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Wind Energy on an ISO System: Case Study

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The Daffy Duck Syndrome

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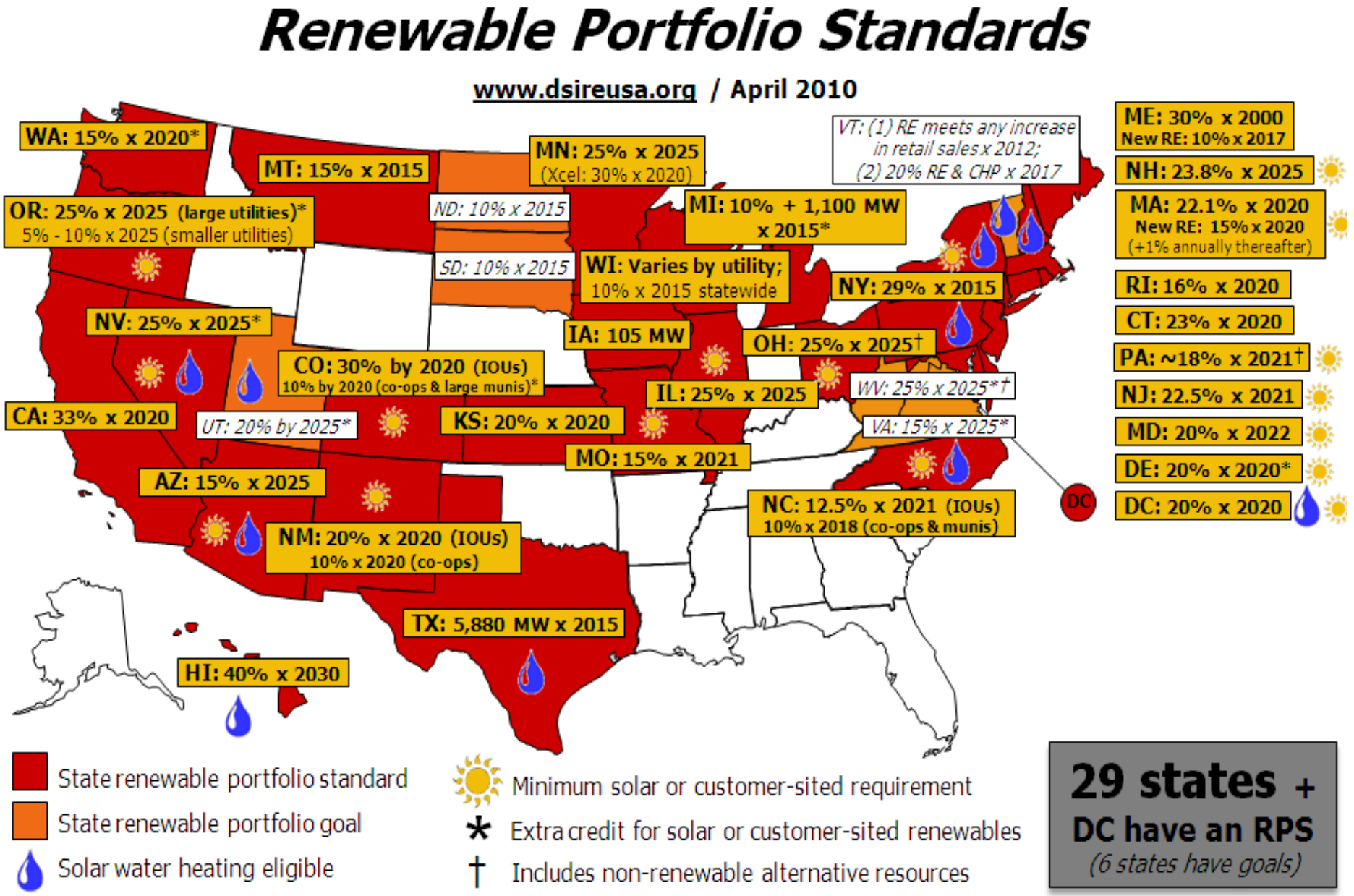
Groundswell of Government Mandates



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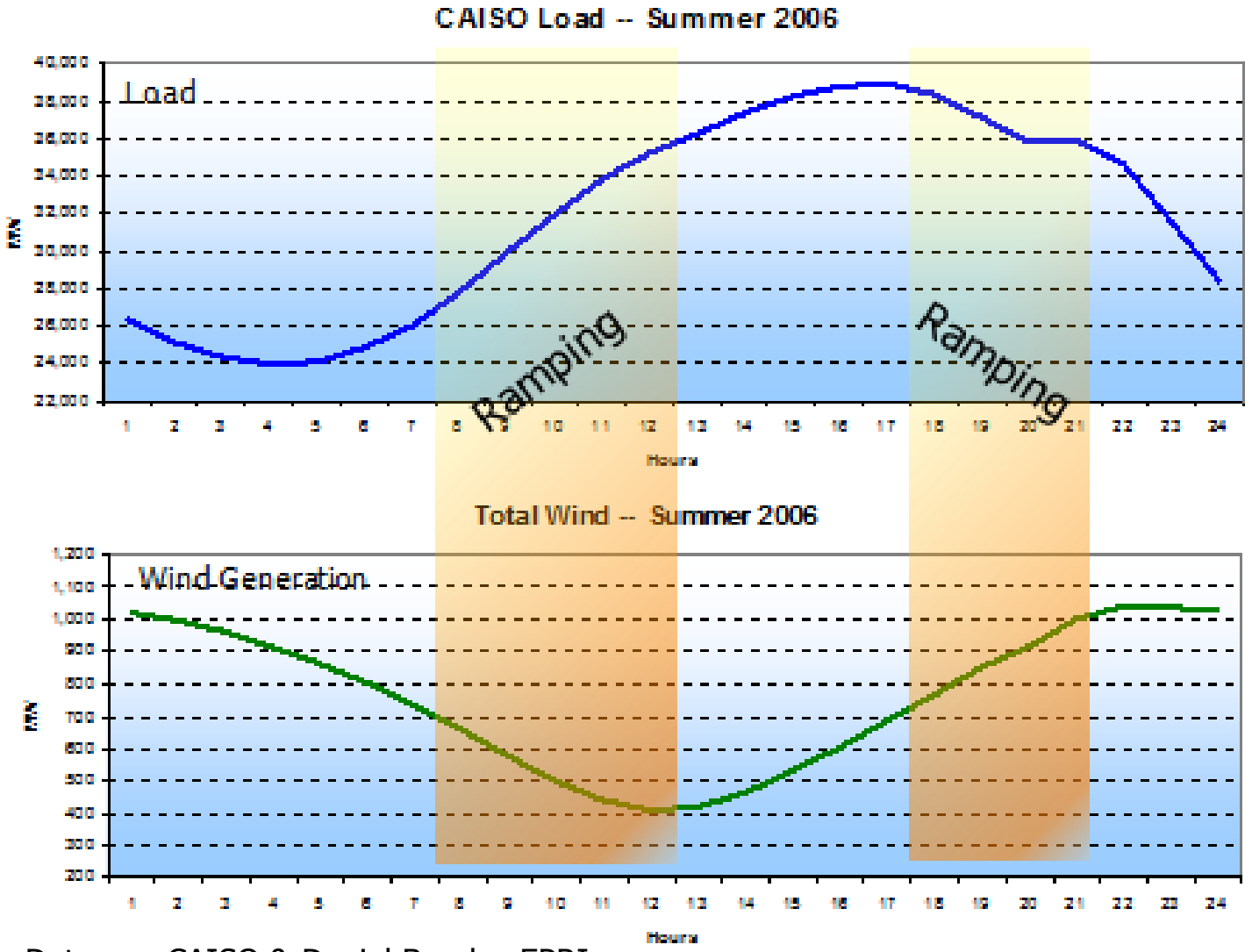
The Complicating Factor* Intermittency

Supply prediction difficulties lead to regulation, reliability and market stability difficulties



* Courtesy – Jim Detmers, CAISO & Daniel Brooks, EPRI

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The Price of **NOT** Getting it Right

- **Average Forecast Error = 35%**
- **Total Annual Wind Mandate by 2020 = 10,000 TWh**
- **35% Error = 3500 Twh**
- **Price Per Mwh = $ 40 (adjusted for inflation)**

3500 * 1000 * 1000 * $ 40 = $ 140,000,000,000

$ 140 Billion

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Cosmic Dodge Ball

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Case Study: ISO

Profile

- Non Profit
- 13 states
- 131,000+ MW of generation capacity
- Stringent renewable portfolio mandates
- 30 private wind farms

Operational Priorities

- Smooth regional flow of electricity
- Competitive wholesale energy market
- Hedging congestion via financial transmission rights
- Regional planning

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Renewable Portfolio Issues: Integration of Wind Energy

Challenges

- Wind forecasting - Variability and predictability
- Remote locations - Wind conditions at farm vs load conditions
- System flexibility - Ramping burdens

What's needed

- Situational awareness for better wind & production forecasts
- Better ramp management
- Situational view of all virtual & physical generation options
- Geospatial asset monitoring to improve capacity factors

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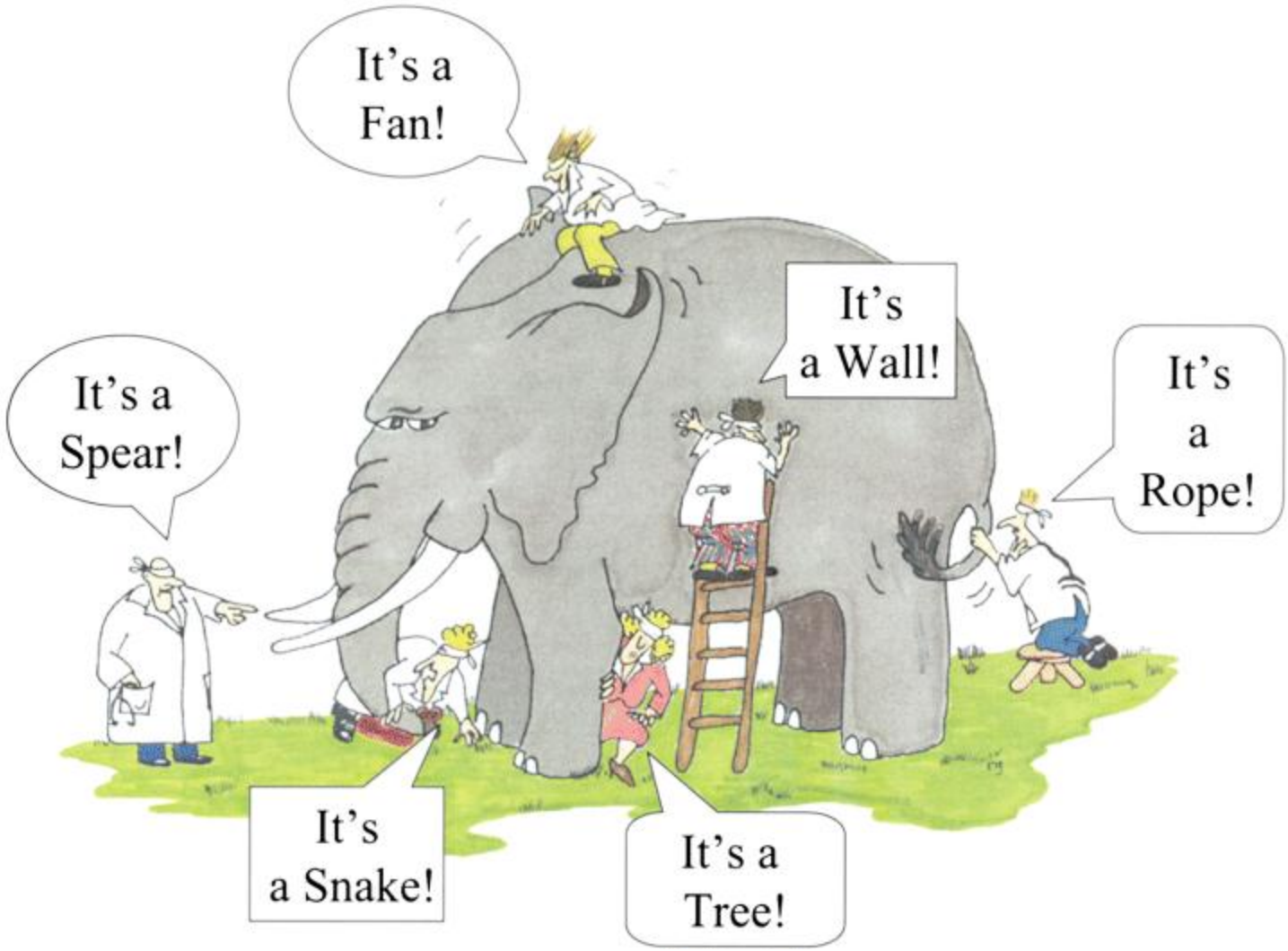
The Big Picture View



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Objectives

Situational Intelligence

- **Real-Time monitoring of grid with enhanced visualization**

Contingency Analysis

- **Optimal power flow under various conditions**

Alerts & Alarms

- **Unit commitment, dispatch, out-of-band performance**

Wind Energy Integration to Transmission Grid

- **Economical integration with decreased curtailment.**

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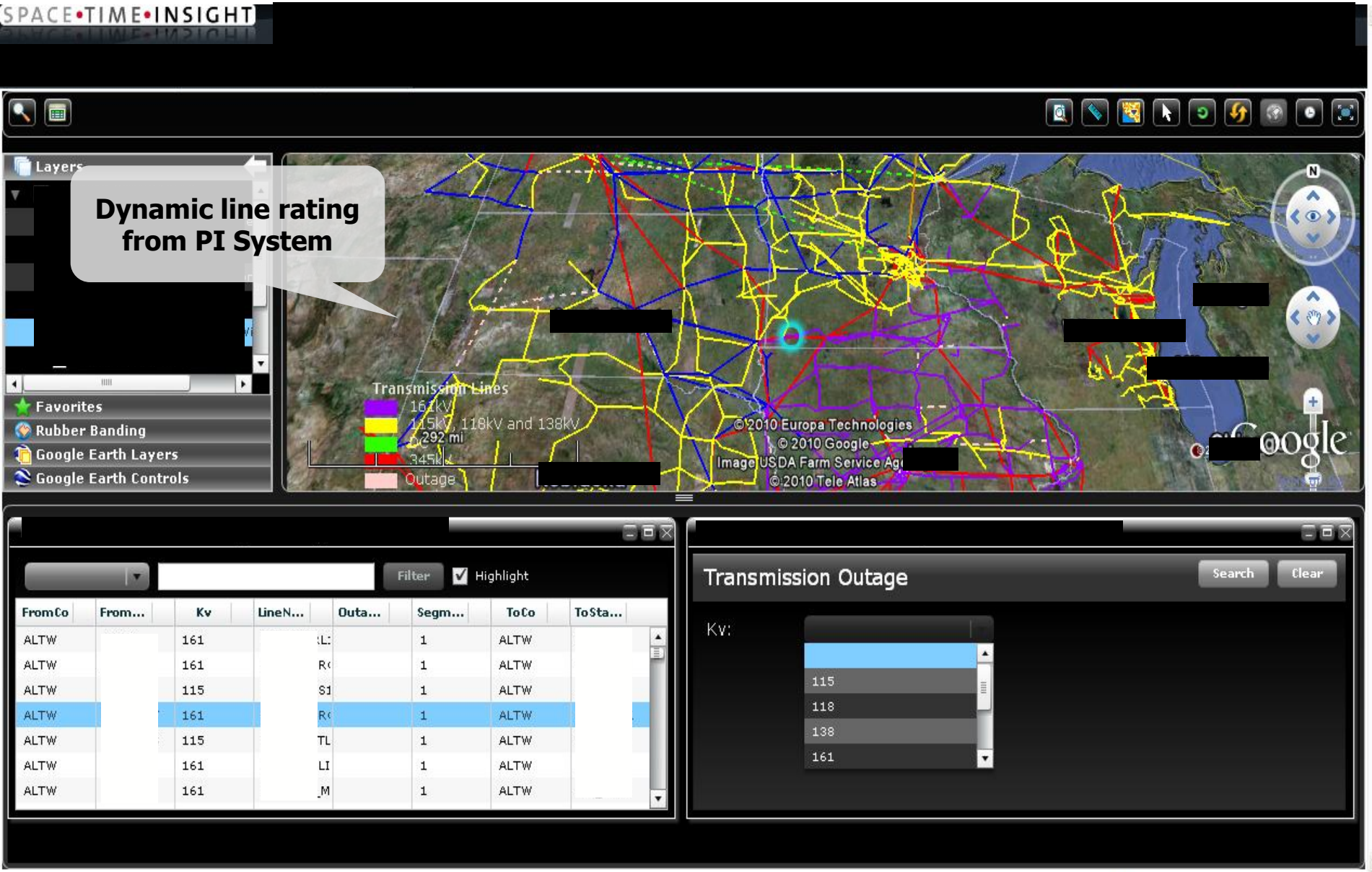
Visualization of Real-Time Transmission Line Rating



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The PI System

To make this work reliably, the PI System is …

- The system of record
- Real-time data and event infrastructure
- Repository for all time-series data

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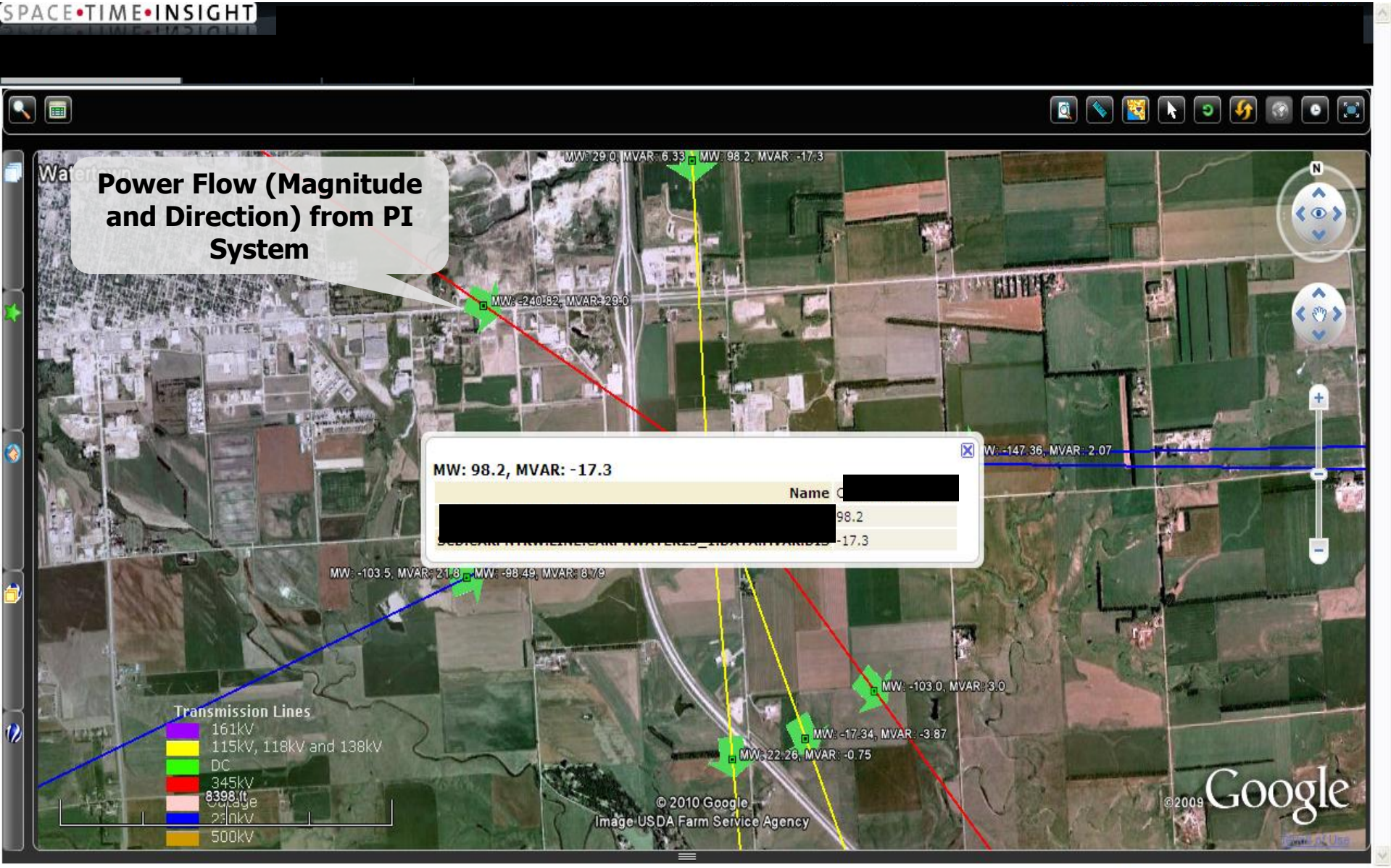
Real-Time Power Flow Visualization



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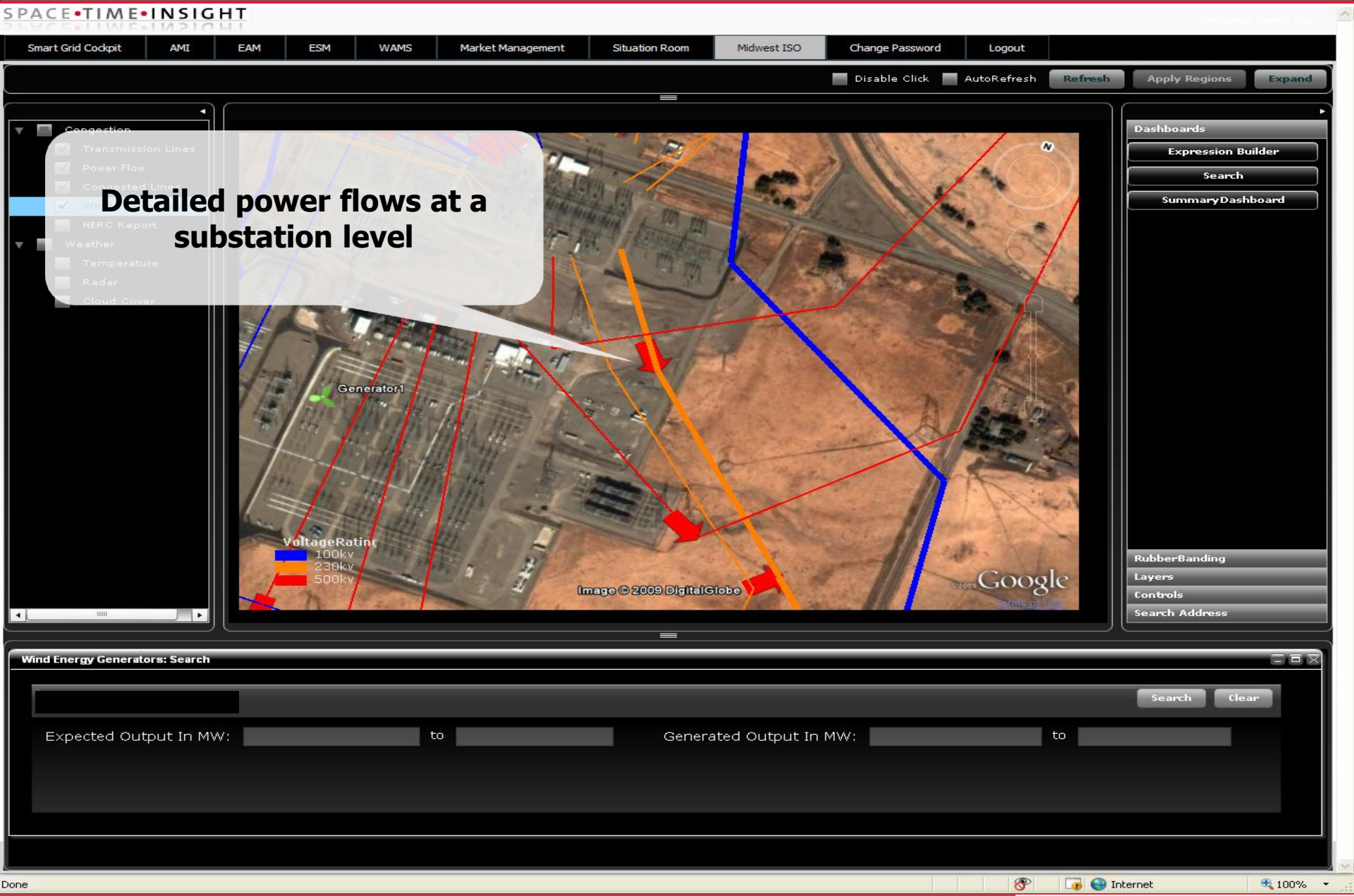
Grid Integration - Detailed Visualization



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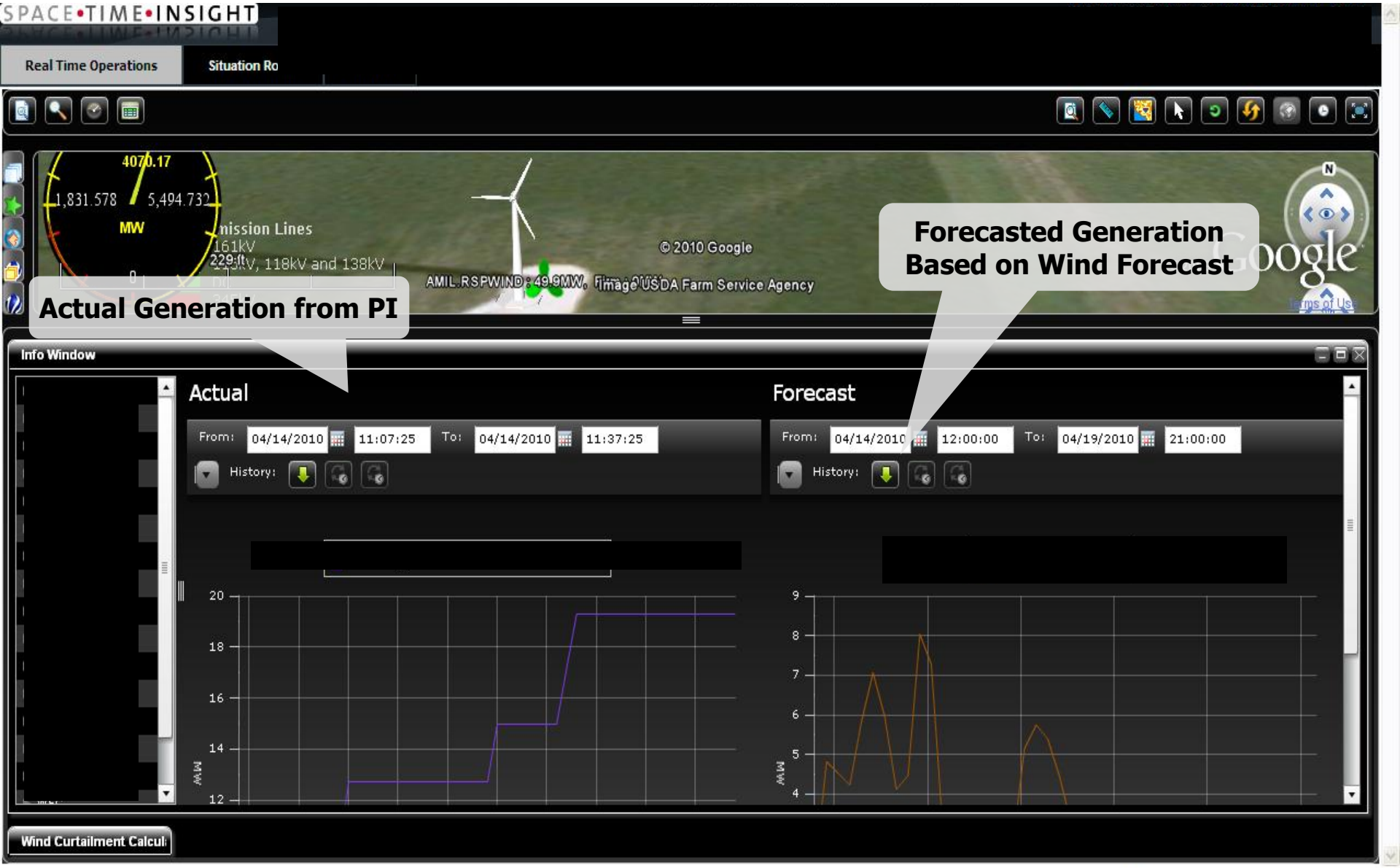
Wind Generation – Forecast Vs Actual



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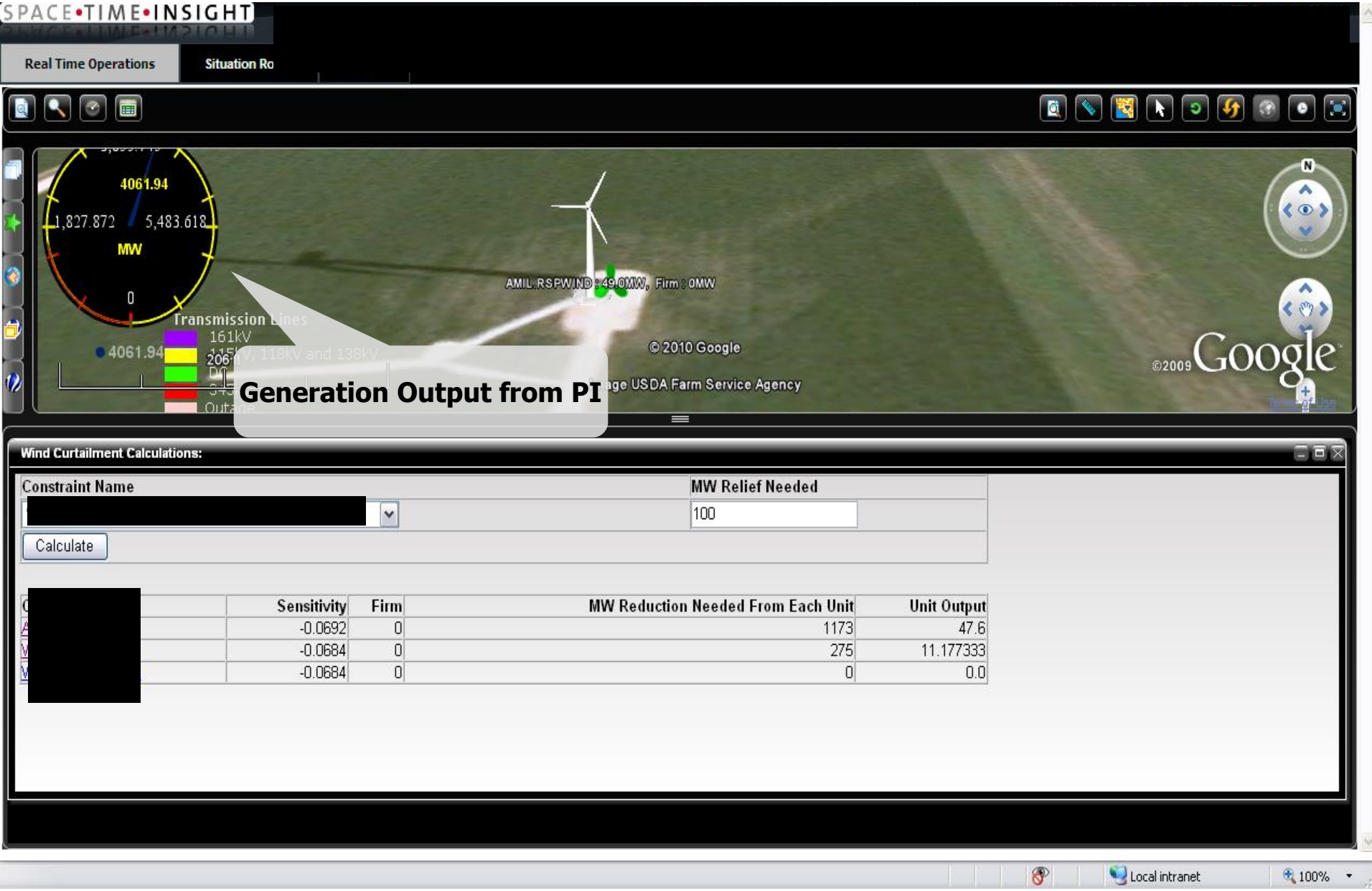
Wind Curtailment



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Generation Imbalance and Reserve Calculations

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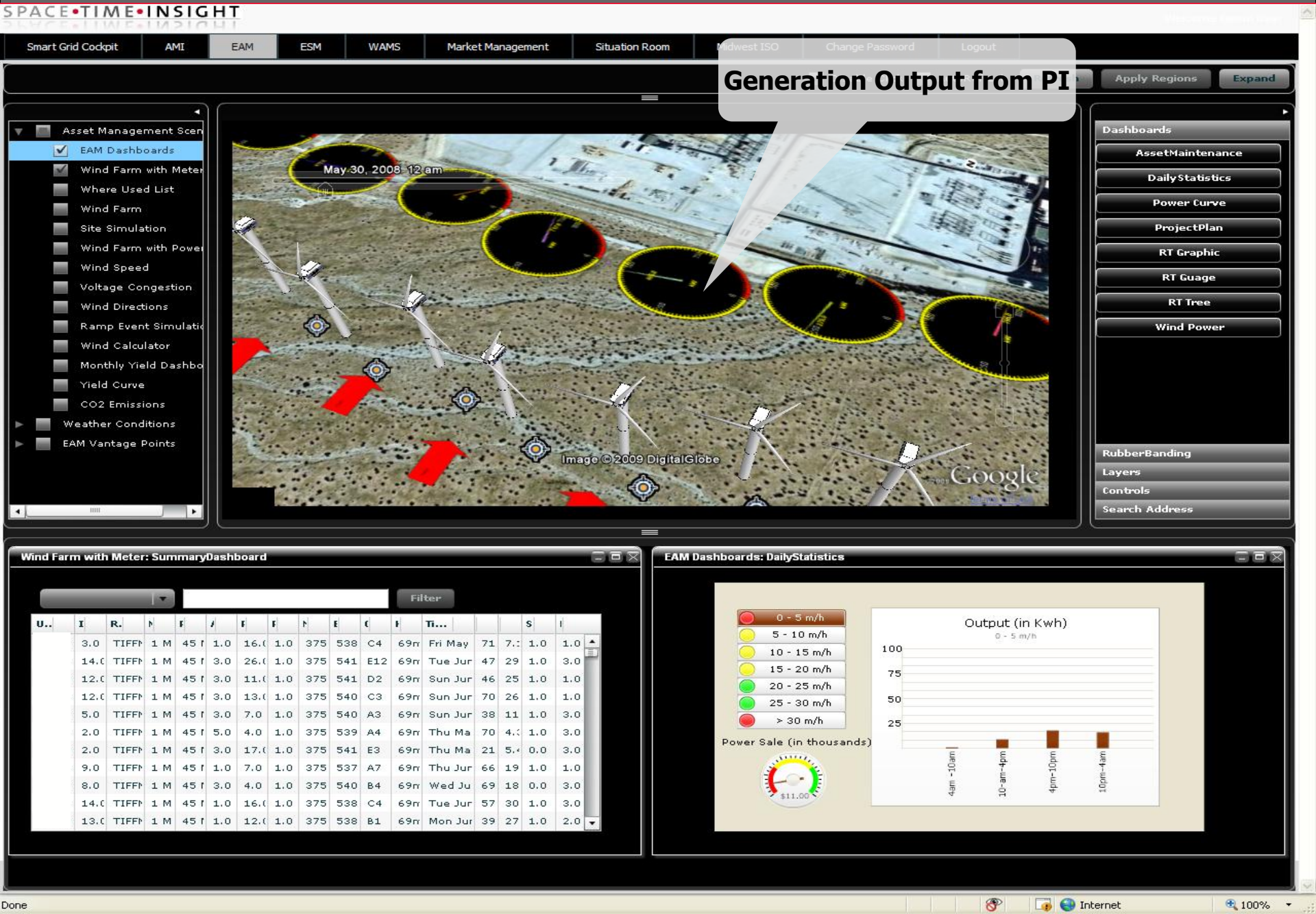
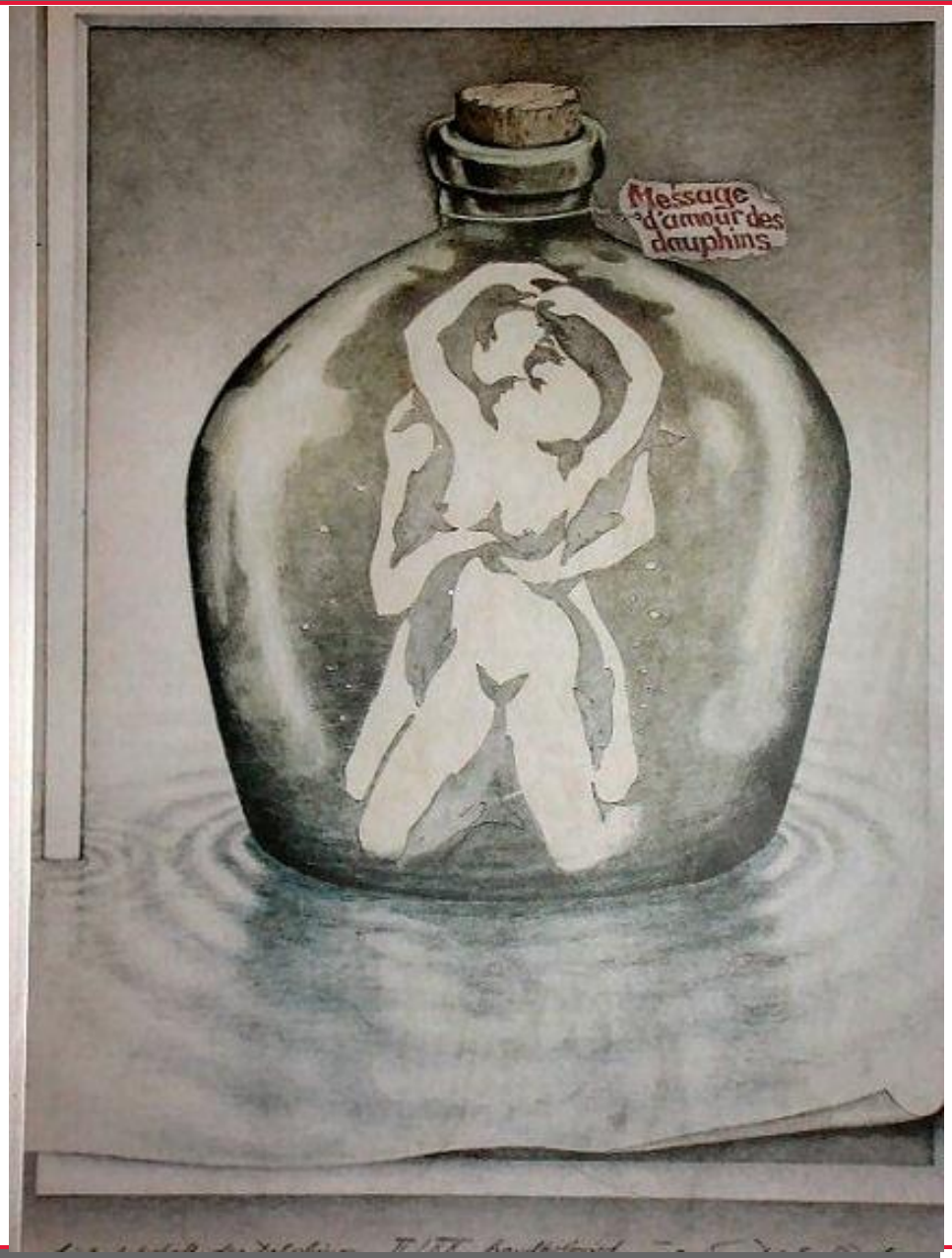
Generation Forecast – Aggregated and Unit Simulation



Visual Bias



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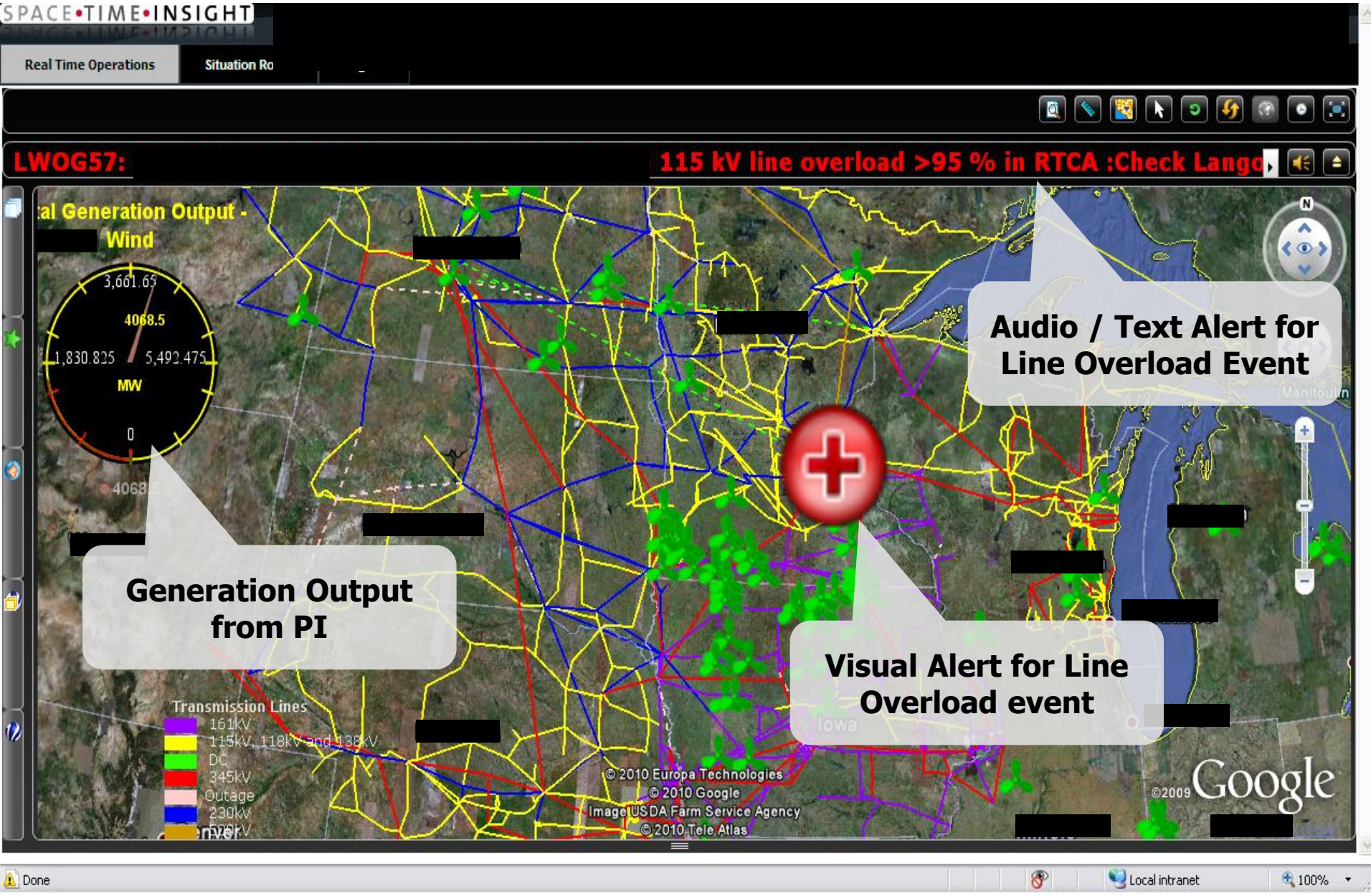
Alerts: System Intact, Prior Outages , Pre-Contingency Conditions



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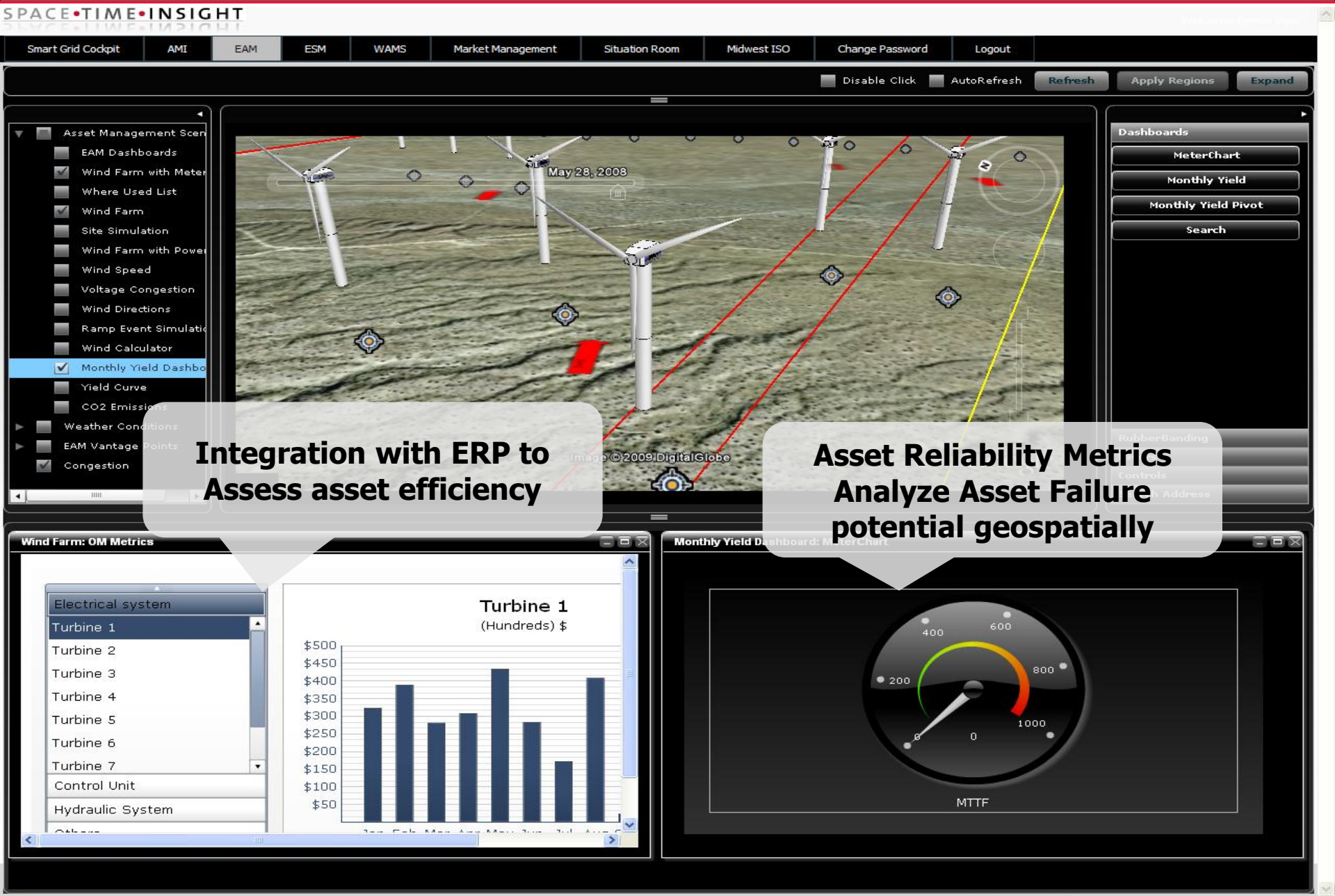
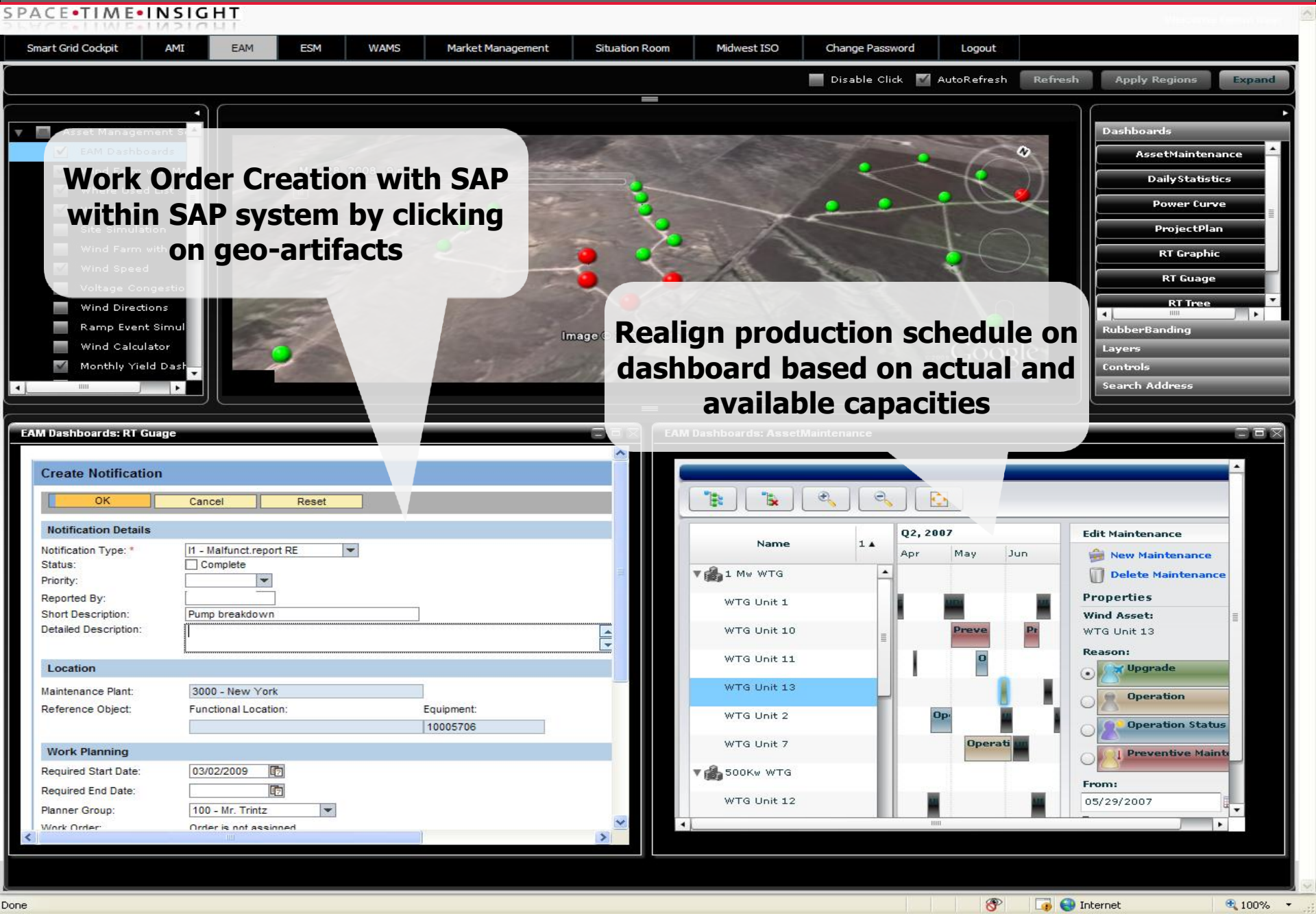
Renewable Assets – Operations



Asset Management

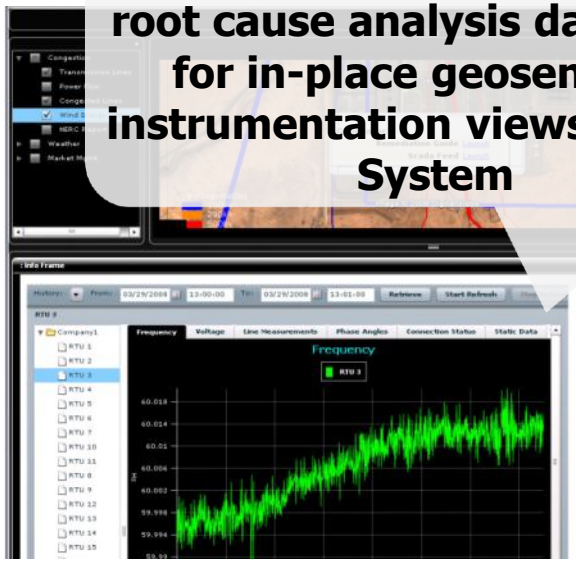


Reports

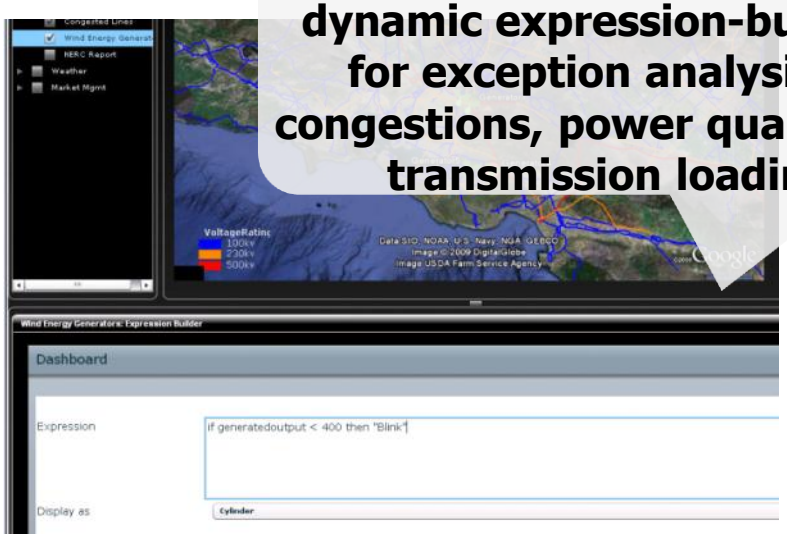
Capacity assessments yield curve, capacity factor, actual vs. forecast assessments

Historical contingencies transmission congestion, power flow visualization, substation telemetry

Root cause analysis SCADA, root cause analysis dashboard for in-place geosensitive instrumentation views from PI System



Exception management dynamic expression-building for exception analysis of congestions, power quality and transmission loading



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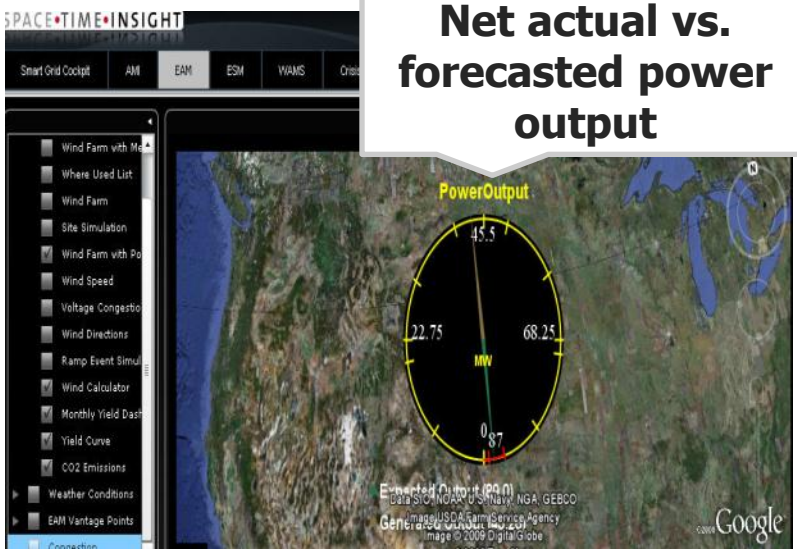
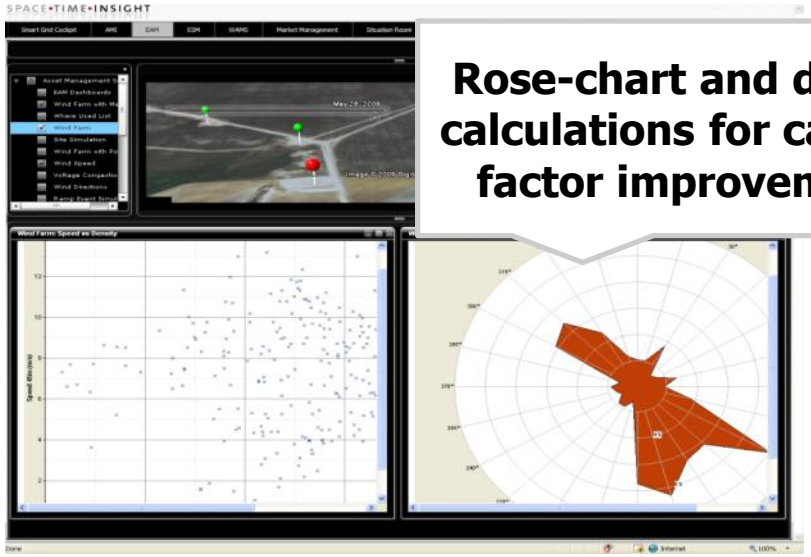
Reports

Net actual vs. forecasted power output



Monthly generated output report

Rose-chart and density calculations for capacity factor improvements



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Real Benefits

- **Economical integration** of renewable energy
- Operational & market **impact assessment**
- Better production forecasts **improved reliability and stability**
- **Better carbon footprint** management
- **Tracking** renewable portfolio and energy efficiency **goals**
- **Peak load reduction** through better renewable usage
- Improved flexibility in **balancing generation** portfolio
- Faster **ramp response** times
- **More renewable energy** to market - **faster, lower cost**

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Thank You !

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