



U.S. Department of Energy

Office of Electricity Delivery and Energy Reliability

Smart Grid R&D at the U.S. Department of Energy

**Presentation at the Hydrogen and Fuel Cell
Technical Advisory Committee Meeting**

Dan Ton

Program Manager, Smart Grid Research and Development

November 5, 2009



Office of Electricity Delivery and Energy Reliability

Office of the Assistant Secretary

Corporate Business Operations

Research & Development (R&D)*

- Clean Energy Transmission and Reliability
- Smart Grid Research and Development
- Energy Storage
- Cyber Security for Energy Delivery Systems

Permitting, Siting, & Analysis (PSA)

- Modeling and Analysis
- Electric Markets Technical Assistance
- Electricity Exports/ Presidential Permits
- Power Marketing Administration Liaison

Infrastructure Security & Emergency Response (ISER)

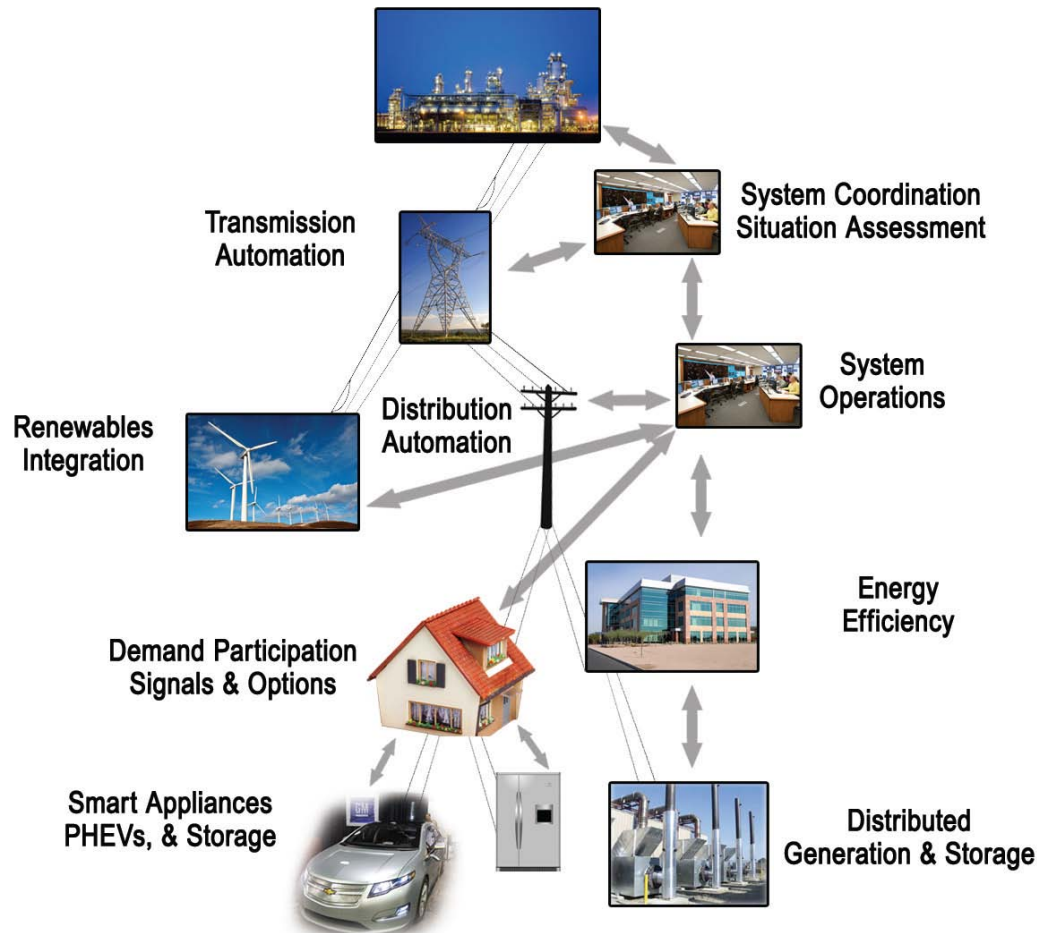
- Energy Infrastructure Protection
- State/Local Gov't Partnerships
- Training and Exercises
- Visualization
- Critical/Vulnerability Assessment
- Emergency response support

* FY10 Budget Line Items



Scope of a Smart Grid

Use of digital technology to improve reliability, security, and efficiency of the electric system with applications for dynamic optimization of system operations, maintenance, and planning





Smart-Grid Vision

Bring digital intelligence & real-time communications to transform grid operations

- **Demand-side resources participate with distribution equipment in system operation**
 - Consumers engage to mitigate peak demand and price spikes
 - More throughput with existing assets reduces need for new assets
 - Enhances reliability by reducing disturbance impacts, local resources self-organize in response to contingencies
 - Provide demand-side ancillary services – supports wind integration
- **Transmission and bulk generation resources get smarter too**
 - Improve the timeliness, quality, and geographic scope of the operators' situational awareness and control
 - Better coordinate generation, balancing, reliability, and emergencies
 - Utilize high-performance computing, sophisticated sensors, and advanced coordination strategies





Defining Smart Grid Characteristics

In 2005-2007, convened several regional stakeholder meetings to create a definition of a smart grid and define its value creation

Seven Defining Functions of the Smart Grid

- Enabling Informed Participation by Customers
- Accommodating All Generation and Storage Options
- Enabling New Products, Services, and Markets
- Providing the Power Quality for the Range of Needs in the 21st Century
- Optimizing Asset Utilization and Operating Efficiently
- Addressing Disturbances – Automated Prevention, Containment, and Restoration
- Operating Resiliently Against Physical and Cyber Attacks and Natural Disasters



DOE Report to Congress, Stipulated under EISA Title XIII – Smart Grid

Smart Grid System Report, July 2009

(http://www.ee.energy.gov/DocumentsandMedia/SGSRMain_090707_lowres.pdf)

- **State of smart grid deployments**
 - Applying 20 metrics—
indicators of deployment progress by penetration levels or maturity levels
 - Metrics crosscutting smart grid scope areas and characteristics
- **Challenges to smart grid deployments**
 - Costs and their recovery
 - Interoperability standards
 - Technical barriers
 - Changing technologies and policies
- **Policy questions for future reports**
(every two years after this 1st report)



Metrics for Smart Grid Transformation toward Achieving the 7 Characteristics

Area Coordination

- Dynamic pricing
- Real-time data sharing
- Distributed resource interconnection policy
- Policy/regulatory progress

Distributed Energy Resources

- Load participation
- Microgrids
- Distributed generation
- Plug-in electric vehicles
- Grid-responsive load

Delivery (T&D) Infrastructure

- T&D system reliability
- T&D automation
- Advanced meters
- Advanced system measurement
- Capacity factors
- Generation, T&D efficiencies
- Dynamic line ratings
- Power Quality

Information Networks & Finance

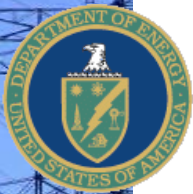
- Cyber security
- Open architecture/standards
- Venture capital investment

Indicators of smart grid deployment progress – not comprehensive measures



Smart-Grid Trends in United States

Trend	Metric Areas
High	Distributed generation, T&D automation, advanced meters, venture capital
Moderate	Dynamic pricing, real-time data sharing, distributed resource interconnection policy, policy/regulatory progress, advanced system measurement
Low	Load participation, microgrids, plug-in electric vehicles, grid-responsive load, gen-T&D efficiencies, dynamic line ratings
Nascent	Cyber security, open architecture/standards
Flat or slight decline	Capacity factors, power quality



Recovery Act Smart Grid Funds: \$4.5 Billion

Office of Electricity Delivery and Energy Reliability	\$ Millions
Smart Grid Investment Grant Program; ≤3 years	\$3,400
Smaller projects, \$300K-\$20M; 40% of funding	
Larger projects, \$20M-\$200M; 60% of funding	
Smart Grid Demonstrations; 3-5 years	\$615
Regional Demonstrations, up to \$100M per project	
Grid-scale Energy Storage Demonstrations	
Interoperability Framework Development by NIST	\$10
Resource Assessment and Interconnection-Level Transmission Analysis and Planning	\$80
State Electricity Regulators Assistance	\$50
Enhancing State Government Energy Assurance Capabilities and Planning for Smart Grid Resiliency	\$55
Workforce Development	\$100





Smart Grid Investment Grant Program

SGIG on manufacturing and/or commercial applications of:

➤ Advanced metering infrastructure

- Smart meters, meter data management, communications backbone, dynamic pricing, back office billing & customer services

➤ Customer systems

- Smart appliances, home/building energy management systems, DERs, energy storage, PEVs, microgrids---all on customer side of the meter

➤ Electric distribution systems

- Distribution/substation automation, inclusive of all RTUs, IEDs, field equipment upgrades, communications links, integrated distribution management systems

➤ Electric transmission system

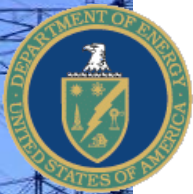
- PMUs, PDCs, visualization tools, etc. for wide-area monitoring and management of bulk power delivery

➤ Integration of AMI, customer systems, distribution automation, and/or transmission system management

➤ Manufacturing of smart grid equipment

Schedule

Notice of Intent (NOI)	April 16, 2009
Funding Opportunity Announcement (FOA)	After 30 day comment period for NOI (June 2009)
Selection of 100 project awards	Announced October 27, 2009
All Funds Obligated	September 2010



Smart Grid Demonstration Program

Smart Grid Demonstrations on demonstrating a suite of technologies to validate performance and cost information for a proven use (business) case:

➤ Regional demonstrations

- Demonstration of technical/operational/business-model feasibility on a regional scale, e.g.,
8 NERC regions,
27 eGrid subregions,
co-ops or publicly owned utilities in the (sub)regions

➤ Grid-scale energy storage demonstrations

Schedule

Draft Funding Opportunity Announcement (FOA)	April 16, 2009
Funding Opportunity Announcement	After 30 day comment period (June 2009)
Project Awards	December 2009



Recovery Act: Smart Grid Standards Development

NIST having primary responsibility to coordinate development of protocols and model standards for interoperability of Smart Grid devices and systems

- **Phase 1:** Identify an initial set of existing consensus standards and develop a roadmap to fill gaps
 - Draft report, *NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0*, published in September for public comment
 - Identified ~80 existing standards that can be used now for smart grid development
 - Identified 14 high priority gaps plus cyber security in need for new or revised standards
- **Phase 2:** Establish public/private Standards Panel by end of December 2009 to provide ongoing recommendations for new/revised standards
- **Phase 3:** Initiate implementation of the testing and certification framework in 2010



Renewable and Distributed Systems Integration Demonstrations

- Nine demonstration projects awarded in 2008 to integrate on-site, clean, distributed generation to demonstrate 15% peak load reduction on distribution feeders
 - Allegheny Power, SDG&E, Consolidated Edison, City of Fort Collins
 - ATK Space Systems, Chevron Energy Solutions
 - Illinois Institute of Technology, University of Hawaii, University of Nevada-Las Vegas
- Technologies for integration:
 - PHEVs, wind turbines, photovoltaics, pumped storage, compressed air storage, microgrid technologies, feeder automation systems, etc.





Smart Grid Information Clearinghouse, Established under ARRA 2009

To “make data from smart grid demonstration projects and other sources available to the public”

- **Competitive award to Virginia Tech (Lead)/EnerNex/IEEE Team to establish Web-based public info clearinghouse**
 - Serving as a central repository for smart grid information, including all Recovery Act smart grid projects
 - Sharing and dissemination of information on knowledge gained, lessons learned, and best practices
 - Supporting decision making by both State/Federal Regulators
- **Responded to high priority identified by NARUC/FERC Smart Grid Collaborative & Electricity Advisory Committee**
- **Clearinghouse User Group comprising key stakeholder groups being assembled to guide collaborative development**



Smart Grid Maturity Model (SGMM)

A management tool to help utilities

- ✓ Identify where they are on the smart grid landscape
- ✓ Develop and communicate a smart grid vision and roadmap
- ✓ Prioritize options and support decision making
- ✓ Benchmark themselves against the industry
- ✓ Measure their progress
- ✓ Share best practices

SGMM Dimensions

- The six *levels of maturity* (Levels 0 – 5) represent the progression of a utility in adopting and deploying smart grid technologies and practices
- The eight *domains* are logical groupings of related capabilities and characteristics at each maturity level



Smart Grid R&D Focus Areas in FY 2009-2010

Integrated communications, connecting components to open architecture for real-time information and control, allowing every part of the grid to both 'talk' and 'listen'

Sensing and measurement technologies, to support faster and more accurate response such as remote monitoring, time-of-use pricing and demand-side management



Advanced components, to apply the latest research in superconductivity, storage, power electronics and diagnostics

Advanced control methods, to monitor essential components, enabling rapid diagnosis and precise solutions appropriate to any event

Improved interfaces and decision support, to amplify human decision-making, transforming grid operators and managers quite literally into visionaries when it comes to seeing into their systems



Smart Grid R&D Multi-Year Program Plan (FY10-14) Development

- Working groups being assembled to plan for development of each of the defined R&D areas to include the goal, objectives, challenges, tasks, and milestones
- Two-stage development process
 - Meeting in October involving national labs
 - Stakeholder Roundtable Meeting in December
- Draft MYPP for public comment in February 2010
- MYPP to guide Smart Grid R&D investments, including a planned FY10 solicitation in March 2010



Smart Grid Task Force

Established under authorization of EISA 2007 to ensure awareness, coordination, and integration of the diverse smart grid activities in the Federal Government

Functions

- ✓ Serves as Federal focal point on all things “smart grid”
- ✓ Coordinates and integrates inter-governmental activities
- ✓ Oversees report production for submission to Congress
- ✓ Collaborates on interoperability framework
- ✓ Guides ARRA investments in smart grid
- ✓ Ensures awareness of Federal smart grid activities
- ✓ Collaborates with and supports the Electricity Advisory Committee

Member Organizations

DOE (OE / EERE / NETL)
FERC
DOC (NIST, ITA)
EPA
DHS
USDA
DoD
FCC

Website

[www.oe.energy.gov/
smartgrid_taskforce.htm](http://www.oe.energy.gov/smartgrid_taskforce.htm)

- ✓ Charter
- ✓ Presentations
- ✓ Publications
- ✓ Events



SmartGrid.gov: Online Presence

○ **LAUNCH DATE:** To Be Determined

○ **URL:** SmartGrid.gov

○ **PURPOSE:** Provide credible and objective information about the Smart Grid and related activities

○ **PERTINENT FACTS:**

- A multi-agency website
- An online venue where non-technical knowledge transfer can occur and broader momentum for the Smart Grid can be established and cultivated
- A single point of entry for the general and trade news media, providing a critical reference point for these groups
- Holding pages launch Q4 2009





Contact Information

Dan T. Ton

Program Manager, Smart Grid R&D

Office of Electricity Delivery and Energy Reliability

U.S. Department of Energy

(202) 586-4618

Dan.ton@hq.doe.gov

For more Information:

OE: www.oe.energy.gov

Smart Grid: www.oe.energy.gov/smartgrid.htm