



# Impact of Wind Generation on ERCOT Operations

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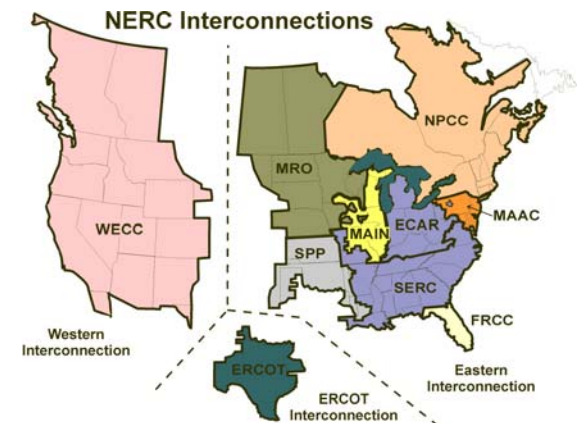
# Outlines

- **Introduction to ERCOT system**
- **Energy and Ancillary Service**
- **Current Operational Challenges**
- **Proposed CREZ Scenarios**
- **Wind Workshop Held to Address current and Future Challenges**
- **Summary**

# INTRODUCTION TO THE ERCOT SYSTEM

## ERCOT Quick Facts

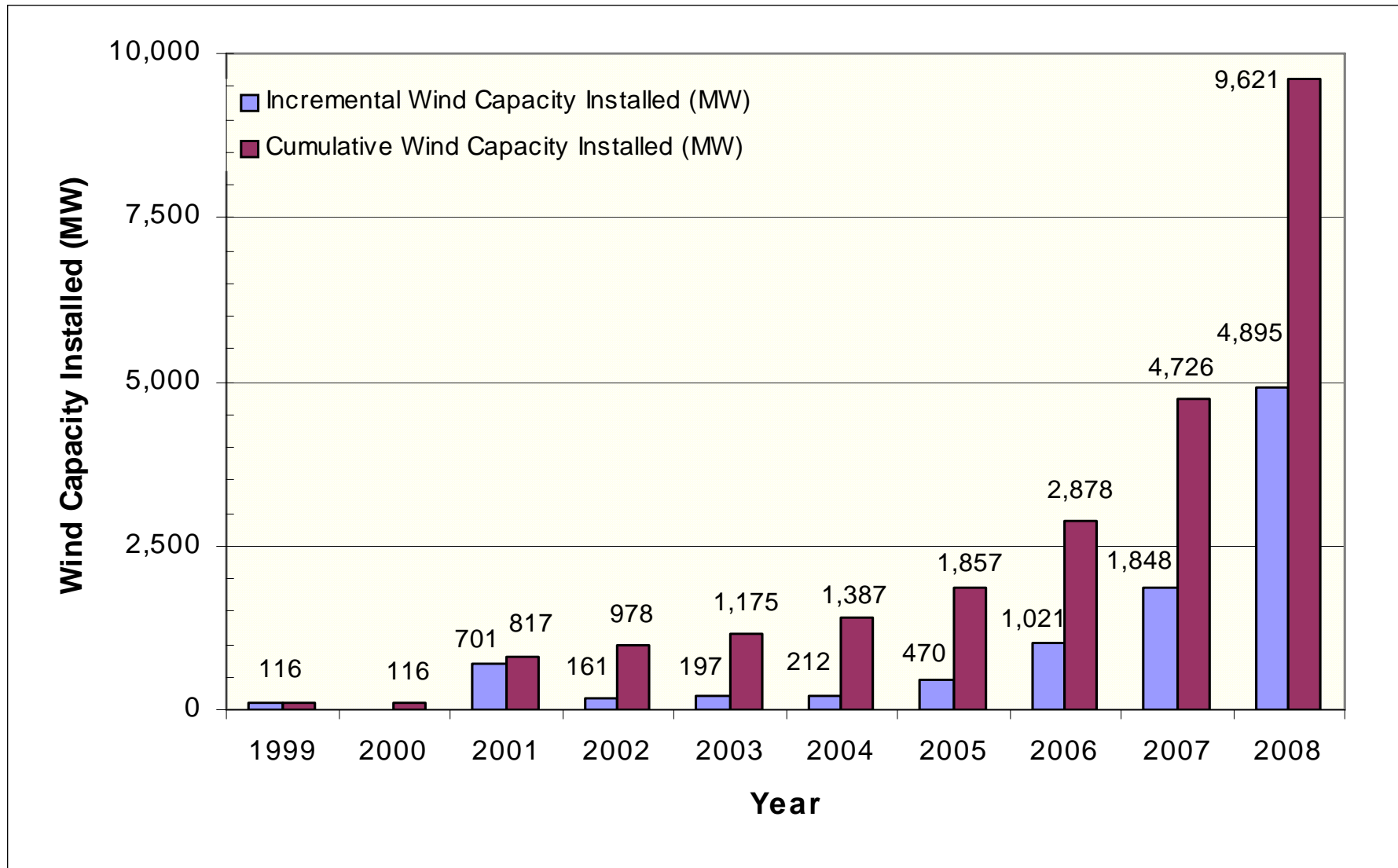
- 71,812 megawatts generating capacity
- 62,339 megawatts system peak demand (August 2006)
- 14.6% reserve margin for 2007 (12.5% target)
- 38,000 miles of transmission lines
- 587 thermal generation units + 51 Wind plants
- 20 million Texans served
- 85% of Texas load
- 75% of Texas land area; 200,000 square miles
- 95% bilateral wholesale market;
- 5% ERCOT-run balancing energy and ancillary services market;
- ERCOT interconnect - approximately 500 – 600 MW loss of generation results in 0.1Hz drop in frequency



# Types of Ancillary Services (ERCOT Protocol 6.1)

- **Regulation Reserve**
  - Regulation power is deployed in response to an increase/decrease in ERCOT System frequency to maintain the target ERCOT System frequency within predetermined limits according to the Operating Guides.
- **Responsive Reserve**
  - Operating reserves ERCOT maintains to restore the frequency of the ERCOT System within the first few minutes of an event that causes a significant deviation from the standard frequency. Furthermore, Responsive Reserve Service provides reserved Resources that are deployed for the Operating Hour in compliance with these Protocols in response to loss-of-Resource contingencies on the ERCOT System.
- **Non-spinning Reserve**
  - Reserves maintained by ERCOT, that are deployed for the Operating Hour in response to loss-of-Resource contingencies on the ERCOT System.
- **Replacement Reserve**
  - The instruction, by ERCOT, for the deployment of Loads or non-synchronized Generation Resources in order to make available additional Balancing Energy Service.

# Wind Installation Growth in ERCOT



# Current Operational Challenges

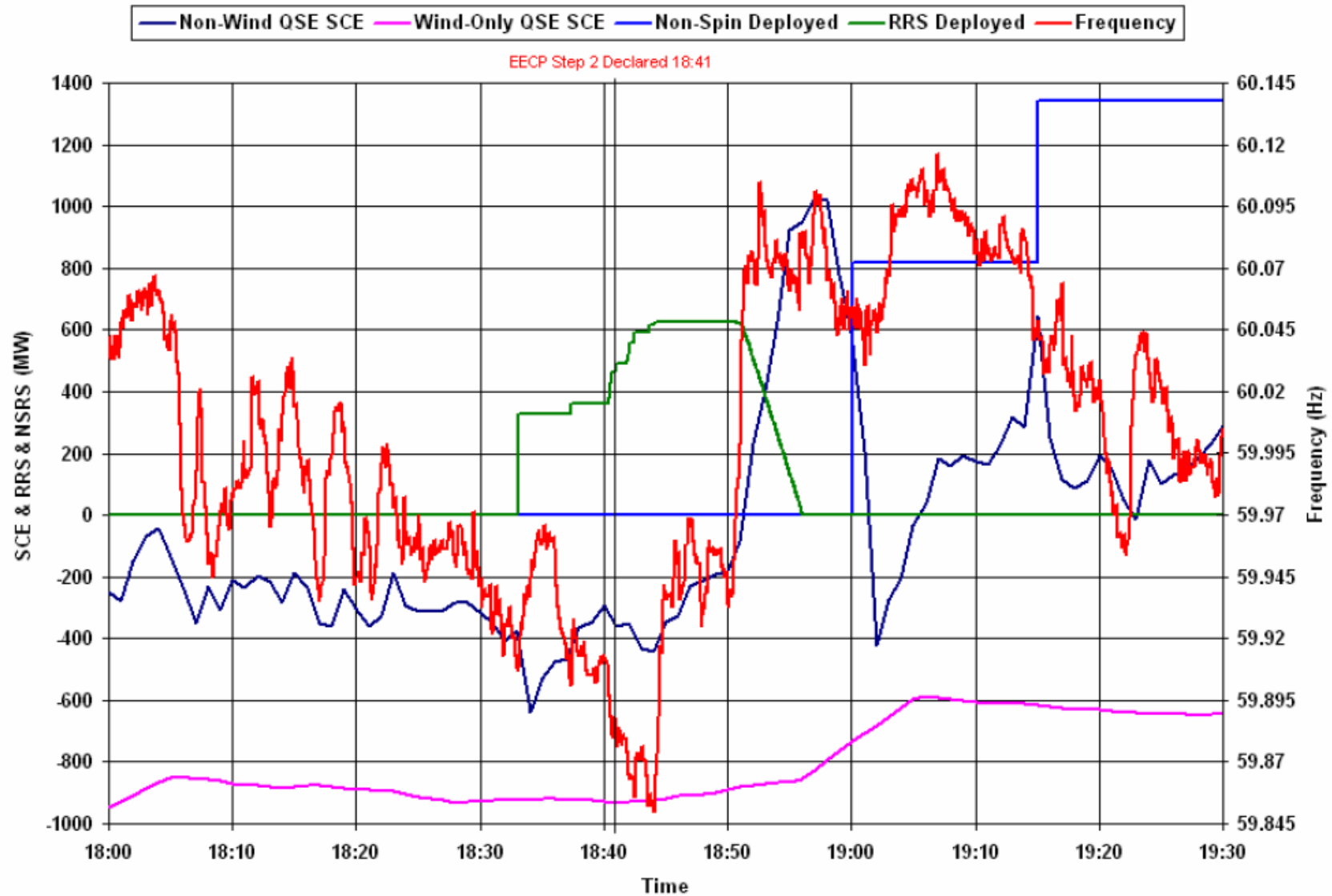
- **Balancing Energy and Scheduling Challenge**
- **Affect on Frequency Control**
- **Load/Wind Forecasting Challenge**
- **West – North Limits Challenge**
- **Local voltage/thermal Issue**
- **Ancillary Service Requirement Challenge**

## Balancing Energy Offset Challenges

- **15-minute Balancing Energy Service is used to follow the short term load changes and to minimize regulation**
  - Short Term load forecast used to predict the load in 5 minute increments up to 1 hour in the future
  - Balancing Energy is deployed to correct the difference between the aggregate of market participants' 15-minute schedules and the short-term load forecast
  - Offset is utilized by the ERCOT operators to correct for known errors in the market participants' schedules. Known errors can be a result of thermal generation forced outages or wind generation schedules and actual output.
  - Differences in real-time load and the aggregate of Balancing Energy Schedules is made up by regulation deployments.

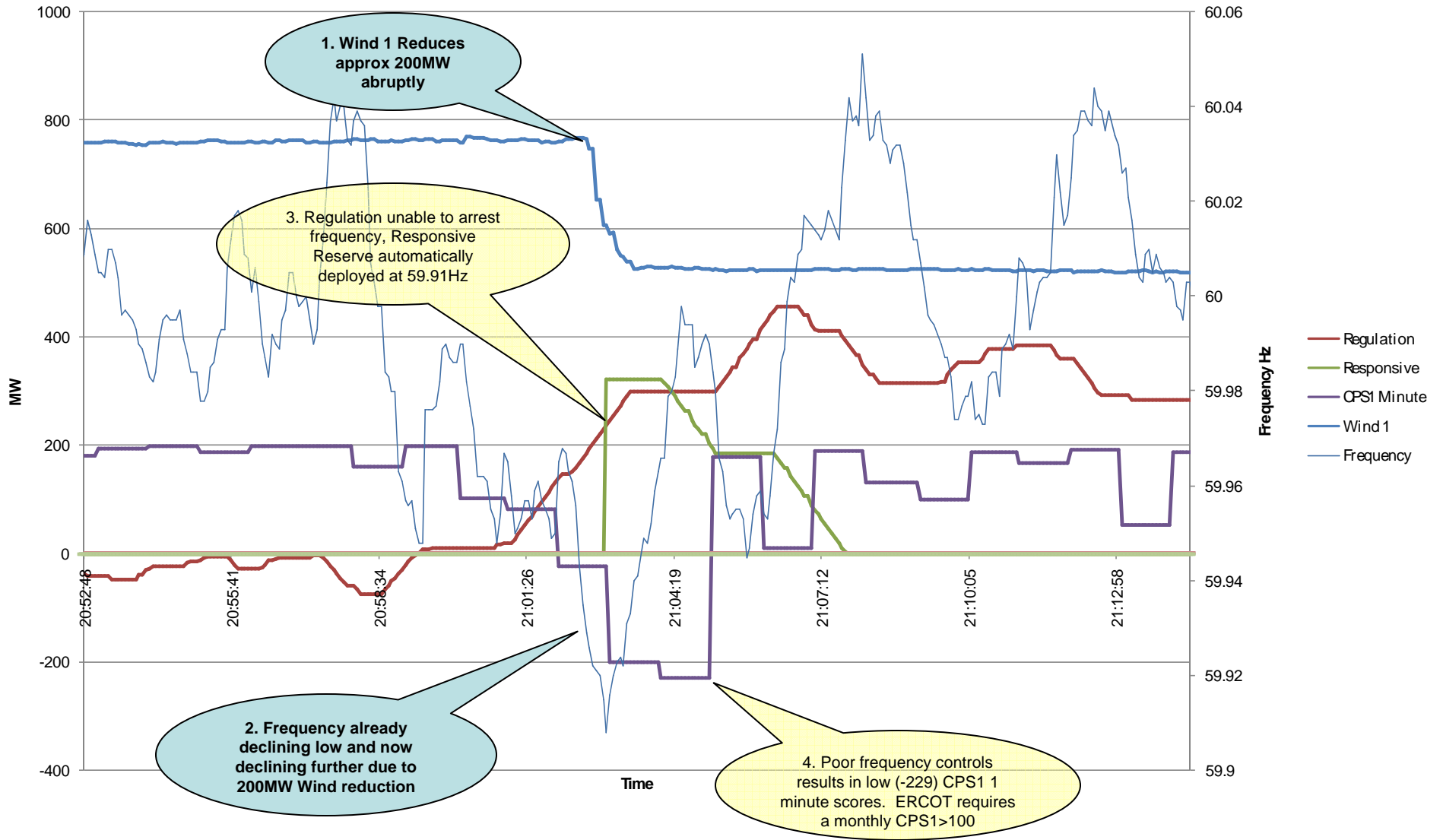
- **When ERCOT issues a balancing down instruction to wind-only QSEs, it is expected that the resources move down by the instructed amount from their current output, not the scheduled output.**
  - Example:
    - Resource Plan of 100 MW, real-time output of 60 MW when RTB executes
    - Down balancing instruction of 10 MW is sent out
    - The expectation is the resource moves to 50 MW, even if the output of the unit has changed since the Real-Time Balancing Energy deployment.

# Schedule Control Errors, Responsive and Non-spinning Reserve Deployments on February 26th



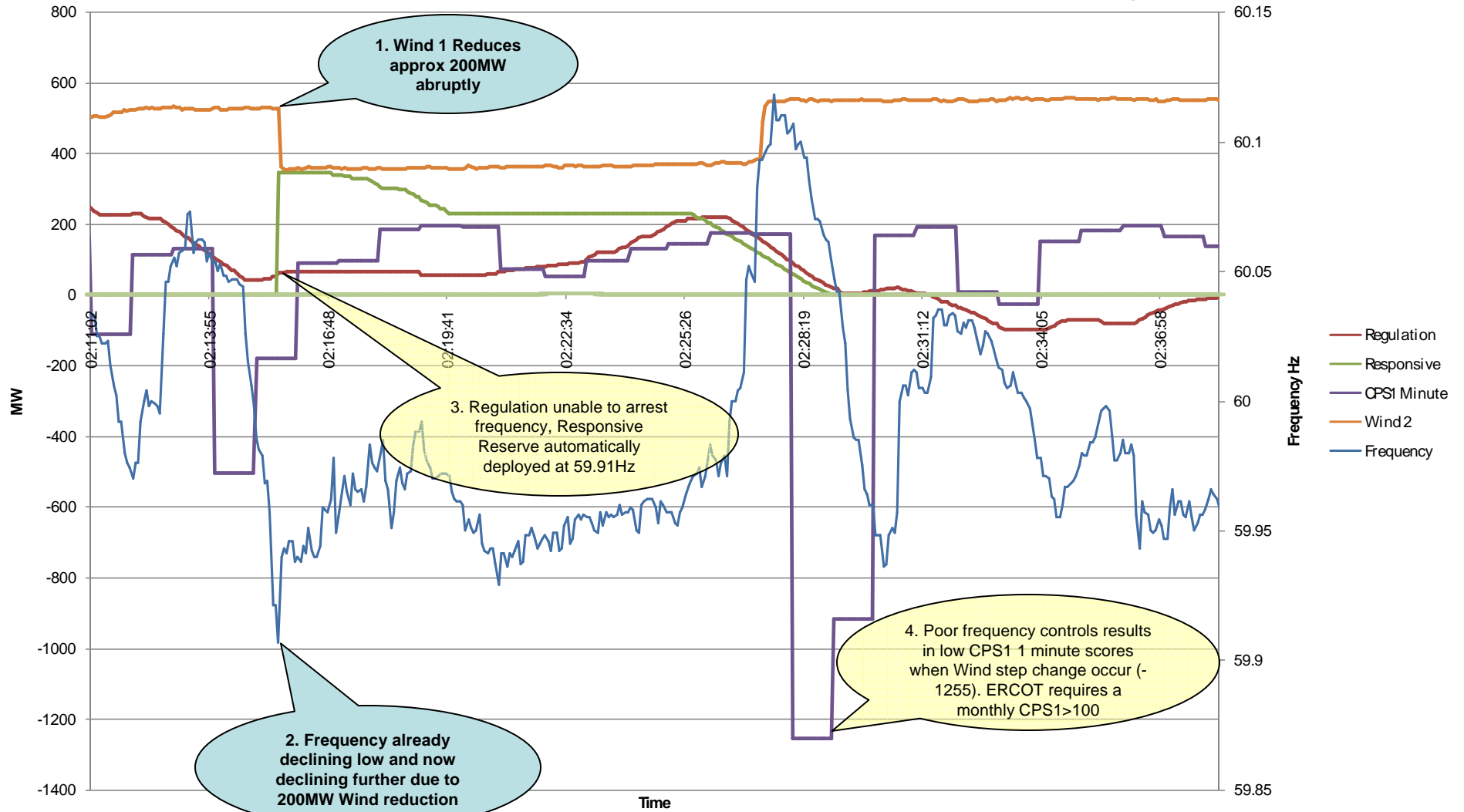


## Effect on Frequency and CPS1 Score due to Instantaneous Wind Changes

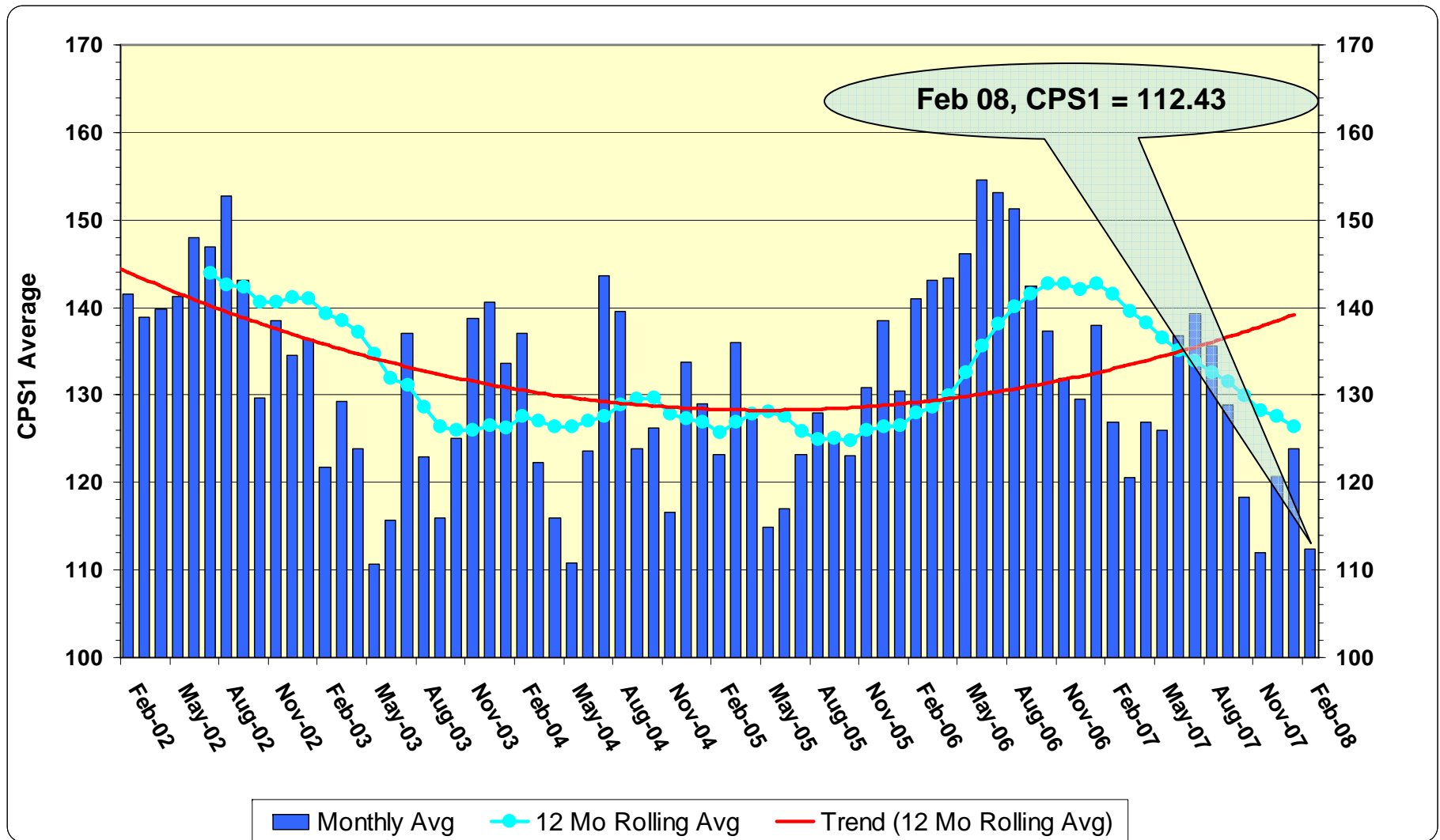




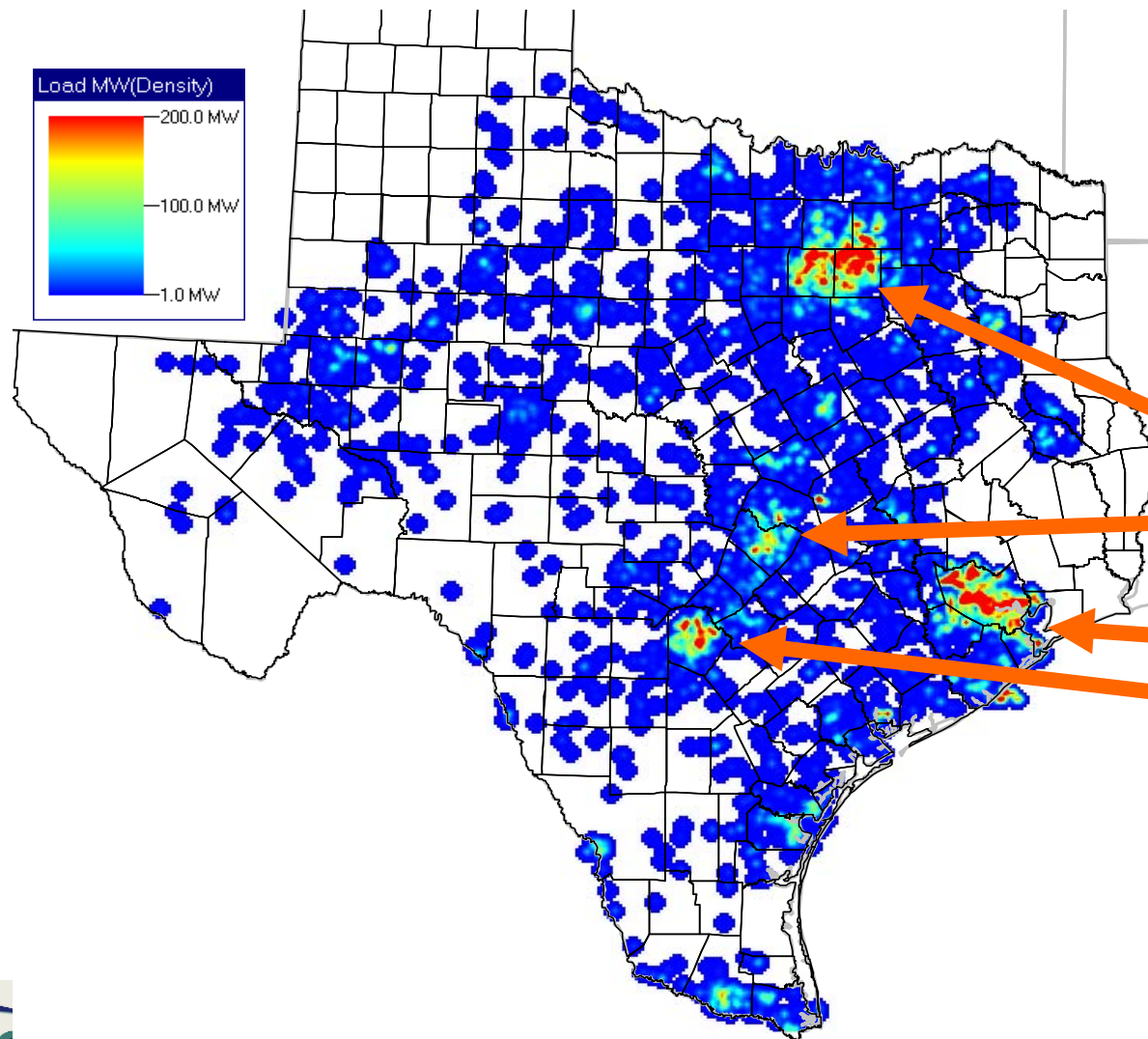
## Effectson Frequency and CPS1 Score due to Instantaneous Wind Changes



# ERCOT CPS1 Scores



# ERCOT Load



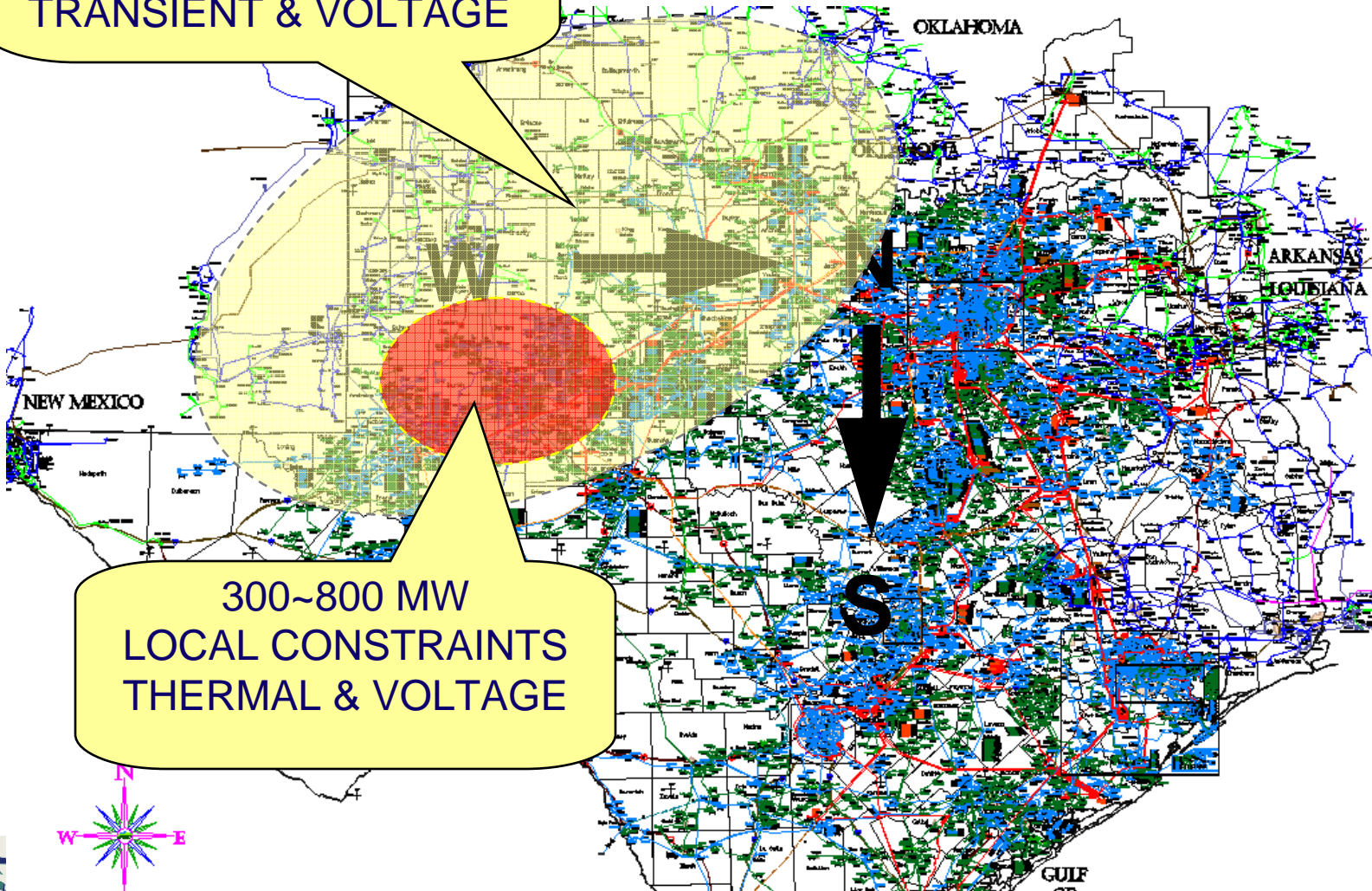
- ~63,000 MW summer peak demand
- Majority of load is concentrated in eastern half of state

- Dallas
- Austin
- Houston
- San Antonio

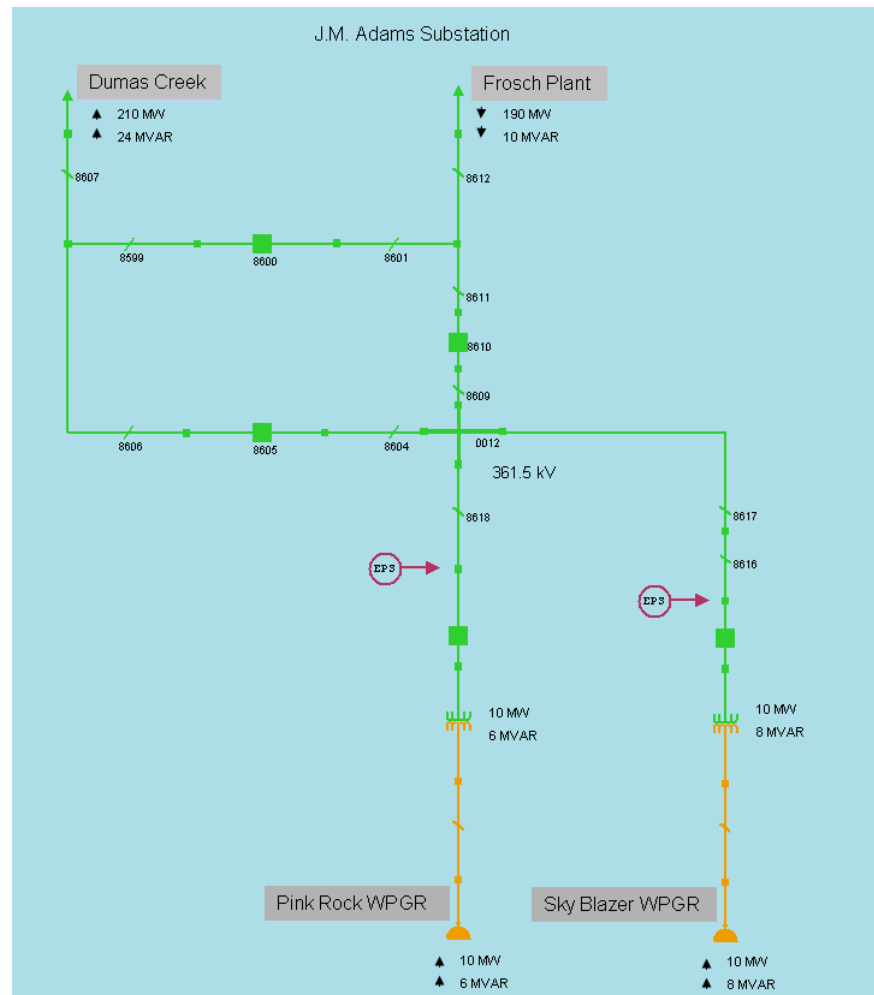
# West Export Zonal Transfer and Limitation

1400~2000 MW  
REGIONAL CONSTRAINT  
STABILITY LIMITED  
TRANSIENT & VOLTAGE

300~800 MW  
LOCAL CONSTRAINTS  
THERMAL & VOLTAGE

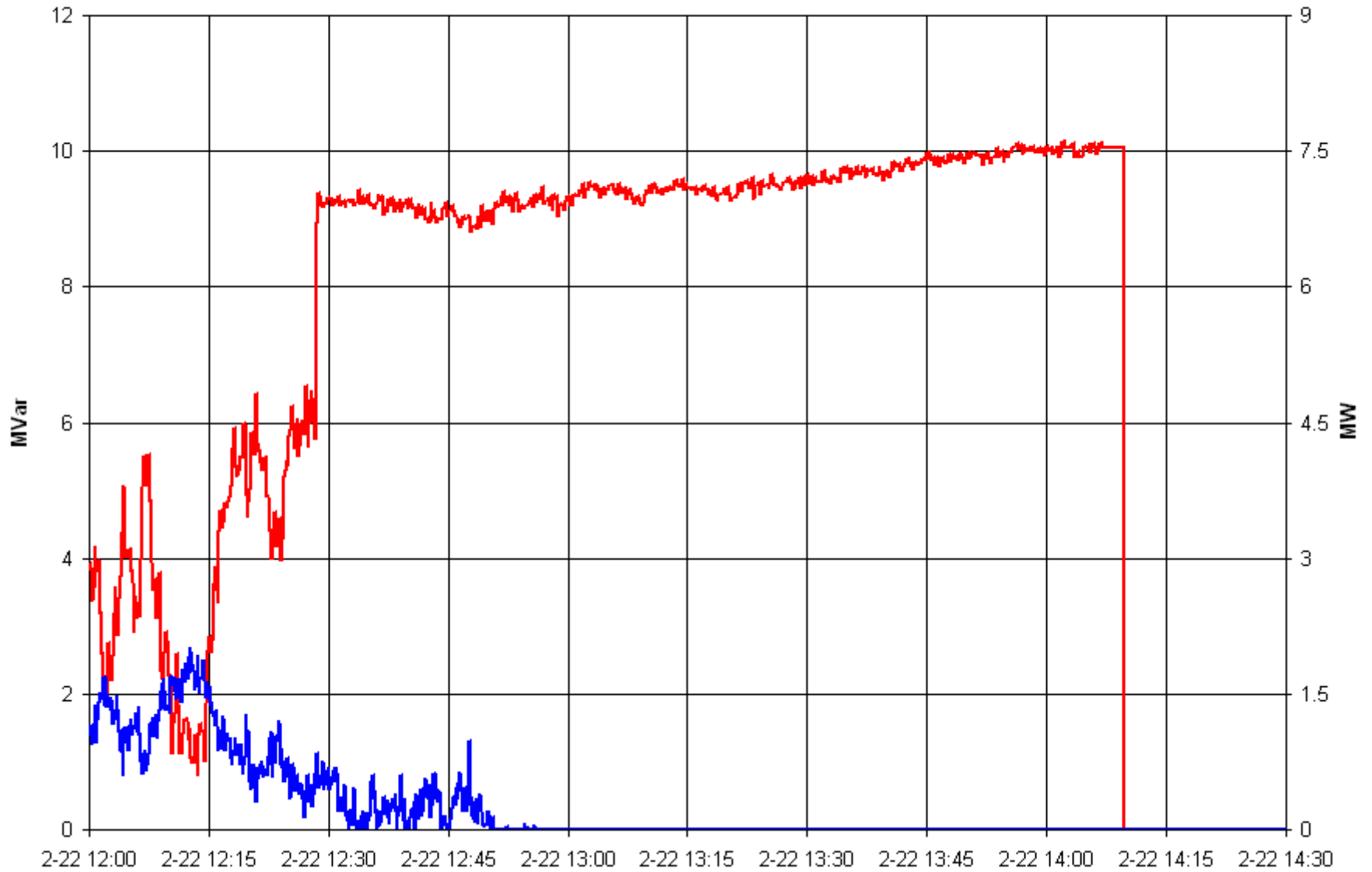


# High Voltage Issue (Voltage Control issue)

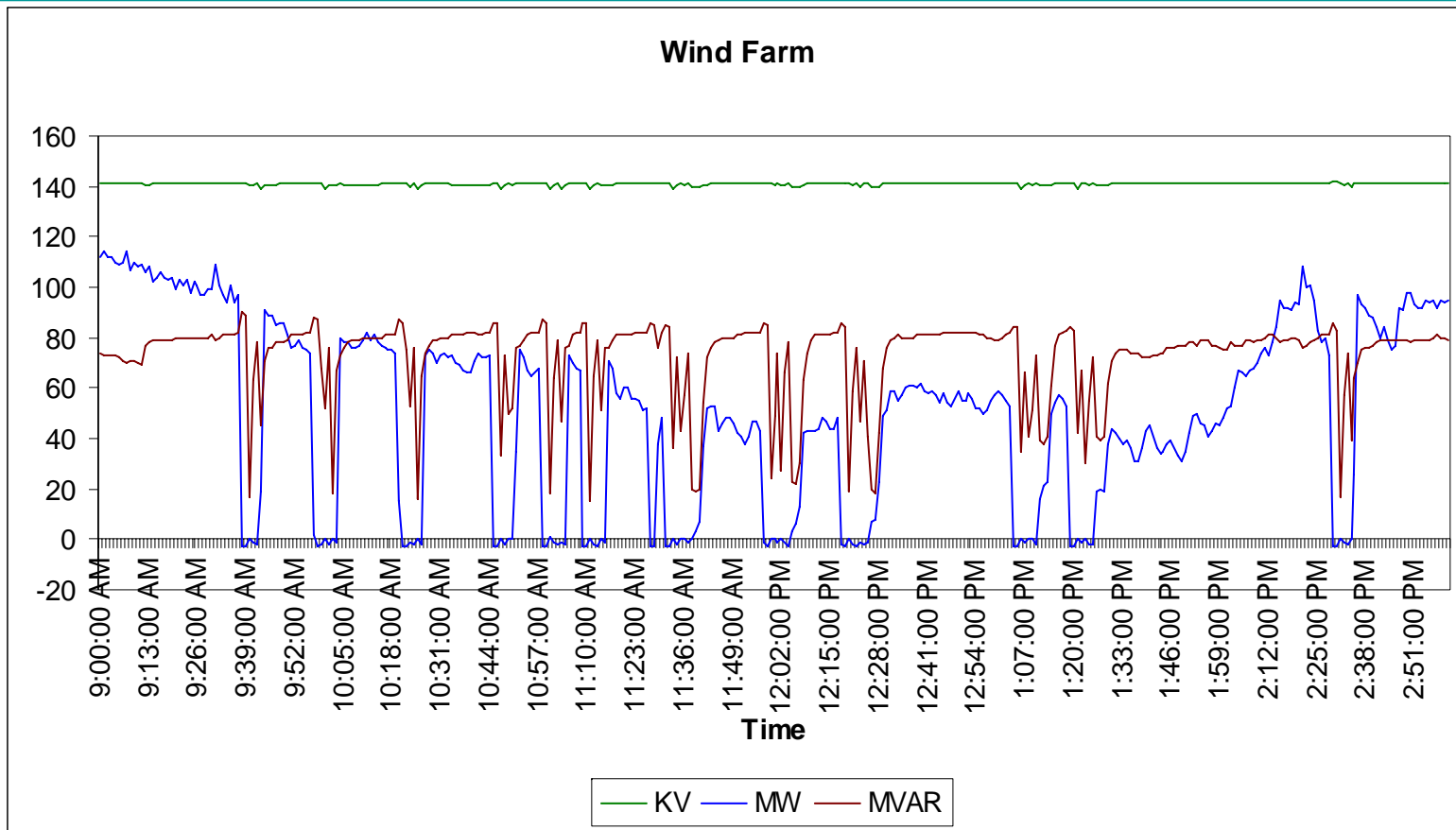




Unit A MVar    Unit A MW



## Abnormal Wind Farm Output: 3/27/2008 9AM ~ 3PM



1. This was the result of an equipment malfunction
2. Voltage is maintained well during abrupt change of reactive, because there are several sizable reactor and SVC in the neighboring substation to provide voltage support.



# PUCT Scenarios for Plan Development



**Capacity of New CREZ Wind by Scenario (MW)**

Wind Zone	Scen. 1	Scen. 2	Scen. 3	Scen. 4
Panhandle A	1,422	3,191	4,960	6,660
Panhandle B	1,067	2,393	3,720	0
McCamey	829	1,859	2,890	3,190
Central	1,358	3,047	4,735	5,615
Central West	474	1,063	1,651	2,051
<b>Total*</b>	<b>12,053</b>	<b>18,456</b>	<b>24,859</b>	<b>24,419</b>

\* Assumes 6,903 MW of existing wind capacity

- **Workshop held to communicate current and upcoming issues related to wind integration and initiate solution development**
- **Immediate needs identified by ERCOT**
  - Improve wind resource plans
    - Protocol to use Wind Forecast in place of Wind Schedules
  - Eliminate instantaneous ramps associated with congestion mgmt
    - Establish Ramp Rate requirements
  - Increase regulation requirement to account for wind variability
    - Incorporate effect of incremental increases in installed wind capacity into current methodology
  - Implement LVRT requirement
    - Operating Guide revision underway

- **Additional needs identified by AS study – multiple solutions possible**
  - Increase ramping flexibility in ERCOT “fleet”
    - Quick start/response service?? (what requirements?)
  - Monitor ramping capability and increase during times of added risk
    - Additional reg/responsive/non-spin during these periods??
- **Additional requirements for high wind penetrations**
  - Inertia and governor response
    - Other on-line generation to provide or provided by wind with appropriate controls and operations

## SUMMARY

- **ERCOT Staff and Stakeholders are working on a list of issues that address the following questions:**
  - What are the problems today
  - What challenges will additional wind capacity present
  - What changes do we make now
  - What changes do we incorporate into Nodal
- **The issues fall into four categories**
  - Needed Protocols/Operating Guide changes
  - Compliance monitoring requirements
  - Interconnect Standard requirements
  - Training requirements

# Questions?

