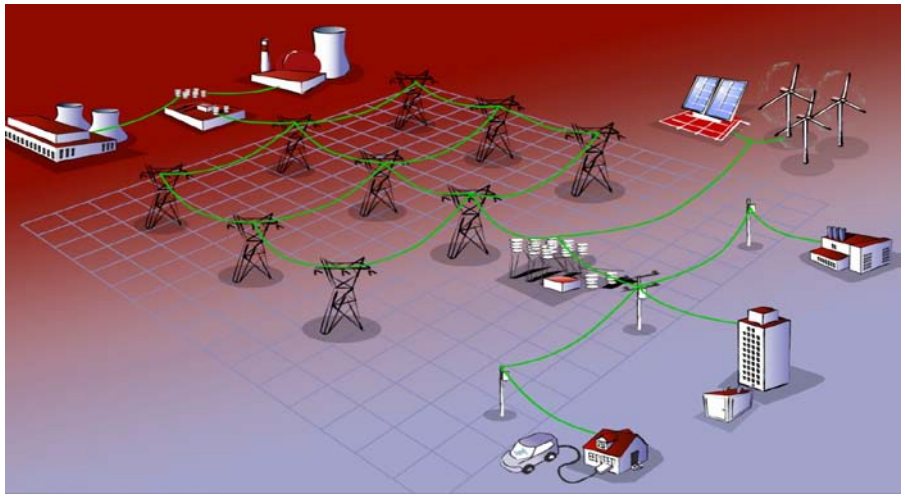
NATIONAL ENERGY TECHNOLOGY LABORATORY



Electric Power System Asset Optimization

Activity 430.01.03

March 4, 2011

Sponsored by the U.S. Department of Energy,
Office of Fossil Energy – Strategic Center for Coal

Approach

- Searched literature to understand current state of industry thinking around Asset Optimization
- Reviewed previous NETL SGIS work to give team members a clear understanding of asset optimization opportunities “offered” by the Smart Grid
- Used team members’ utility experiences
- Identified opportunities for further research (areas not currently getting much attention)

What is Asset Optimization?

- **General Definition**
  - A broad set of interrelated decisions on obtaining, operating, and maintaining ***physical*** and ***human*** resources for electricity generation, transmission, and distribution that minimize the total cost of providing electric power to all classes of consumers, subject to engineering, market, and regulatory constraints.
- **Optimization Metrics include improvements in:**
  - Reliability
  - Efficiency
  - Economics
  - Environment
  - Security

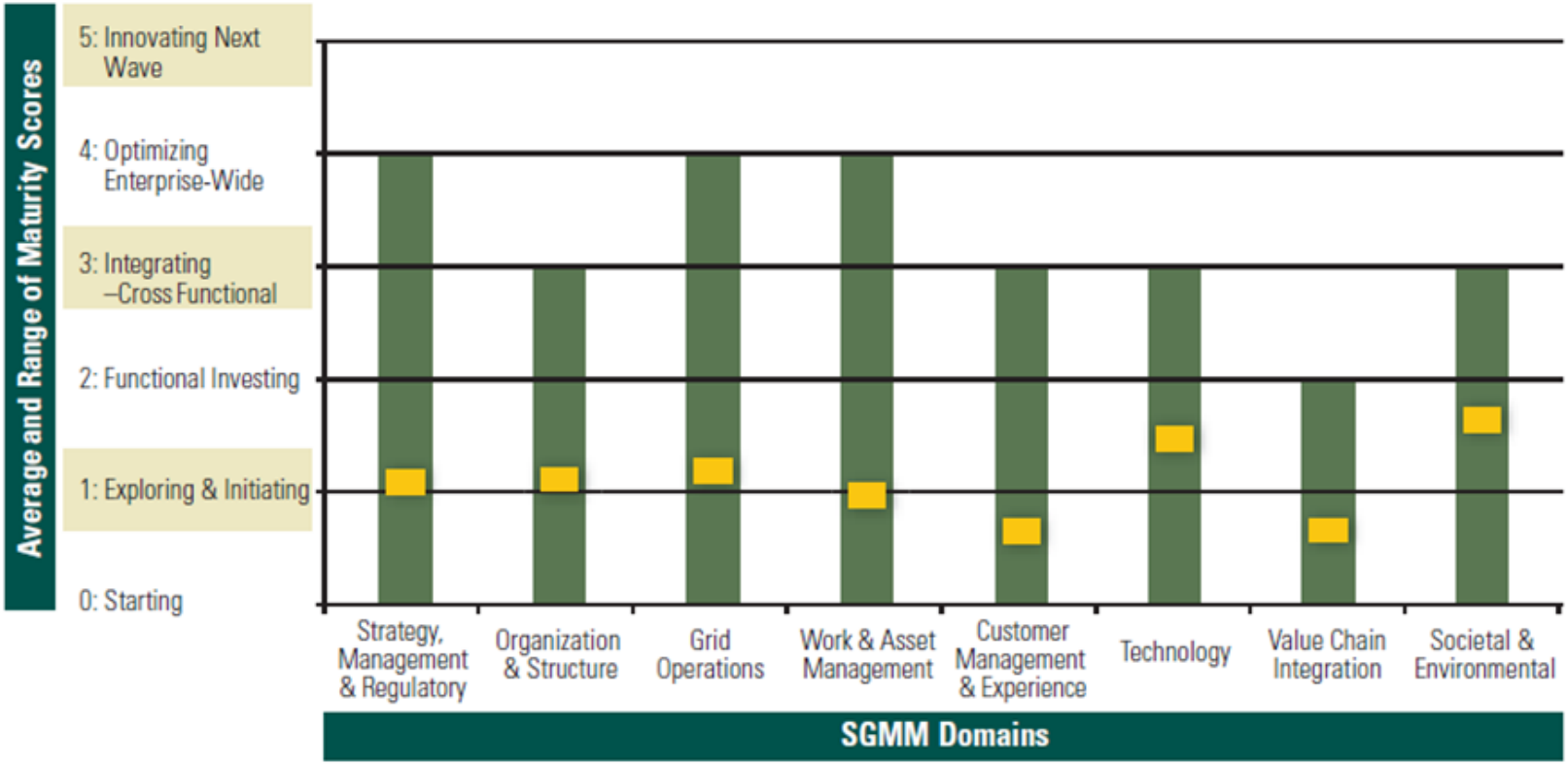
Utility Business Processes

- **Planning – develop plans for new assets to support increased demand, improved reliability, and new interconnections, etc.**
- **Engineering – design, procure, construct facilities, modify and repair**
- **Operations – monitor conditions, assess impacts, operate reliably and efficiently, dispatch crews and manage switching operations, support repairs**
- **Maintenance - develop and implement programs to reduce corrective maintenance, perform preventive and predictive maintenance, and implement repairs**
- **Customer Service – process meter data into bills, manage revenue, interact with customers to address issues and educate**

These processes are mature but limited in performance – the Smart Grid provides opportunities to optimize them further

Opportunity Exists for Improvement

Smart Grid Maturity Model



Source: Carnegie Mellon University (2009)

How is the Smart Grid Different?

- **Decentralized Supply and Control** — *the Smart Grid vision is to move to a more decentralized operating model increasing the number of generating and storage resources dramatically—from thousands of centralized plants today to tens of millions of decentralized resources.*
- **Two-way Power Flow at the Distribution Level** — *today's distribution system is primarily a radial design with power flow in one direction. As decentralized sources are deployed at consumer premises and by utilities on their distribution circuits, power will begin to flow in both directions. New Smart Grid technologies and applications are needed to support this change.*
- **Two-way Information Flow** — *the level of deployment of measuring and control devices in today's transmission and distribution system varies. At the distribution level, the deployment of SCADA and the number of points instrumented is very limited and what is available often employs only one-way communication. The ubiquitous deployment of measuring and control devices, along with an integrated two-way communication system, will enable the Smart Grid to process vastly more information and exert control that is more granular and sophisticated.*

What are the Characteristics of the SG?

- Enable active participation by consumers
- Accommodate all generation and storage options
- Enable new products, services, and markets
- Provide power quality for the digital economy
- Optimize asset utilization and operate efficiently
- Anticipate & respond to system disturbances (self-healing)
- Operate resiliently against attack and natural disaster

How can the SG improve Asset Optimization?

- **Deployment of integrated technologies**
  - Integrated communications
  - Sensors and measuring devices
  - New advanced components
  - Advanced control methods
  - Improved interfaces and decision support tools
- **Implementation of new applications**
  - Advanced Metering Infrastructure (AMI)
  - Consumer systems
  - Distribution Management System (DMS)
  - Information and Communication Technologies (ICT)
  - Demand response
  - Distributed energy resources (DER) operation and microgrids
  - RTO / ISO process integration

Many of these technologies and applications are maturing rapidly

DMS – Platform for Integration

- Common enterprise network electrical connectivity model
- Geographic information system (GIS)
- Supervisory control and data acquisition (SCADA)
- Customer Information System (CIS)
- Engineering Information System (EIS)
- Advanced Metering Infrastructure (AMI)
- Outage management system (OMS)
- Distribution automation (DA)
- Conservation Voltage Reduction (CVR)
- Condition-based maintenance and asset health monitoring
- Workforce Management System
- Distribution planning tools
- Advanced Network Applications

The great value of DMS is its capability to display multiple overlays to give users a complete context of various parameters that have been historically separated by utility department processes and technologies (silos).

Conclusions

- Utilities have made slow but steady progress in optimizing their assets
- Progress has been restrained by the limited availability of grid intelligence, granularity of control, and lack of integration of key processes
- Regulatory policy supports asset optimization ("Used and Useful")
- Smart Grid technologies and applications create new opportunities for taking asset management to the next level
- Industry is moving forward with many asset optimization initiatives

Progress is being made

Some Asset Optimization Opportunities are moving forward:

- **Distribution Management System—as an integration platform for distribution**
- **Conservation Voltage Reduction—to reduce consumption and losses**
- **Asset Optimization and Operational tools for Distribution—fast simulation to enable "what-ifs"**
- **Condition Based Maintenance—integrated with smart grid technologies to improve asset health**
- **Transmission Congestion—using dynamic ratings to increase line capacity**

Other opportunities exist but need further development

Summary of Recommendations

Microgrids

- **Theme – "*Can Microgrids Improve Asset Utilization?*"**
- **Merit – Varying opinions exist on the true value of microgrids. Utilities generally view them as a threat. This proposed work would examine microgrids objectively.**

Smart Grid Data Management

- **Theme – *"Leveraging the Value of Smart Grid Data"***
- **Merit – The Smart Grid will generate huge volumes of data; however, how this data will be managed is not well defined. This proposed work would suggest a specific process to stimulate industry debate and action.**

Demand Dispatch

- **Theme – *"The Feasibility and Value of Demand Dispatch in a Smart Grid Environment"***
- **Merit – Demand dispatch (DD) represents a new approach for integrating intermittent resources and reducing peak loads. This proposed work would estimate the potential benefits of DD.**

Additional research is recommended in these three areas

"*Can Microgrids Improve Asset Utilization?*"

Study Objectives

- Evaluate and validate the claims and concerns regarding the value and feasibility of utility and community microgrids.
- Share the results of the study with Smart Grid stakeholders to stimulate further debate and resolution

Approach

- Research current state of microgrids
- Define and develop vision / possible architectures
- Understand how microgrids integrate with Smart Grid
- Develop business case to understand value proposition
- Compare to BAU including DER operation without microgrids
- Identify barriers and issues
- Reach conclusion addressing both claims and concerns

"Leveraging the Value of Smart Grid Data"

Study Objectives

- Understand the data and information requirements for supporting the overall asset management processes.
- Develop a data management process that leverages the value of Smart Grid data.
- Share the results of the study with Smart Grid stakeholders to stimulate further debate and resolution.

Approach

- Research current state of data management processes including DOE investment grant and demonstration projects
- Define the data required by each of the five utility processes and the Smart Grid applications and identify how that data might be acquired.
- Define the communication requirements (speed, volume, reliability)
- Develop a process map defining how data might be identified, acquired, communicated, stored, and processed.
- Identify and discuss the gaps and issues that must be addressed.

"The Feasibility and Value of Demand Dispatch in a Smart Grid Environment"

Study Objectives

- Understand the current industry thinking / status of demand dispatch.
- Evaluate the feasibility, benefits and overall value proposition of utilizing demand dispatch in a Smart Grid environment.
- Share the results of the study with Smart Grid stakeholders to stimulate further debate and understanding.

Approach

- Search for and document current state of Demand Dispatch.
- Identify how DD might be integrated with other Smart Grid technologies and applications to improve overall SG benefits.
- Identify the types of loads that are candidates for a DD program.
- Estimate the potential capacity represented by the candidate loads.
- Estimate the potential benefits of DD in these applications.
- Identify and discuss the gaps and issues that must be addressed to support a successful DD program.
- Reach a conclusion on the feasibility of DD