

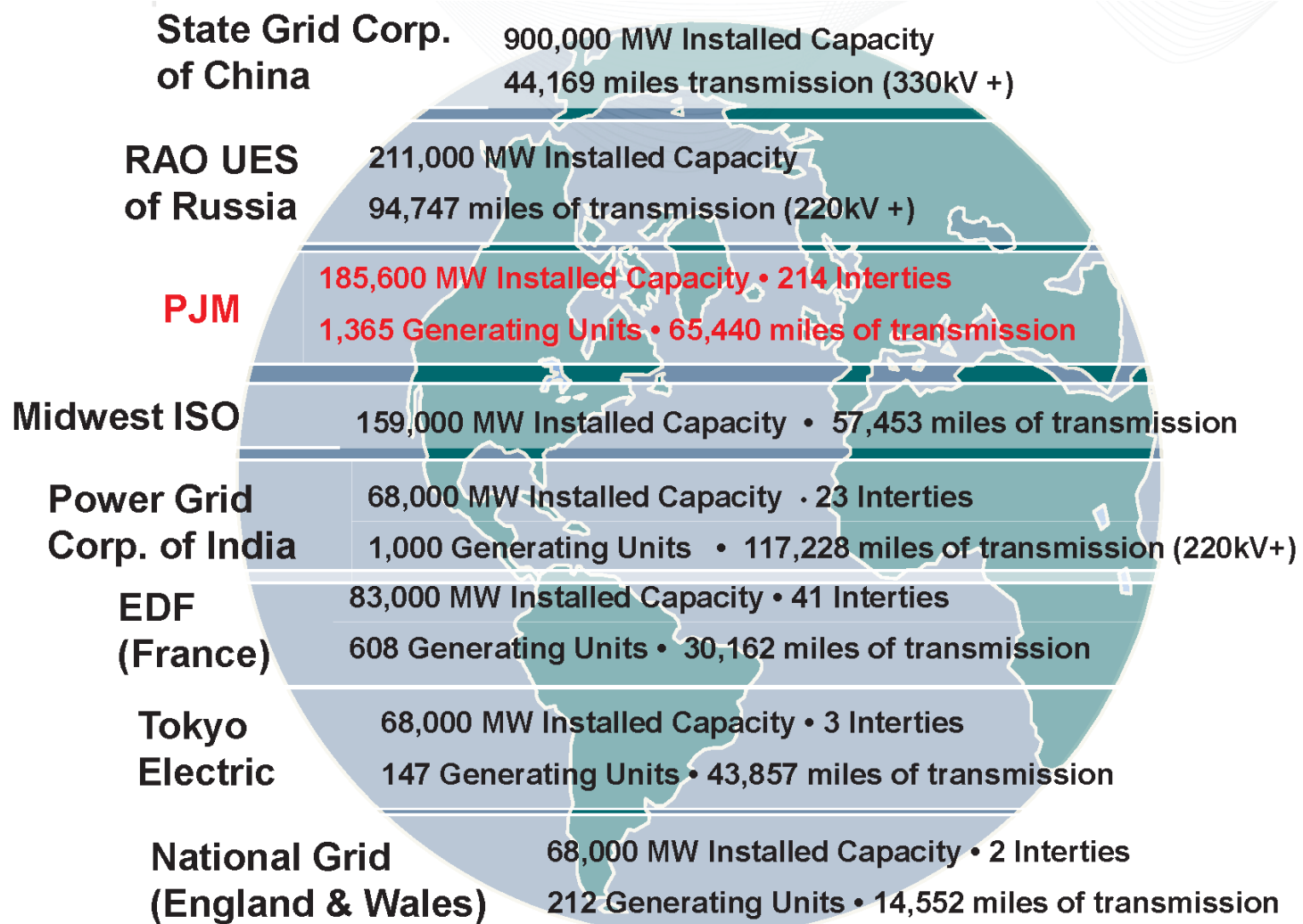
**USAID Regional Energy Security, Efficiency & Trade Program (RESET)**

**Information interactions in PJM**

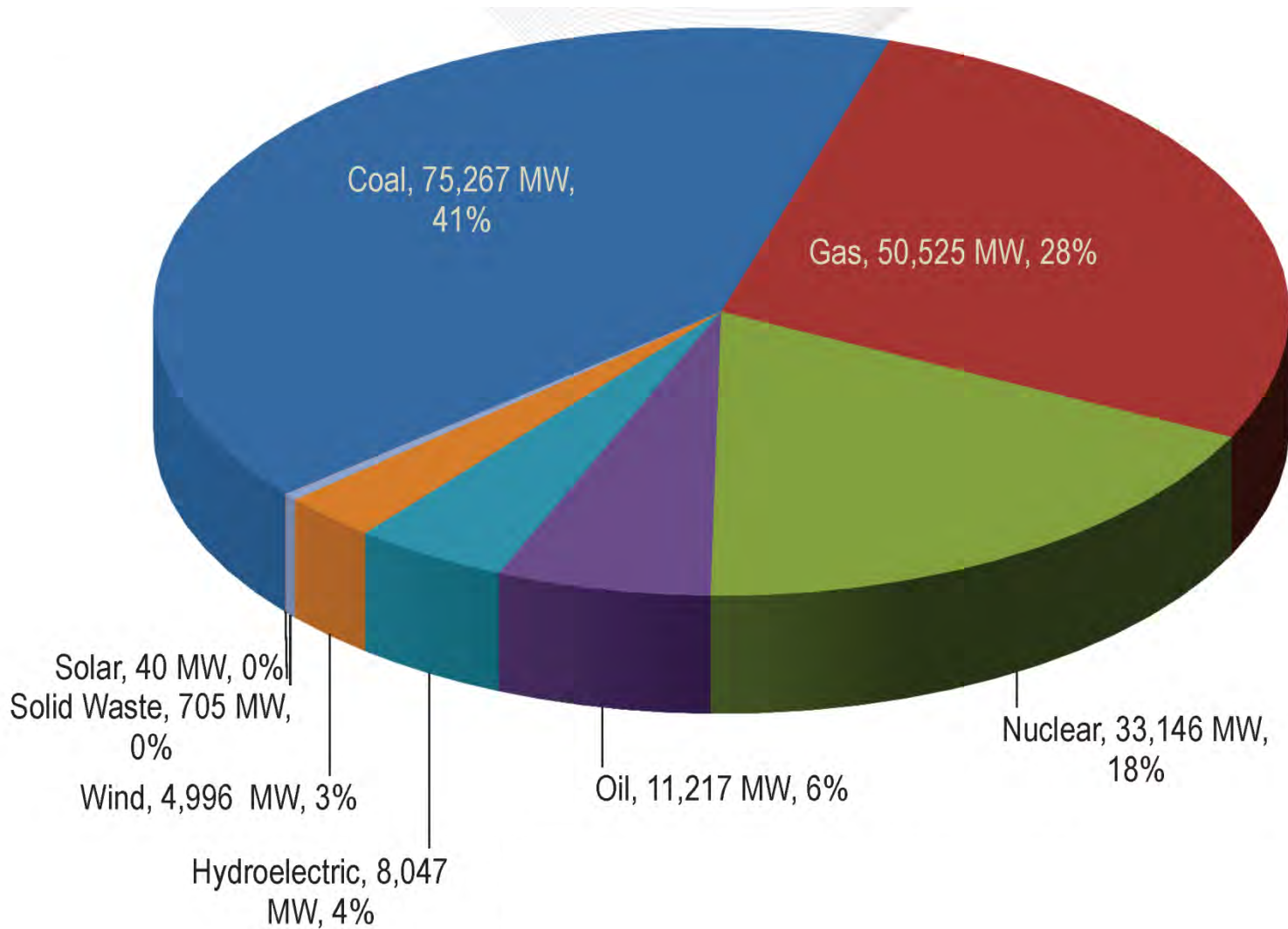
**Advanced Control Center AC2 – integration of new technologies.**

Oleg Ryaskov  
27 September, 2012  
Bangkok, Thailand

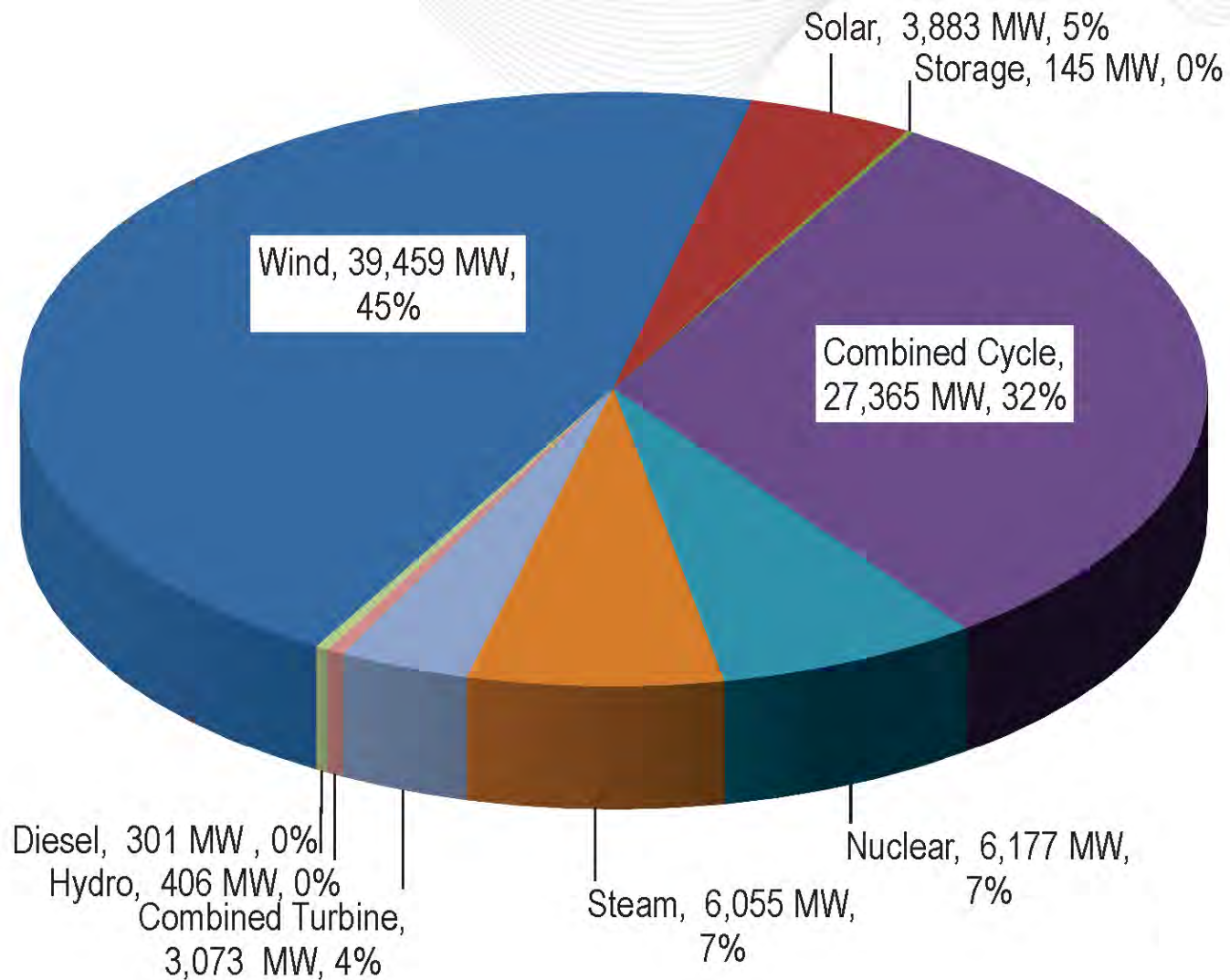
# PJM in The World



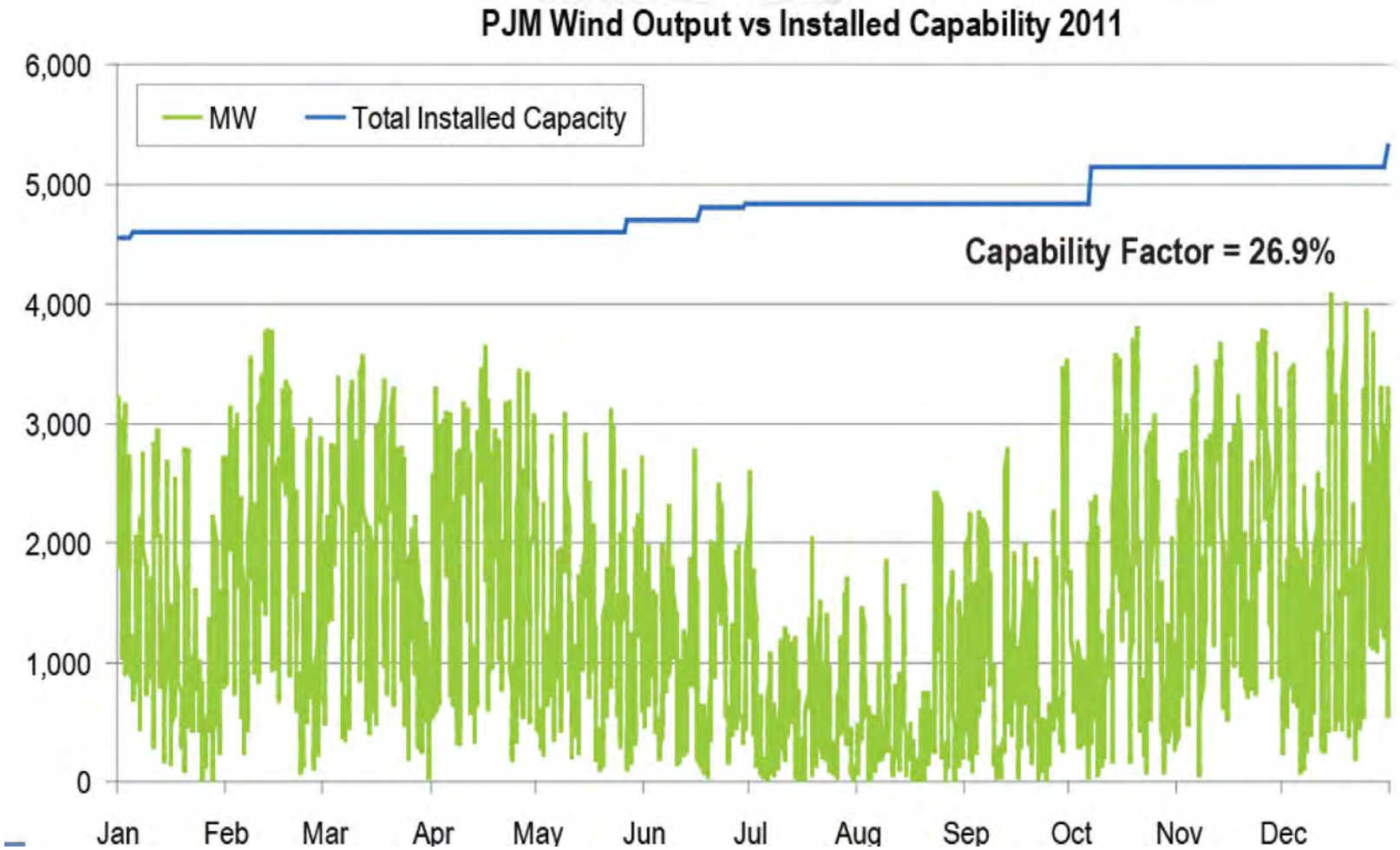
# PJM Installed Capacity



# New Resources in PJM Planning Queues



# Intermittent Wind Generation



# PJM Development Milestones

**1962 – the first computer to manage installed generation**

**1968 – the first energy management system (EMS) commissioned**

**1996 – the first website created**

**1997 - FERC approved PJM as the first fully functional ISO**

**2002 – Service Oriented Architecture (SOA) implemented**

**2011 – Shift to Energy Management System (EMS) AC2: SOA-SIM-virtualization**

**"From the beginning of system design, PJM sought to integrate security controls, scalability and flexibility into a new generation of systems to enhance grid reliability and sustain wholesale power market innovations," said Terry Boston, PJM president and chief executive officer.**

**"This is a formidable breakthrough for grid operators around the world; we now have proven that innovative IT technology, such as Service Oriented Architecture, can be adapted to high performance, mission-critical environments for the Smart Grid. It also provides a CIM-compliant and secure model-driven integration platform for PJM's diverse set of EMS, MMS and legacy systems, allowing for improved flexibility, innovation and protection of PJM's IT investment," said Jan Mrosik, chief executive officer of the global Smart Grid Division within the Siemens Infrastructure & Cities Sector.**

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# Advanced Control Center AC2

- **Swift technology developments in the power sector and increasingly sophisticated security threats have prompted regional transmission organization PJM Interconnection to switch from its aging centrally dispatched legacy system to two “state-of-the-art” primary control centers as part of Advanced Control Center (AC2) program.**
- **It was initiated in 2006 with Siemens Power Transmission & Distribution to define and develop a secure architecture and open messaging platform for modern, large-scale energy management and market management systems.**
- **Primary reasons PJM opted to sail ahead with the initiative were to reduce total cost of ownership by technology standardization and to upgrade its systems to new standards for security and resiliency because PJM’s membership had more than doubled since its legacy systems were installed.**
- **Another reason was that the grid entity realized “innovations beyond marginal improvements in existing control systems” would be necessary to maintain power reliability.**



# Advanced Control Center AC2 (continued)

- **In December 2011, as a result of the Advanced Control Center (AC2) program run by the regional transmission grid operator PJM Interconnection, one of the most advanced grid management system in the world commenced operation.**
- **The grid management system integrates the Siemens Spectrum Power energy management system and is based on a shared architecture integration platform.**
- **Shared architecture is a standardized integration platform for application that differ in terms of their technologies, such as energy management, market management and distribution management systems.**
- **The system is operated at two different sites. The control centers of each site are fully functional and capable of running the grid either independently or jointly as single virtual control center.**
- **The open architecture allows integration of traditional utility applications into new Smart Grid applications**

# Advanced Control Center AC2 (continued)

- **The AC2 program reduces risk because the two fully staffed primary control centers better ensure uninterrupted operation of markets and grid control if functionality were lost at either center.**
- **The scalable, service-oriented architecture (SOA) for large energy management/market management systems promotes interoperability that cannot be found in proprietary, legacy systems.**
- **The SOA-based system provides a common approach for software applications and computer-based infrastructure to exchange data and information.**
- **It allows technology from other vendors to communicate and interoperate without special adaptation.**
- **It is the only grid operator in the U.S.—and only one of three worldwide, including the British Columbia Transmission Corp. and Transpower in New Zealand—to have or have considered dual primary control centers.**

# Advanced Control Center AC2 (continued)

The uniqueness of this PJM implementation is found in two elements:

- The scale across the business enterprise and, most importantly,
- Its use in ‘real-time’ monitoring and control systems.

“While SOA has a proven history in other industries as the backbone of transaction-based software applications, to our knowledge, this is the first demonstrated deployment for real-time electric and market systems,” PJM spokesperson Paula DuPont-Kidd.



# Shared Architecture

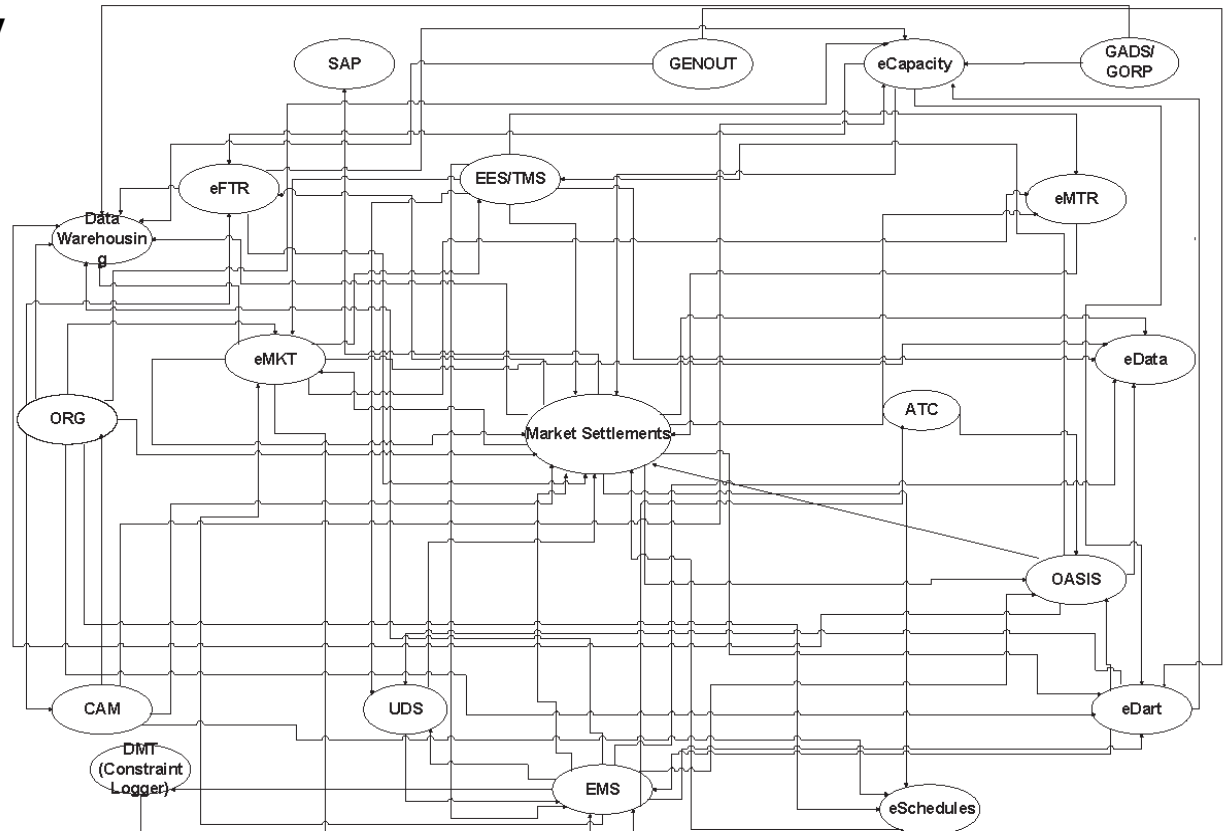
- **Shared Architecture (SA) and its components, including XML messages, Web services description and application program interfaces is the result of a joint investment by Siemens and PJM.**
- **SA is a product-based, secure integration platform for technologically diverse energy, market and distribution management systems. This new architecture is a foundation to enable the development of Smart Grid solutions.**
- **The Shared Architecture (SA) is designed around the industry standard common information model and common market extensions (CIM/CME), a model-driven information enterprise service bus (ESB), and integrates standardized business service components. All are deployed in a service-oriented architecture and Web services framework.**
- **The platform also provides other essential system services such as activation orchestration, hardware and application monitoring, naming service, context and state management, and supporting services for other common integration design patterns.**

# Shared Architecture (continued)

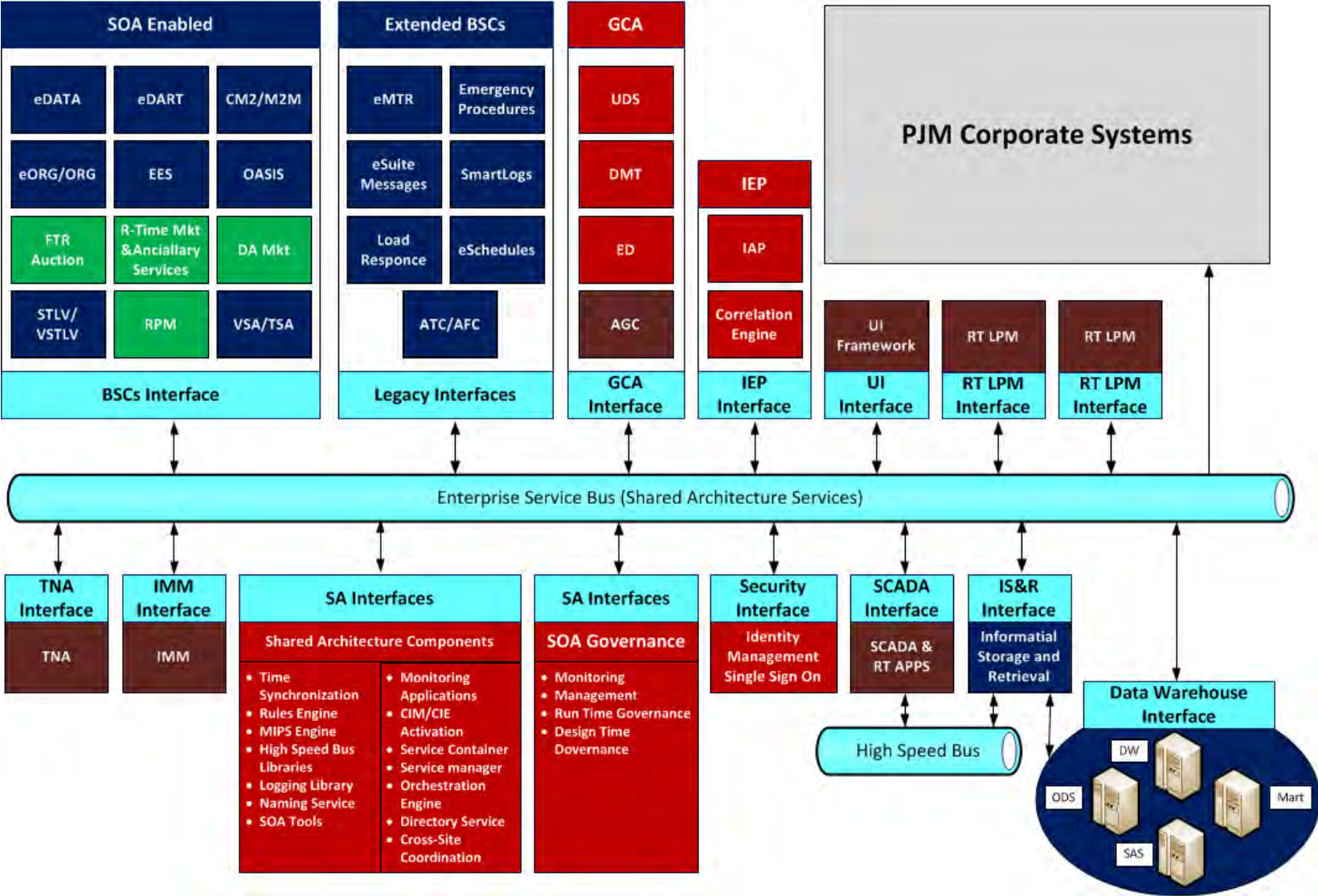
- **The platform provides choices for customers in their technology plans and strategic roadmaps.**
- **Elements of complex EMS/MMS/DMS systems may be enhanced or replaced without disturbing the underlying standards-based system foundation.**
- **This feature will then result in decreasing system transitional risks and costs of modernization.**
- **This approach fosters component competition and invites broader-based innovation throughout the energy industry.**

# AC2 Web Services / SOA Conceptual Model

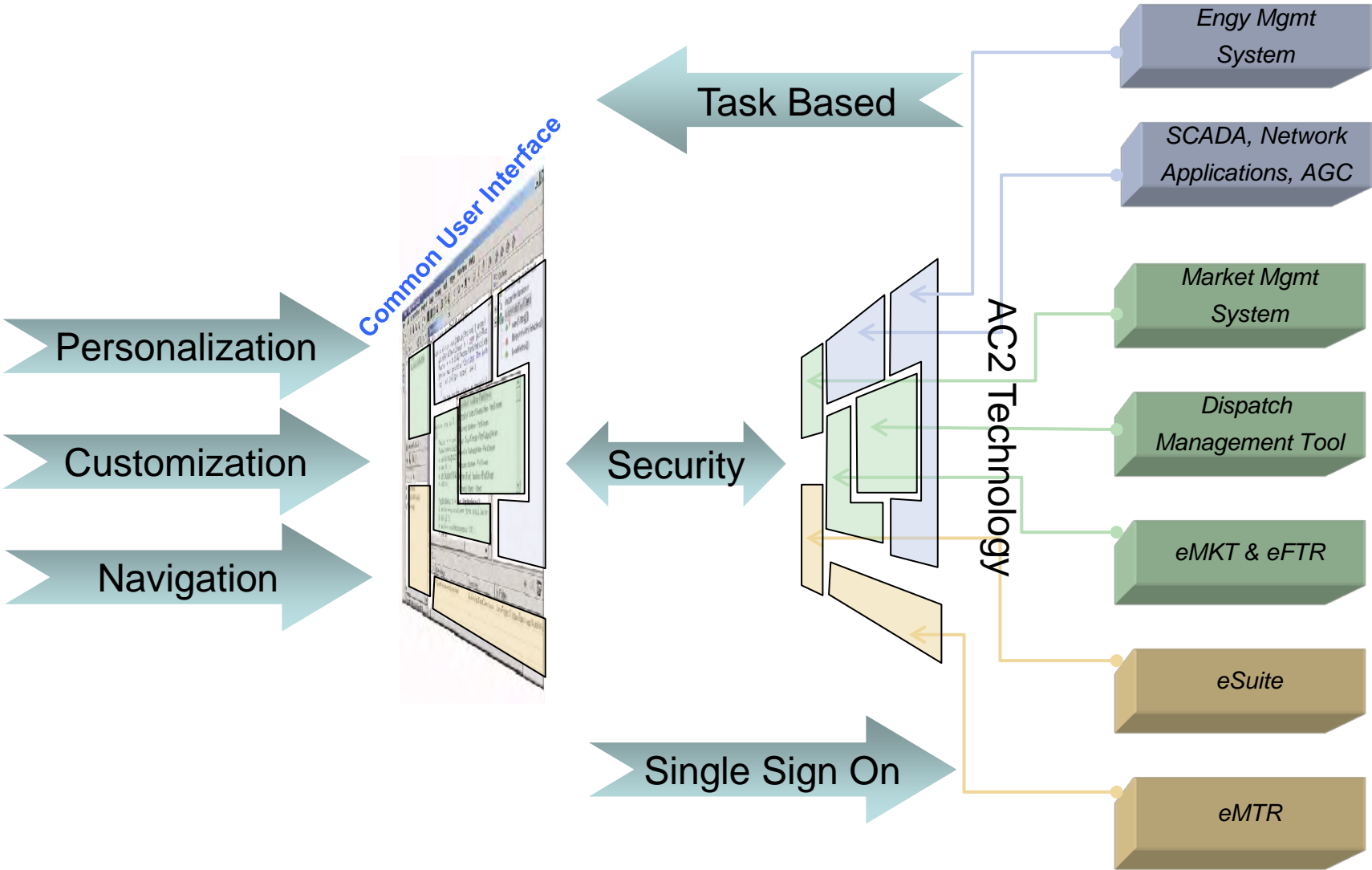
- Previously PJM operated with multiple applications.
- These applications communicated back and forth through various bridges
- This process was working with over 500 bridges
- To increase efficiency and accuracy, **SOA** was the solution of choice and was implemented as the first components of the **Shared Architecture project**



# AC2 Architecture



# AC2 A Common User Interface





# AC2 Virtualizations

x86

Windows/Linux Platform



IBM RS/6000

AIX Platform



PJM Environment at Siemens (MN)

Physical servers:2

Virtual servers:~38

PJM Environment in PA

Physical servers:4 X Blades

Virtual servers:~24

*Excludes Dedicated servers*

PJM Environment at Siemens (MN)

Physical servers:6

Virtual servers:~60

PJM Environment in PA

Physical servers:2

Virtual servers: ~20

*Excludes Dedicated servers*

# Implementation of Large Scale IT Projects

- **There are a number of techniques, knowledge libraries, models and standards for project management**
- **Basically everything comes down to a conscious goal setting and development of way to monitor and control further process**
- **Full-scale project management process often requires significant resources, arouses some skepticism and formal attitude**
- **Further thorough analysis of unplanned deviations in a project's implementation discovers errors which could have been easily avoided with proper organization of the project management process in the first place**
- **In some cases, it is reasonable to use a simplified assessment of project preparation and implementation efficiency**

# CMMI – Maturity Model

- **Capability Maturity Model Integration – (to achieve comprehensive efficiency) and maturity model – a set of models for improving processes in organizations with various types of activity**
- **It appeared in 1980s with the purpose of improving the quality of IT development for the US Department of Defense within terms and conditions of established budget't. The model was used for evaluating potential developers**
- **Positive and negative experience of past projects was used in creation of this model to minimize risks and eliminate problems with delays and cost overruns**
- **The model gives recommendations for eliminating or reducing risks in achieving each goal**

# Maturity levels– final evaluation indicators

## **Five maturity levels:**

- 1. Initial zero level**
- 2. Recognition level**
- 3. Manageability level**
- 4. Measurability level**
- 5. Improvement level**

**The model and its application are simple. For large enterprises at the initial, stage it is reasonable to use their own resources for:**

- Evaluating current condition of the enterprise and trend analysis**
- Evaluating potential suppliers of IT solutions**

# 1. Initial Level

- **Chaotic condition and unpredictability**
- **Results are achieved by efforts of certain individuals**
- **The person is gone – the project is at risk**
- **It is difficult to evaluate the project development status**
- **It is acceptable for small companies to independently develop projects, and**
- **Small projects are developed on request**

## 2-3. Recognition and Management Level

- **Manageable on the project level**
  - **Processes are described and replicable, planned, measured and controlled**
  - **Projects meet the organization requirements**
  - **Lacking the whole picture, projects are controlled in fragments from an organizational perspective**
- **Manageable on the organization level**
  - **Standards are established for the whole organization**
  - **All processes are described in detail**

## 4-5. Measurability and Improvement Level

- **Quantitatively manageable**
  - **Subroutines are chosen that use quantitative methods to allow for controlling the quality of project implementation**
  - **Process effectiveness is predictable and can be managed**
- **Constant improvement**
  - **Requires accurate evaluation of process effectiveness**
  - **Process improvement is possible by introducing new methods and improving the existing methods based on results of the evaluations**

# Opportunities for Cooperation with RESET on Issues of Integrating Information Systems Interactions

- **Support in developing technical specifications for systems integration taking into account modern technologies, protocols and interfaces**
- **Support on different levels of implementing integration interaction of existing and newly introduced systems**
- **Training on creating modern unified interfaces of information interaction, selecting and using instruments**
- **Training on using modern information interaction interfaces**
- **Support in designing and deploying an service bus for an enterprise integration**
- **Demonstration and implementation of a pilot project for deployment of enterprise integration bus**
- **Deployment and demonstration of a monitoring system for an enterprise integration bus**
- **Training on using technologies and tools of enterprise integration bus and monitoring system**



# Thank You!

## Questions???

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