OSIsoft® UC2010

Real Time Information — Currency of the New Decade

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Enterprise Integration of Operational Data from Wind Farms

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John Deere Renewables

Contents

- Overview of John Deere Renewables
- Operational Goals & Challenges
- Options & Alternatives for Data Integration
- Issues to Consider
- Examples / Demo of the JDR EMS
- Realized Benefits
- Lessons Learned

John Deere Renewables - Overview

A business unit within Deere & Co.

Headquartered in Johnston, Iowa

Developers, owners, financing partners, constructors, and operators of mid-sized wind farms

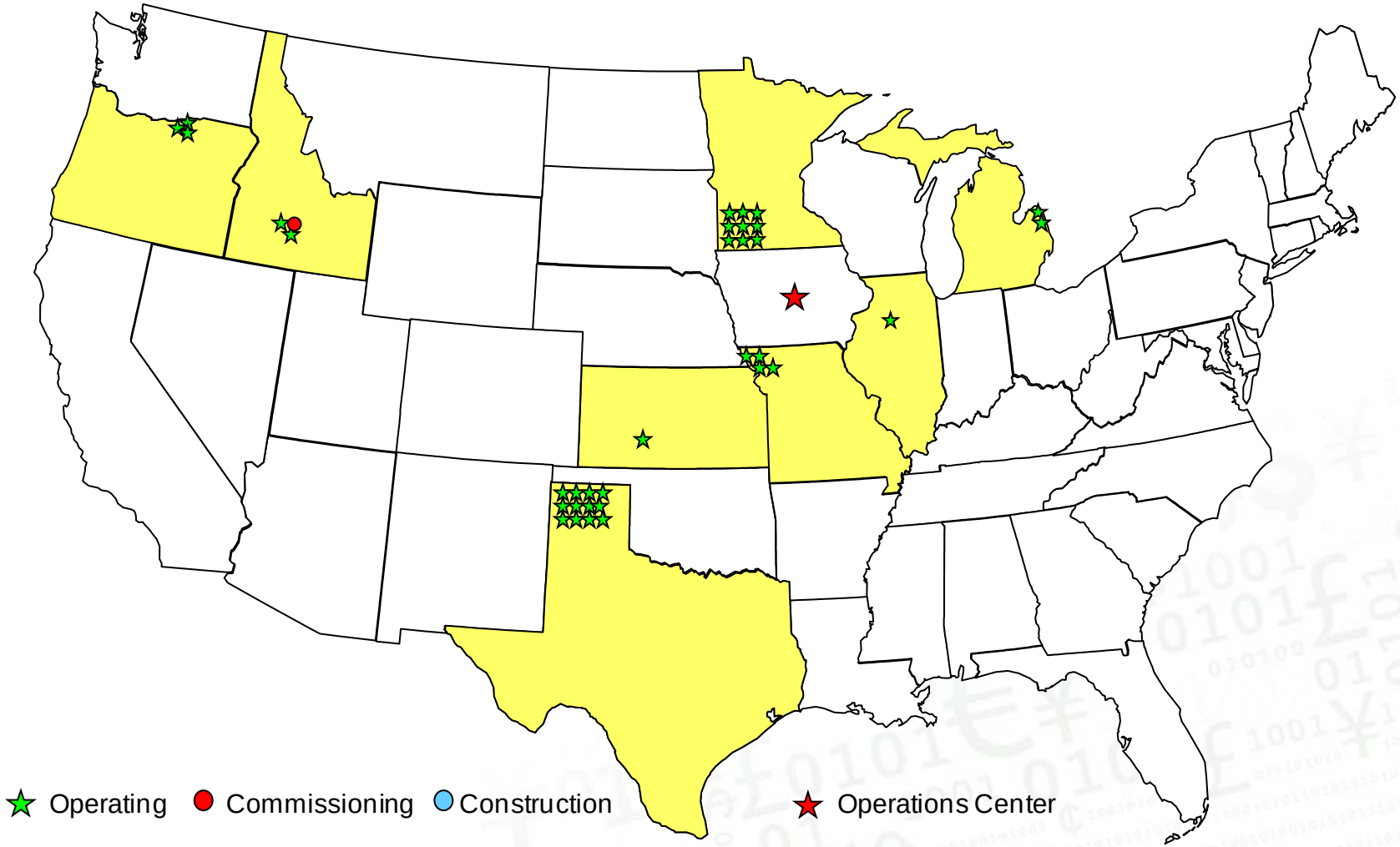
- Started in 2005 with community-based wind, tied to the landowners
- Current fleet:
  - 700+ MW of installed generation capacity
  - Over 400 turbines
  - 37 farms
  - 8 U.S. states

Overview (con't.)

- Operating assets include turbines as well as Balance-of-Plant equipment (transformers, meters, breakers, etc.)
  - S64
  - S88
  - V82
  - SLE1.5
  - MM92
  - SEL

- Each manufacturer has their own SCADA imbedded

JDR – Project Locations



Operational Goals & Challenges

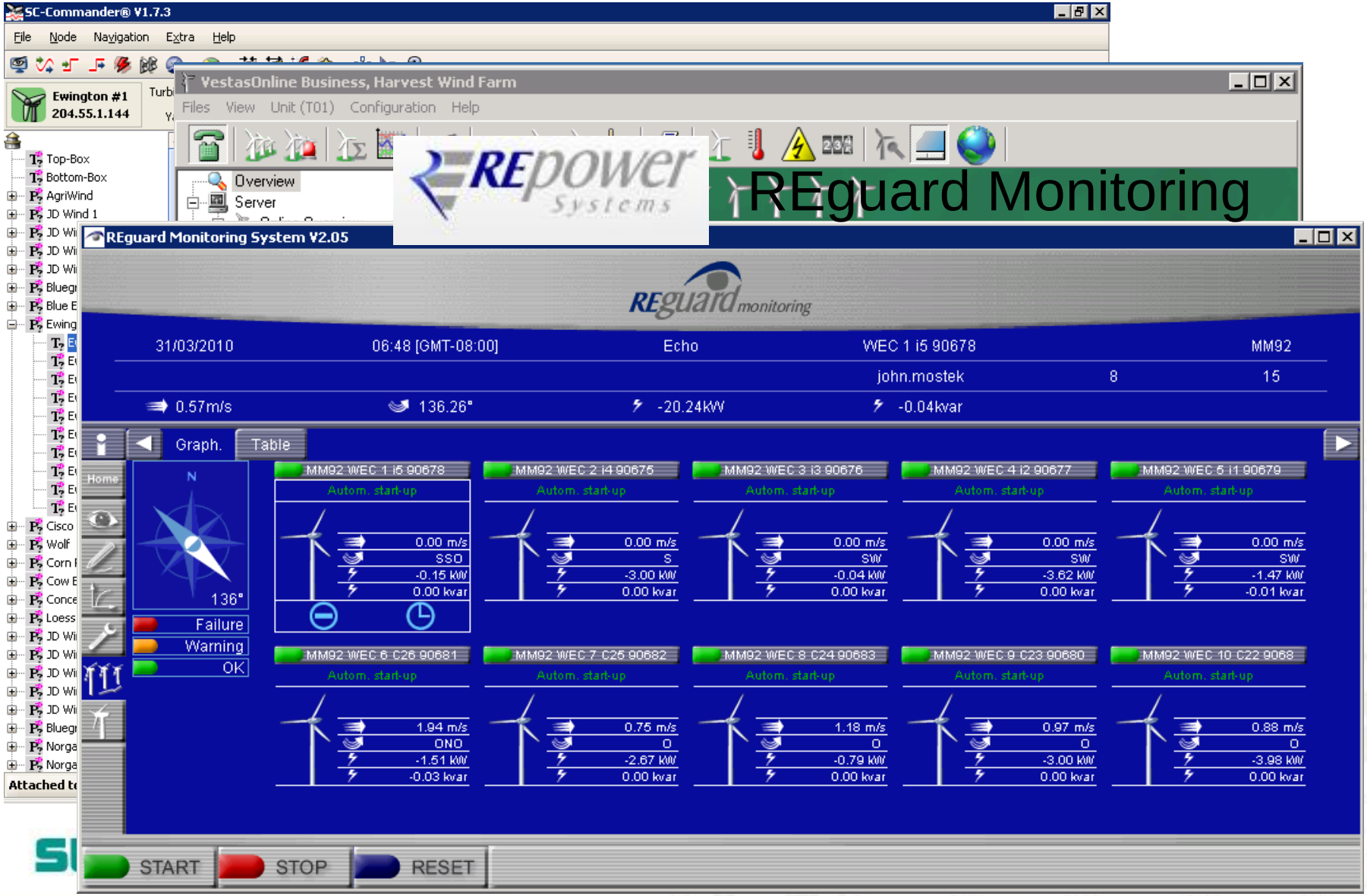
Goal: Maximize power generation, while maintaining safe & reliable operation over the project life

- We sell every kW produced
- Turbine uptime (i.e. availability) is important, but so is the wind
- Concept of Energy Capture – a capacity utilization metric

Challenge: How to utilize data to gain operational awareness on many multiples of similar assets that are installed across a wide geographic distribution?

Options & Alternatives

1. Use manufacturer's supplied SCADA systems
   - Purpose-built as HMI to operate turbines (PLC interface)
   - Each system is unique
   - Limited capabilities for data visualization, especially at the macro (enterprise) level
   - No means to historize "real-time" data



Options & Alternatives (con't.)

2. Create custom-built relational database
   - Resource-intensive
   - Specialized skill set

3. Deploy off-the-shelf, 3rd party data historian
   - Functionality right out of the box
   - Customizable for specific content
   - Extensible for future needs

Solution

3. Deploy off-the-shelf, 3rd party data historian
   - PI system met Deere's functional requirements
     - Integration of all data sources from wind farm operations into one common platform =

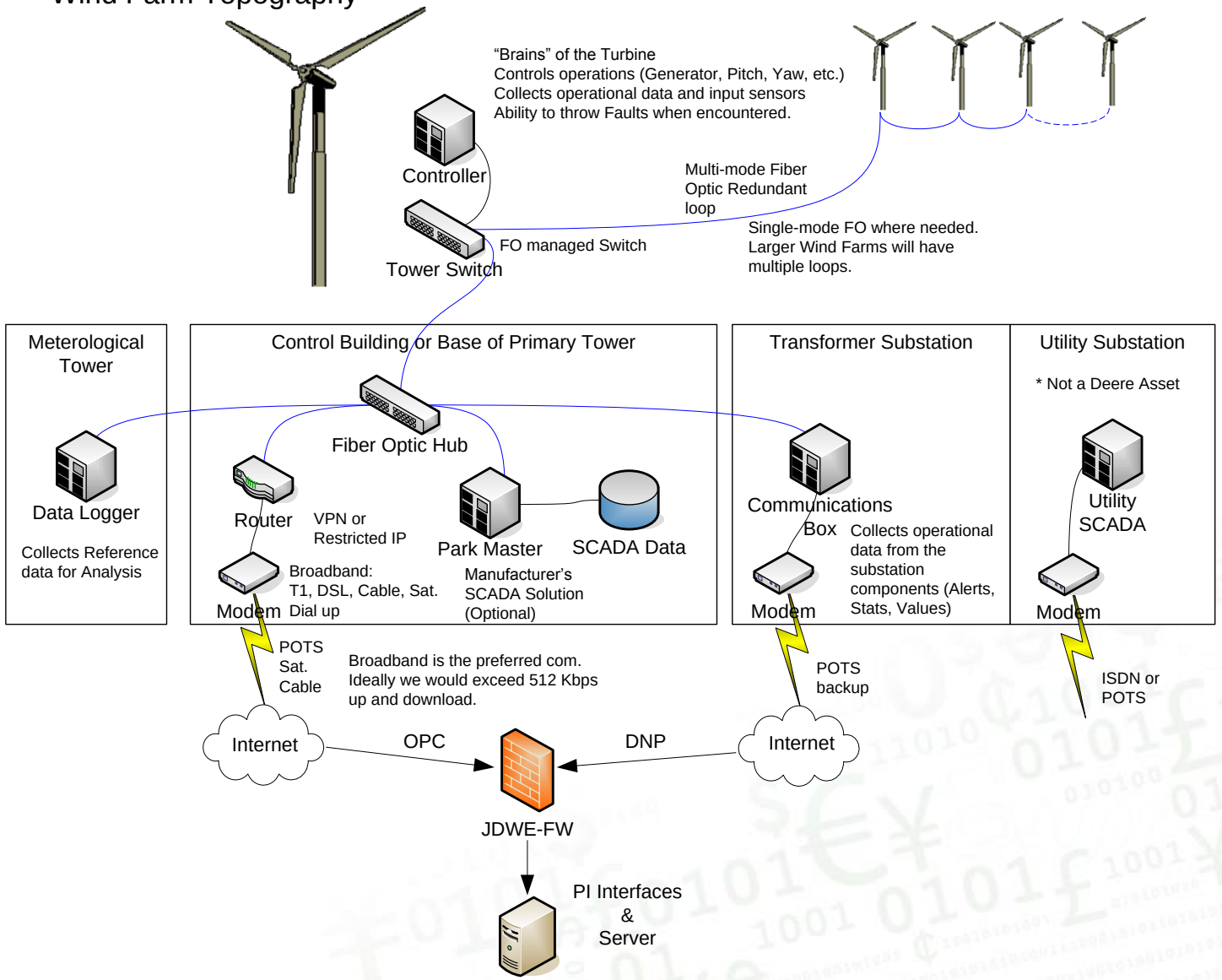
       Enterprise Management System
     - Historization of real-time data over the 20-year lifespan of the assets
     - Customizable data visualization
     - Scalability to easily incorporate growth

Issues to Consider

1. Architecture – centralized vs. distributed
   - Our initial approach was to centralize interfaces and a single PI server
     - Minimize field deployment of hardware
     - Licensing considerations
     - Requirements for network & data security
   - We ended up with a hybrid model

** Consider limitations posed by network & communications infrastructure deployed in remote areas

Wind Farm Topography



Issues to Consider (con't.)

2. How much / what kind of data to collect
   - Understand the inherent restrictions on what the equipment suppliers can & will allow
     - Costs of programming, equipment needed for data concentration
     - LAN and WAN traffic – bandwidth
   - Adoption of / adherence to standardized communications protocols (e.g. OPC, DNP, Modbus)
   - Recommend close collaboration with suppliers as <u>strategic partners</u>

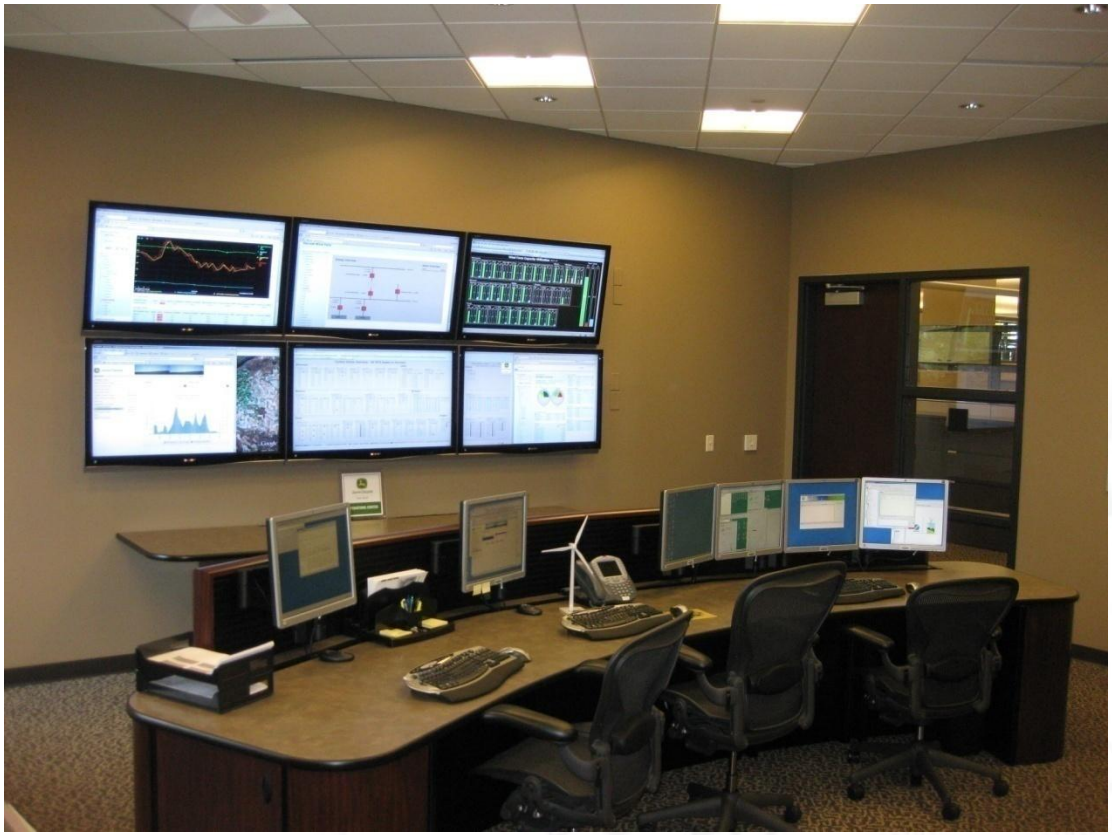
Issues to Consider (con't.)

3. What to do with all that data?
   - Dashboards can provide context to key performance indicators
   - Transformation from "noise" to actionable intelligence

   ➢ JDR Enterprise Management System

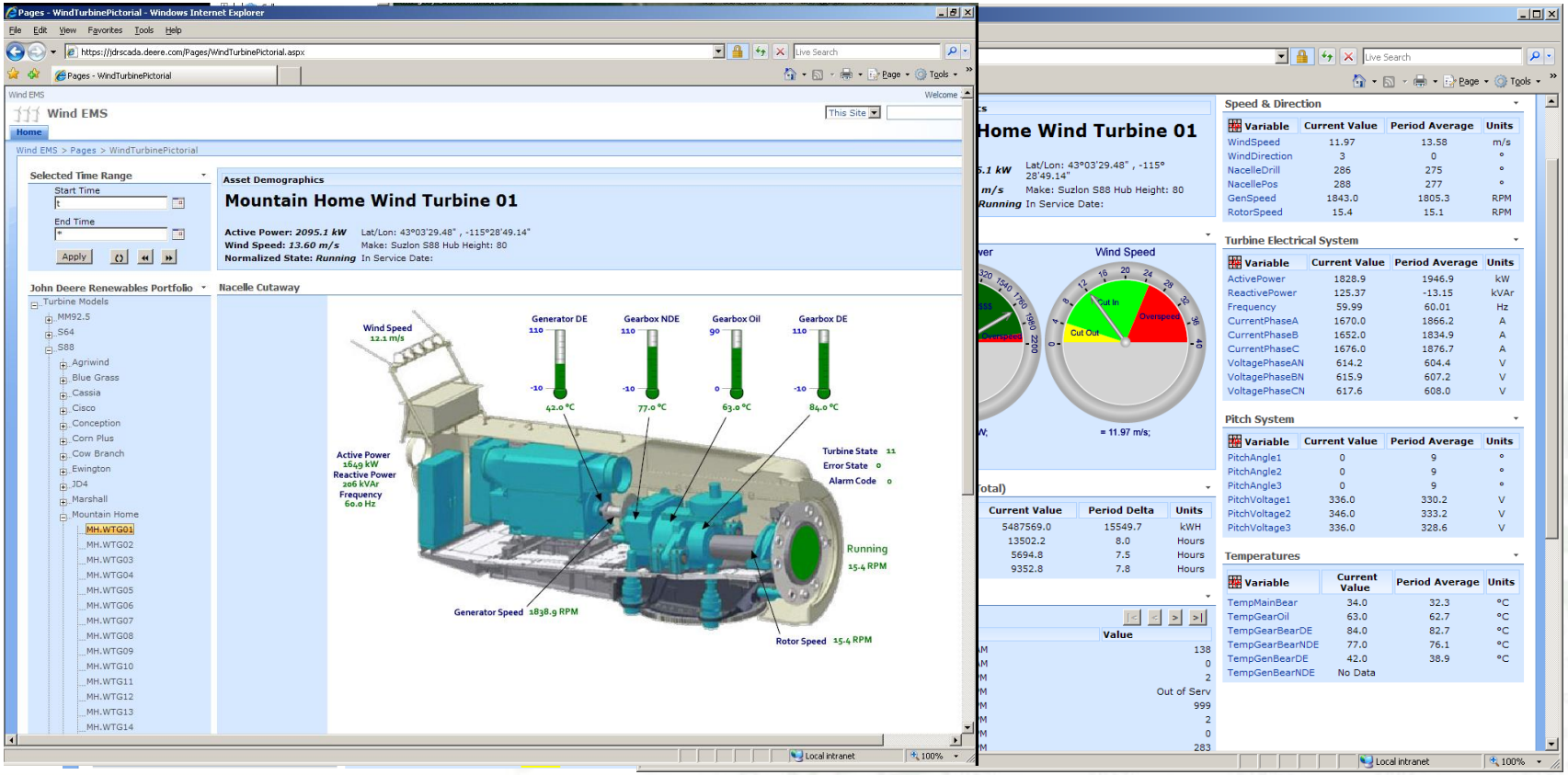
JDR Enterprise Management System

PI is the foundation on which our EMS is built, and is the basis for dashboards monitored in our Operations Center



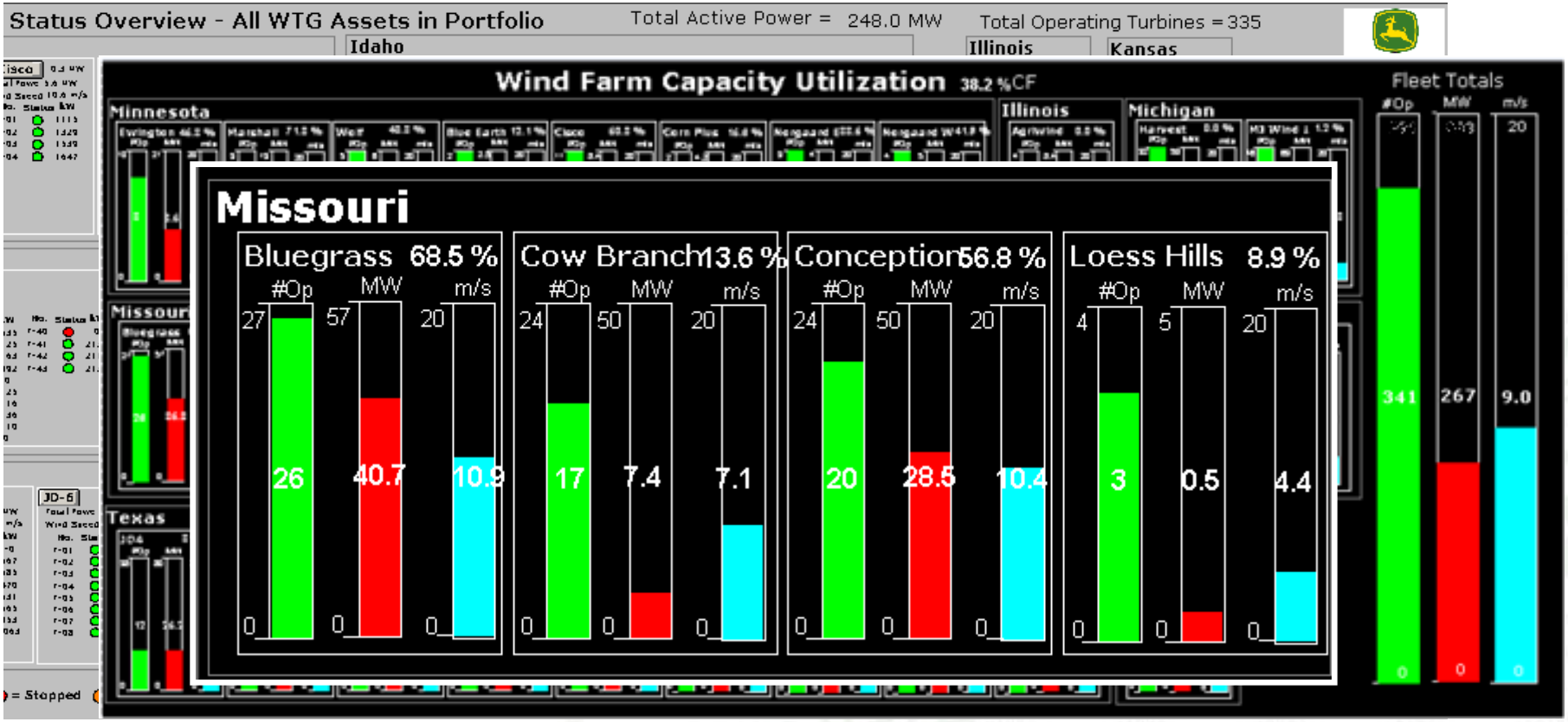
JDR EMS - Examples

Dashboards – displayed in SharePoint portal environment on intranet, using PI WebParts



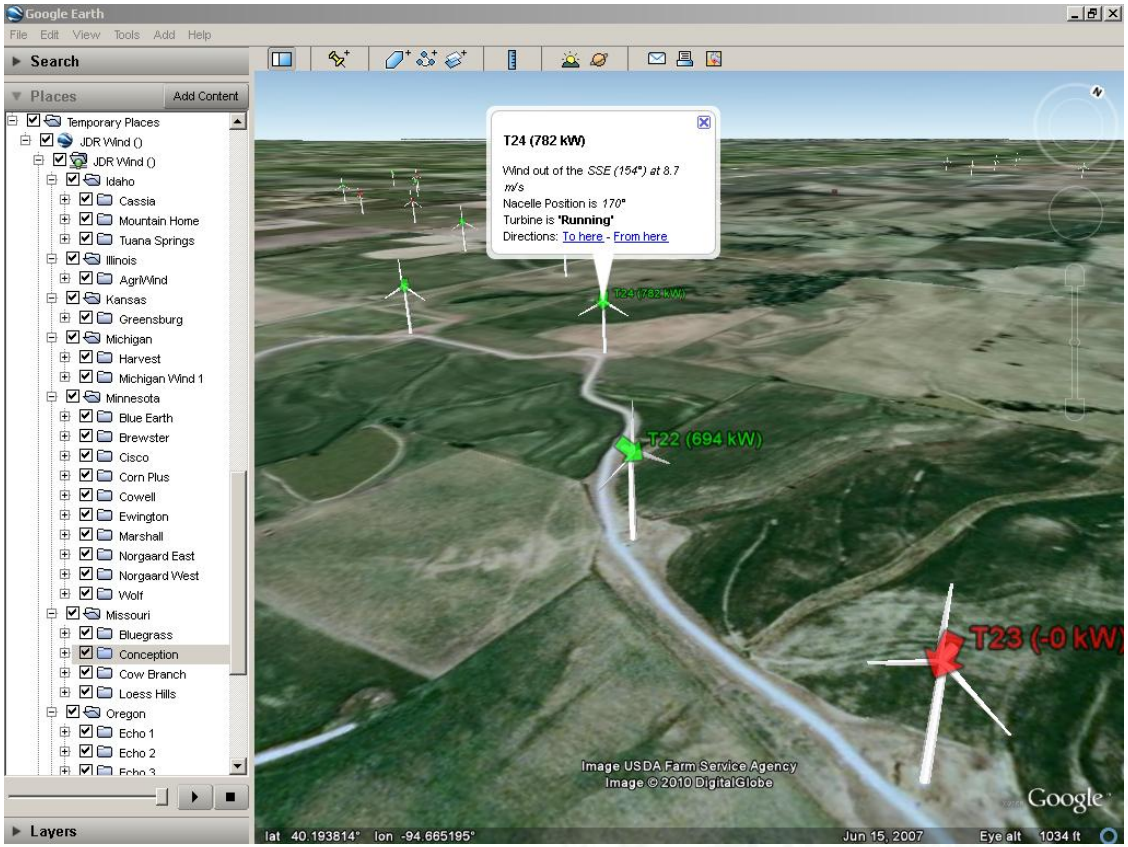
JDR EMS - Examples

Real-time status displays – using PI ProcessBook rich client application



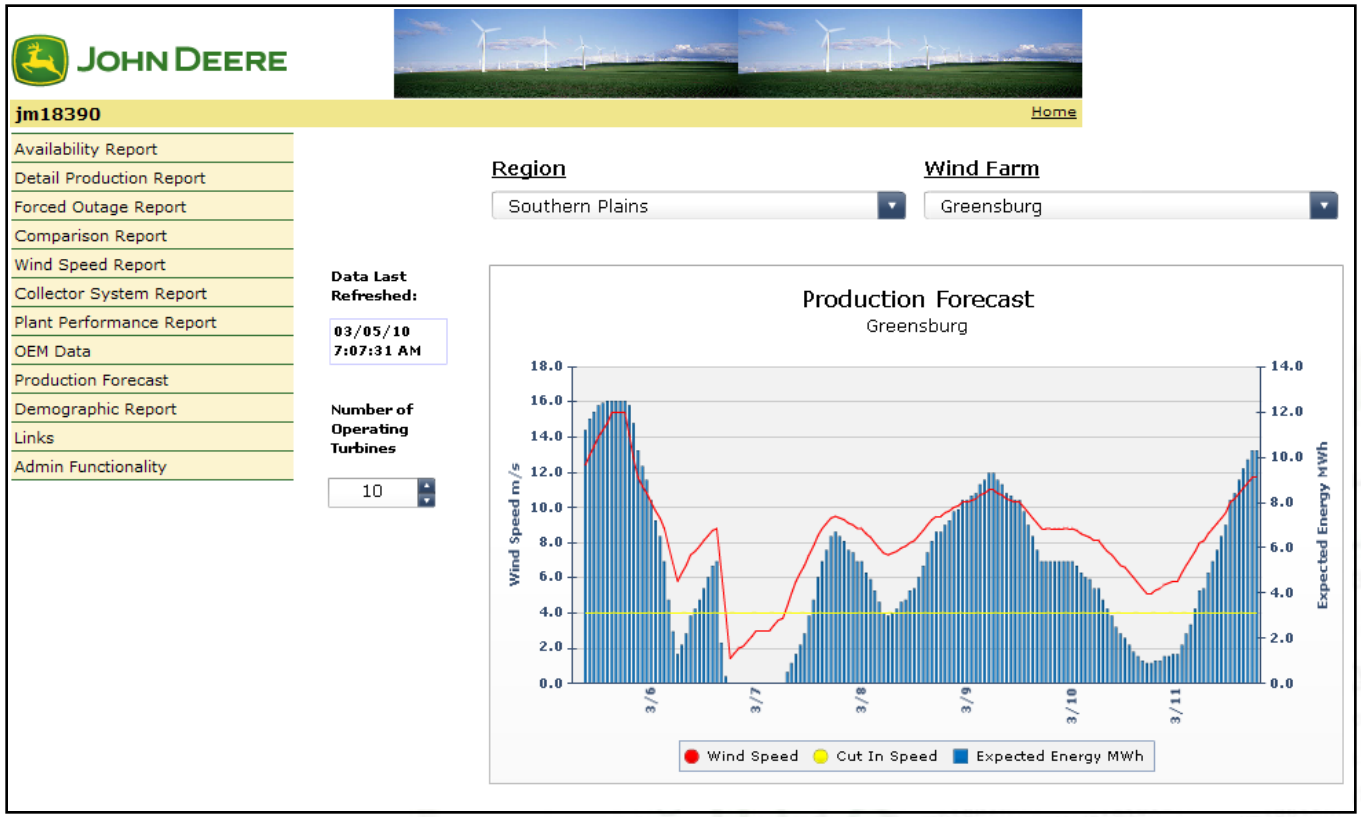
JDR EMS - Examples

Geospatial context – customized code to overlay real-time PI data in the Google Earth environment



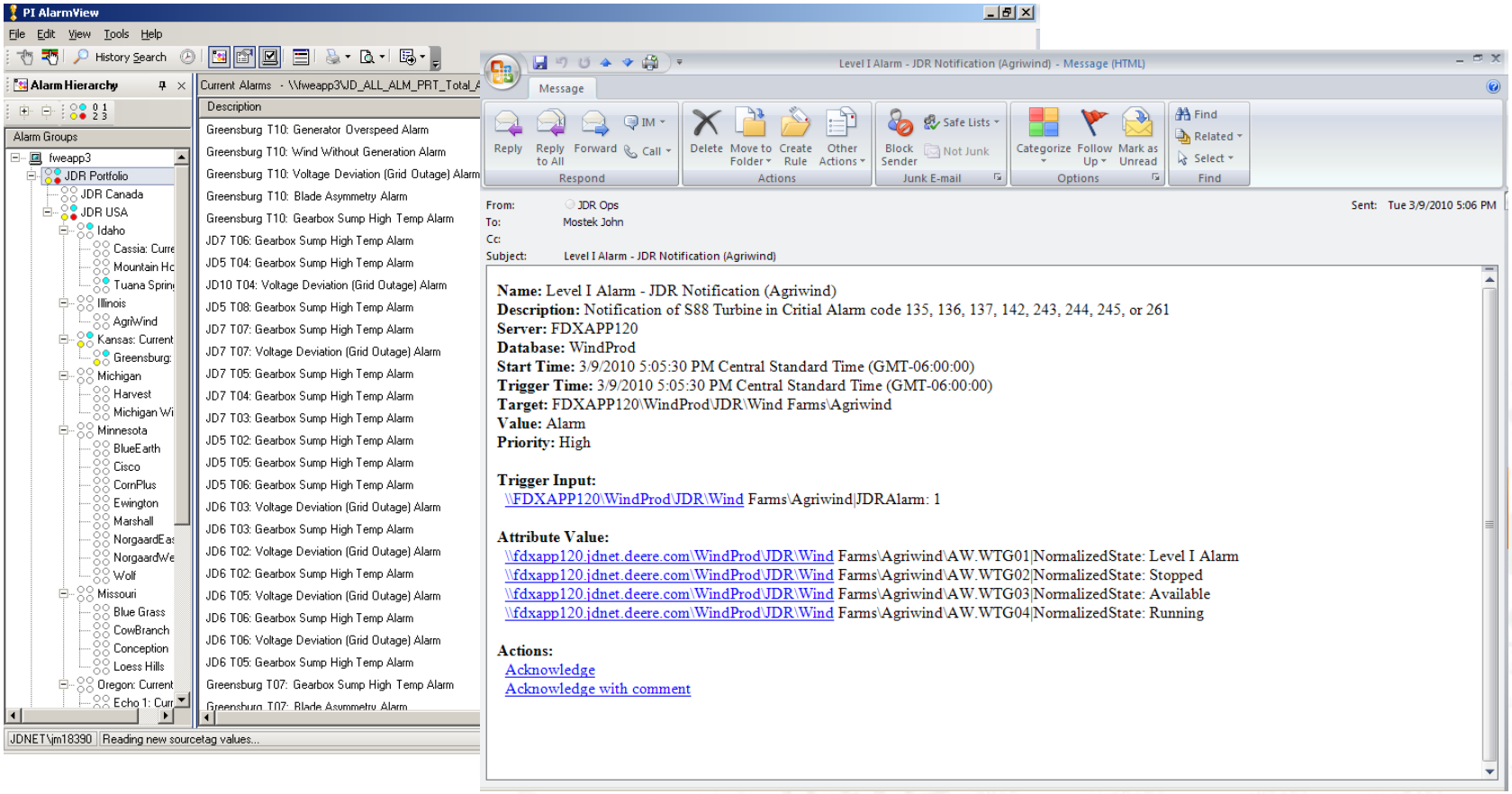
JDR EMS - Examples

Production Forecasting – combine web services with PI data queries, served up in Business Objects using Flash



JDR EMS - Examples

Other OSIsoft applications in use – Alarms & Notifications



JDR EMS - Examples

3rd Party access to data – multiple external consumers of information

- Real-time operational data to offtakers (PI-to-PI)
- Time-averaged data periodic transfer via web services or secure FTP
- External web portal access for minority stakeholders

Benefits

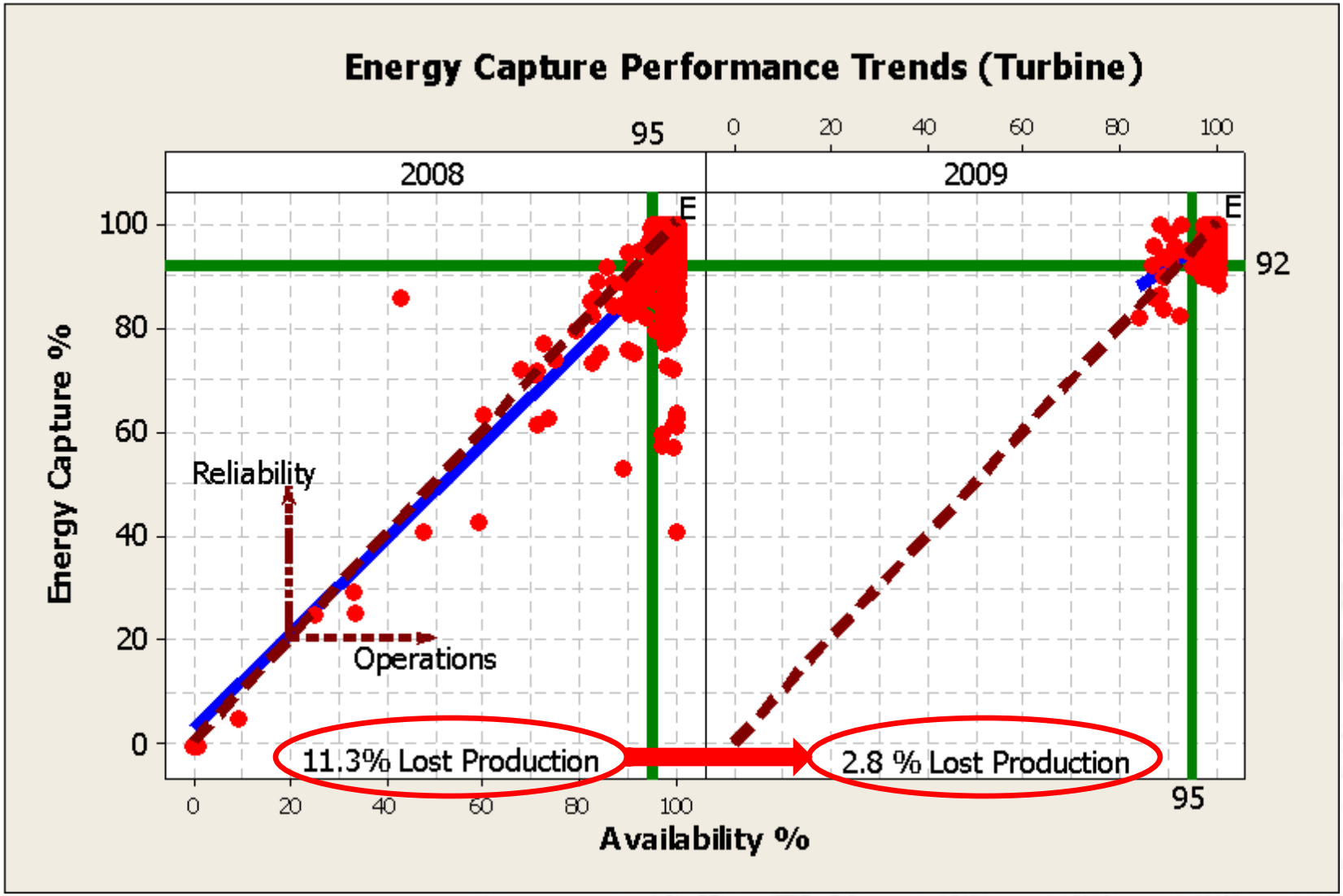
- Data fit within a consistent Enterprise platform
- Use of templates / AF hierarchy structure = rapid integration of new project sites
  - Leverages existing sources of Metadata (project Demographic info)
  - Extensive library of off-the-shelf interfaces available from OSI
- Future data sources become an easy fit
  - Condition-based monitoring
  - Met Towers
  - Substation devices (voltage regulation, capacitor banks, curtailment & power regulation)

Benefits (con't.)

Top-line impact of Operational Awareness

- 77% improvement across our fleet in Energy Capture performance metric within first 6 months of PI roll-out
  - Drives revenue
  - Beyond warranty coverage for Turbine Availability
- Actions and results are based on facts (data)

Case Study – Driving Production Improvements



Lessons Learned

- A skilled 3rd party integrator can help get you up and running quickly …

  DLL Solutions, Inc.
  The Process Information Specialists

  … but, you should also consider concurrently developing in-house talent (for long-term support)
- Close collaboration with your suppliers is key
  - Each system is unique and purpose-built
  - Helps to define requirements / expectations up front
  - Access to technical resources (i.e. programmers & software developers, not sales)

Lessons Learned (con't.)

- Define strategies for architecture, data structure, templates, tag naming convention, etc. early on in the process
- Have the end consumer(s) of the data in mind, or at least plan for the unknown
- Treat your data as another operating asset
  - Systems require ongoing maintenance and attention
- Sometimes the hardest part is starting
  - Data not collected today is data lost forever!

Questions?

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Thank you