



CPS1 Forecast

ERCOT Board of Directors
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- **Time and resource constraints required focusing on a limited number of the many factors influencing CPS1 scores that are expected to change and can be reasonably forecast**
 - Total generation (energy requirements)
 - On-line conventional generation capacity
 - Wind generation as % of total energy
- **Forecast used linear, not probabilistic analysis**
- **Backcast indicated the forecast could be useful**
- **Forecast indicates that a continuing decline in CPS 1 scores can be expected, but not below the NERC Standard**
- **Forecast does not reflect control improvements that will come with Nodal operation or changes in other factors**

- **CPS1 is a measure of how well ERCOT is matching its generation with demand. (i.e. controlling frequency)**
- **Formula used:**
$$\text{CPS1 \%} = (2 - ([\Delta F])^2 / (30 \text{ mHZ})^2) * 100$$

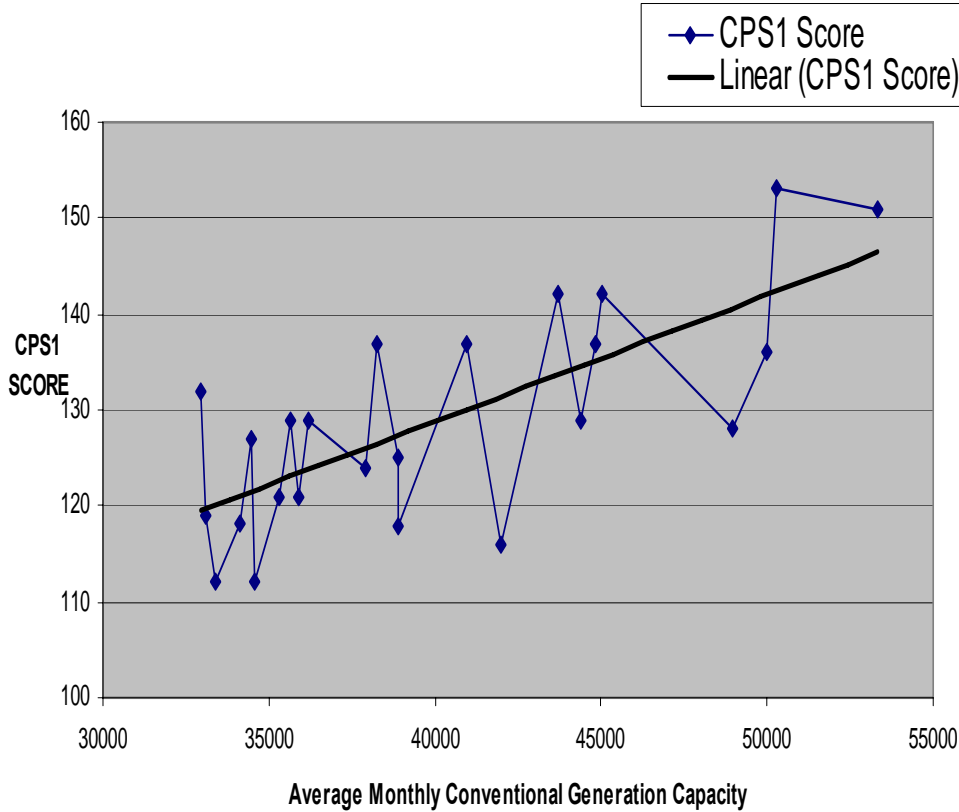
calculated each minute
where ΔF is the deviation from scheduled frequency, which is usually 60 Hz
- **A CPS1 score of a rolling 12 month average of at least 100% is required to pass NERC Standards**
- **The maximum CPS1 score that can be attained is 200%**
- **There is no limit to the minimum score. It can be negative.**

- **CPS1 performance is affected by variability in generation and load, and by their inherent response to frequency changes**
- **ERCOT System Operations staff identified a number of factors which affect CPS1 scores:**
 - Non-conforming load swings (e.g. steel mills)
 - Sudden weather/load change
 - Load loss events
 - Intermittent generation (wind)
 - Conventional generation on line
 - Generation schedule changes
 - Rapid changes in QSE Schedule Control Error
 - Unit trips
 - Control System performance

- **Time and resource constraints required focusing on a subset of factors that appear to have a significant affect on CPS 1, are expected to change going forward and could be reasonably forecast.**
 1. Total Generation Energy
 - Average total system generation delivered over a month
 2. Conventional Generation Capacity
 - Average total system generation capacity on-line, including any spinning reserve and excluding wind generation
 3. Wind Penetration
 - Average amount of wind generation energy as a percentage of total average generation energy
- **Analysis assumes no changes in other factors going forward**

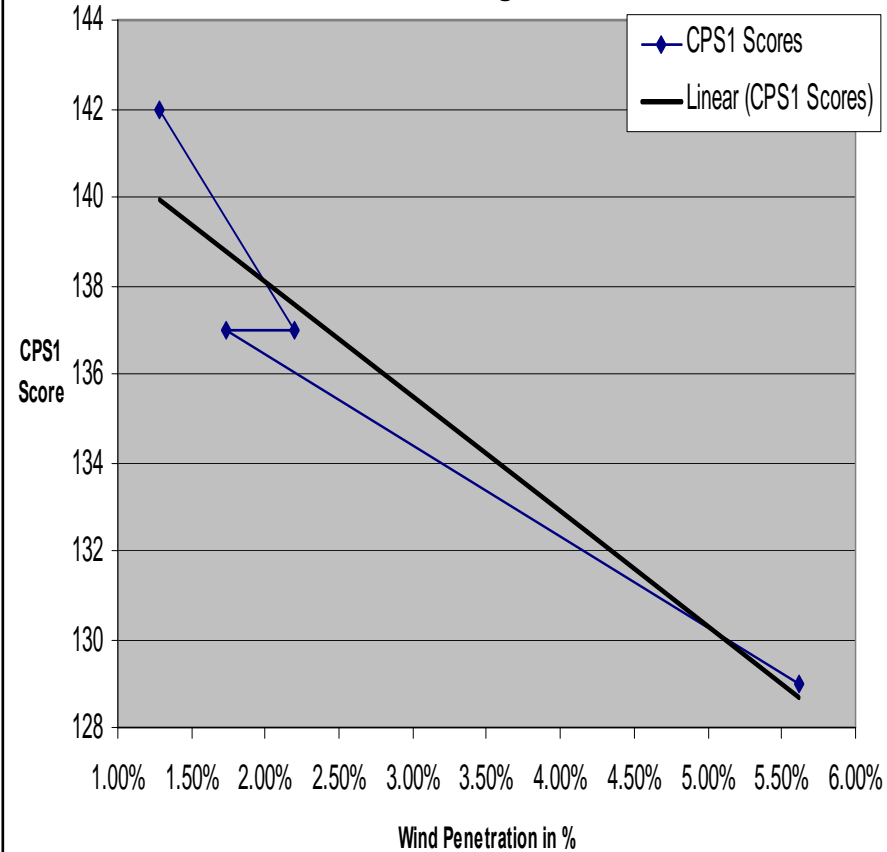
- **Linear equations were developed for these factors**

Relation between ERCOT Conventional Generation Capacity and CPS1 Score



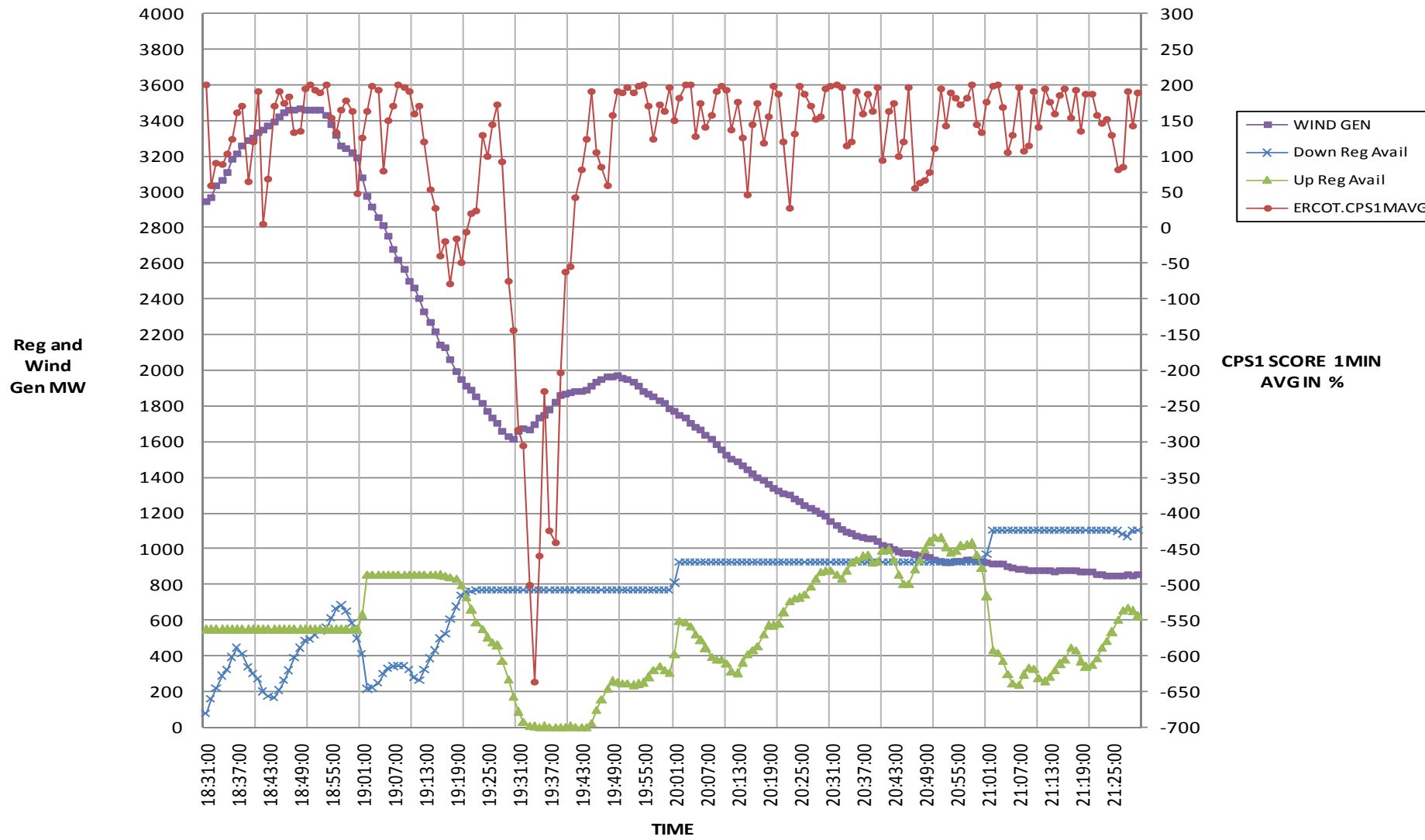
Relation between CPS1 Score and Wind Penetration %

(at 35,000-45,000 MW total generation)



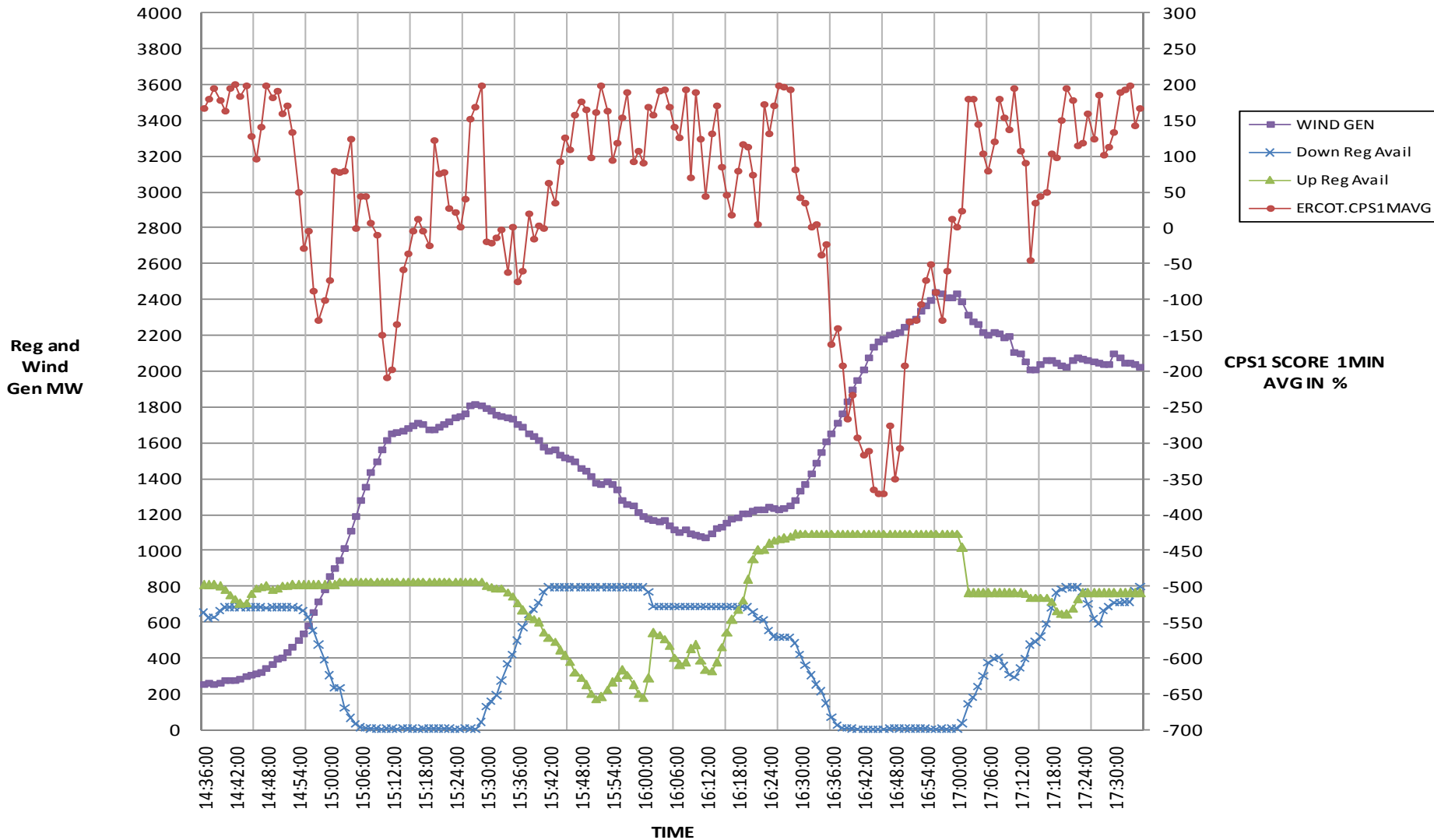
Example of Wind Generation Impact on CPS1 Performance

CPS1, Wind Gen and Reg 8-Jul-08 18:30

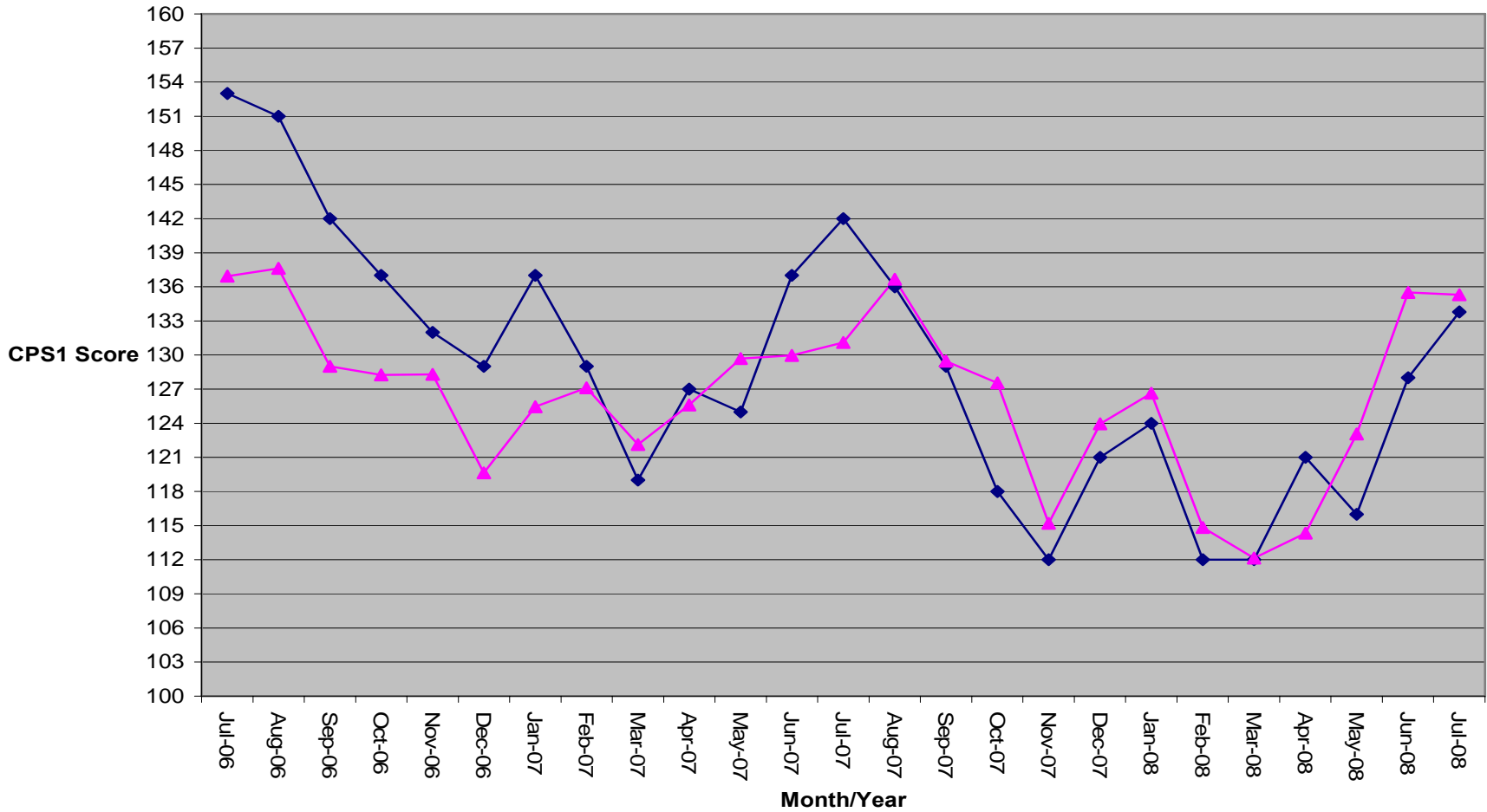
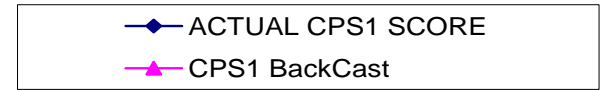


Example of Wind Generation Impact on CPS1 Performance

CPS1, Wind Gen and Reg 1-Aug-08 14:35



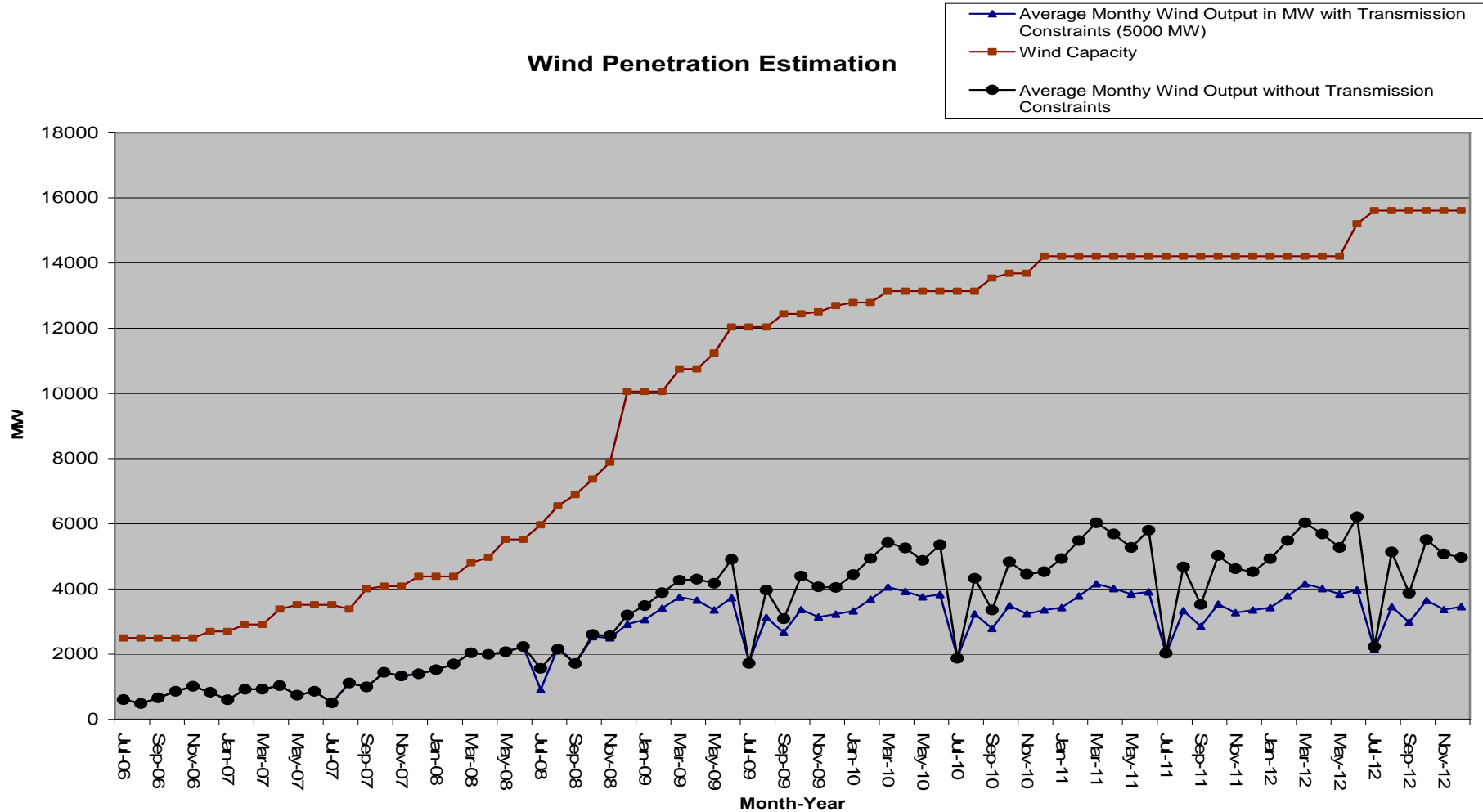
CPS1 Score Back-Casting



Estimation of Inputs

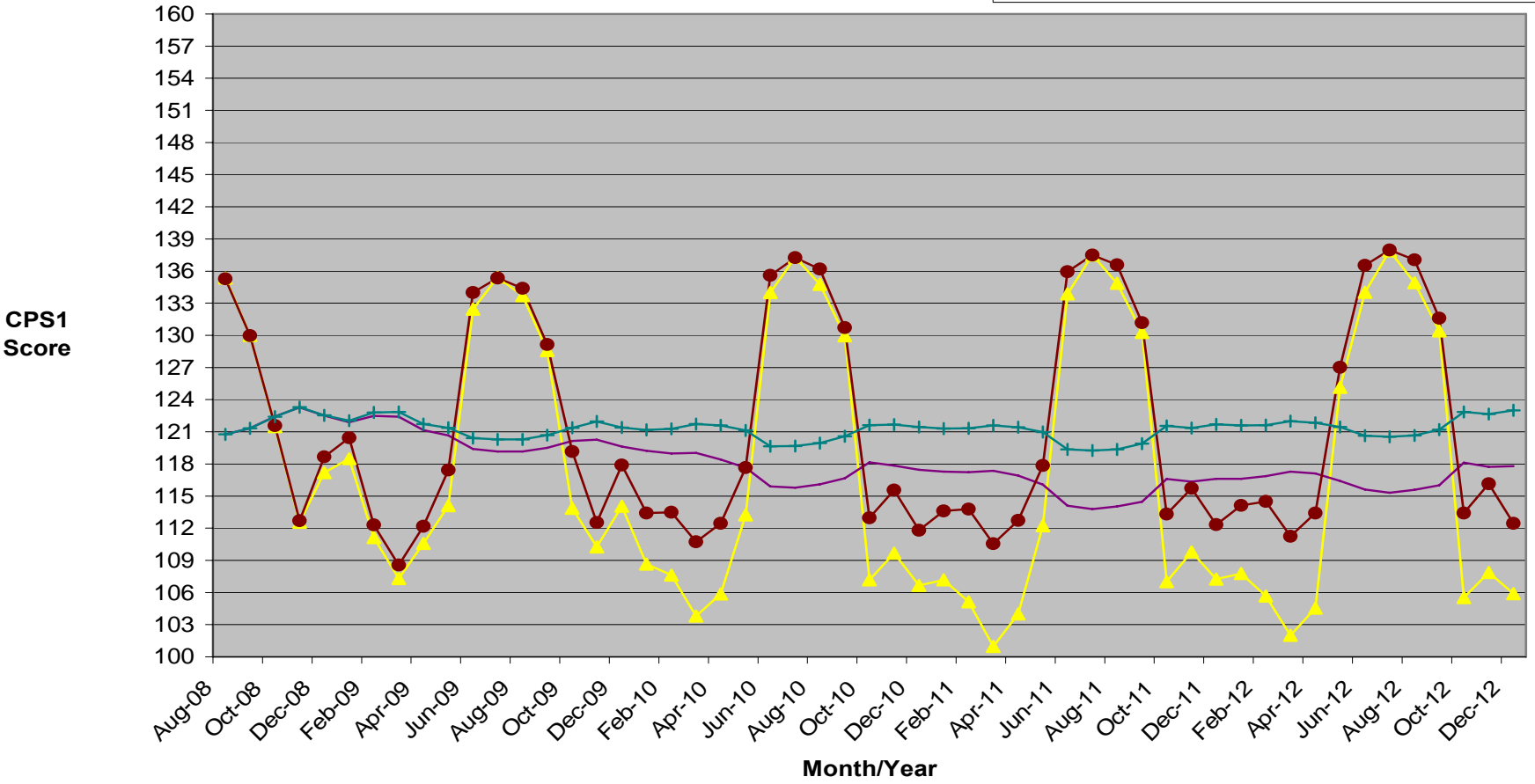
- Annual Growth Factor of 3 % was assumed for ERCOT energy
- Annual Growth Factor of 3 % was assumed for ERCOT Capacity

Wind Penetration Estimation



CPS1 Score Forecasting

- ▲ CPS1 Score forecast without Transmission Constraints
- CPS1 12-Month Rolling Average W/O Constraints
- CPS1 Score forecast with Transmission Constraints
- + CPS1 12-Month Rolling Average with Constraints



- **Frequency Control is expected to improve in Nodal**
 - Units will be continuously ramped to match the load.
 - Unit base points will be updated at least every five minutes.
 - Operators will have the ability to re-run SCED whenever required (more often).
 - In Nodal all the uncertainties associated with current 30 minute ahead zonal balancing market will be mitigated.
 - The Load Frequency Control (LFC) being implemented includes a CPS1 performance factor which “targets” desired performance and will avoid control action as long as possible.
- **It was not possible to quantify the effect of Nodal and the new LFC algorithm in this analysis.**
- **The analysis used simplified linear relationships. This assumption does not account for extreme events.**
- **ERCOT will incorporate further analysis into its Operations Training Simulator to identify non-linear effects.**

Questions ?