

## **Smart Grid Policies, Regulations & Standards**

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# **Discussion Topics**

## **Smart Grid Policies, Regulations, & Standards**

### **Stakeholders**

**U.S. Department of Energy**

**National Institute of Standards and Testing**

**Federal Energy Regulatory Commission**

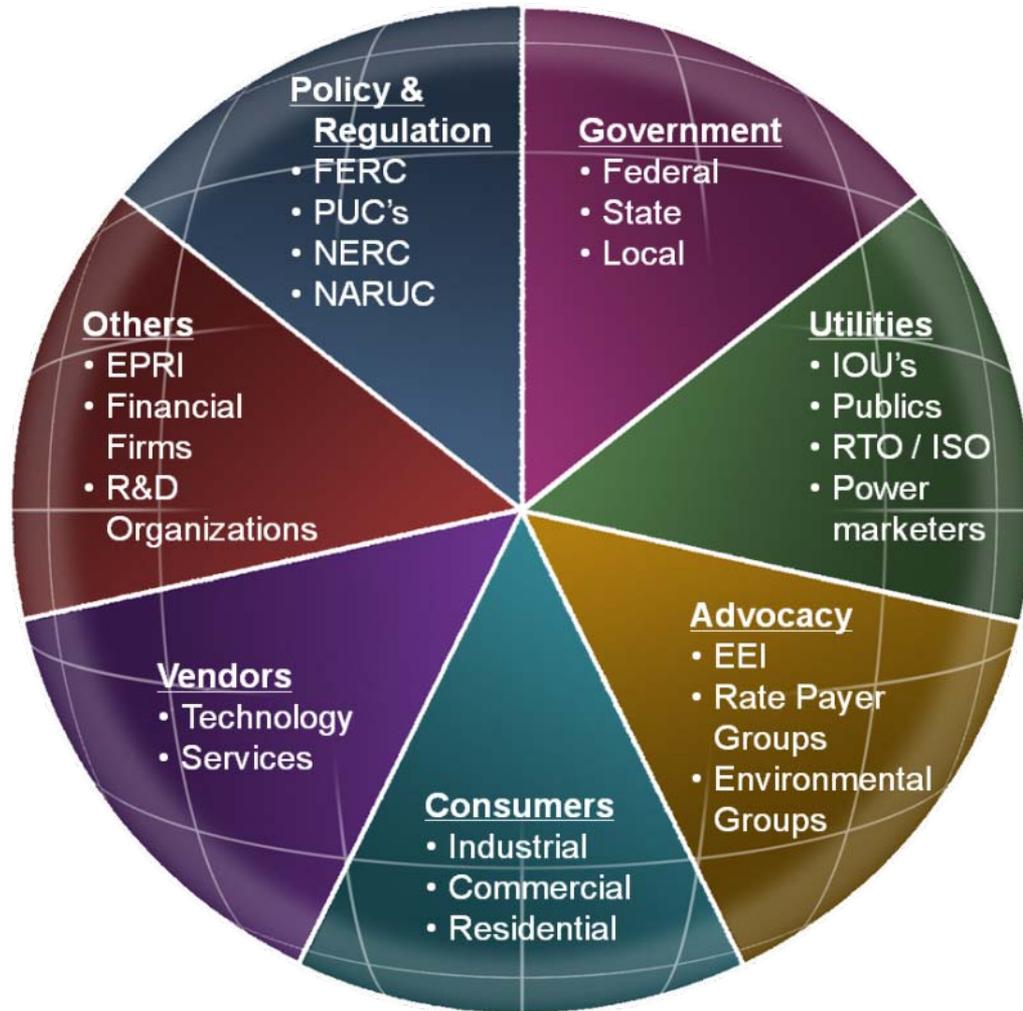
**National Association of Regulatory Utility Commissioners**

**National Electricity Reliability Corporation**

**Other Thoughts, Other Organizations, Other Efforts**

**Foreign Smart Grid Policy, Regulations, Standards**

# Smart Grid Stakeholders



# U.S. Department of Energy

# **U.S. Department of Energy Smart Grid Goals**

## **OE Mission**

**...lead national efforts to modernize the electric grid**

## **Goals for Smart Grid technology**

- Reduce peak energy demand by 20%**
- Improve system efficiency by 40%**
- Incorporate 20% of electricity capacity from distributed and renewable energy by 2030**
- Serve all critical loads at all times**

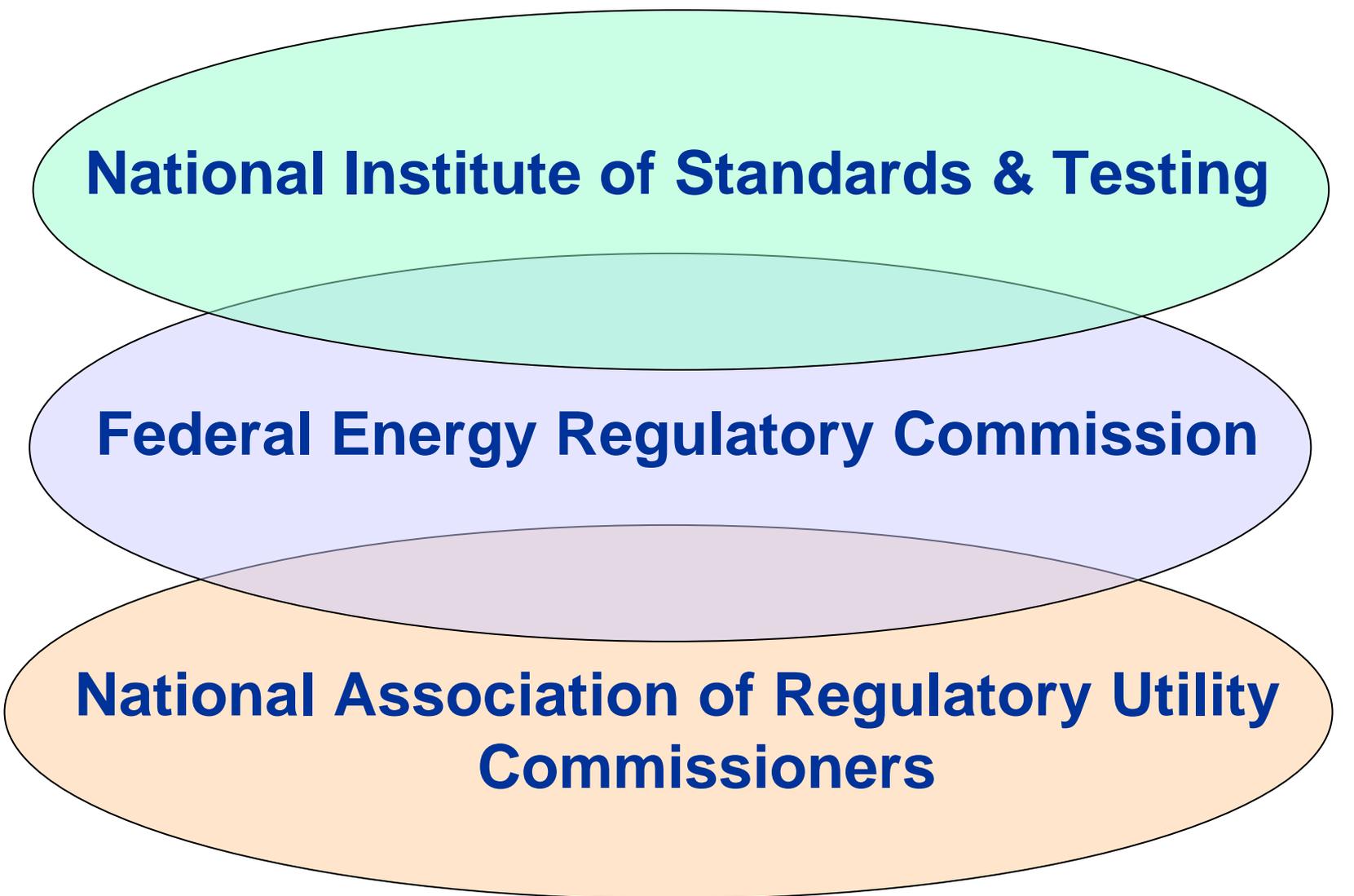
# Energy Independence and Security Act of 2007

## **Title XIII - Smart Grid**

- **Policy of US to support modernization of electric T&D system**
- **Smart Grid System Report**
- **Smart Grid Advisory Committee**
- **Smart Grid Task Force**
- **Smart Grid Technology R&D and Demonstration**
- **Smart Grid Interoperability Framework**
- **Federal Matching Fund for Smart Grid Investments**
- **State Consideration of Smart Grid**
- **Study of Private Wire Laws on the Development of CHP**
- **Study of Security Aspects of Smart Grid Systems**
  
- **New energy efficiency standards for appliances**

# Smart Grid American Recovery and Reinvestment Act of 2009

- **Smart Grid Investment Grants (99 projects)**
  - \$3.4 billion Federal; \$4.7 billion private sector
- **Smart Grid Demonstration Projects (42 projects)**
  - \$684 million Federal; \$1 billion private sector
- **Interoperability Framework by NIST (\$12M)**
- **Transmission Analysis and Planning (\$80M)**
- **State Electricity Regulator Assistance (\$49M)**
- **Enhancing State Energy Assurance (\$44M)**
- **Enhancing Local Government Energy Assurance (\$8M)**
- **Workforce Development (\$100M)**



**National Institute of Standards & Testing**

**Federal Energy Regulatory Commission**

**National Association of Regulatory Utility  
Commissioners**

**NARUC – FERC Smart Response Collaborative**

# National Institute of Standards and Testing

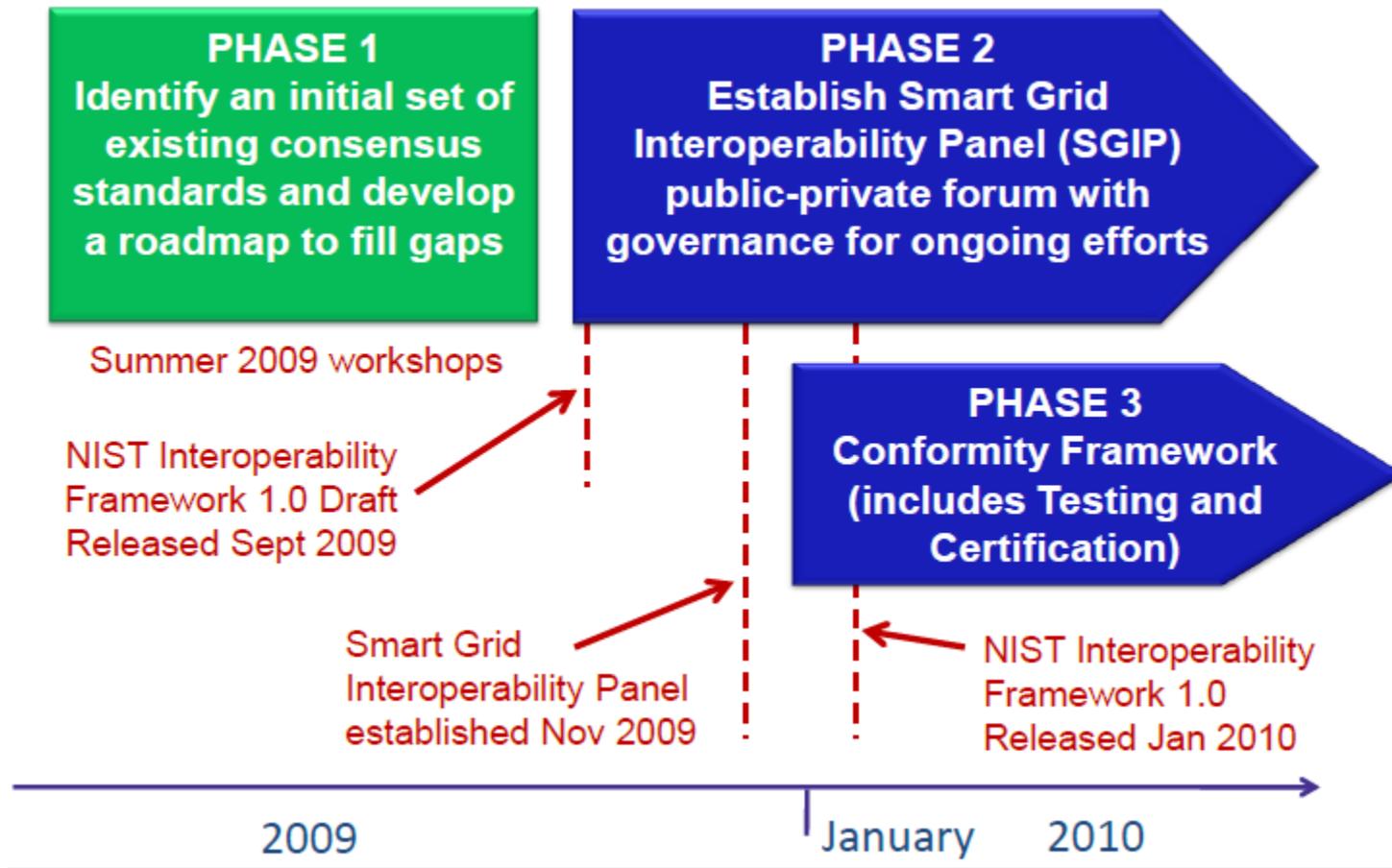
# NIST Interoperability Standards

- **U.S. National Institute of Standards and Testing (NIST)**
  - developing interoperability standards for equipment,
  - focused on defining consistent communications protocols
- **Energy Independence and Security Act (EISA) of 2007** - develop "flexible, uniform, **and technology neutral**" framework to achieve interoperability of smart grid devices
  - Enable technologies different than available today,
  - Add functionality and innovative electric products/services.
  - Gather data and information from multiple locations
  - Adjust to accommodate dynamic system changes

# Interoperability

- Interoperability described as "the ability of a system or a product to work with other systems or products without special effort on the part of the customer."
- Standards determines whether it:
  - reflects a sufficient consensus;
  - Is necessary for smart grid functionality and interoperability in "interstate transmission of electric power, and regional and wholesale electricity markets";
  - raises known cyber security issues.

# NIST Three Phase Plan



# Phase 1

- Work with stakeholders to achieve consensus on the standards.
- Focus on developing the Smart Grid "architecture," as well as priorities for interoperability and cyber security standards
  - Ensure that components work together seamlessly and to protect the network against disruptions
  - Establish an initial set of standards and plans to meet remaining standards.
- NIST held 3 public workshops/stakeholder summits
  - More than 1,500 people representing hundreds of organizations.

# Phase 2

- Phase 2 launched November 2009 & formed "Smart Grid Interoperability Panel"
  - Public-private partnership consisting of more than 400 organizations.
  - Formal partnership charged with developing additional standards aimed at addressing any remaining gaps and integrating new technologies.
  - Creates an ongoing standards process "that supports cycle after cycle of Smart Grid innovation and helps to transform our economy."
- NIST focused initial efforts on developing standards that are more **urgent** than others, including **demand response and energy efficiency, cyber security, network communications, electric transportation and advanced metering infrastructure.**

# NIST Framework & Roadmap

- Sept 1, 2009 - draft “NIST Framework and Roadmap for Smart Grid Interoperability Standards”
- Identified about 80 initial standards
  - Representatives of more than 80 organizations submitted about 400 comments on the draft
- Jan 19, 2010 - final “NIST Framework and Roadmap” Identified:
  - 75 standards in place and able to apply immediately
  - 15 "high-priority gaps" to enable a vast number of interconnected devices and systems along the grid to communicate safely & requires new or revised standards
  - Each of those gaps has its own action plan specifying the organizations to address the gaps and deliver results on aggressive timelines.

# NIST Framework & Roadmap (continued)

- Final report contains significantly expanded sections on **privacy, vulnerability categories, potential security issues**, and overall approach to achieving smart grid **cyber security**.
- Like the initial draft, the second draft allowed public review
  - Comments due on April 2, 2010
- Identifies applicable standards originating from agencies and industry groups, including :
  - ANSI, IEEE, Open Geospatial Consortium Inc., U.S. Dept of Homeland Security's cyber security division and the ZigBee Alliance.
- Addresses everything from **time management and clock synchronization across the grid, to exchanging geographic data, to increased security of control systems for better protection against physical and cyber attacks**

# Cyber Report – Feb 2010

- Companion Document - "Smart Grid Cyber Security Strategy and Requirements"
  - Identifies more than 120 interfaces for two-way flows of electricity & communication
  - Classifies risks posed in the event of a security breach.
- NIST is treating cyber security standards as a separate process being developed by a **cyber security coordination task group** consisting of nearly 300 members from both the public & private sectors.
  - Assessing risks, vulnerabilities, threats and impacts
  - Tailor security requirements to provide adequate grid protection

# Guidelines for Smart Grid Cyber Security

- **Report released Sept 2, 2010**
- **Includes framework for assessing risks, evaluation of privacy issues and strategies to protect the power grid from attacks, malicious code and cascading errors**
- **Identify 137 interfaces, or points of interactions within or between different smart grid systems and subsystems.**
  - Assigned to categories on the basis of shared or similar functional and security characteristics.
  - Details 189 **high-level security requirements** applicable either to the entire smart grid or to particular parts of the grid and associated interface categories.

# Phase 3

- NIST to establish standards for testing and certifying smart grid devices and systems to ensure that new technologies are compatible with the rest of the grid and ensure cyber security and interoperability standards.
- Both the second and third phases to be completed by the end of the 2010, according to NIST.
  - Initial standards readied by the end of the summer 2010
- **Letter from NIST to FERC October 6th, 2010 identifying initial five standards and providing a narrative containing information that would be useful to regulators in their consideration.**

# First 5 Standards

- IEC61970, provides common language or common dictionary or data model and the grammar for **communication that deals with operations primarily in the transmission domain**. Describe the components of the power system, relationships between them in a structured way similar to how HTML is the foundation for a common language in the web.
- IEC61968, provides the same type of functionality, but now in the **distribution part of the grid**.
- IEC61850, deals with **substations** and provides the common language for describing the devices in a substation, how they can interact and to allow control of these devices in a multi-vendor environment.
- IEC6870-6, is an inter-control center standard that allows **control centers within and among utilities to exchange critical real-time information** such as time series data, event notifications and accounting data. This standard is used today in almost every utility.
- IEC62351, addresses **cyber security**. It specifies means through which authentication, authorization access control, intrusion detection, encryption and this sort of functionality which is critical to secure operation is enabled.

# Federal Energy Regulatory Commission

# FERC Smart Grid Policy Statement (PL09 - 4)

- Issued July 2009
- To be followed by a more formal FERC rulemaking proceeding after a "sufficient consensus" has been reached on the proper standards under the coordination of NIST.
- Two cross-cutting issues - system security and intersystem communication, deserve high priority in the development of smart grid standards,
  - Identified four key grid functionalities: wide-area situational awareness, demand response, electric storage and electric vehicles.
- NIST and the smart grid community agree with FERC's prioritization list
  - Advanced metering and distribution system automation should be added.
  - Initial standards will include emerging technology standards that affect both transmission and distribution level facilities.

# FERC Process

- FERC Staff outlined series of recommendations for FERC to adopt smart grid interoperability standards, which it said are based on discussions it had with NIST and the smart grid community during the preceding year.
  - NIST should post on its website a group of standards ready for consideration by FERC,
  - FERC will initiate a rulemaking proceeding to consider adopting those standards.
  - As each set of standards is readied by NIST, that process would be repeated.
  - Eventually, FERC will initiate a rulemaking to adopt the standards developed by NIST, though some of the standards outlined in the January 2010 report will not require adoption because they are already used voluntarily by the industry.

# **National Association of Regulatory Utility Commissioners**

# National Association of Regulatory Utility Commissioners

- **Represent 51 regulatory utility commissions**
- **Share best practices and lessons learned**
- **Formed Smart Grid collaborative with FERC**
  - Smart Grid and Demand Response

# National Association of Regulatory Utility Commissioners

## 2 NARUC committee draft Smart Grid resolutions –early 2010

- **Committee on Consumer Affairs:**
  - conduct detailed **Cost Benefits Analyses** before SG programs are deployed and utility customers are required to pay for them.
  - accompanied by considerable **customer education** so consumers, especially the elderly and customers on fixed incomes, understand how the technology works.“
- **Telecommunications Committee:**
  - Consumer Protections for **Privacy** while allowing Smart Grid benefits.
  - highest priority to ensure that consumers are protected as the smart grid evolves.

# Regulatory Challenges

- **Time-based rates**
- **Clear cost recovery policies**
- **Policy changes that remove disincentives to utilities**
- **Societal benefits included in business case**
- **Increased utility commission workload**
- **Collaboration among state utility commissions**
- **Potential cost of “carbon management”**
- **Future proofing vs. stranded assets**
- **Consumer privacy concerns**
- **“Least cost”**
- **“Used and useful”**
- **New operating and market models**
- **Interplay between T&D assets and markets**

# Maybe 51 Regulatory Utility Commissions Are A Good Thing

- **Diversity of perspectives and approaches**
- **Nearly impossible to achieve consensus**
- **Consensus compromises decisions**
- **Consensus can cause delays and cost increases**
- **Maintain practices and processes of commissions**
- **Protect values of constituency**
  - Generation mix, demand response, dynamic markets, renewable, economic development, environmental, reliability, electric vehicles, electricity bills
- **Collaborate, when appropriate**

# NARUC – FERC Collaborative

- **“Smart Response” Collaborative**
  - Previously, separate ongoing efforts, one on demand response and another on the smart grid.
  - Decided to combine the two initiatives into one meeting - First meeting on July 18, 2010
- **Joint Tech Conf on NIST Standards**
  - held at NARUC 122nd Annual Meeting Nov 2010
  - FERC led, FERC & State Commissioners in attendance
- **FERC not yet determined sufficient consensus & proposed another Technical Conference**

# FERC Technical Conference

- **Docket RM11-2-000**
- **Monday, January 31, 2011**
  - Obtain further information to aid the Commission's determination of whether there is "sufficient consensus" that the five families of standards posted by NIST are ready for FERC consideration in a rulemaking proceeding

# North American Electric Reliability Corporation

# FERC-NERC Relationship

- **FERC regulates interstate transmission of electricity**
- **FERC oversees NERC in U.S.**
- **Provincial governments in Canada oversee NERC**
- **Electricity Reliability Organization has authority to develop and enforce mandatory standards for the reliable operation and planning of the bulk power system throughout North America, as called for in the U.S. Energy Policy Act of 2005.**
- **NERC was designated as this “electricity reliability organization” by FERC on July 20, 2006.**

# North American Electric Reliability Corporation

## Smart Grid Task Force

- **Reliability standards for bulk power**

### Work Areas

- Integration of smart grid onto bulk power system requires development of new planning and operating tools, models, and analysis techniques
- Integration of smart grid devices/systems will change the character of the distribution system
- Engage Standard Development Organizations in the U.S. and Canada to increase coordination and harmonization in standard development
- Develop risk metrics that measure current and future system physical and cyber vulnerabilities

# **Smart Grid Policies, Standards, and Regulations**

**Other Thoughts**

**Other Organizations**

**Other Efforts**

**DER interconnections, microgrid, EVs, and RPS**

**Standards (and best practices)**

**Performance Feedback Program**

**Federal Smart Grid Task Force**

**Smart Grid Policy Center**

**Regulatory Assistance Project**

# Some Smart Grid-Related Standards, Policies, and Incentives

**Completion of IEEE 1547.4 for microgrid requirements is needed**

## **29 States with RPS standards**

Drive policies for DER interconnection, net metering, EE programs, and regulatory recovery of investments

**As of June 2010, 39 states, Washington, D.C., and Puerto Rico have adopted variations of an DER interconnection policy.**

**Incentives to purchase EVs and PHEVs are either planned or provided in 21 states.**

**Federal tax credit of \$2,500 to \$7,500 for EVs and PHEVs, depending on battery size.**

# Smart Grid Standards (& Best Practices)

- **International Electrotechnical Commission identified 25 standards applicable to Smart Grid**

## Requirements

Methodology to develop requirements for energy systems

## Technical specifications

Control centers

Substations

Security

Hardening

## Distribution

Distribution resources

Metering

## Pro-sumer

Energy management model

# American National Standards Institute Accredited SDOs with Smart Grid Aspect

<b>ACCE</b>	<b>BISCI</b>	<b>NETA</b>
<b>AHRI</b>	<b>CEA</b>	<b>IPC</b>
<b>ATIS</b>	<b>DISA</b>	<b>NAHBRC</b>
<b>ASHRAE</b>	<b>EASA</b>	<b>NECA</b>
<b>ASME</b>	<b>IEEE</b>	<b>NEMA</b>
<b>ASSE</b>	<b>IESNA</b>	<b>NFPA</b>
<b>ASTM</b>	<b>INCITS</b>	<b>NERC</b>
<b>AWEA</b>	<b>ISA</b>	<b>NAESB</b>
<b>AHAM</b>	<b>ICC</b>	<b>UL</b>
<b>AIM</b>		

# **Additional Smart Grid Standards (or Best Practices)**

- **Real-time operations**
  - **AMI, DER, DMS, microgrid, V2G interface, markets**
- **Maintenance**
- **Business case development**
- **Design**
- **Construction**
- **Testing and commissioning**

# Performance Feedback Program Vision

***The Smart Grid Performance Feedback Program facilitates the sharing of Smart Grid experiences and learnings thereby allowing stakeholders to continuously improve, avoid pitfalls, and build upon the best practices of others to more effectively, efficiently, and safely achieve their Smart Grid vision.”***

***NETL Smart Grid Implementation Team***

# Value of the Smart Grid PFP

- Improves the efficiency and efficacy of Smart Grid implementation
- Keeps implementation costs down
- Maintains Smart Grid implementation momentum
- Keeps “us” on track with plans and schedules
- Reduces the potential for repeating “missteps”
- Prevents “reinventing the wheel”
- **Provides guidance for future codes and standards development**
- Provide a means to communicate progress to the stakeholders to encourage their support and feedback
- Create “best-in-class” for various Smart Grid applications that will enable others to benchmark their projects

# Possible PFP Leaders

- **National Action Plan Coalition (NAP)**
- **GridWise Alliance (GWA)**
- **Smart Grid Consumer Collaborative (SGCC)**
- **Institute of Electrical and Electronics Engineers (IEEE)**
- **Edison Electric Institute (EEI)**
- **National Rural Electrification Cooperative Association (NRECA)**
- **Electric Power Research Institute (EPRI)**
- **American Public Power Association (APPA)**
- **Software Engineering Institute— Smart Grid Maturity Model (SEI)**
- **National Association of Regulatory Utility Commissioners (NARUC)**
- **NETL Smart Grid Implementation Team (SGI)**
- **University Research Consortia**

# Federal Smart Grid Task Force

- **Department of Energy**
  - Office of Electricity Delivery and Energy Reliability
  - Office of Energy Efficiency and Renewable Energy
- **Federal Energy Regulatory Commission**
- **Department of Commerce**
  - International Trade Administration
  - **National Institute of Standards and Technology**
- **Environmental Protection Agency**
- **Department of Homeland Security**
- **Department of Agriculture**
- **Department of Defense**
- **Federal Communications Commission**

\* Agencies in red have role in Smart Grid policy, regulation, and standards

# Smart Grid Policy Center

- **Non-lobbying arm of GridWise Alliance**
- **Members include NETL, NREL, PNNL, BPA**
  - Conduct policy research on such energy issues as reliability, efficiency, security and climate change
  - Conduct a comprehensive study on the best practices in regulatory models
  - Create avenues for dialogue and cooperation between the private and public
- **Paths to Smart Grid Interoperability: A Smart Grid Policy Center Whitepaper**

# DOE Regulatory Assistance Program

- **Smart Grid and Policy**

- Electric grid company business model

- Electricity delivery plus
    - Energy management, communications, entertainment

- Price structures

- Retail prices more accurately reflect real cost of generation and delivery

# Regulatory Assistance Project

Smart Capabilities	Smart Policies
Micro-grids provide power during grid outages	Support investment in clean distributed resources, simplify interconnection standards and procedures
Dynamic integration of wind and solar resources	Better planning for renewable resources, require grid company investments
Continuous building diagnostics	Require grid company to invest in energy efficiency measures
Improve evaluation of efficiency measures	Develop procedures to measure and verify energy program savings, continue improving program design
Increase demand response	Special prices or incentives, consumer access to energy usage data, support for automated controls
Improve energy efficiency for distribution system	Performance-based regulation or incentives for grid company to optimize voltage and reactive power

# Smart Grid Policy, Regulation, and Standards in Foreign Countries

- **Australia**

- State of Victoria mandated smart meters for all customers

- Mandatory Renewable Energy Target of 20% by 2020

- Developing strategy for energy efficiency (standards)

- National Broadband Network will enable Smart Grid data

- **China**

- 2007 policy to strengthen T&D networks and DSM

- Develop emergency response system for reliability

- Exert control over power use to conserve energy and improve efficiency

- Reinforce Renewable Energy Law

- Renovate rural grid

- Developing smart grid standards; 22 core criteria

- Unified national strong and smart grid by 2020

# Smart Grid Policy, Regulation, and Standards in Foreign Countries

- **India**
  - Issues
    - Increased load with growing economy cannot be met by supply
    - Drive to electrify rural, agricultural population
    - Mitigate operating inefficiencies to reduce financial losses
  - Access to electricity for all households
  - Demand to be met by 2012 with adequate spinning reserve
  - Supply of reliable and quality power
- **European Union Energy and Climate Package**
  - 20 % reduction of GHG emissions compared to 1990 levels
  - 20 % of renewable energy sources in the EU 27 energy mix
  - 20 % reduction in the primary energy used
  - Smart meter into 80% of homes by 2020

# Smart Grid in EU

**Smart meter regulations in Finland, Sweden, Norway, Italy, France and Great Britain**

**CHP is more prevalent in EU**

**Preferences for source of power generation varies**

**Moving toward interconnected transmission systems**