAE (m/sec)	2.3	13,155
Normalized Forecast Error		
Annual ME	2.6%	-7.1%
Annual MAE	30.3%	51.3%
Average Wind Speed or Gen	7.61	25,622
Annual Skill Score		
vs. Persistence	24.0%	21.8%
vs. Climatology	25.7%	24.9%
Wind Forecast Delivery		
Possible Forecasts	730	
Forecasts Delivered	726	
%	99.5%	

Annual Mean Absolute Errors of Wind Speed and Energy Forecasts

