

NIST Engagement with Smart Grid: A Case Study

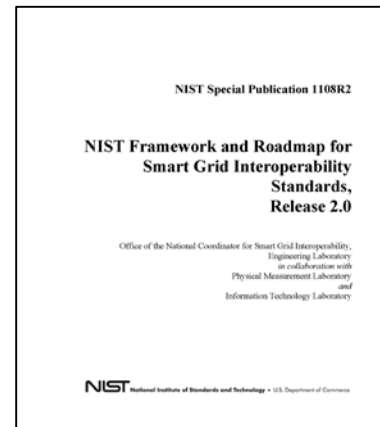
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Smart Grid Case Study

- How NIST became a smart grid convener
- How NIST did it
- At what cost?
- What the outcome has been



NIST SG Framework (Release 1.0, 2.0 & 3.0)



Smart Grid Interoperability Panel (SGIP)

Backstory: 2007

- House science committee contacted a NIST Lab to discuss how NIST could help advance the smart grid
- Several conversations (over months) led to a plan to improve metrology and standards
- Seemed like a great way to increase support for core work in the Quantum Electricity Metrology Division
 - This was an area with underinvestment for many years resulting in continuous loss of staff and capability

Energy Independence and Security Act of 2007

EISA had new roles and responsibilities for DOE, NIST and FERC

NIST is given

“primary responsibility to coordinate development of a framework that includes ...standards ...to achieve interoperability of smart grid devices and systems...”

But

- **No funding**
- **No measurements**
- **A convening role**

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2008: NIST response

- **No funding**
- **No measurements**
- **A convening role**
- **“Volunteer” staff level activities**
- **Small team (~10 staff in several Labs)**
- **Interactions with stakeholders (Domain Expert Working Groups)**

Smart Grid heats up

National Priority

- Administration change in January 2009, emphasis on smart grid

Government Engagement

- ARRA “stimulus” \$4.5B for smart grid (DOE)
- NIST Framework/interoperability standards needed to support deployments, avoid stranded investments

Industry Engagement

- National priority/urgency of smart grid and fear of FERC-mandated standards motivated positive engagement/defensive participation

NIST ramps up 2008-2010

NIST reassigns/redirects numerous staff to address smart grid (~16 FTEs)

- 5 from Quantum Electrical Metrology Division (including DC and GL) and 3+ from other parts of the Lab (PML)
- 3+ from ITL (cyber security, networks/timing)
- 3+ from EL (smart buildings, industrial control systems)
- Reassigned an SES (George Arnold) to lead the program
 - 2 new staff hires for standards coordination (not measurements!)
 - Additional support from Director's Office/Public Affairs, contracting office, ...

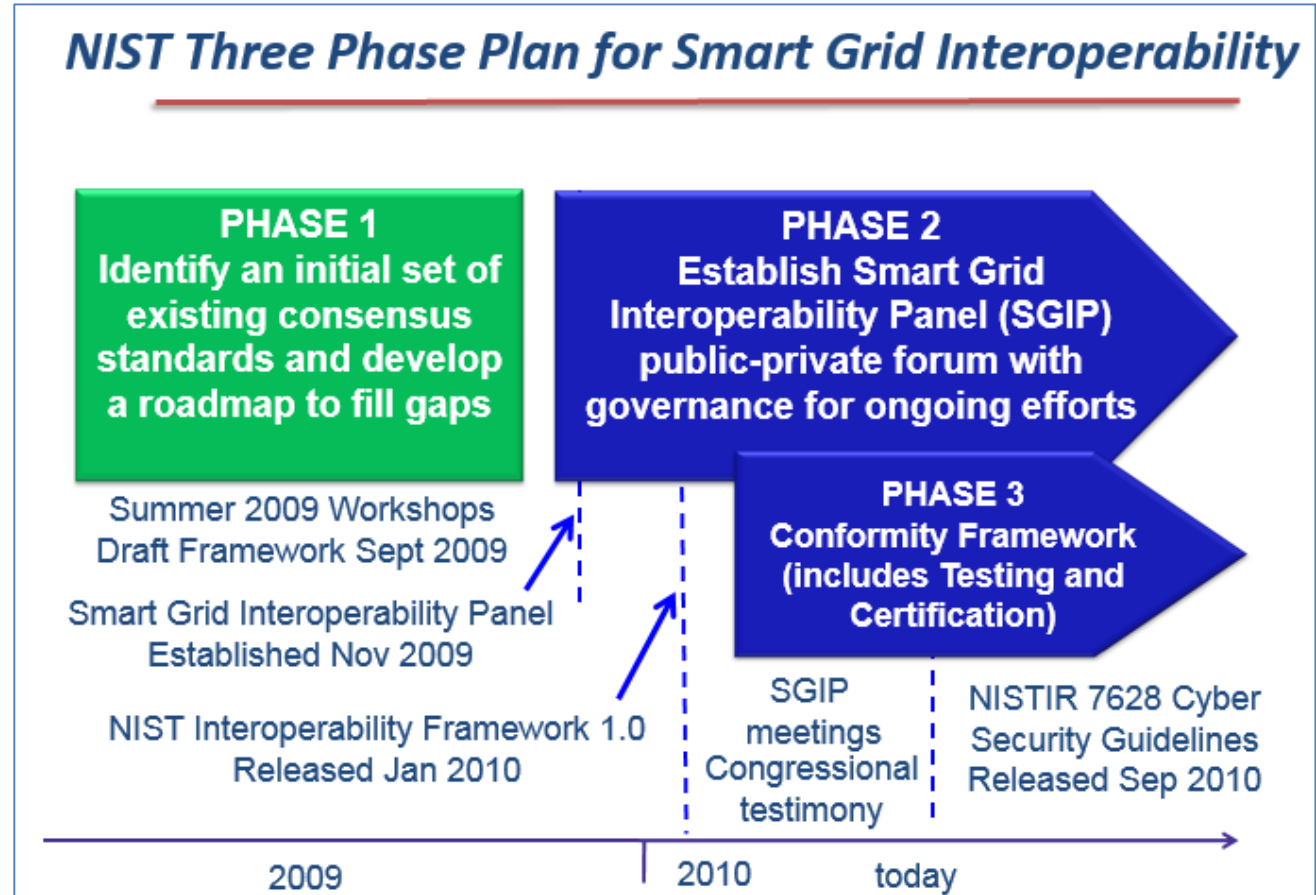
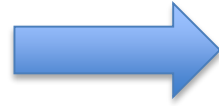
Discretionary nature of NIST funding allows this

Primarily impact is opportunity cost, but it put even more pressure on Quantum Electricity Metrology Division technical work

NIST plan for convening

NIST “Three-Phase Plan” (April 2009)

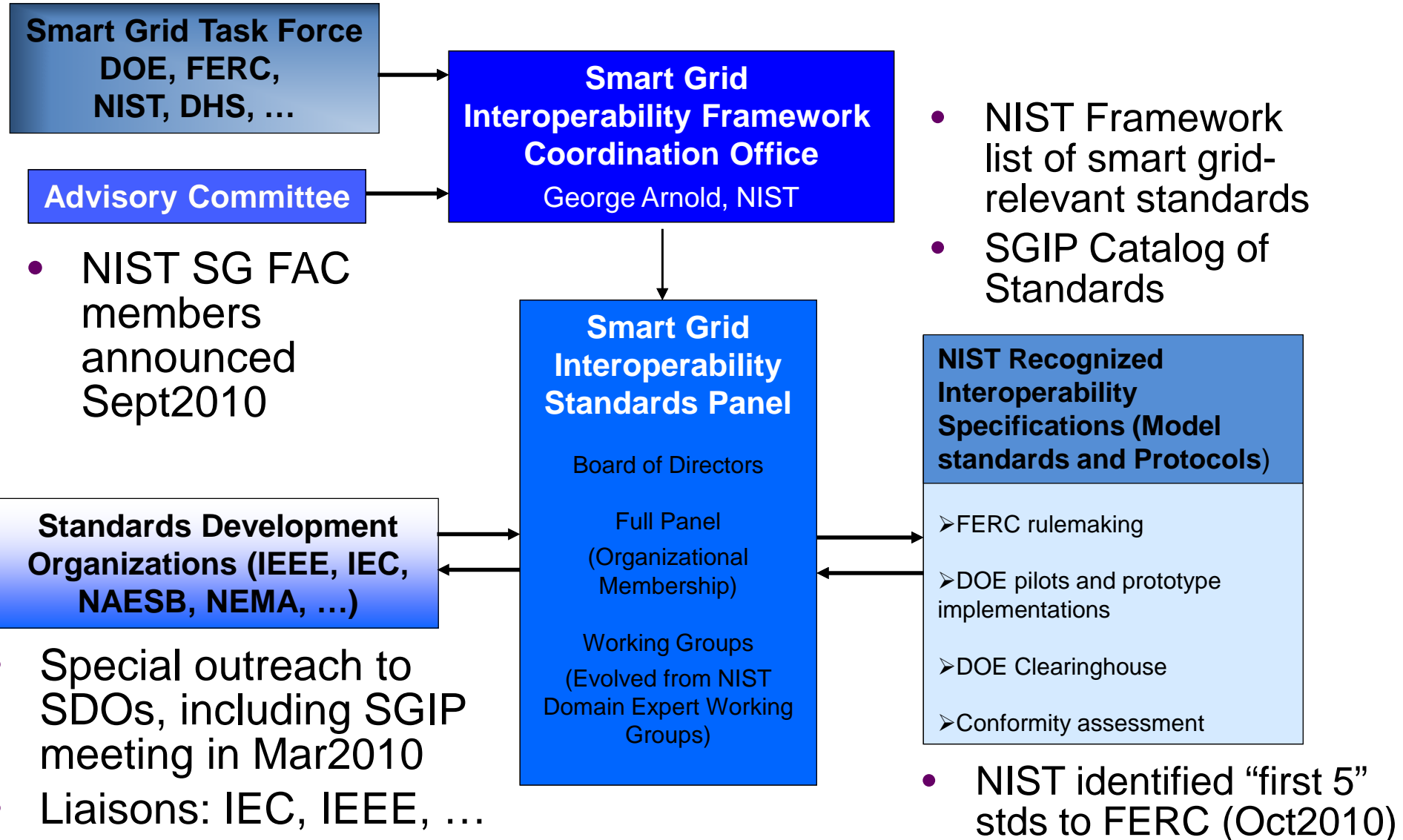
- White House Kickoff Meeting including DOC & DOE Secretaries



- Deeper engagement w/DOE & FERC, industry and standards orgs
 - NIST provided high-level national (and international) coordination
 - NIST team is able to competently leverage others

Heavy NIST involvement in “coordination machinery”

Color code:
deeper “blue”
indicates
greater NIST
involvement



Help arrives

Smart Grid began as unfunded mandate, with NIST bearing the cost by reassigning and redirecting staff

2009 One-time ARRA stimulus funding (totaling \$18M)

- Pass-through funding, used to build standards coordination infrastructure
\$10M (+ later \$2M) from DOE ARRA, \$5M from NIST ARRA , \$1M NIST ARRA grants program
Applied to SGIP costs 2009-2011 ~\$4M-5M/year contacts, plus accelerating standards work
Contract and activity management consumed significant NIST staff effort

2010 NIST Budget increase +\$5M (first smart grid initiative)

2011 NIST Budget increase +\$3.5M (second smart grid initiative)

- Mostly used to pay for Smart Grid Office and SG Framework infrastructure as ARRA was spent down, and to support NIST staff in SGIP coordination activities

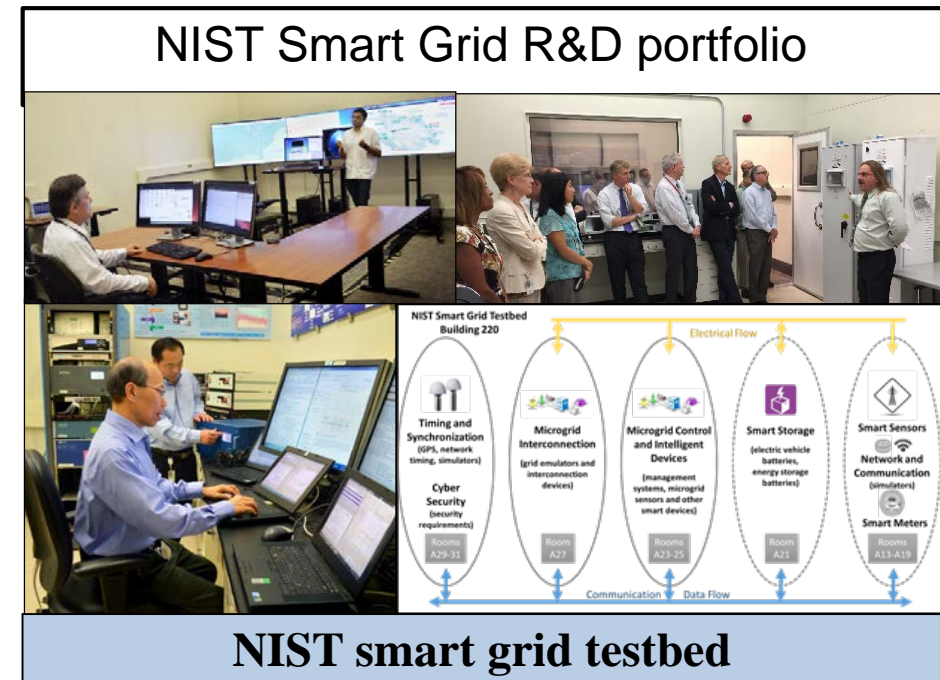
Today

NIST funding continues to support Standards Coordination Framework

- Starting 2012 we have tapered back (SGIP transitioned to non-profit organization)
- Goal is to reduce to \$500k/year by FY18

Now funds can be reinvested

- NIST smart grid program
 - SG coordination (less over time)
 - Smart grid testbed capability
 - Associated research & standards

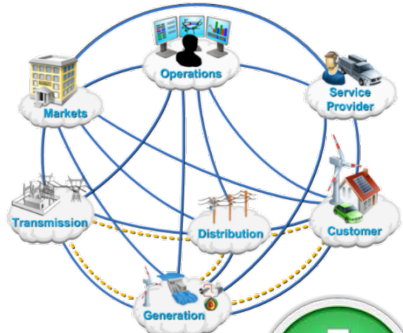


Going forward ... stakeholder engagement

- **Healthy programs interact vigorously & intentionally with stakeholders...**
- **Grid 3.0 Multi-Organization Collaboration** – convening with larger umbrella
 - Grid 1.0: legacy grid (traditional grid, centralized generation/control)
 - Grid 2.0: smart grid (current state, new IT/intelligence+communications)
 - Grid 3.0: future grid (fully modernized grid; operations fundamentally different: flexible, resilient, highly-interactive, new capabilities to meet evolving policy goals)
 - Participating orgs: EPRI, NIST, DOE, NEMA, GWAC, SGIP, EEI, UCAIug, IEEE, ...
- **Cyber-Physical Systems (CPS)** – synergy with Smart Grid in a broader multi-infrastructure context, informed by work of CPS Public Working Group (CPS Framework) and testbed science development (federated testbeds)

Outcomes

NIST SG Framework (Release 1.0, 2.0 & 3.0)



Priority Action Plans (PAPs)



White House Kickoff



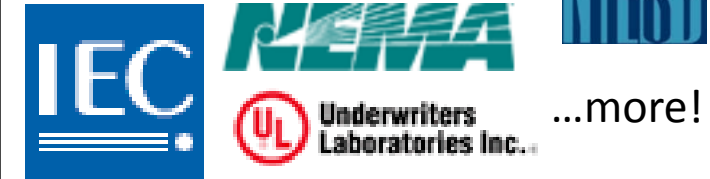
NISTIR 7628 Guidelines for Cyber Security

Smart Grid Interoperability Panel



Catalog of Standards, Governing Board, Completed PAPs, Committees/Pubs, ...

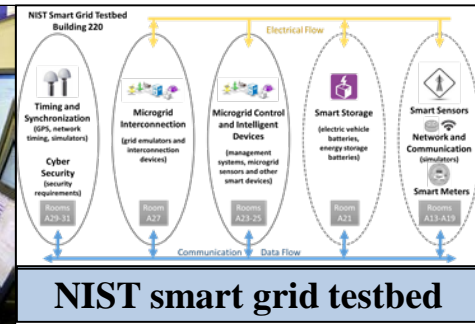
New/revised smart grid standards, guidance, implementations



...more!

NEMA SG-AMI 1, IEC 61850/CIM, IEEE 1547 & C37.118, UL1741, OASIS Energy Interop, ASHRAE 201 FSGIM, NAESB Green Button (ESPI)...more!

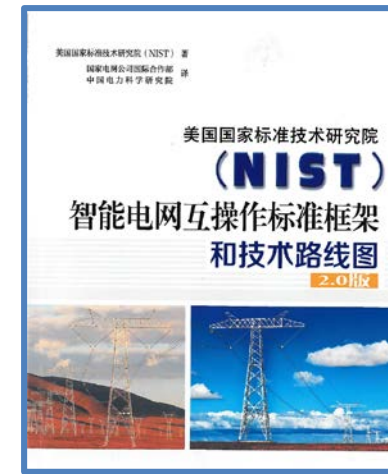
NIST Smart Grid R&D portfolio in EL, ITL, PML, CTL: R&D, standards, testing/certification, publications, ...



NIST smart grid testbed

Outcomes/Impacts: Recognition

- **Grid Week** awards
(2010, Leadership, International Standards Coordination & 2012, Taming Complexity: SGIP and Smart Policy: Green Button)
- **Functioning SGIP** (now transitioned to non-profit SGIP2.0) that has completed 18 PAPs; 76 entries in SGIP Catalog of Standards
- **Project Management Institute Award:** 2013 Distinguished Project Award for the “NIST Smart Grid Interoperability Panel (SGIP) Program”
- **DOC** Gold, Silver and Bronze medals



NIST SG Framework translated into other languages

DOC Gold, 2011
(SG Framework)



DOC Silver, 2015
(Green Button)



DOC Bronze
2012 (SG Timing)
2012 (PMU)
2015 (PMU T&C)

Summary – Smart Grid Case Study for VCAT

NIST was given new assignment (*though different from what NIST had hoped for*)

- Legislation: EISA – signed into law in Dec2007, convening role for NIST in smart grid
- But authorization **without funding** (*also different from what NIST had hoped for*)

NIST executed

- Reassigned/redirected numerous staff, cancelled/delayed planned work
- Used fortuitous ARRA funding to build a standards coordination infrastructure

NIST was successful

- NIST Framework and Roadmap for Smart Grid Interoperability Standards R3 (recognized internationally)
- Smart Grid Interoperability Panel (now transitioned to non-profit 501c3)
- NIST smart grid efforts recognized by industry, regulators
- Lessons learned for other similar NIST activities (frameworks, public-private partnerships)
- Continuing implementation of smart grid by industry/utilities, new benefits (ex: distribution system sensors)

But there's an opportunity cost....