



U.S. Department of Energy

Office of Electricity Delivery and Energy Reliability

US Department of Energy Smart Grid Perspectives & Implementation Experience

**Presented at KSP Workshop
for the Energy Smart Communities Initiative**

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Presentation Outline

- **Overview of Smart Grid**
Definition, Applications, Value Creation
- **Smart Grid Implementation by DOE**
 - American Recovery and Reinvestment Act Investments in Grid Modernization
 - Smart Grid R&D Program
- **International Smart Grid Action Network**
- **Information Resources**

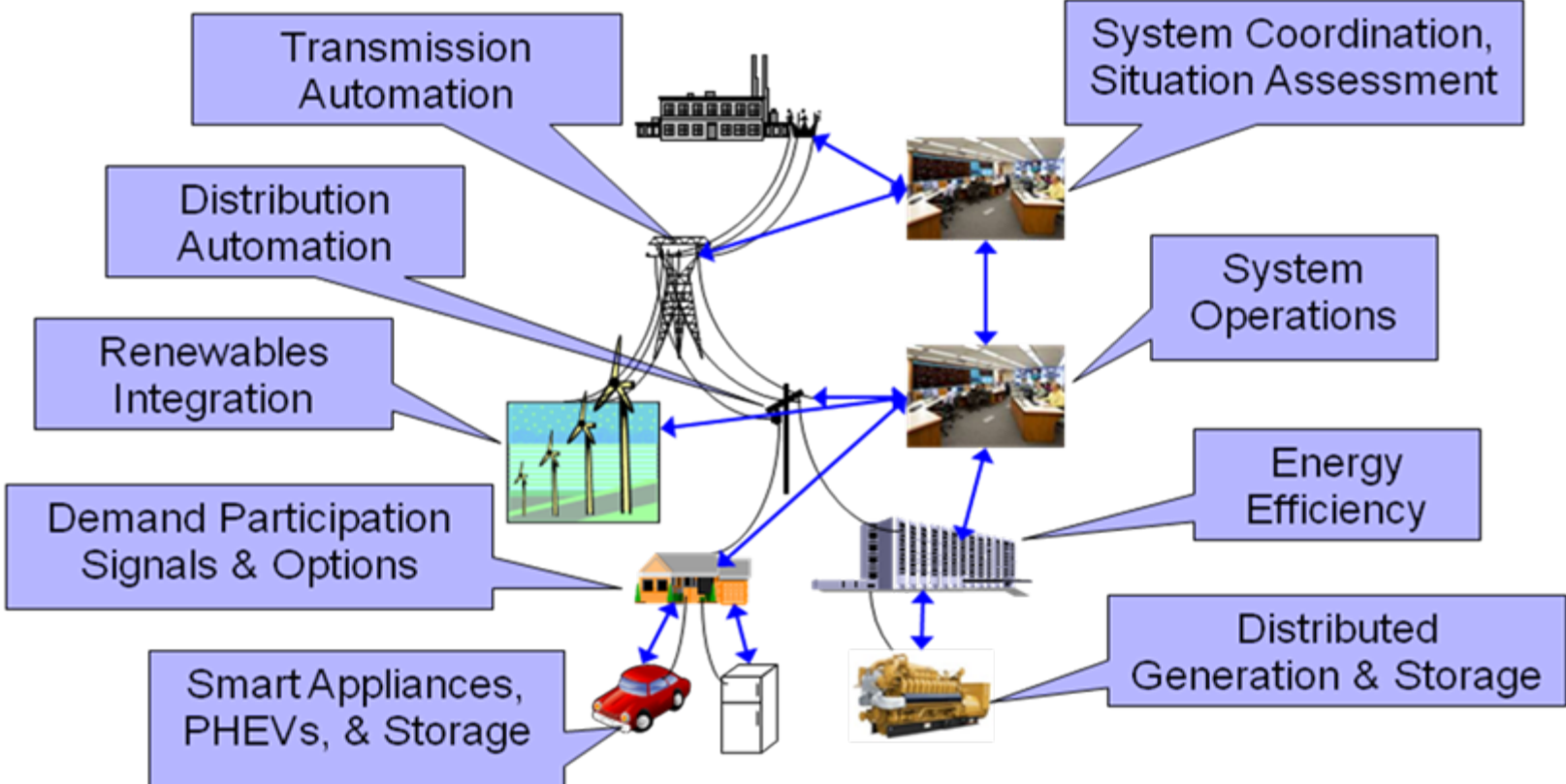
Smart Grid: What is it?

DOE has defined seven core Smart Grid characteristics



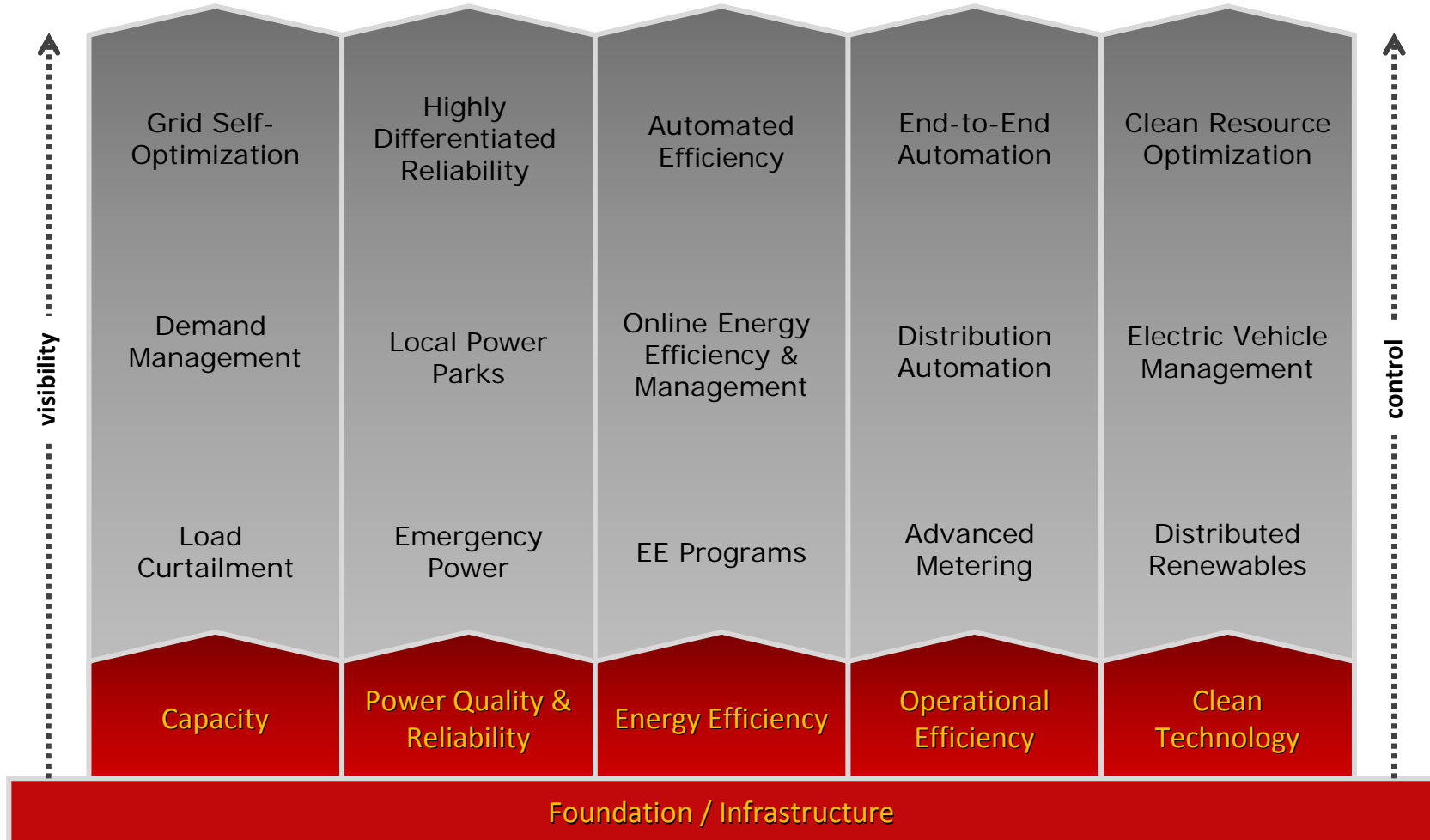
The Smart Grid Initiative seeks to develop and implement advanced information, communication, and control technologies, along with supportive policies, to achieve all seven characteristics.

Smart Grid Applications



Smart Grid Value Creation

21st Century Smart Grid



Recovery Act – Grid Modernization

Programs created by statute

- Energy Infrastructure Security Act 2007:
 - Smart Grid Investment Grants (Sec. 1306)
 - Smart Grid Regional Demonstrations (Sec.1304)

- Recovery Act Directed Programs:
 - Workforce Training - \$100M
 - Interconnection-wide Transmission Planning and Resource Analysis - \$80M
 - Interoperability Standards - \$12M

Top 10 States by Total Awarded	
State	Amt (\$M)
NC	434
CA	419
TX	293
NY	276
FL	270
PA	265
MD	233
DC	213
AL	166
OH	146

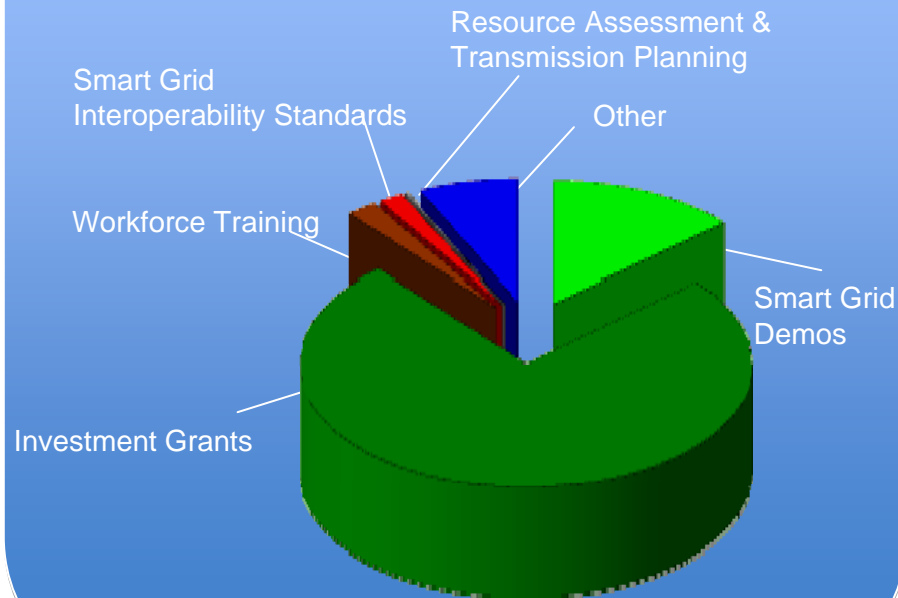
Additional OE initiatives

- State & Local Energy Assurance
- State Regulatory Assistance

\$4.5 billion obligated by end of FY10
\$1.6 billion paid out to date

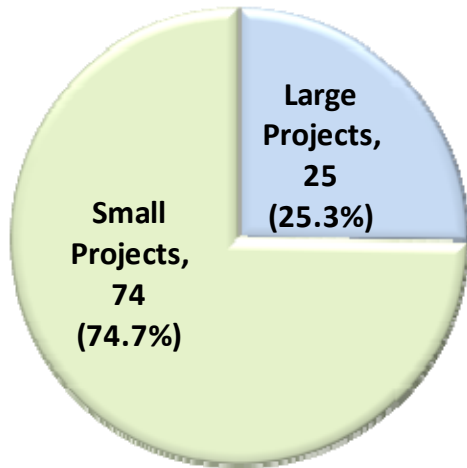
One-time Appropriation, \$4.5B in ARRA funds

- \$620M for demonstration projects
- \$3.425B for deployment projects

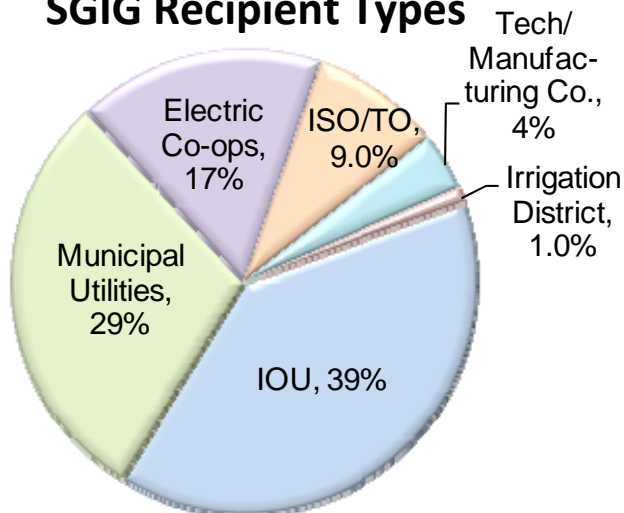


Smart Grid Investment Grants (SGIG)

Number of Projects



SGIG Recipient Types

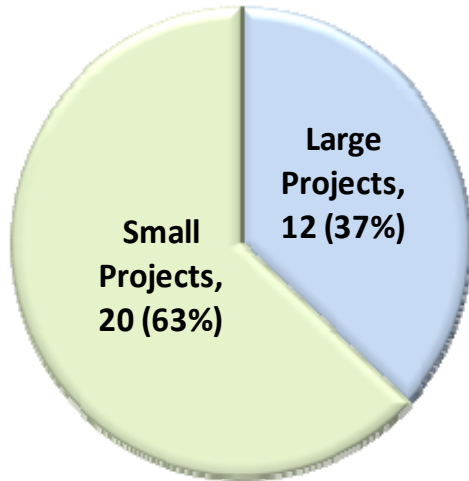


Selected Projects	
Total Funding	\$7,863,897,259
Federal Share	\$3,425,938,323
Total Number of Projects	99

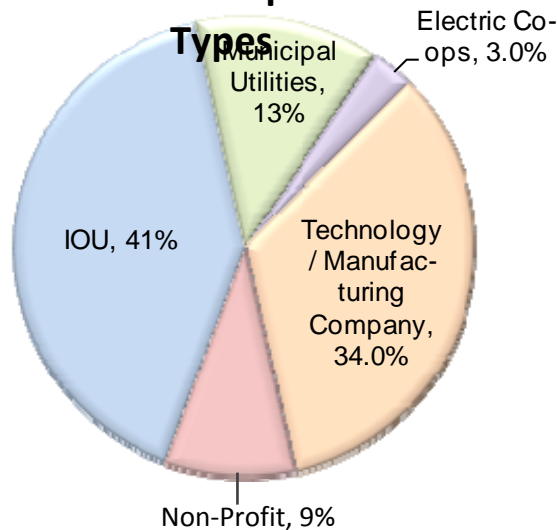
- Deployment of current technological components for immediate commercial use
- Support of manufacturing, purchasing, and installation of smart grid technologies
- Large projects: \$20M-\$200M
Small projects: \$394K-\$20M (Federal share)
- 3-year projects

Smart Grid Demonstration Program (SGDP)

Number of Projects



SGDP Recipient Types



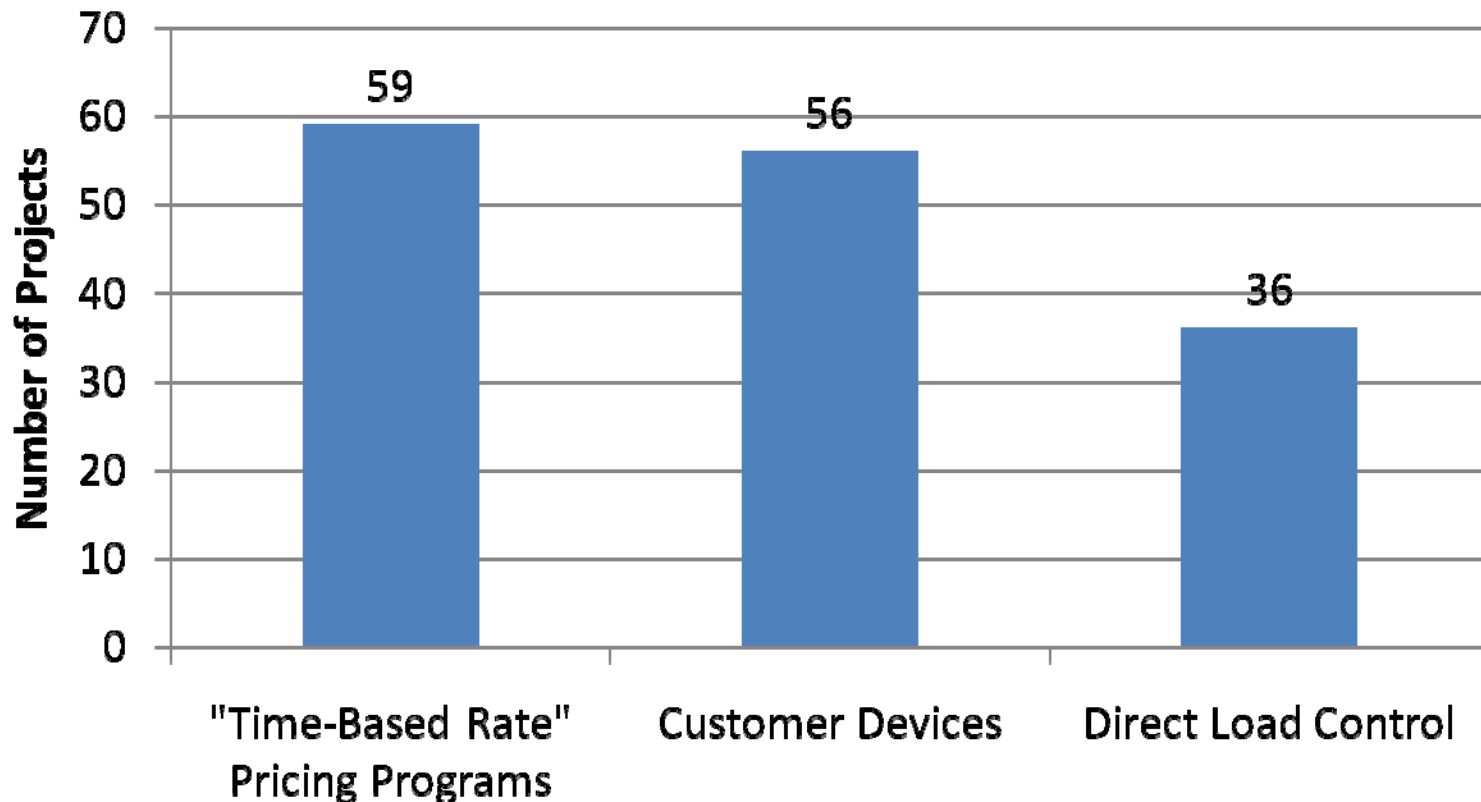
Selected Projects

Total Funding	\$1,647,637,256
Total Federal Funding	\$620,027,274
Total Number of Projects	32

- **Demonstrate emerging technologies (including energy storage) and alternative architectures**
- **Validate business models**
- **Address regulatory and scalability issues**
- **Large projects: \$20M-\$89M**
Small projects: \$720K-\$20M (Federal share)
- **4-year projects (average)**

Recovery Act – AMI Projects & Customer Engagement

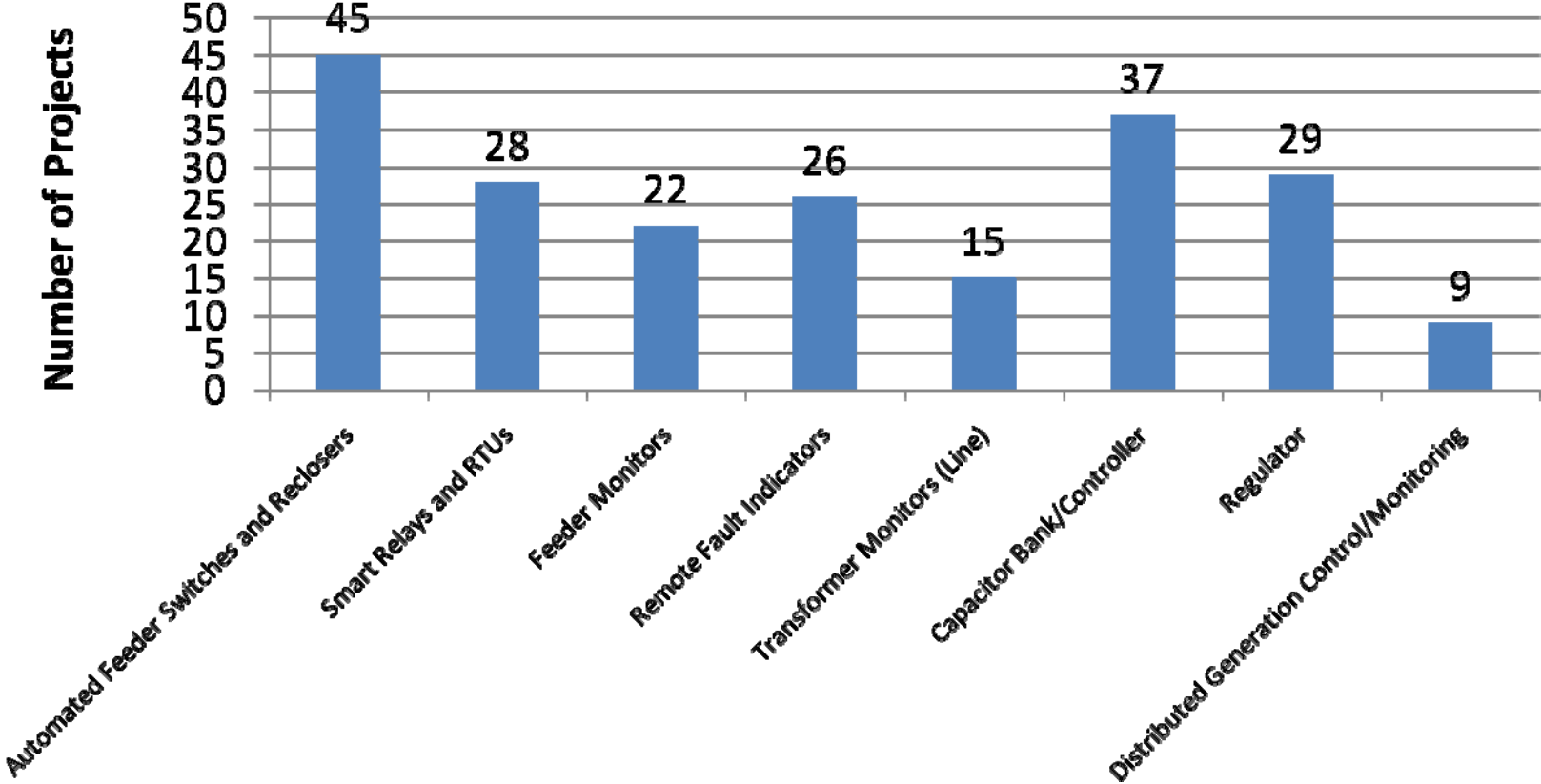
76 projects have AMI and some type of customer program, most being pilot activities engaging a limited segment initially



Note: Project components are NOT mutually exclusive

Recovery Act – Distribution Automation

Distribution Automation Function



Recovery Act - Energy Storage

\$586 million in private investment from \$185 million in federal funds
→ Better than 3:1

Energy Storage Regional Demonstration Projects Include

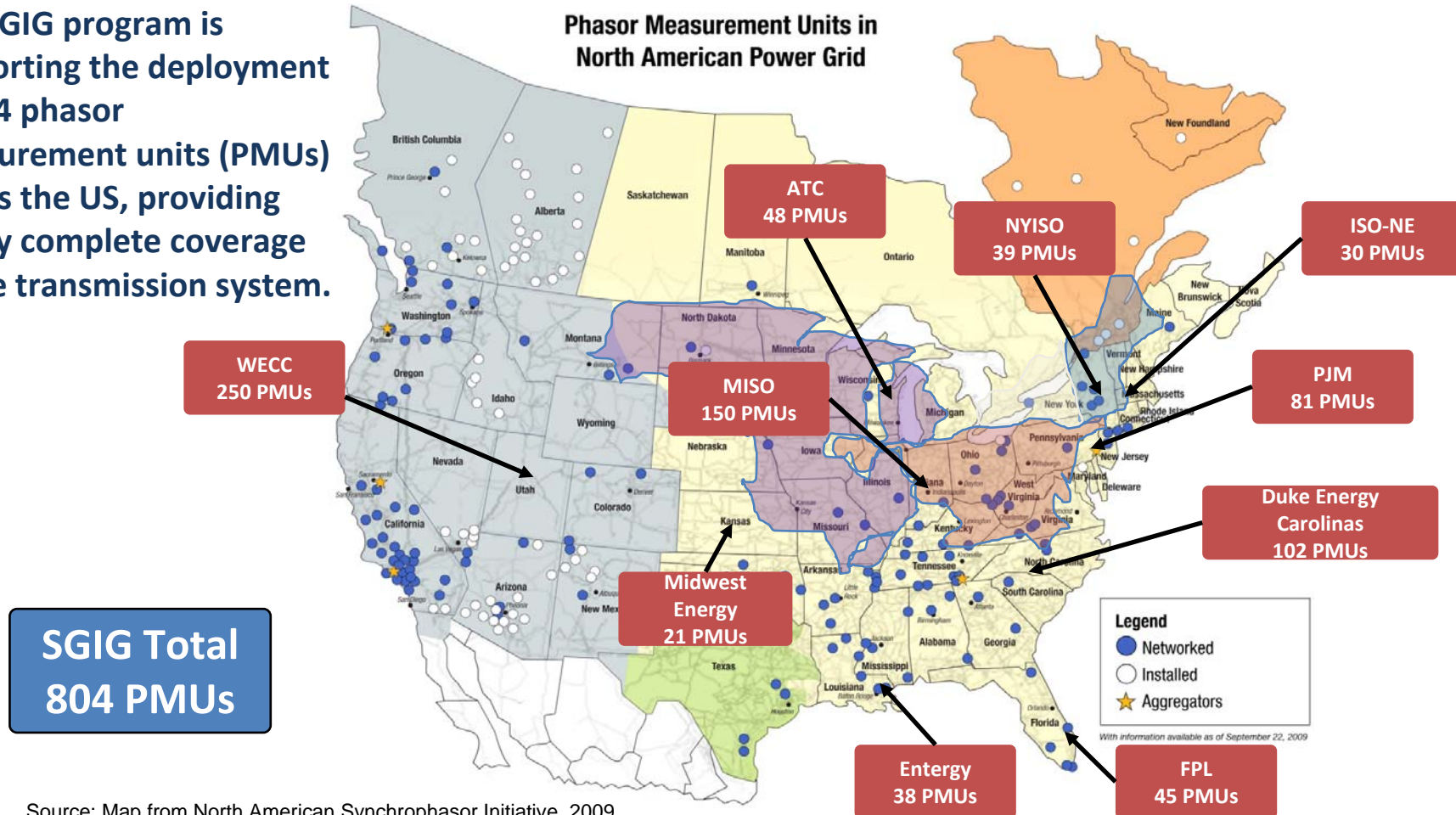
- Large Battery Systems
(3 projects, 53MW)
- Compressed Air
(2 projects, 450MW)
- Frequency Regulation
(20MW)
- Distributed Projects
(5 projects, 9MW)
- Technology Development
(5 projects)



20 Li-Ion community energy storage units on Detroit Edison grid

Recovery Act – PMU Deployment

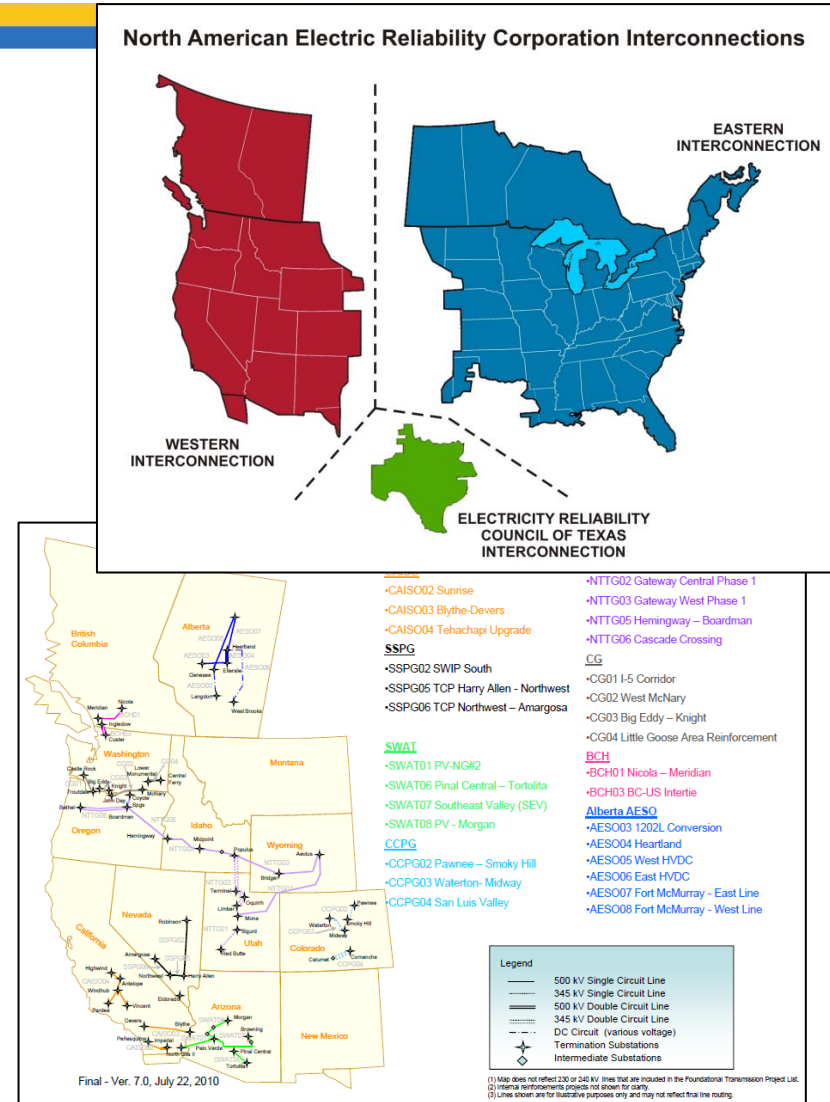
The SGIG program is supporting the deployment of 804 phasor measurement units (PMUs) across the US, providing nearly complete coverage of the transmission system.



Source: Map from North American Synchrophasor Initiative, 2009

Recovery Act - Transmission Planning

- Consensus scenarios for future electricity supplies and analyzing environmental and other considerations that will be incorporated into transmission plans
- Long-term resource and transmission planning studies in 2011, with update in 2013
- The knowledge and perspective gained from this work will inform policy and regulatory decisions in the future and provide critical information to electricity industry planners, states, and others to develop a modernized, low-carbon electricity system
- Time horizon expanded to 20 years for planning
- First time environmental stakeholders included in process





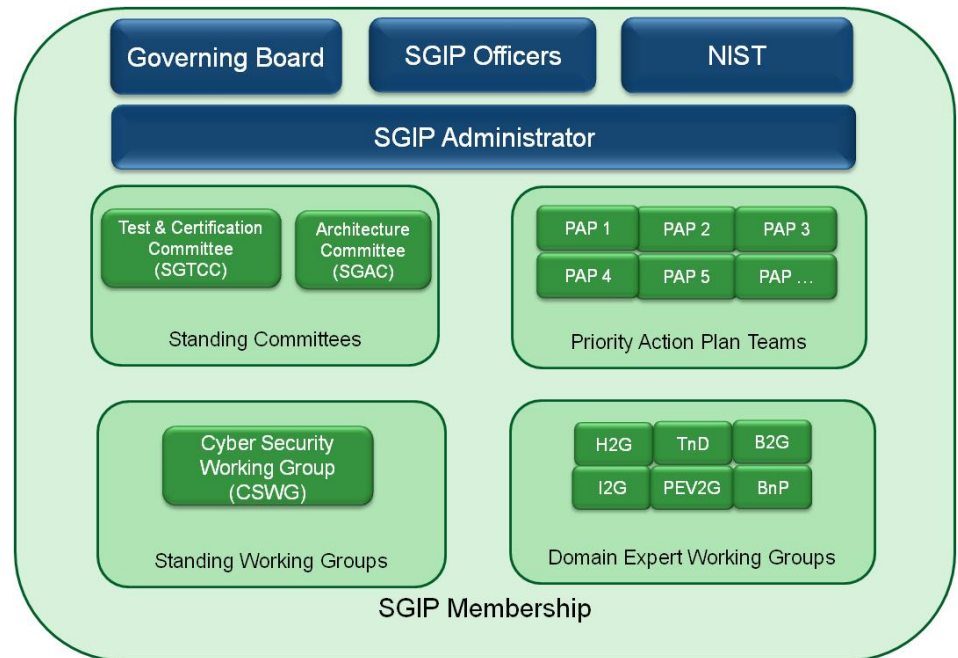
Recovery Act - Workforce Training

- Recipients of the Recovery Act funds will provide training in demand response, distributed generation, energy utilization/optimization, and cost simulations
- \$100 million in Recovery Act funds were being offered to 54 workforce training programs. Target benefits include:
 - Up to 175,000 technicians, staff, and management positions filled with qualified personnel
 - Skilled workforce educated in energy conservation and renewable energy
 - Increased investment in advanced laboratory equipment, faculty development, and academic research
 - Increased skills and pay rates for technicians and displaced workers
 - Increased awareness of cybersecurity issues

Recovery Act - Smart Grid Interoperability Framework

Through close work with DOE, the NIST Smart Grid Interoperability Standards Program has:

- Released **NIST Framework and Roadmap** for Smart Grid Interoperability Standards, Release 1.0
- Released Guidelines for **Smart Grid Cyber Security**
- Launched **Smart Grid Interoperability Panel (SGIP)** to provide a forum for collaboration with the private sector – now 1,750 members from 634 organizations



Recovery Act – Goals

■ Deployment of Smart Grid Technologies

- 15.5 million smart meters
- 800 Phasor Measurement Units
- 6,500 Distributed Circuits

■ Economic Benefits

- Reductions in monthly bills for customers with smart meters/enabling technologies
- Reductions in peak demand translate to less generation capacity required
- Reductions in operating costs for distribution circuits with automated equipment

■ Reliability Benefits

- Reduction in length of power outages
- Reduction in frequency and geographic scope of power outages

■ Environmental Benefits

- Reductions in energy wasted (line losses) in distribution circuits
- Reduced emissions of CO₂, NO_x, and SO_x associated with electricity consumption of customers with smart meters and enabling technologies

Smart Grid Benefit Analysis:

DOE Smart Grid Computational Tool (SGCT)

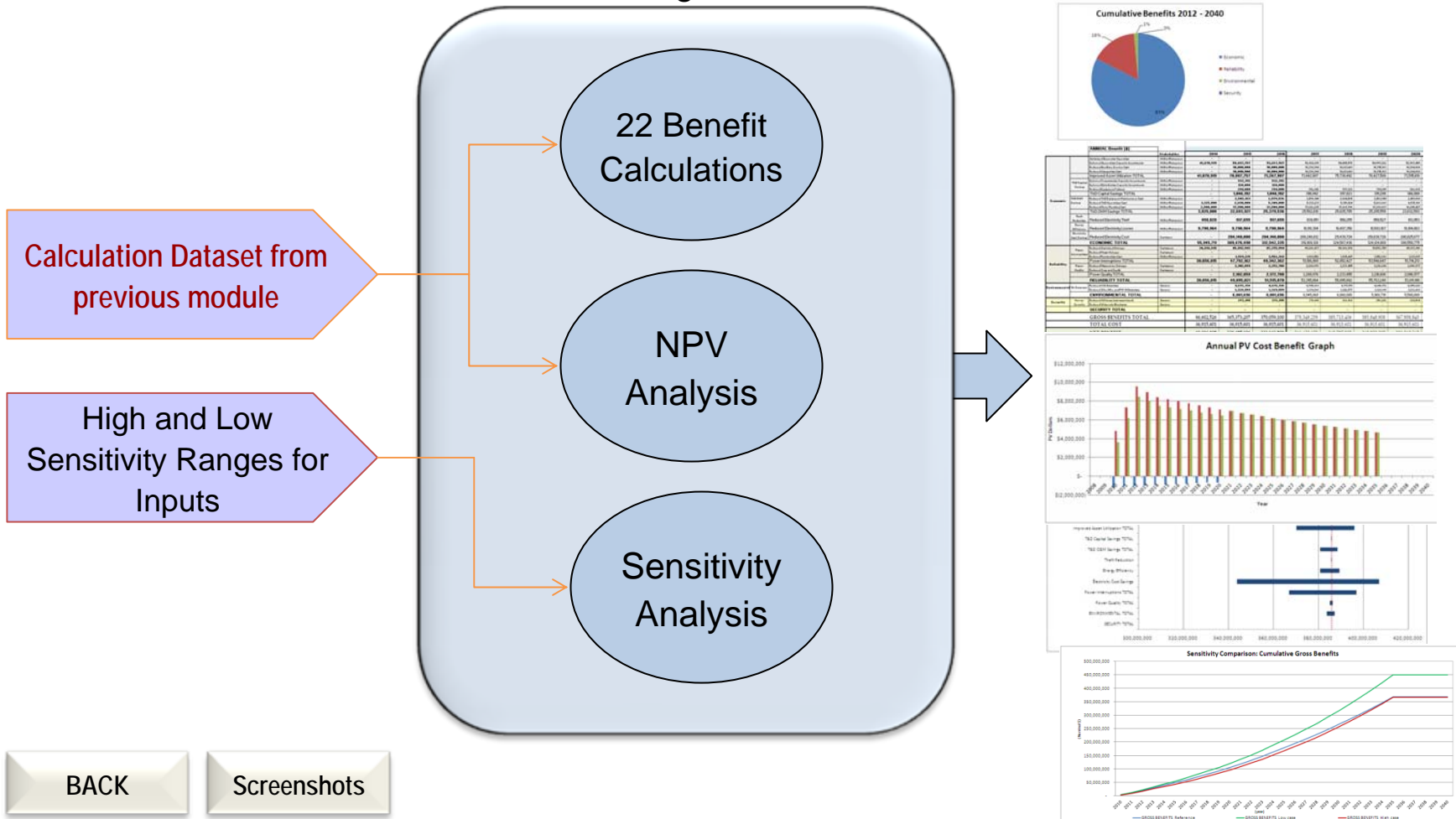
- The SGCT is an analysis tool that identifies the benefits of a SG project and guides the user through an analysis that quantifies those benefits
- The SGCT characterizes smart grid (SG) projects by identifying what technology will be installed and what functionality that technology will enable
- Based on the characterization of a project it identifies the economic, reliability, environmental, and security benefits the SG project will yield
- The SGCT uses user-entered data to calculate the monetary value of benefits and prepares graphs and tables that compare the costs and benefits to help determine the project's overall value
- The SGCT can also perform a sensitivity analysis

SGCT Computational Modules

INPUTS

Calculation Engine

OUTPUTS



BACK

Screenshots

The SGCT will be used to calculate the value of specific benefits*

Benefit Category	Benefit Sub-category	Benefit
Economic	Improved Asset Utilization	Optimized Generator Operation (utility/ratepayer) Deferred Generation Capacity Investments (utility/ratepayer) Reduced Ancillary Service Cost (utility/ratepayer) Reduced Congestion Cost (utility/ratepayer)
	T&D Capital Savings	Deferred Transmission Capacity Investments (utility/ratepayer) Deferred Distribution Capacity Investments (utility/ratepayer) Reduced Equipment Failures (utility/ratepayer)
	T&D O&M Savings	Reduced Distribution Equipment Maintenance Cost (utility/ratepayer) Reduced Distribution Operations Cost (utility/ratepayer) Reduced Meter Reading Cost (utility/ratepayer)
	Theft Reduction	Reduced Electricity Theft (utility/ratepayer)
	Energy Efficiency	Reduced Electricity Losses (utility/ratepayer)
	Electricity Cost Savings	Reduced Electricity Cost (consumer)
Reliability	Power Interruptions	Reduced Sustained Outages (consumer) Reduced Major Outages (consumer) Reduced Restoration Cost (utility/ratepayer)
	Power Quality	Reduced Momentary Outages (consumer) Reduced Sags and Swells (consumer)
Environmental	Air Emissions	Reduced Carbon Dioxide Emissions (society) Reduced SO _x , NO _x , and PM-10 Emissions (society)
Security	Energy Security	Reduced Oil Usage (society) Reduced Wide-scale Blackouts (society)

*Methodological Approach for Estimating the Benefits and Costs of Smart Grid Demonstration Projects, EPRI, January 2010.

Smart Grid R&D Program

Dollars in Thousands	
FY 2011	FY 2012 Planning
23,000	20,000

Promotes the development of an efficient, fully integrated “smart” grid through the adaptation and integration of digital information and communication technologies into the Nation’s electricity delivery system.

* MYPP available at: http://www.smartgrid.gov/sites/default/files/oe_mypp.pdf

R&D Areas Guided by MYPP* on:

- › Renewable & distributed systems integration
- › Microgrids
- › Integration of Plug-in Electric Vehicles (PEVs)
- › Modeling & Analysis
- › Advanced communications & controls
- › Foundational standards and best practices
- › Demand response and consumer acceptance

International Smart Grid Action Network (ISGAN)

Bringing high-level government attention and action to accelerate world-wide development and deployment of smarter electricity grids

ISGAN...

- Facilitates dynamic knowledge sharing, technical assistance, peer review and, where appropriate, project coordination
- Sponsors activities that accelerate smart grid deployment and address knowledge gaps
- Builds on the momentum of and knowledge created by the substantial investments being made in smarter grids globally
- Fulfills a key recommendation in the Smart Grids Tech. Action Plan
- Leverages cooperation with the International Energy Agency, Global Smart Grid Federation, and other relevant stakeholders



ISGAN Scope

- Five key topic areas
- Core emphasis on sharing of knowledge and lessons learned
- Projects may cover several topics areas



Four Foundational Projects

1

- **“Global Smart Grid Inventory”**
of enabling programs and policies

2

- **Smart Grid Case Studies**
using a common framework and metrics

3

- **Benefit/Cost Methodologies**
(bottom-up & top-down) and related policy toolkits
to assess smart grid investments

4

- **Synthesis of Insights for High-level Decision Makers**
(e.g., CEM Ministers) from ISGAN and other
related projects

- Recognized that ISGAN is not the only entity developing an “inventory”
- Several such efforts underway regionally
 - ENARD Annex V
 - ASGI
 - EEGI
 - EC-directed (JRC)
 - Etc.
- Although different drivers for each, there are opportunities for cooperation

Others Projects and Collaboration Proposed or Under Consideration

Coordination with the ENARD IA
(Electricity Networks, Analysis, Research & Development)

Continuing dialog
with private sector and
other stakeholders

(e.g., Global Smart Grid Federation, [ADB](#), SGIP)

**Engagement with other
international efforts**
(e.g., the US-EU Energy Council and
APEC Smart Grid Initiative)

Joint Projects with the DSM IA

Information Resources

Smart Grid Information Clearinghouse

- Smart grid project summaries (with focus on non-ARRA projects), use cases, and business cases for the U.S. and internationally
- >200 & >50 smart grid projects in the U.S. and overseas; >1,000 smart grid-related documents and multimedia (use cases, c/b analyses, business cases, legislation & regulation, standards, and technologies)



Smartgrid.gov

- ARRA smart grid project summaries and other Federal program activities
- Reporting of ARRA SGIG & SGDP projects (progress, metrics and benefits, consumer behavior studies) and provision of analysis results to the public



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