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U.S. Department of Commerce

NIST Smart Grid Program – Overview for Smart Grid Task Force

David Wollman
Smart Grid Team
National Institute of Standards and Technology
U.S. Department of Commerce
April 20, 2011

George Arnold: National Coordinator for Smart Grid Interoperability (NIST)

NIST Smart Grid Program – Outline (Template)

- **High-level goals and objectives of your agency and/or program relating to smart grid**
  - Legislative authority (as applicable to Smart Grid-related activities)
- **Smart grid activities by your agency (responsive to the goals and objectives above)**
  - In the U.S. (including both ongoing and planned activities, with separate listings)
  - Internationally (including both ongoing and planned activities, with separate listings)
- **Smart grid activities in which you would like to collaborate with other agencies**
  - Under each Smart Grid area, identify specific collaboration activities and the roles and responsibilities of collaborating agencies. (Note that smart grid areas could include: R&D, demonstrations and deployments, policies/standards/regulation, business models and markets, consumer engagement, workforce development, energy efficiency, demand response, etc.)
- **Motivation for agency involvement in Smart Grid** (e.g., Smart Grid involvement of agency was included and described in Federal budget; compliance with agency goals; reducing costs; etc.)
- **Smart grid activities that are ongoing with other agencies that you'd be interested in**
  - Under each Smart Grid area, identify specific activities of interest to you
- **Annual budgets in smart grid related activities**
  - Estimated spending in FY10, FY11, and FY12, type of funding including internal, ARRA, other agency-supported
- **Key smart grid stakeholders and customers of your agency**
  - List, under each applicable smart grid area, stakeholders your agency has strong relationships with
  - Explain the customers that agency activities and products target (For example, for DOD, Smart Grid may be serving internal purposes; whereas DOE Smart Grid is for public purposes; USDA RUS is focused more on rural population, etc.)

NIST Smart Grid Program Overview – Outline

- **NIST High-level Goals and Objectives, Motivation for Agency Involvement**
  - Nation's Measurement Experts (Weights and Measures Constitutional Role)
  - Intersection of Industry, Academia, and Government
  - National Technology Transfer and Advancement Act
  - Energy Independence and Security Act (EISA) Roles
- **NIST Budget Overview including Smart Grid**
  - Estimated spending in FY10, FY11, and FY12
- **NIST Smart Grid Activities**
  - Coordination of Smart Grid Standards Framework, Acceleration of Standards and Testing, R&D
  - International Outreach and Involvement, Use of International Standards Where Possible
- **NIST Smart Grid Collaboration Areas, Interests with Respect to Other Agencies**
  - NIST SGIP Standards Coordination
  - R&D Interests of NIST Laboratories
- **Key Smart Grid Stakeholders and Customers for NIST**
  - Interagency Coordination DOE-NIST-FERC plus others, Smart Grid Task Force
  - Policy Coordination: NSTC Subcommittees, OSTP
  - Smart Grid Community: SGIP organization, stakeholder groups

NIST
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National Institute of Standards and Technology

- Non-regulatory agency in the U.S. Department of Commerce
  - Originally National Bureau of Standards (established 1901)
- NIST Laboratories research activities at two main campuses
  - Gaithersburg, Maryland and Boulder, Colorado

- $507M for Laboratories; over 2700 employees (3 Nobel prizes)
- Strong partnerships with industry, academia, government
- Research, calibrations, standard reference materials, data …
- Recently reorganized, mission-oriented

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National Tech Transfer and Advancement Act and OMB A-119

Directs Federal Agencies to **use voluntary consensus standards** developed by consensus standards bodies, where possible

Encourages Government participation in voluntary consensus standards bodies when compatible with missions, authorities, etc.

Directs **NIST to coordinate Federal standards and conformity assessment activities** with those of the private sector

IEC ISO ITU

ANSI American National Standards Institute

IEEE

NEMA

SAE International

VAESB

UCA International Users Group

SHRAE

OGC® Open Geospatial Consortium, Inc.

IETF®

ZigBee® Alliance

OASIS

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NIST Role: Energy Independence and Security Act (2007)

In cooperation with the DoE, NEMA, IEEE, GWAC, and other stakeholders, **NIST** has "primary responsibility to **coordinate development of a framework** that includes protocols and model standards for information management **to achieve interoperability of smart grid devices and systems**…"

Cybersecurity and other IT mandates

- National Security Presidential Directive 54 / Homeland Security Presidential Directive 23 (NSPD-54/HSPD-23): Comprehensive National Cybersecurity Initiative
- Information Technology Management Reform Act of 1996, Section 5131
- Federal Information Security Management Act (FISMA) of 2002
- Computer Security Research and Development Act of 2002
- Homeland Security Presidential Directive #12, WHTI Certification, OMB M04-04 E-Authentication Guidance for Federal Agencies, Information Technology Management Reform Act of 1996, Public Law 104-106, OMB Circular A-130 and OMB Directive 05-24, ….
- DNSSEC: OMB memo M-08-23
- National Initiative for Cybersecurity Education (NICE)
- Identity Management: National Strategy for Trusted Identities in Cyberspace
- C loud Computing: Federal CIO direction to NIST on cloud security and standards
- Internet Protocol version 6 (IPv6): OMB memo, Transition Planning
- Voluntary Voting System Standards: Help America Vote Act

NIST Organizational Structure

Patrick Gallagher is our Under Secretary of Commerce for Standards and Technology, and NIST Director

NIST has 3 Associate Directors:

- Laboratory Programs (Principal Deputy)
- Innovation and Industry Services (External)
- Management Resources (Internal)

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NIST Budget ($ millions, base funding)

	FY 2010	FY 2011 CR	FY 11 vs. FY 10
Laboratory Programs	494.9	497.4	2.5
Baldrige	9.6	9.6	-
Congress Directed	10.5	-	(10.5)
Base STRS, Total	**515.0**	**507.0**	**(8.0)**
Manufacturing MEP	124.7	128.4	3.7
Tech Innovation TIP	69.9	44.8	(25.1)
ITS, Total	194.6	173.2	(21.4)
NIST Construction	80.0	69.9	(10.1)
Competitive Grants	20.0	-	(20.0)
Congress Directed	47.0	-	(47.0)
CRF, Total	147.0	69.9	(77.1)
NIST Total	**$856.6M**	**$750.1M**	**$(106.5)**

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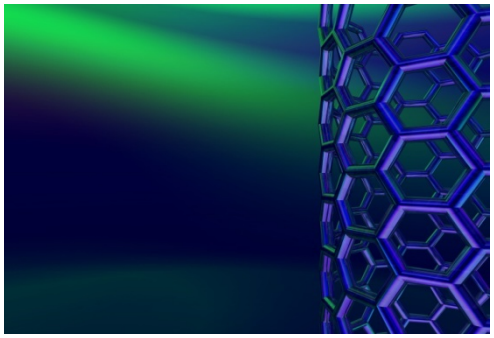
NIST – Targeting Investments to Advance U.S. Innovation and Boost Economic Recovery

FY 2012 Request Addresses Challenges in Key Priority Areas:

- Manufacturing
- Information Technology and Cybersecurity
- Healthcare
- Environment and Consumer Safety
- Energy
- Physical Infrastructure

Photo Courtesy: Eric Brandt

Physical infrastructure: Improved infrastructure codes and standards



Credit: Shutterstock/S. Ekatarina

Nanomanufacturing: New measurement tools for advanced materials manufacturing

Cybersecurity: Improved response to cyber threats

Credit: Shutterstock/Junede

Courtesy: techibuzz.com/GM Autos

Energy: Measurements and standards for energy security

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NIST FY 2012 Scientific and Technical Research (+$178.4M)

- Tools for Manufacturing Competitiveness
  - Strengthening Measurement Science and Standards in Support of Industry Needs (+$20M)
  - Advanced Materials for Industry (+$14.2M)
  - Innovations for 21st Century U.S. Manufacturing: Faster, Smarter and Cleaner (+$13.3M)
  - Measurement Services and Standards to Support Biomanufacturing (+$9.5M)
  - Measurements to Support the Manufacture and Production of Nanotechnology-based Products (+$28.3M)

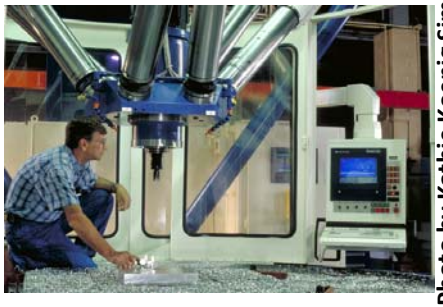

Photo by Kathie Koenig Simon

- **Ensure a Secure and Robust Cyber Infrastructure (+$43.4M)**
- **Interoperability Standards for Emerging Technologies (+$22.8M)**
- **Measurements and Standards to Support Increased Energy Efficiency and Reduced Environmental Impact (+$13.3M)**

Courtesy: Inhabitat.com

- Measurements to Support Advanced Infrastructure Delivery and Resilience (+$10.6M)
- Postdoctoral Research Program (+$3.0M)

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NIST Organizational Structure – Smart Grid

NIST Smart Grid Team:

- Special Programs
  - George Arnold: National Coordinator for Smart Grid Interoperability
  - Smart Grid Office
- Laboratories:
  - Engineering Laboratory
  - Information Technology Laboratory
  - Physical Measurement Laboratory
- Director's Office
  - Public and Business Affairs
  - Congressional Affairs

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NIST Smart Grid funding ($ million)

	ARRA	FY 2011 CR	FY2012 Request
Smart Grid Office and Laboratories		5	+15 (increase)
SGIP Contract	10 (via DOE)	TBD	(included above)
Other SG	6 (via NIST)	-	-
Total	**16**	**5**	**20**

Relevant Laboratory Programs not included in above numbers
~$10M building energy (Engineering Laboratory) plus ~$2M ARRA plus Cybersecurity program (Information Technology Laboratory)

Other Agency funding support: DOE, DOD, …
Other: NIST Measurement Services (Calibration) Income

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NIST Role: Coordination of Interoperability Standards

- NIST Deliverables:
  - Smart Grid Interoperability Framework and Reports to Congress (Year1 report submitted, others as needed)
- Relationship to **Federal Energy Regulatory Commission** (and State Public Utility Commissions)

  *"…after **[NIST]'s work has led to sufficient consensus** in [FERC]'s judgment, [FERC] shall institute a **rulemaking** proceeding to **adopt such standards and protocols** as may be necessary to insure smart-grid functionality and interoperability in interstate transmission of electric power, and regional and wholesale electricity markets."*
- Use of these standards is a criteria for Department of Energy Grants Programs

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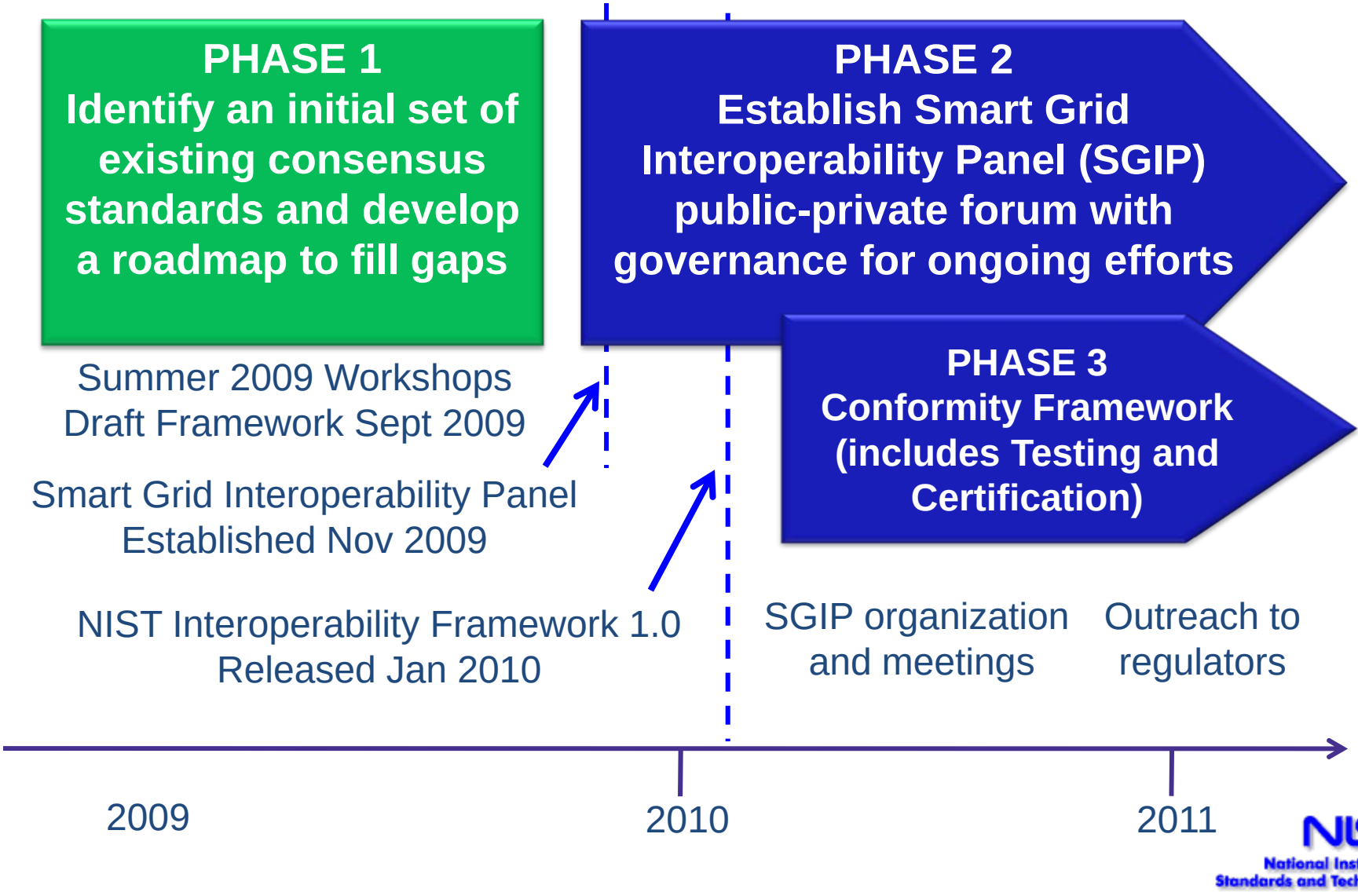
NIST Three Phase Plan for Smart Grid Interoperability



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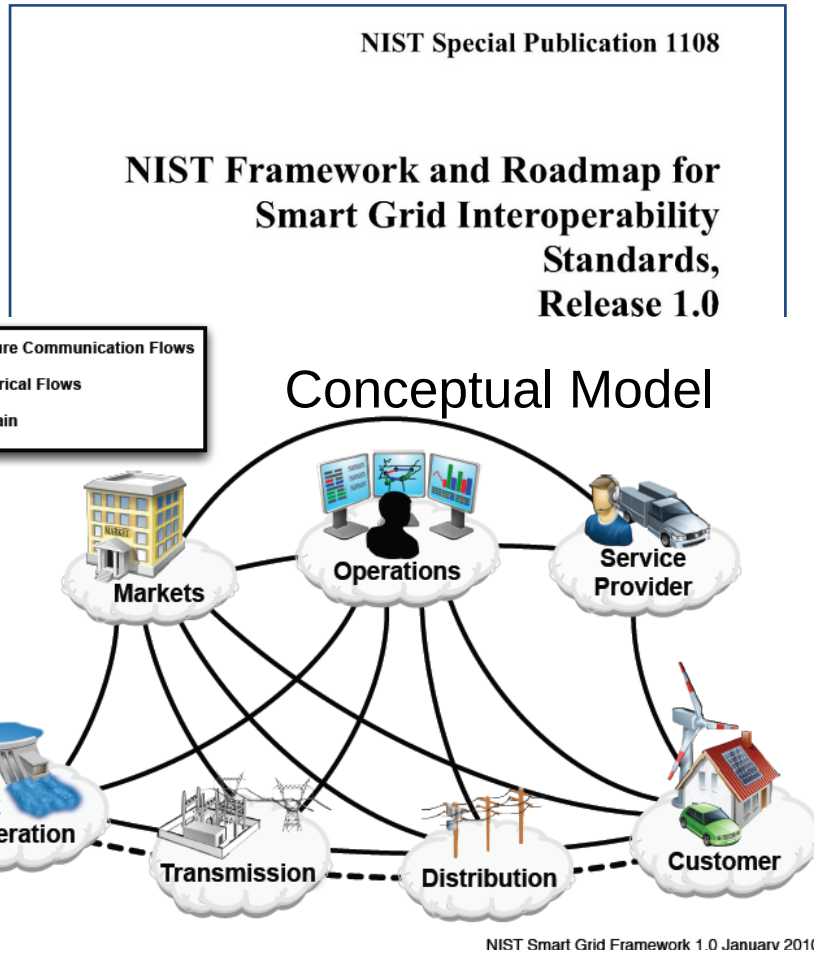
NIST Framework and Roadmap, Release 1.0

- Final version January 2010
  - Public comments on draft reviewed and addressed
- Smart Grid Vision / Model
- 75 key standards identified
  - IEC, IEEE, …
- Priority Action Plans to fill gaps (some completed, new)
- Includes cyber security, companion document NISTIR 7628, Guidelines for Smart Grid Cyber Security published in September 2010
- Release 2 revision is underway, with SGIP involvement



http://www.nist.gov/smartgrid/

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Filling Gaps in the Standards

- Priority Action Plans (led by NIST staff)

#	Priority Action Plan	#	Priority Action Plan
0	Meter Upgradeability Standard	9	Standard DR and DER Signals
1	Role of IP in the Smart Grid	10	Standard Energy Usage Information
2	Wireless Communication for the Smart Grid	11	Common Object Models for Electric Transportation
3	Common Price Communication Model	12	IEC 61850 Objects/DNP3 Mapping
4	Common Scheduling Mechanism	13	Time Synchronization, IEC 61850 Objects/ IEEE C37.118 Harmonization
5	Standard Meter Data Profiles	14	Transmission and Distribution Power Systems Model Mapping
6	Common Semantic Model for Meter Data tables	15	Harmonize Power Line Carrier Standards for Appliance Communications in the Home
7	Electric Storage Interconnection Guidelines	16	Wind Plant Communications
8	CIM for Distribution Grid Management	17	Facility Smart Grid Information

NIST Smart Grid Interoperability Panel

- Public-private partnership created in Nov. 2009
- Over 650 member organizations, 1700 participants
- Open, public process with international participation
- Coordinates standards development
  - Identifies Requirements
  - Prioritizes standards development programs
  - Works with over 20 SDOs including IEC, ISO, ITU, IEEE, …
- Web-based participation

SGIP Twiki:
http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/SGIP

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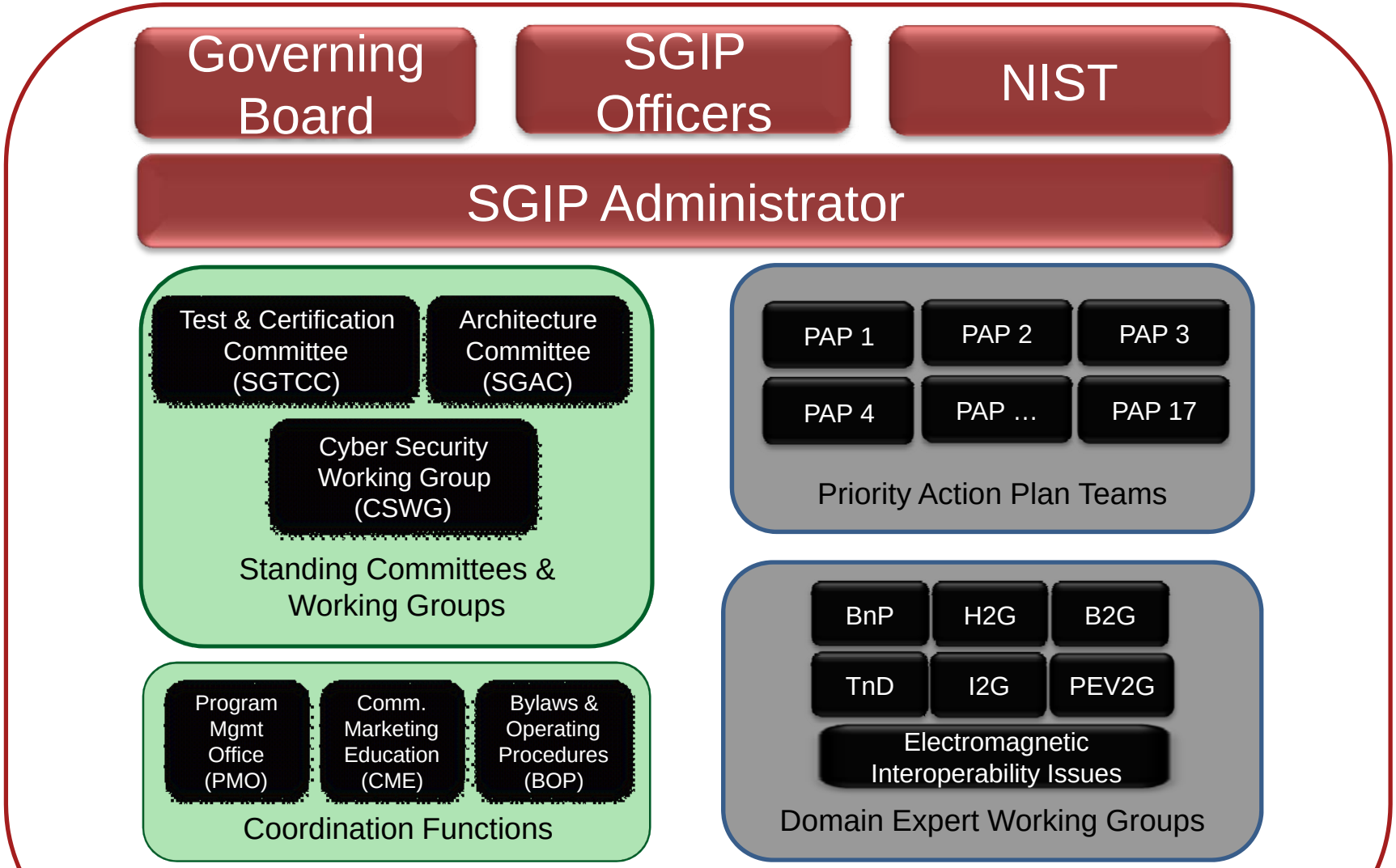
SGIP Organization



SGIP Membership

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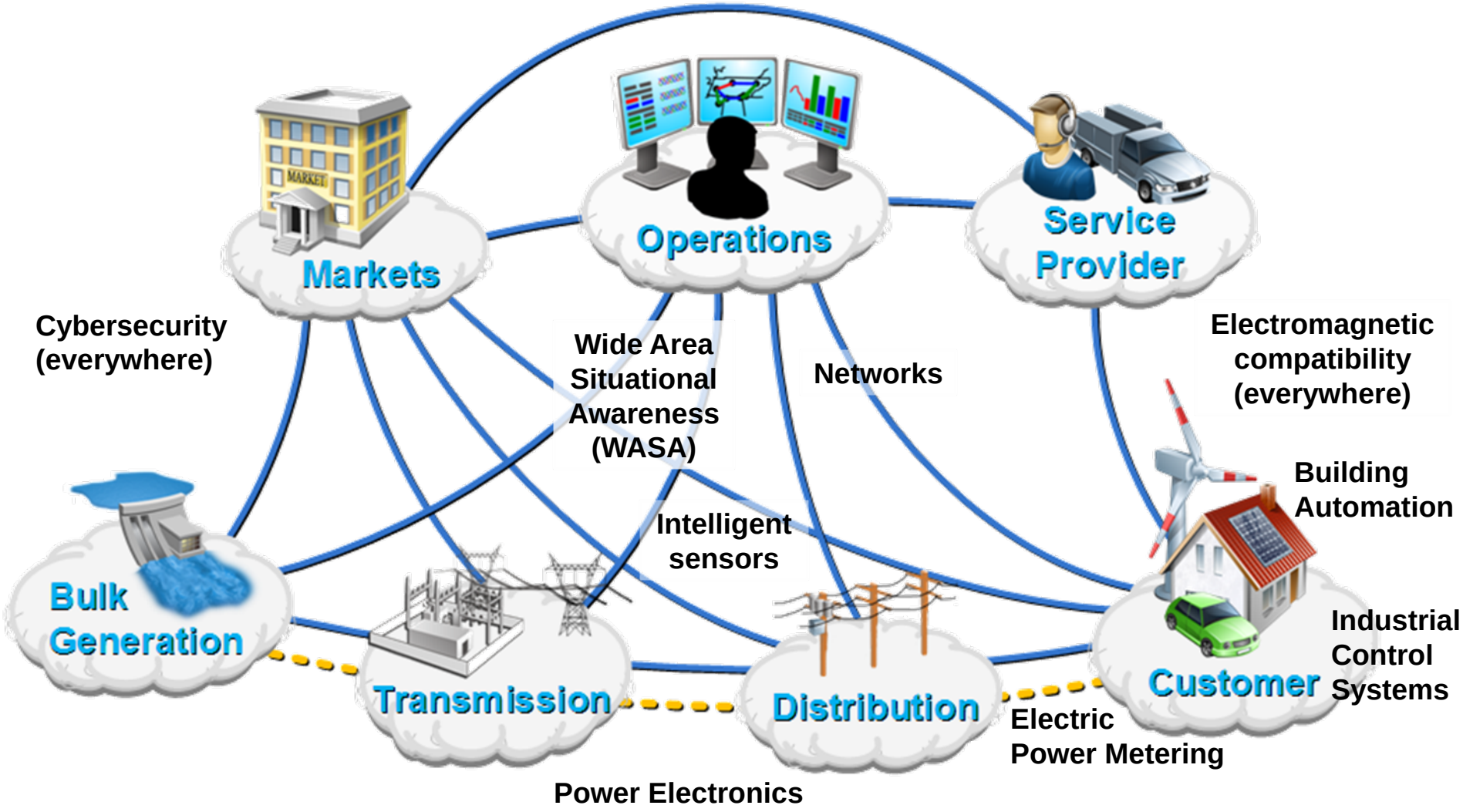
NIST Smart Grid Research Examples



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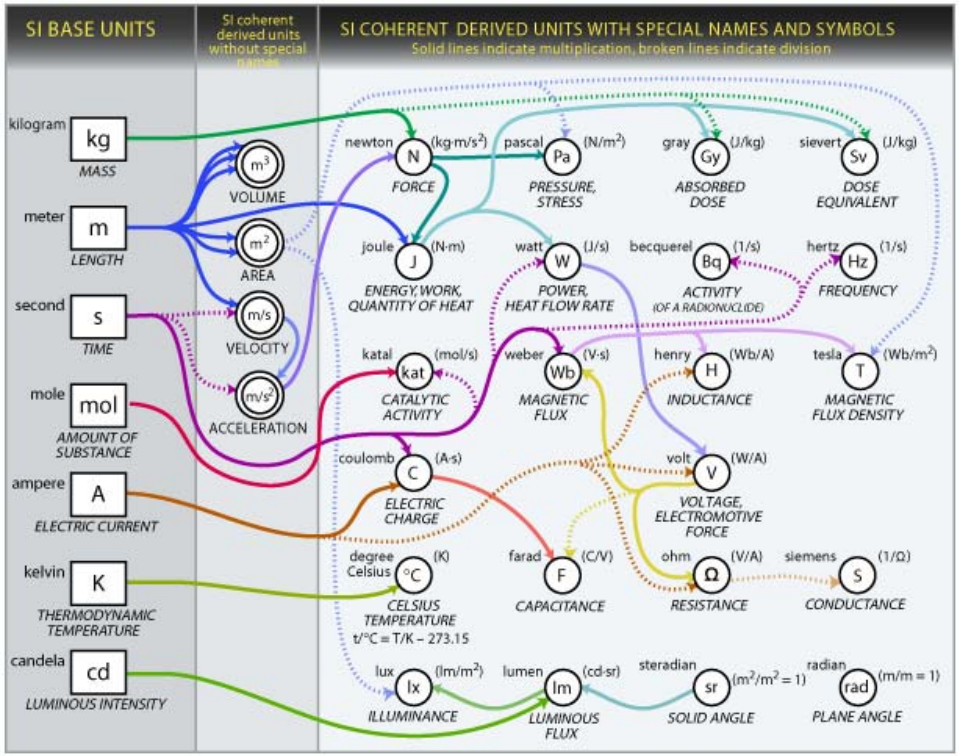
Physical Measurement Laboratory

- **Quantum Measurements**
  - Quantum Computing and Information
  - Quantum Based Standards
- **Electrical Measurements**
  - National Electrical Standards
  - Equipment Calibrations
  - Measurements Supporting Power Industry (PMUs, meters)
- **Time and Frequency Measurements**
  - Atomic Clocks
  - GPS improvements
- **Electromagnetics**
  - Electromagnetic compatibility
  - Wireless communications
  - Microwaves, magnetics, …
- **Mechanical Measurements …**
  - Mass, force, length, pressure, …
- **Semiconductor Electronics**
  - Power Electronics
- **Ionizing Radiation**
- **Optoelectronics/Optical Technology**



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  - Atomic Clocks
  - GPS improvements
- **Electromagnetics**
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  - Microwaves, magnetics, …
- **Mechanical Measurements …**
  - Mass, force, length, pressure, …
- **Semiconductor Electronics**
  - Power Electronics
- **Ionizing Radiation**
- **Optoelectronics/Optical Technology**

Phasor Measurement Units: Electrical grid measurements with accurate timestamping

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Engineering Laboratory

- **Smart Manufacturing, Construction, and Cyber-Physical Systems**
  - Smart Manufacturing Processes and Equipment
  - Next-Generation Robotics and Automation
  - Smart Manufacturing and Construction Systems
  - Systems Integration for Manufacturing and Construction Applications
- **Disaster-Resilient Buildings, Infrastructure, and Communities**
  - Fire Risk Reduction in Communities
  - Fire Risk Reduction in Buildings
  - Earthquake Risk Reduction in Buildings and Infrastructure
  - Structural Performance Under Multi-Hazards
- **Sustainable and Energy-Efficient Manufacturing, Materials, and Infrastructure**
  - Sustainable Manufacturing
  - Sustainable, High-Performance Infrastructure Materials
  - Net-Zero Energy, High-Performance Buildings
  - Embedded Intelligence in Buildings

Interoperability of building and manufacturing systems with the Smart Grid

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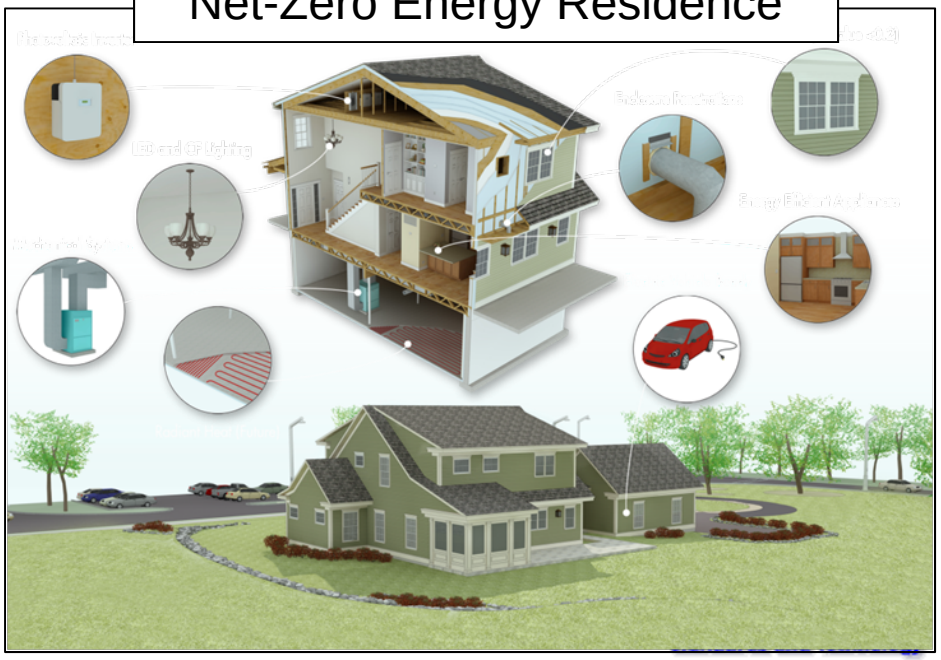
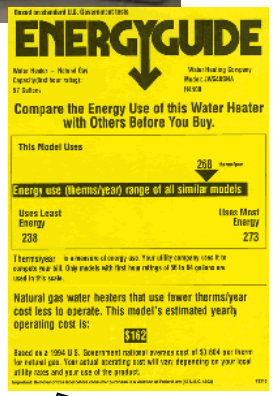
  - Embedded Intelligence in Buildings
- **Disaster-Resilient Buildings, Infrastructure, and Communities**
  - Fire Risk Reduction in Communities
  - Fire Risk Reduction in Buildings
  - Earthquake Risk Reduction in Buildings and Infrastructure
  - Structural Performance Under Multi-Hazards

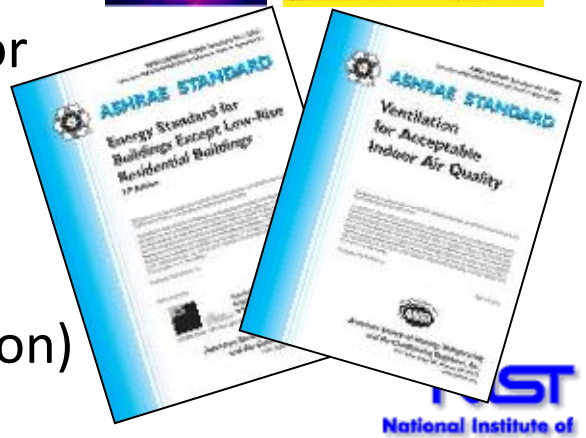
Net-Zero Energy Residence



Engineering Laboratory

- **Building Automation and Control** – enabling energy savings, reduced operating costs, and improved occupant comfort and safety via BACnet standard for integration of building automation and control systems adopted by ISO, CEN, and over 30 countries
- **Energy Efficiency of Appliances** – enabling energy savings, reduced operating costs, and consumer awareness via standard DOE testing and rating procedures for HVAC, water heaters, and appliances
- **Indoor Air Quality** – enabling efficient use of energy in buildings nationwide by providing minimum threshold standards for ventilation, standard quantitative methods for assessing building envelope airtightness, and reference materials for assessing VOC emissions
- **Renewable Energy** – enabling use of solar equipment through test method and rating procedure development that forms the basis of industry (Solar Rating and Certification Corporation) certification programs





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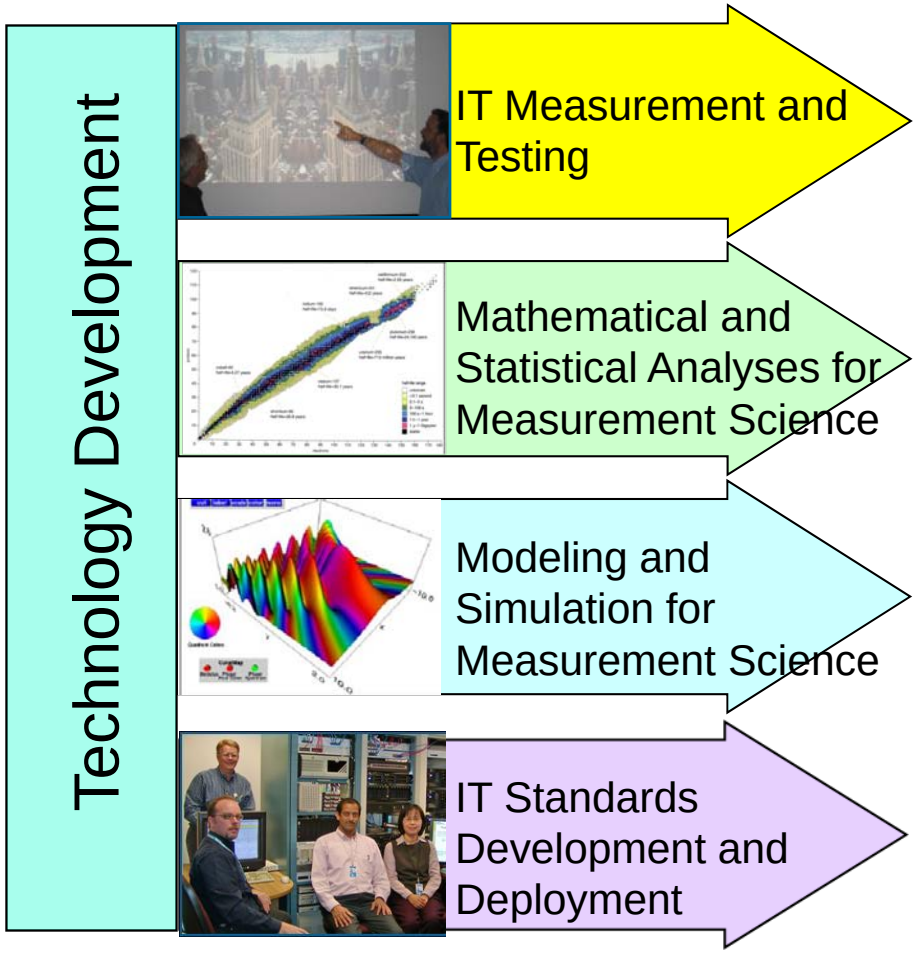
Information Technology Laboratory

- **National Priorities**
  - Biometrics
  - Cloud Computing
  - Cyber Security
  - Domain Name System Security (DNSSec)
  - Health Information Technology
  - Identity Management
  - Internet Protocol Version 6 (IPv6)
  - Smart Grid
  - Statistics for Uncertainty (e.g., Gulf Oil Spill Response)
  - Voting Systems
- **Emerging Technologies**
  - Complex Systems
  - Pervasive Information Technology
  - Quantum Information
  - Virtual Measurement Systems
- **Enabling Scientific Discovery**



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Smart Grid Opportunities

- Metering
  - Bidirectional metering, testbeds…
- Sensors and automated control
  - PMUs, time synchronization, distributed sensors…
- Smart Grid architecture and operations
  - Research/modeling of grid stability (load/generation)
  - Microgrids, …
- Power Electronics
- Electromagnetic Compatibility/Interference
- Energy Efficiency, Renewable Energy
- Integration with Net-Zero Buildings
- Cybersecurity
- Electric Vehicles/Storage
- Communication protocols
- Testing and certification activities, many others …

Smart Grid Opportunities for Collaboration

- Metering – DOE
  - Bidirectional metering, testbeds…
- Sensors and automated control – DOE, NASPI
  - PMUs, time synchronization, distributed sensors…
- Smart Grid architecture and operations – many groups
  - Research/modeling of grid stability (load/generation) - DOE
  - Microgrids, … - DOD, DOE
- Power Electronics – DOE, DOD
- Electromagnetic Compatibility/Interference – FCC, NTIA
- Energy Efficiency, Renewable Energy – DOE, EPA
- Integration with Net-Zero Buildings – DOE, EPA
- Cybersecurity – DOE, NERC … DHS, DOD .. others?
- Electric Vehicles/Storage – DOE, DOT?
- Communication protocols - many
- Testing and certification activities, many others …
- International (DOC/ITA, DOE, many others)

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U.S. Government Roles in Smart Grid

Federal

Office of Science & Technology Policy; National Economic Council; & Council on Environmental Quality

U.S. DEPARTMENT OF ENERGY

Smart Grid Task Force / National Science & Technology Council Smart Grid Subcommittee

Other Federal Agencies (EPA, …)

NIST National Institute of Standards and Technology U.S. Department of Commerce

FCC Federal Communications Commission

Federal Energy Regulatory Commission

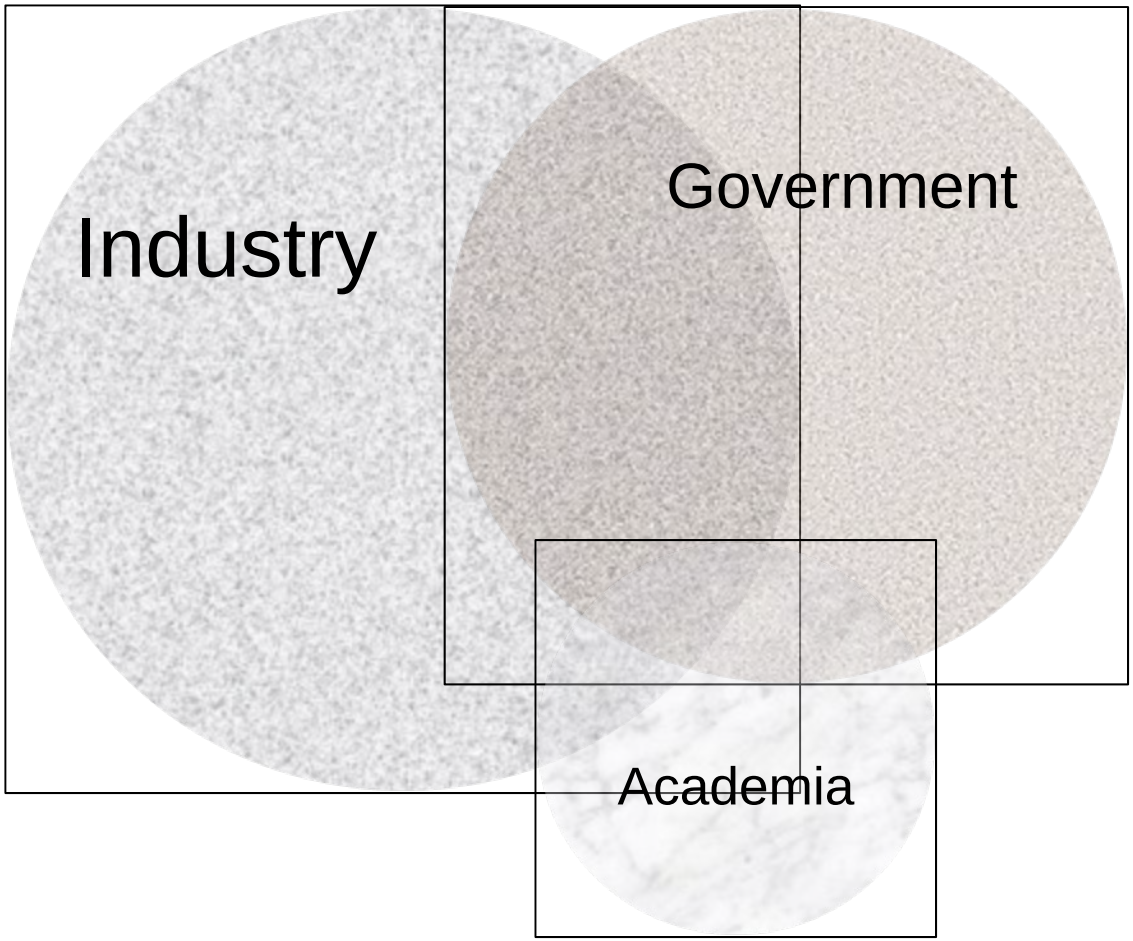
State

FERC – NARUC Smart Response Collaborative

Public Utility Commissions (National Association of Regulatory Utility Commissions)

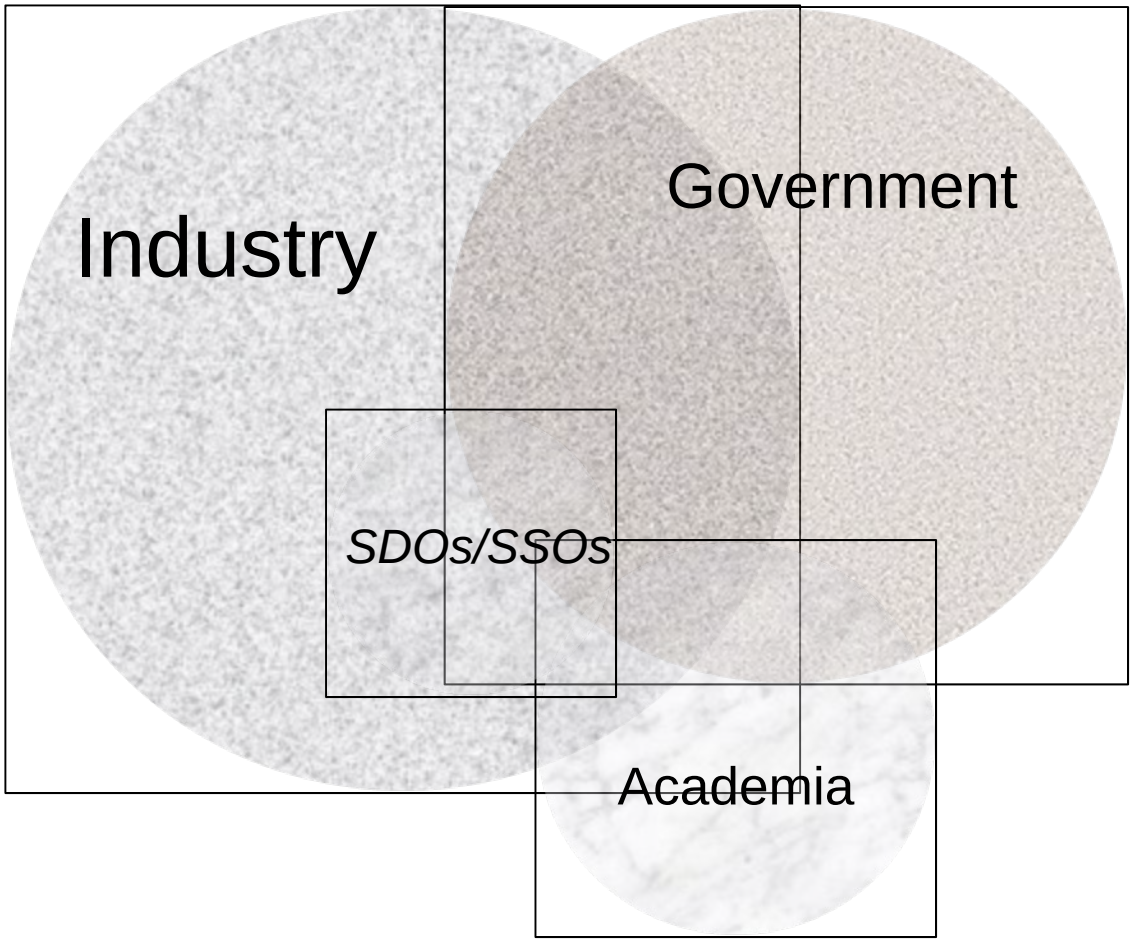
Stakeholders and Customers

- Industry, Government, Academia



Stakeholders and Customers

- Industry (including Standards Developing Organizations/Standards Setting Organizations), Government, Academia



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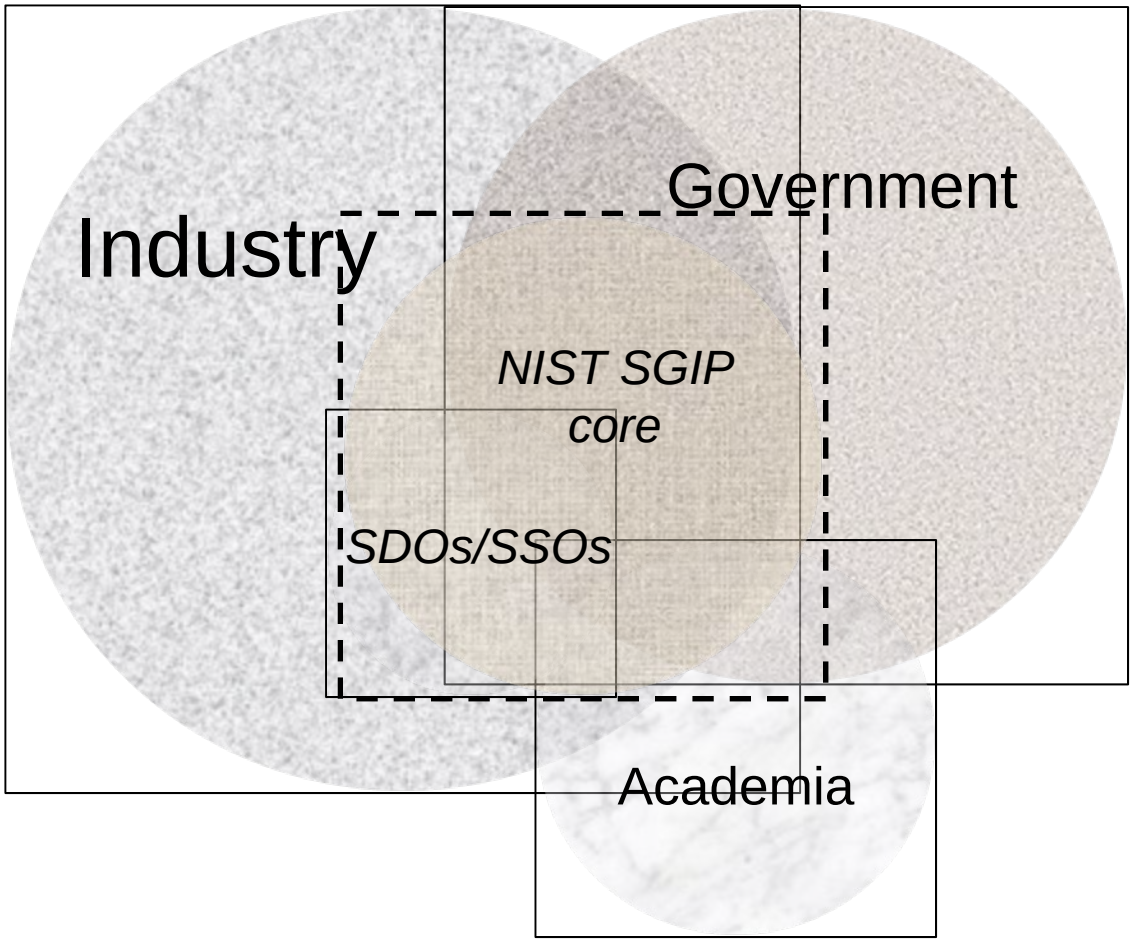

SGIP Stakeholder Categories

1	Appliance and consumer electronics providers
2	Commercial and industrial equipment manufacturers and automation vendors
3	Consumers – Residential, commercial, and industrial
4	Electric transportation industry Stakeholders
5	Electric utility companies – Investor Owned Utilities (IOU)
6	Electric utility companies - Municipal (MUNI)
7	Electric utility companies - Rural Electric Association (REA)
8	Electricity and financial market traders (includes aggregators)
9	Independent power producers
10	Information and communication technologies (ICT) Infrastructure and Service Providers
11	Information technology (IT) application developers and integrators
12	Power equipment manufacturers and vendors
13	Professional societies, users groups, and industry consortia
14	R&D organizations and academia
15	Relevant Government Agencies
16	Renewable Power Producers
17	Retail Service Providers
18	Standard and specification development organizations (SDOs)
19	State and local regulators
20	Testing and Certification Vendors
21	Transmission Operators and Independent System Operators
22	Venture Capital

SGIP stakeholder category membership examples

- Category 18 SDOs includes ATIS, ASHRAE, IEC, IEEE, INCITS, ISO, ISA, IETF, ITU-T, Modbus, NEMA, NFPA, NAESB, OASIS, OMG, ODVA, OPC, OGS, SAE, TIA, UISOL

- Category 5 IOUs includes Alliant Energy, Inc., American Electric Power, Arizona Public Service Co. (APS), Avista Utilities, Baltimore Gas & Electric, BC Hydro, Black Hills Power, Bonneville Power Administration, CenterPoint Energy, Consolidated Edison Company of NY, Inc., Dayton Power & Light Co., Detroit Edison/DTE Energy, Duke Energy Corporation, El Paso Electric, Exelon, FirstEnergy Service Company, Florida Power & Light, Green Mountain Power, Hydro-Quebec, Idaho Power Company, Indianapolis Power & Light Company, Kansas City Power & Light Co., MidAmerican Energy Company, National Grid, Northeast Utilities, Pepco Holdings Inc., Portland General Electric Company, Progress Energy, Puget Sound Energy, San Diego Gas & Electric, Southern California Edison, Southern Company Services, Inc, State Grid Corporation of China, Tucson Electric Power, United Illuminating Company, We Energies, Westar Energy Inc., Xcel Energy Inc.

- Category 15 Relevant Federal Agencies: DHS Control Systems Security Program (CSSP), Nuclear Regulatory Commission, Inmetro (National Institute of Metrology, Standardization and Industrial Quality, Brazil)

Further Information and Discussions

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