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Real Time Information — Currency of the New Decade

Better wind operations by reducing uncertainty in intra-hour forecasting

WINDataNOW Technologies

WINDataNOW Technolgies

- Building better "WindTelligence"
  - High quality installations
  - Next-gen logger based on the PI System infrastructure
- Field tested
  - Loggers, power systems, and telemetry have been operating in real world conditions for 2 years
- ARRA Grant - Yes We Can!

RECOVERY.GOV
TRACK THE MONEY

  - WINData awarded a grant with OSIsoft in 2009 to develop a novel way to reduce uncertainty around intra-hour forecasts

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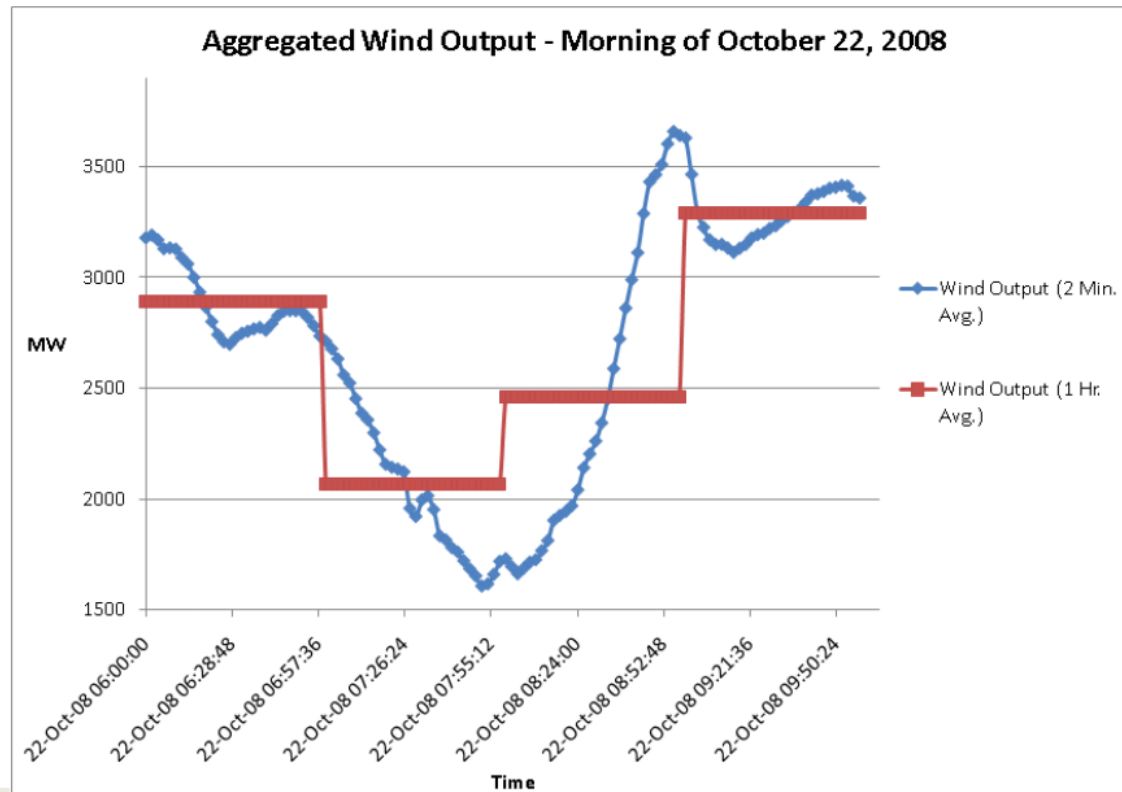
Not your friend.

RAMP EVENTS

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Ramp events captured by ERCOT

Ramping Example 2

Aggregated Wind Output - Morning of October 22, 2008
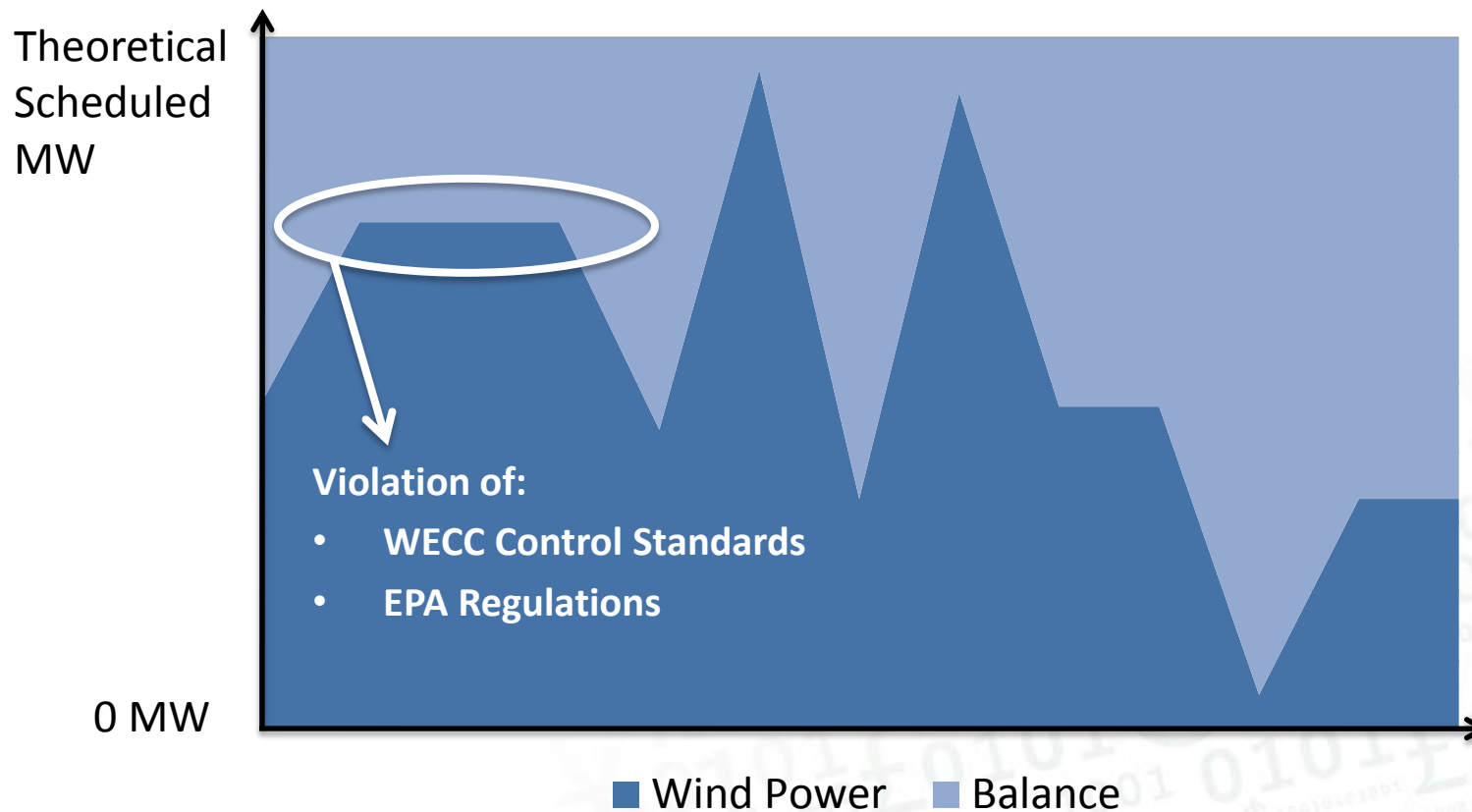
A series of events at BPA

- Wind power ≅ **15%** of peak load

- Large deviations ≅ power use of **Portland, OR**

Theoretical Scheduled MW

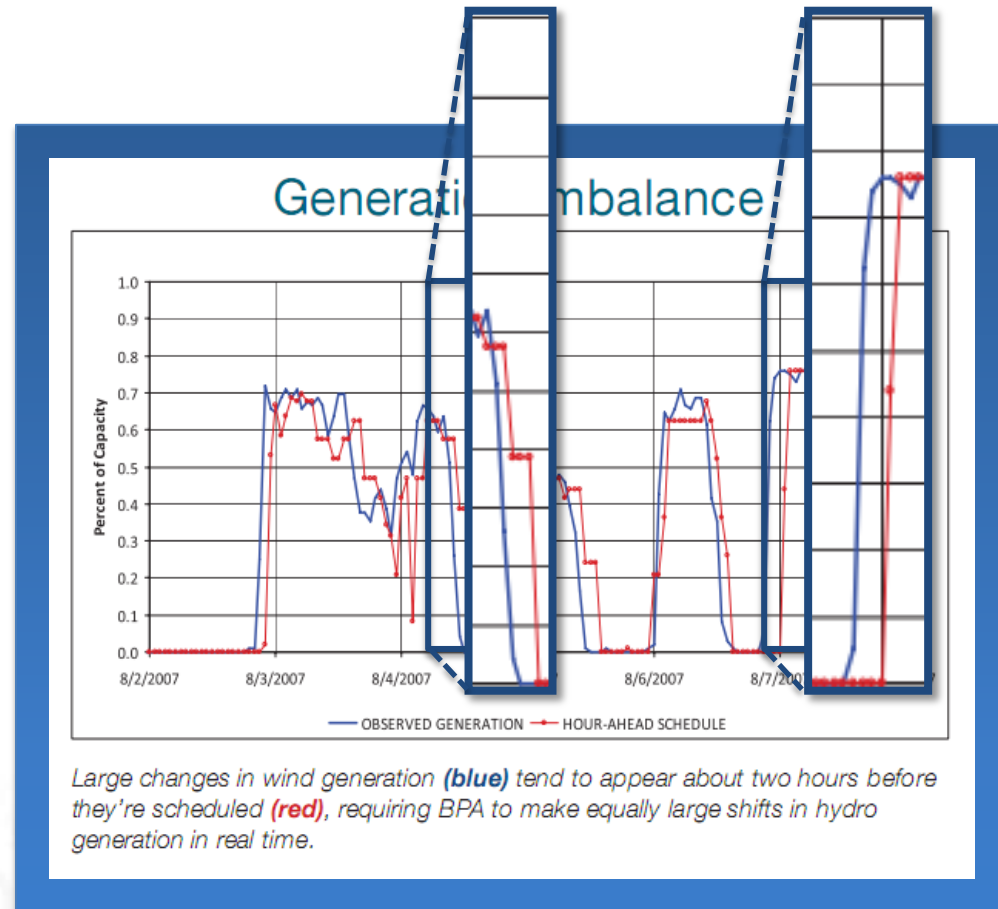400 MW

730 MW

680 MW

625 MW

0 MW

■ Wind Power ■ Balance

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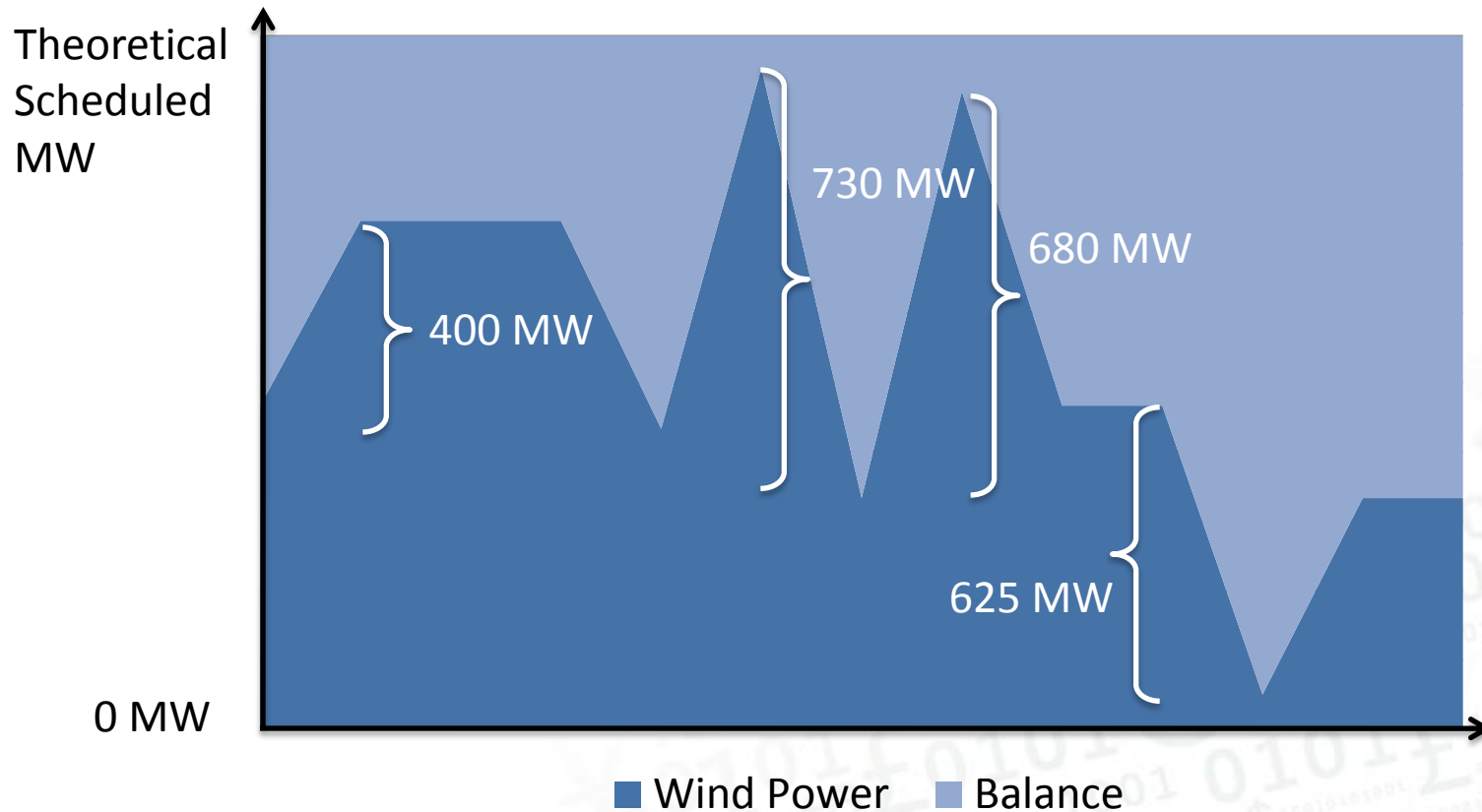
Consequences

- Wind power is backed by another generation asset

- Unintended results

Theoretical Scheduled MW

0 MW

Violation of:

- **WECC Control Standards**

- **EPA Regulations**

■ Wind Power ■ Balance

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Scheduling around ramp events

- Forecasts are good at predicting that there WILL be a ramp event
  - When will it arrive?
    - Phase error
  - How significant?
    - Amplitude error

- Forecast error tends to increase around ramp events

Generation Imbalance

Large changes in wind generation (blue) tend to appear about two hours before they're scheduled (red), requiring BPA to make equally large shifts in hydro generation in real time.

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Updating the status quo on the government's dime

ARRA: THE PLAN
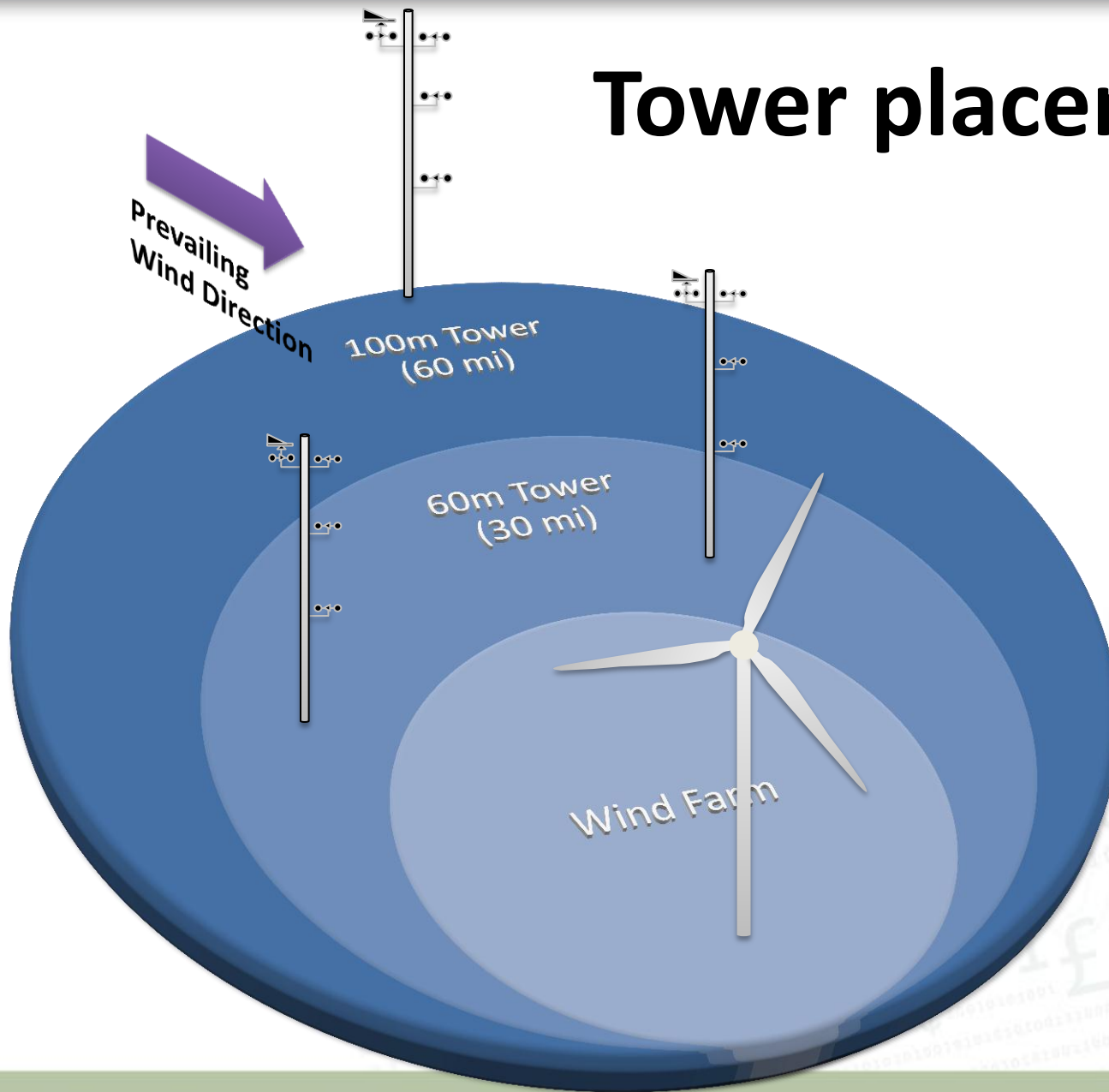
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Grant Participants

- WINDataNOW
- OSIsoft
- A wind farm
- A forecaster

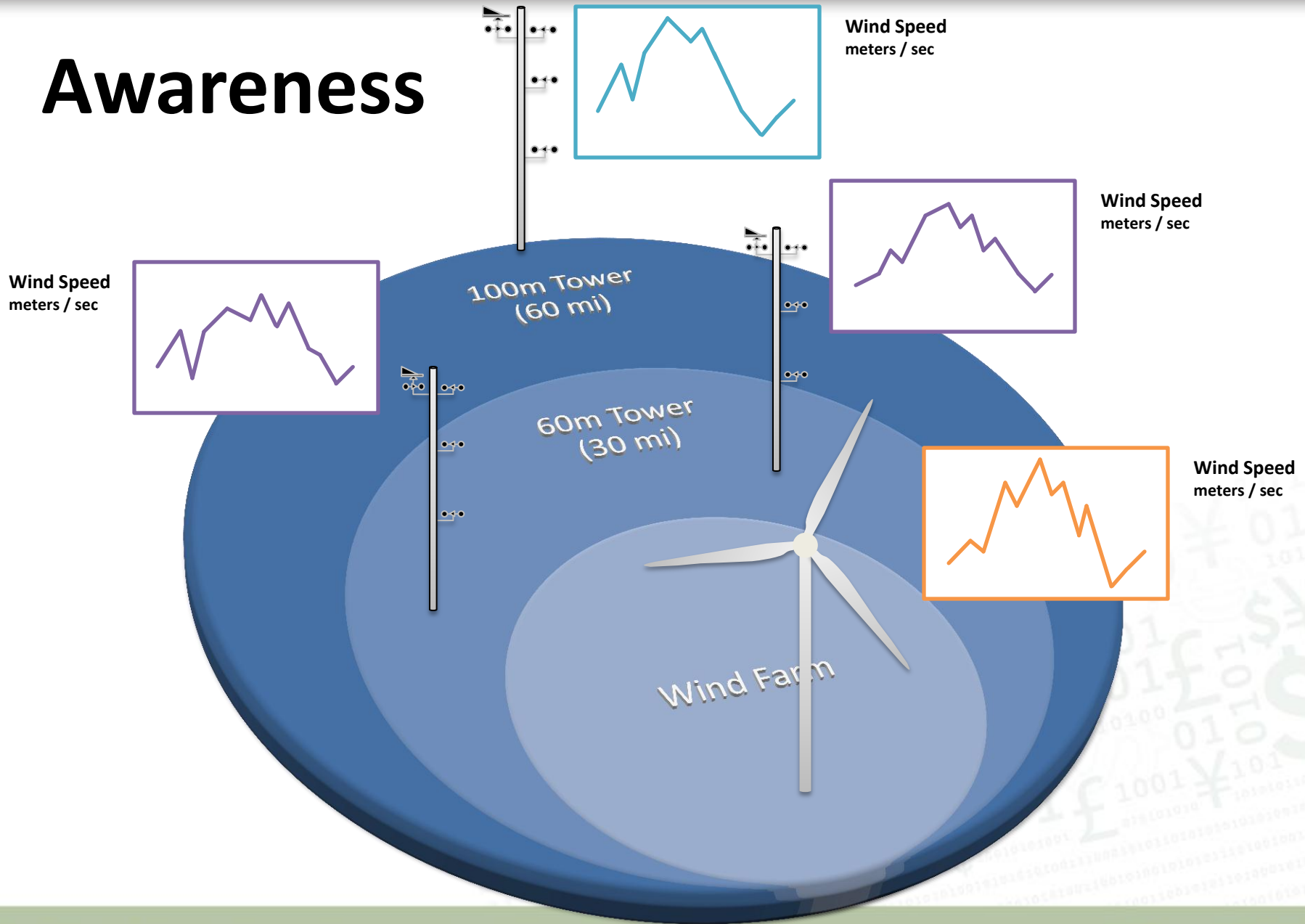OSIsoft. UC 2010

Goal: Reduce the forecast uncertainty

- Idea
  - Can short-term forecasts be improved by using actual upstream met observations?

- Requirements
  - Off-site meteorological data from predominant wind directions
  - Deliver measurements with enough resolution and timeliness to be useful

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Tower placement

Prevailing Wind Direction

100m Tower (60 mi)

60m Tower (30 mi)

Wind Farm

Awareness

Wind Speed
meters / sec

Wind Speed
meters / sec

Wind Speed
meters / sec

Wind Speed
meters / sec

100m Tower
(60 mi)

60m Tower
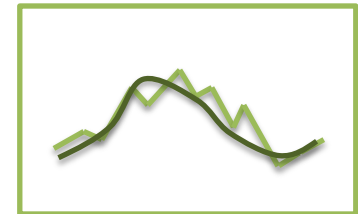(30 mi)

Wind Farm

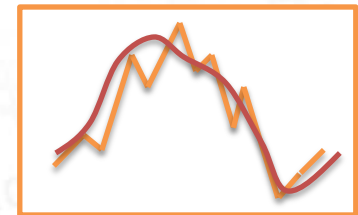**OSI**soft. **UC** 2010

Result: smoother operations

- Anticipate changes
  - Ramp up
  - Ramp down
- Improved wind energy integration on the grid

Apply "line of site" data to better understand near-term transients

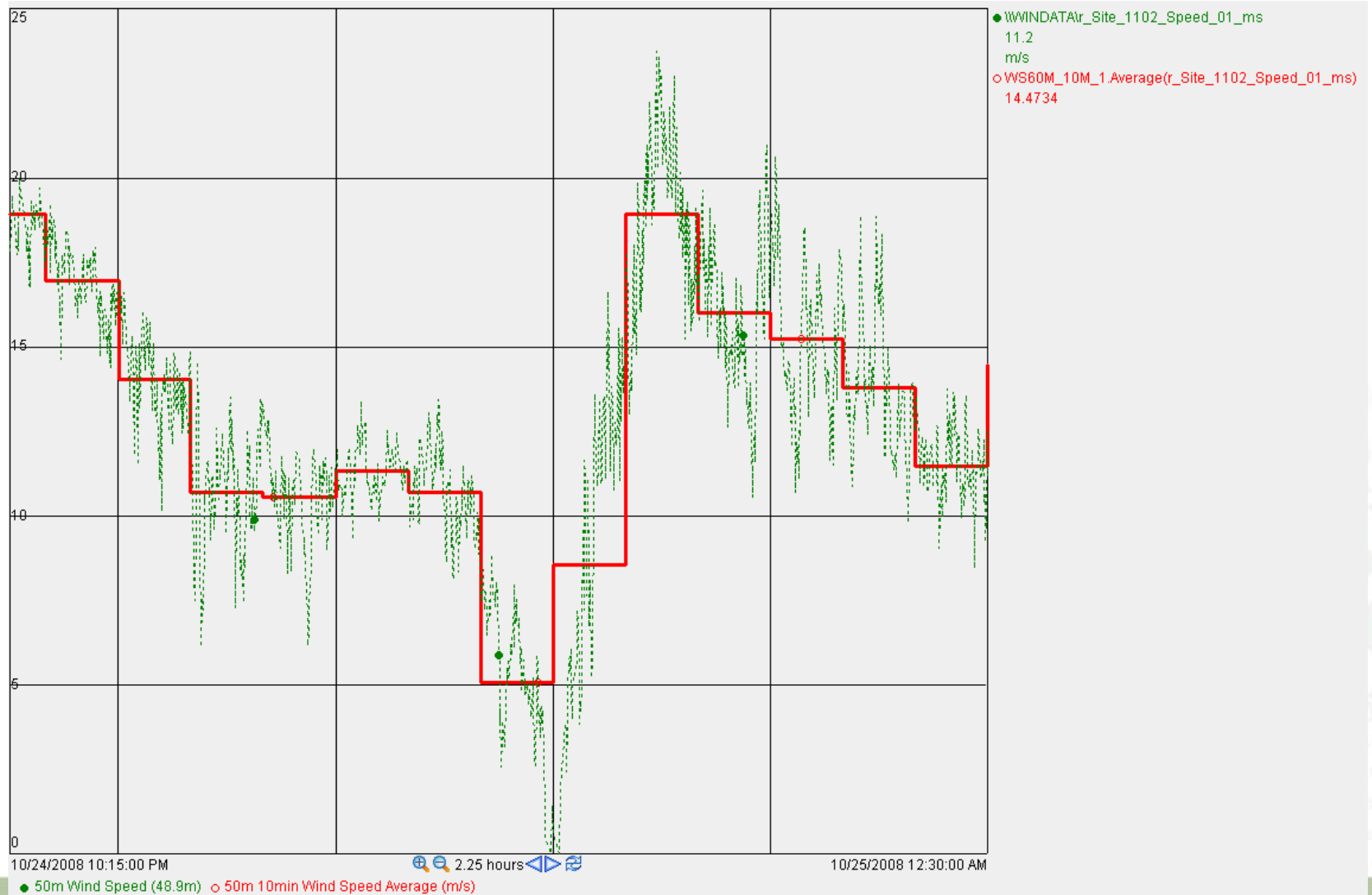**Power Production vs. Augmented forecast** MWh

Wind Speed vs. Augmented forecast meters / sec

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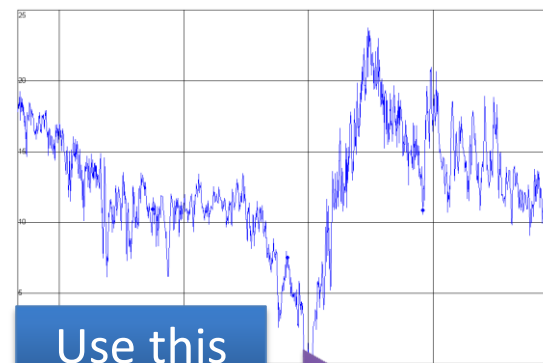How does high fidelity data impact operations?
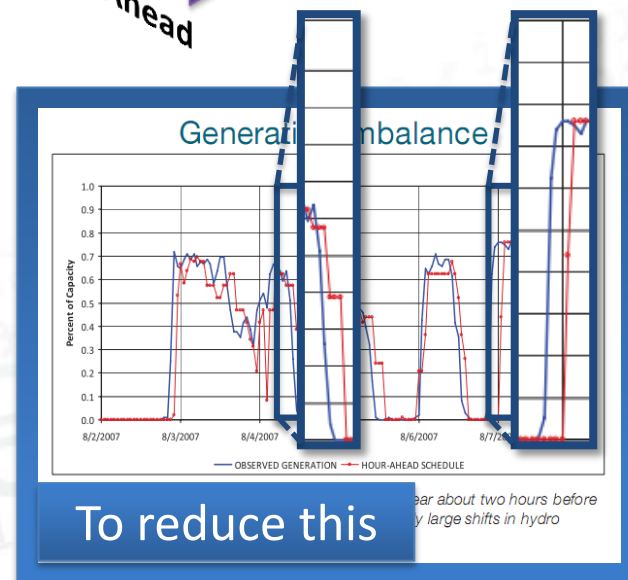
AN EXAMPLE

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Hi-fi vs. 10m averages

Combine better data with upstream locations

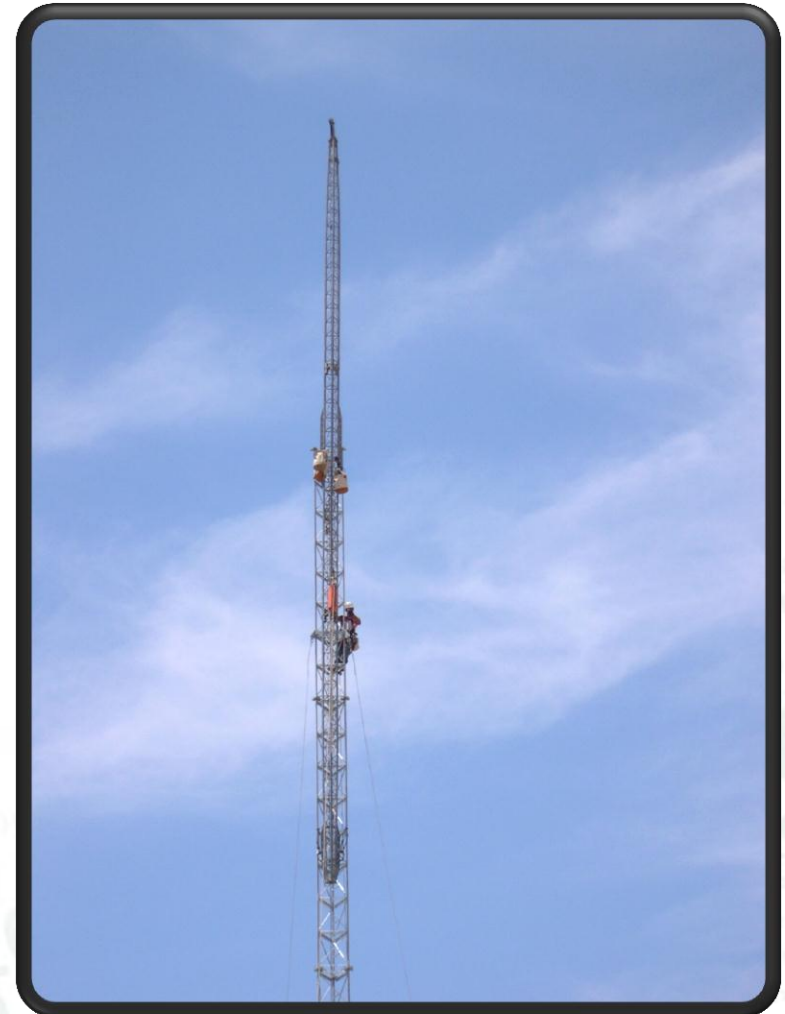- Decrease forecast error around ramp events

- Operate less conservatively

Use this

Hour Ahead

Generation Imbalance

To reduce this

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What we've been up to lately

CURRENT EXAMPLES

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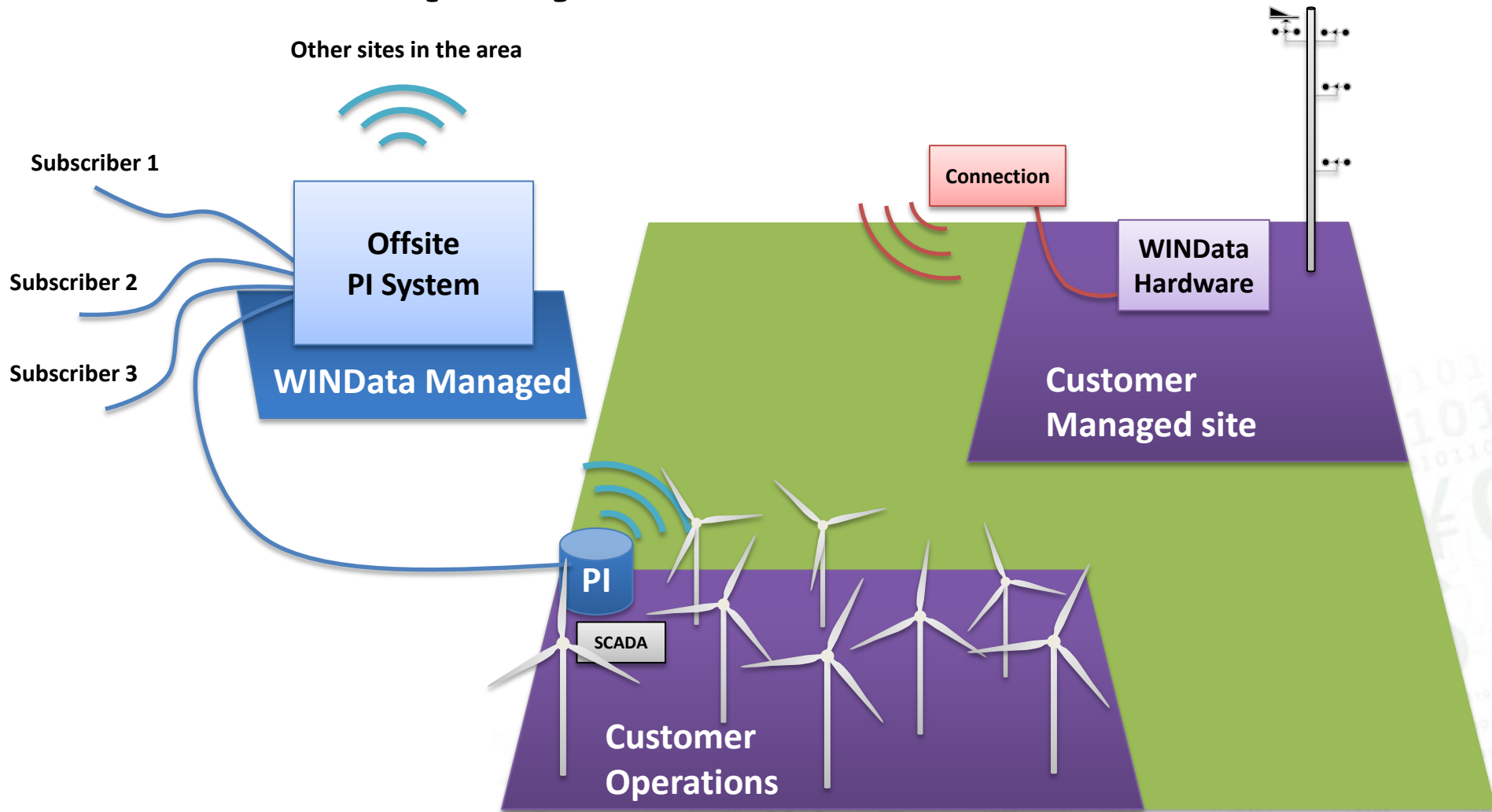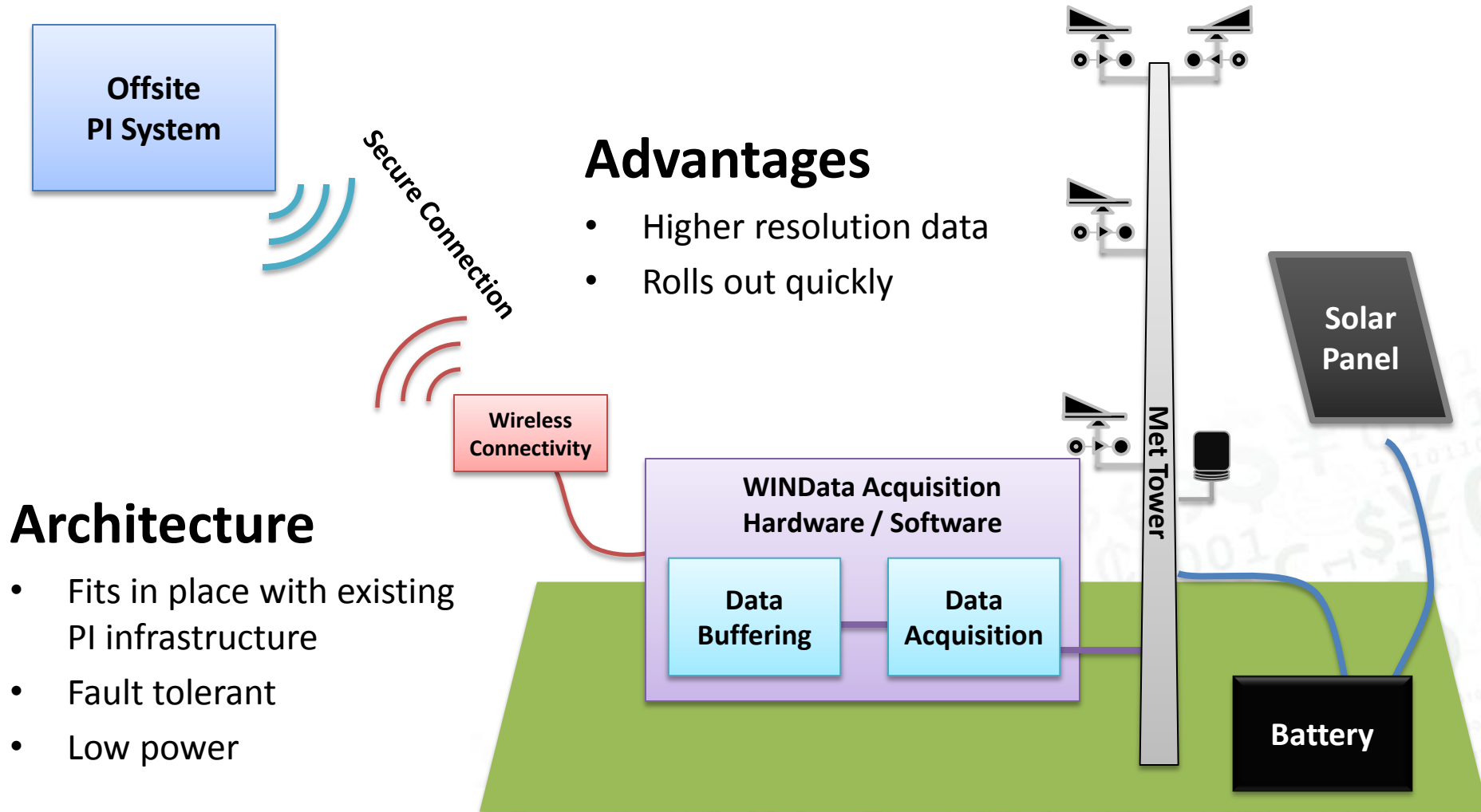
WINDataNOW's technology

- Use modern technology:
  - PI System infrastructure
  - Sensors
  - Logger equipment
  - Mobile technology – Transpara's Visual KPI
- Focus on configuration vs. programming
- Emphasis on history recovery

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Deployed architecture

Other sites in the area

Subscriber 1

Subscriber 2

Subscriber 3

Offsite
PI System

WINData Managed

Connection

WINData
Hardware

Customer
Managed site

PI

SCADA

Customer
Operations

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Acquisition architecture

Offsite PI System

Secure Connection

Wireless Connectivity

Advantages

- Higher resolution data
- Rolls out quickly

Architecture

- Fits in place with existing PI infrastructure
- Fault tolerant
- Low power

WINData Acquisition Hardware / Software

Data Buffering

Data Acquisition

Met Tower

Solar Panel

Battery

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Siting Choices

- Geographically disperse
- Use assessment data to establish locations
- Account for off-site terrain and topology

- Questions:
  - Do we need tall towers?
  - How do other assessment technologies play into this (SODAR / LIDAR)?
 - Mesh sensing of certain measurements?

Research topics

- Estimating time delay from off-site to wind farm
- Establish a correspondence between off-site observations to actual power production
  - Speed changes
  - Direction shifts
  - Vertical phenomena (eventually…)
- Incorporate a wide array of existing observations
- Develop a program to improve operations
  - Collaboration between operator, forecaster, and WINData

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Current status

- Off-site tower installed and operational
  - New met-site power system
  - Advanced data acquisition programming
  - Fault recovery measures in place
  - Dual-channel communications
- PI Server collecting data
  - From our logger
  - From many FTP sites (PI UFL)
- Analysis is beginning

Current data acquisition

- Wind farm SCADA

- Wind farm met towers

- Off-site met towers

- ASOS data
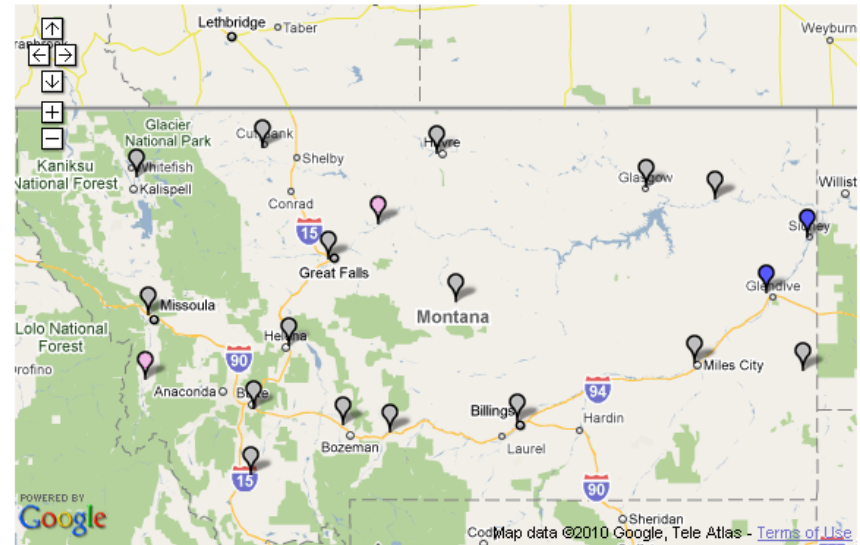
| ID	Location	County	State	Frequency	Phone	Type
KBHK	Baker	Fallon	MT	135.475	(406) 778-3312	ASOS
KBZN	Belgrade - Bozeman	Gallatin	MT	ATIS 135.425	(406) 388-4882	ASOS
KBIL	Billings - Logan International	Yellowstone	MT	ATIS 126.3	(406) 248-2773	ASOS
KBTM	Butte - Berte Mooney	Silver Bow	MT	135.175	(406) 494-1870	ASOS
KCTB	Cut Bank	Glacier	MT	119.025	(406) 873-2939	ASOS
KDLN	Dillon	Beaverhead	MT	135.225	(406) 683-5470	ASOS
K79S	Fort Benton	Chouteau	MT	122.8	(406) 622-5976	AWOS A/V
KGPI	Glacier Park - Kalispell	Flathead	MT	ATIS 132.625	(406) 756-8879	ASOS
KGDV	Glendive	Dawson	MT	135.075	(406) 687-3346	AWOS III
KGTF	Great Falls International	Cascade	MT	ATIS 126.6	(406) 452-9844	ASOS

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Transition from lag to lead behavior

Met tower is situated in one of the primary wind flow directions.

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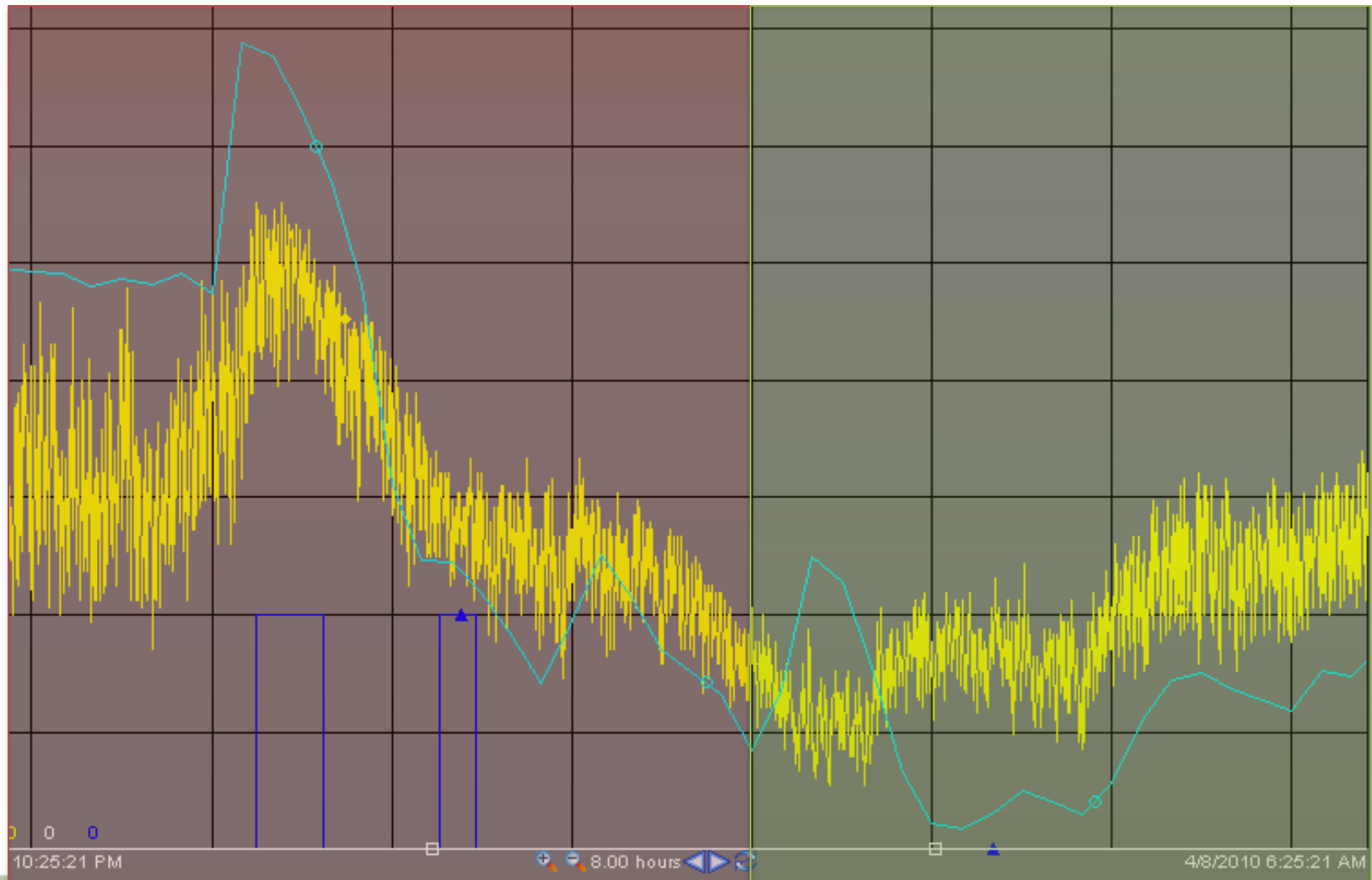
Pressure gradients

ASOS data vs. Normalized production data

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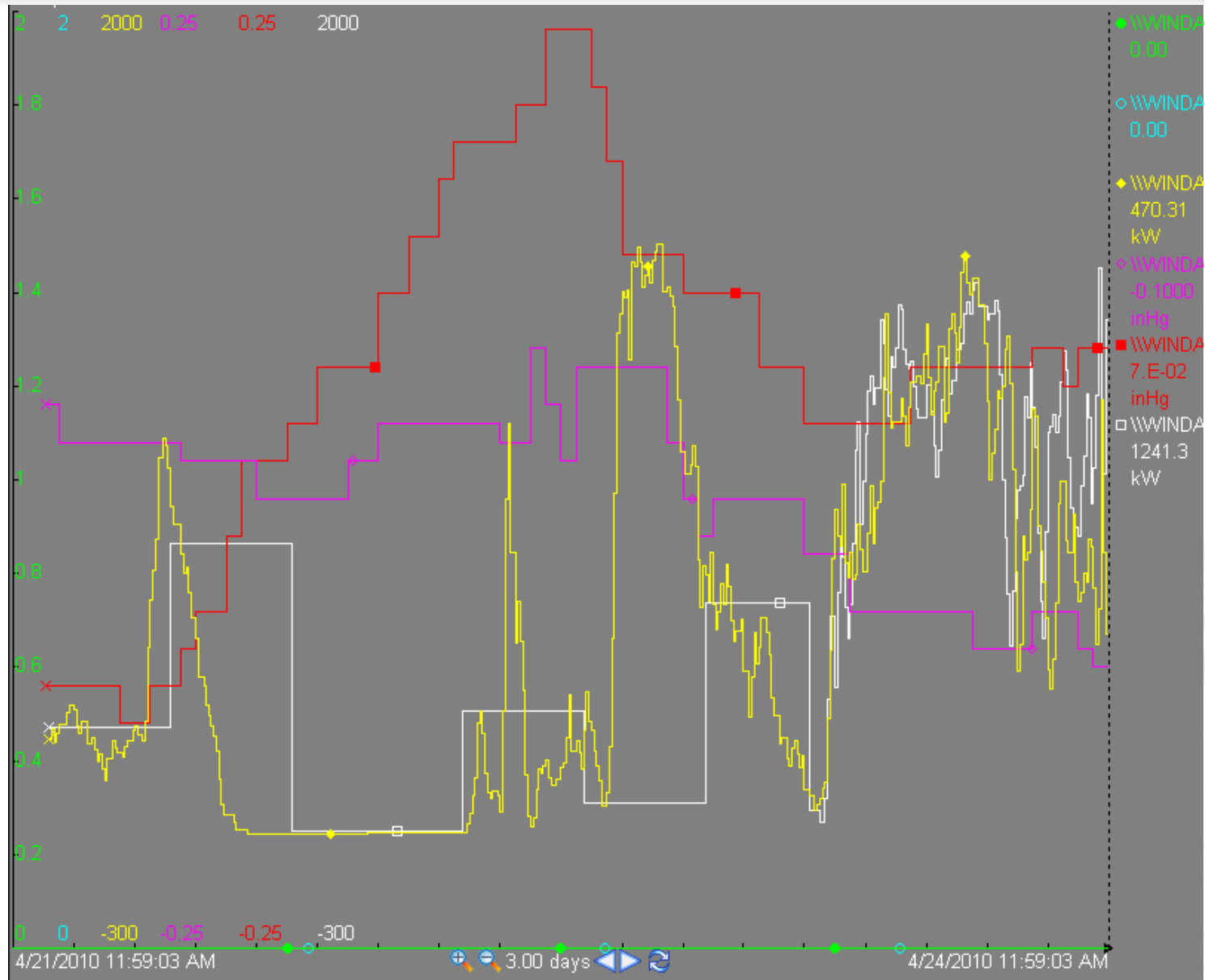
Maybe lead / lag

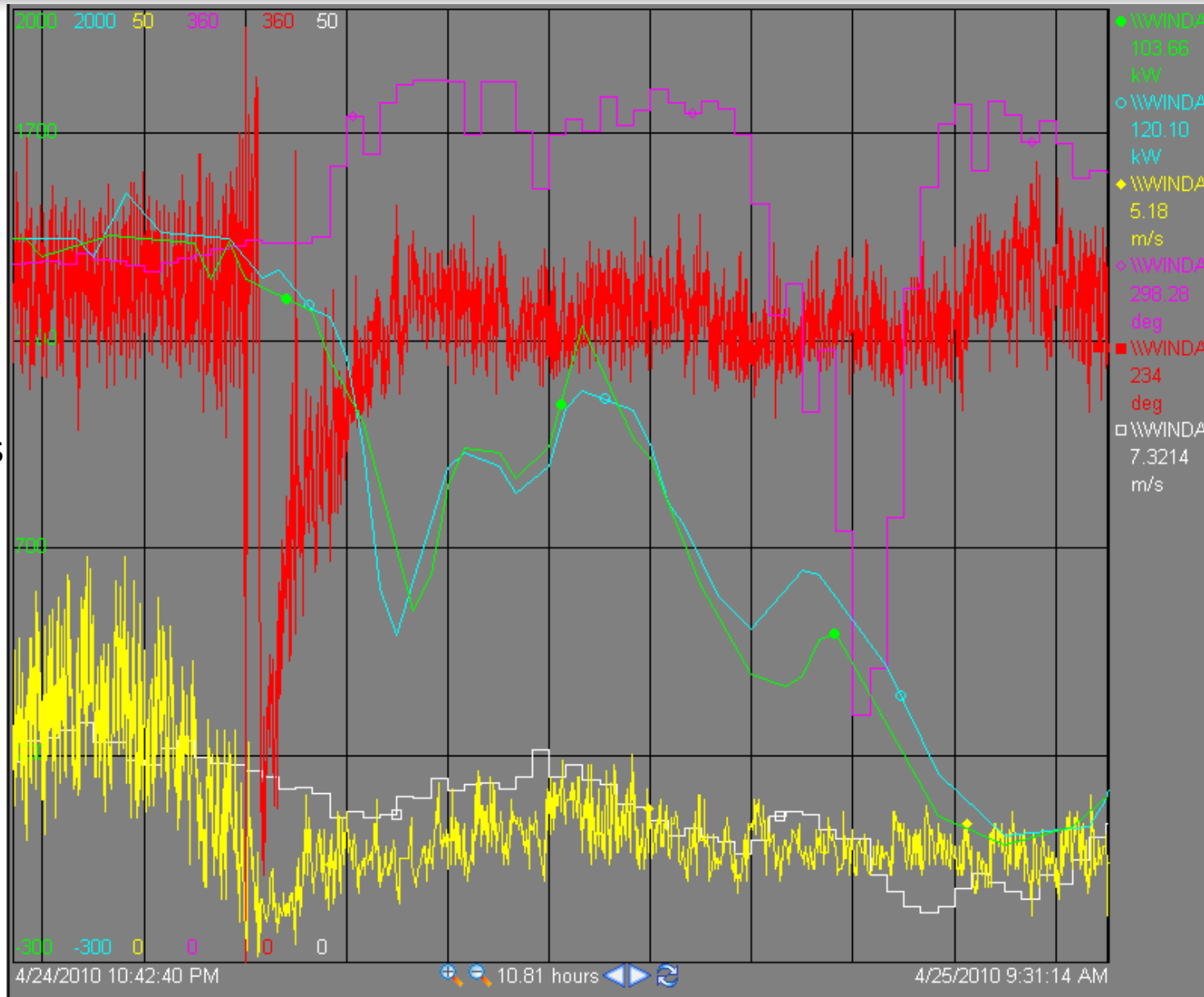~30-40 min delay

Analysis required!
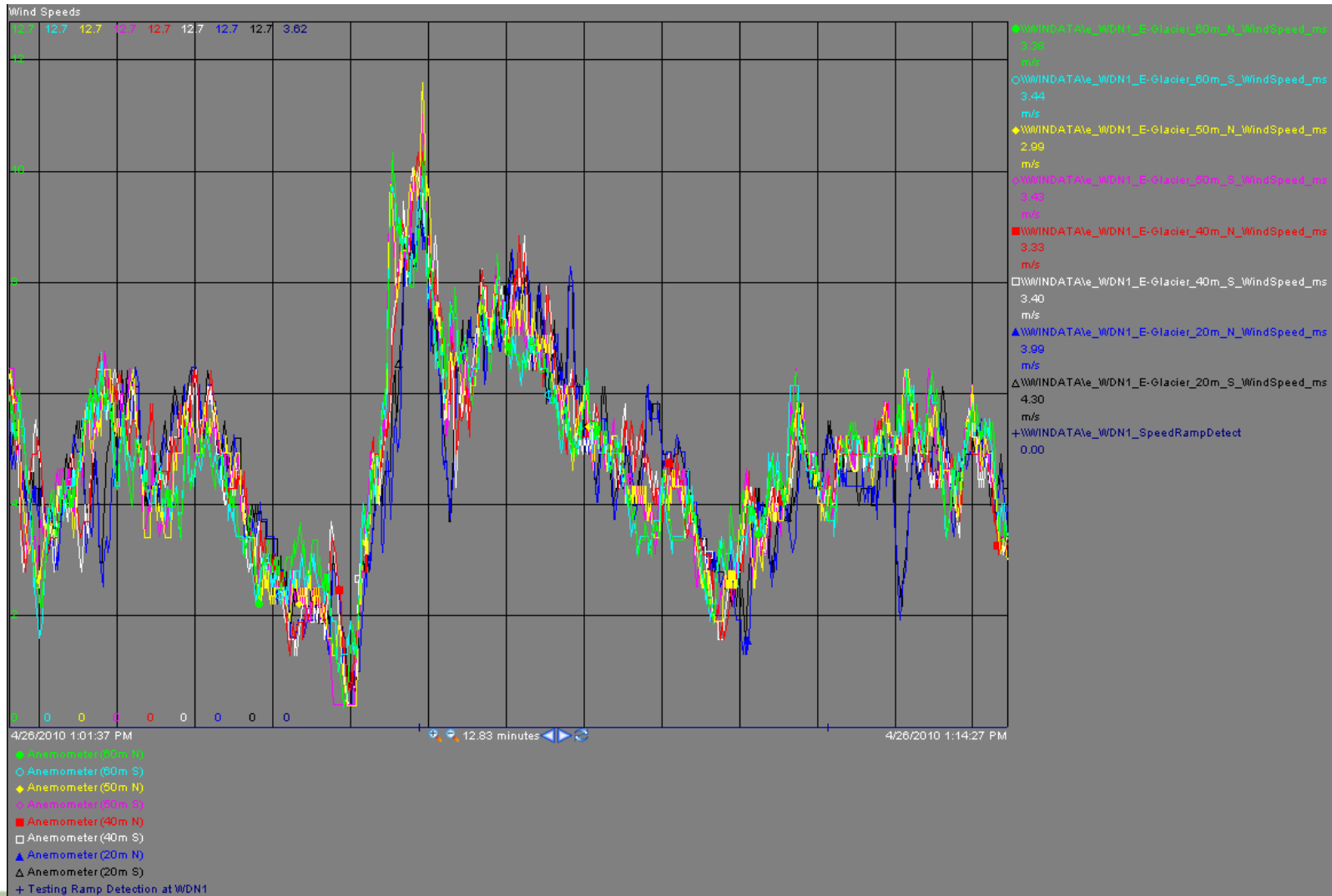
OSIsoft. UC 2010
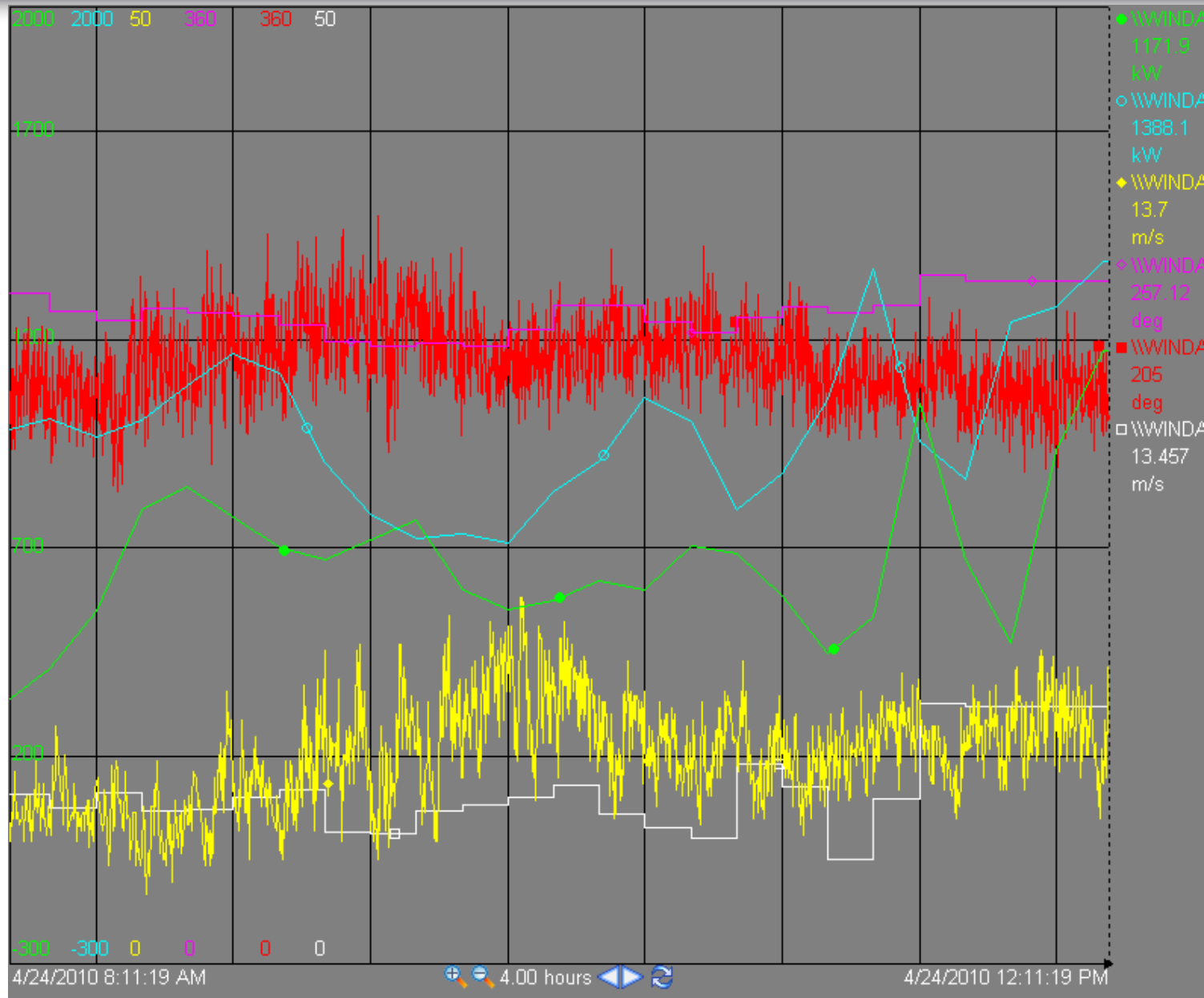
Something rampy

Direction and wind speed are very important.

Again, more analysis is required…

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Something gusty

Short term gusting behavior may have a pattern that could be tracked over time.

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Looking forward

- Upstream observations can dramatically improve forecasts (Papers by Kristin Larson, 3TIER)

- Significant interest from utilities, operators, and forecasters in short-term ramp event detection

- Applicability to other renewable resources

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Thanks & Contact

- Thanks to:
  - The Department of Energy
  - Grant participants
  - John Deere Renewables
  - Dave Roberts, Chuck Wells, Travis Fulton
  - OSIsoft
  - Transpara

- Marty Wilde
  - marty.wilde@windata-inc.com

- Gregg Le Blanc
  - gregg.leblanc@windata-inc.com

Thank you