OE Peer Review

Smart Grid R&D

November 2-4, 2010

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Presentation Outline

- OE Program Overview
- Smart Grid Program Goals and Strategies
- OE Programs Addressing Smart Grid Development
  - Recovery Act Programs
  - Smart Grid R&D Base Program
- International Coordination

OE Programs and Funding

(Dollars in Thousands)	FY 2010	FY 2011			FY 2010 Appropriation to FY 2011 Request	
	Appropriation	Request	House Mark	Senate Mark		
Research and Development						
Clean Energy Transmission and Reliability	37,373	35,000	34,000	35,000	-2,373	+6%
Smart Grid Research and Development*	31,541	39,293	34,872	39,293	+7,752	+25%
Energy Storage	13,608	40,000	26,674	40,000	+26,392	+194%
Cyber Security for Energy Delivery Systems	38,880	30,000	30,000	30,000	-8,880	-23%
SUBTOTAL, Research and Development	**121,402**	**144,293**	**125,546**	**144,293**	**+22,891**	**+19%**
Permitting, Siting, and Analysis	6,400	6,400	6,400	6,400	0	0%
Infrastructure Security and Energy Restoration	6,187	6,188	6,187	6,188	+1	0%
Program Direction	21,420	29,049	27,049	29,049	+7,629	+36%
Congressionally Directed Activities	13,075		6,800	4,250		
TOTAL, Electricity Delivery and Energy Reliability**	**168,484**	**185,930**	**171,982**	**190,180**	**+17,446**	**+10%**

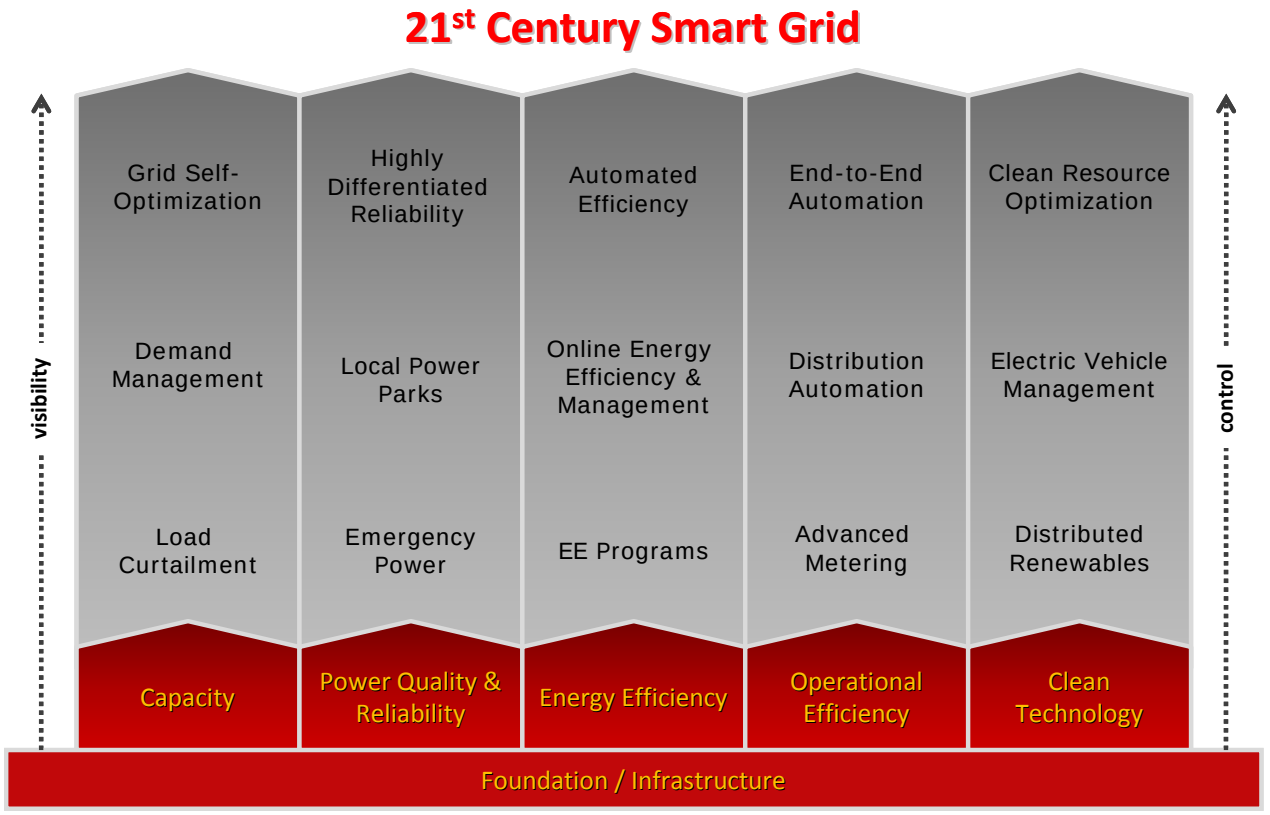
*Included in Smart Grid R&D is Power Electronics R&D with an FY10 budget of $5M and an estimated FY11 budget of $10M.
**$4.5 billion in ARRA funds was appropriated to OE in FY09.

Smart Grid Program Goals & Strategies

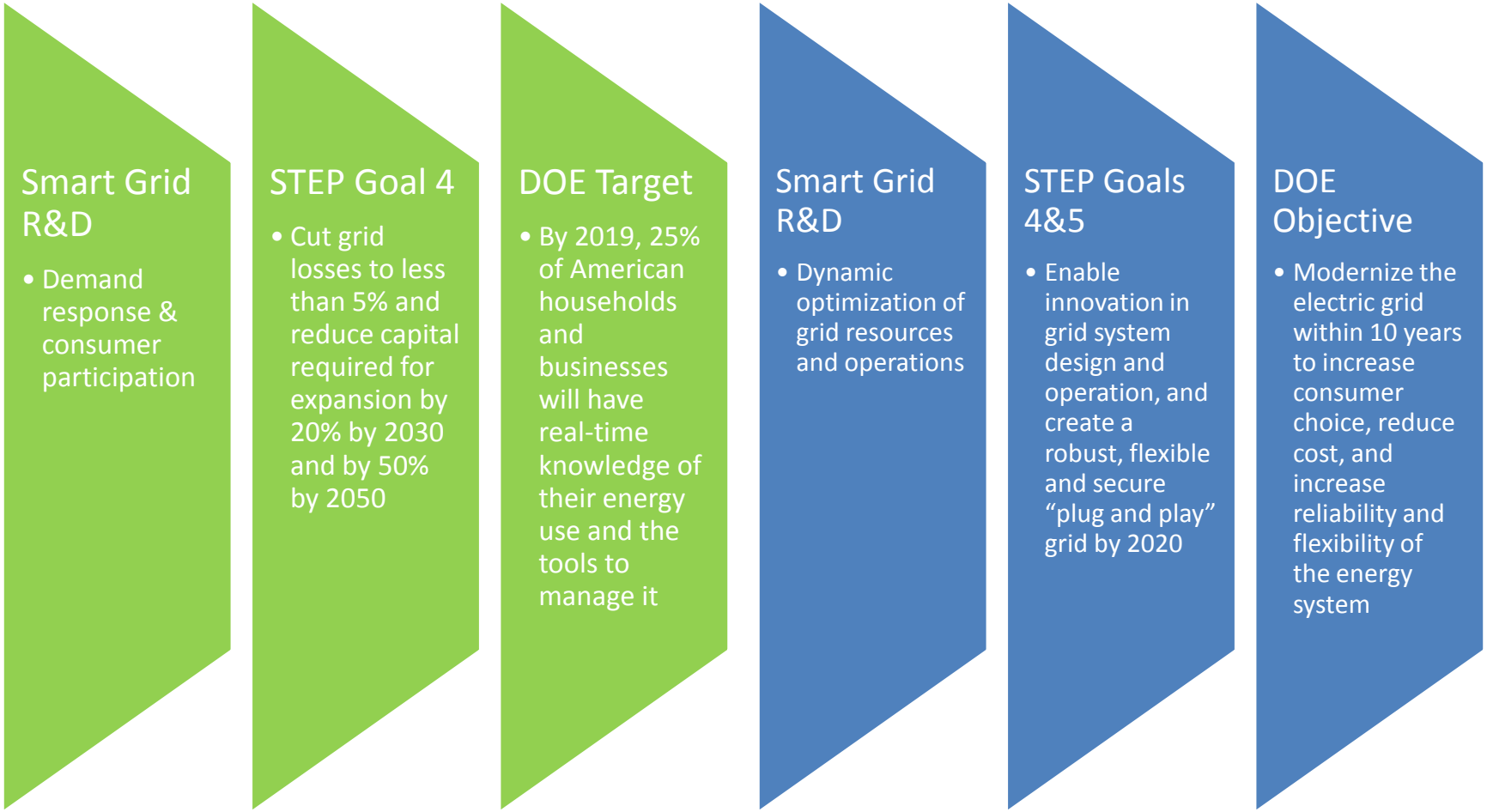
Goals

- Dynamically optimize grid operations and resources
- Fully integrate demand response and consumer participation into grid resource planning and operations

Strategic Areas of Focus →



Alignment with DOE Objective & Target



OE Programs Addressing Smart Grid Development

Recovery Act

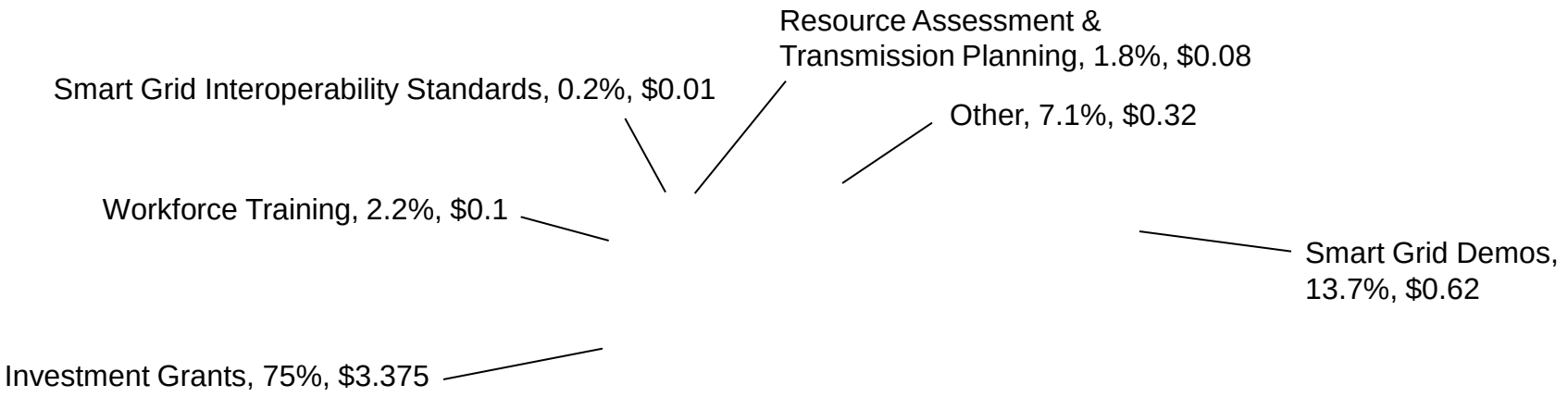
Commercial applications and demonstrations of near-term technology

Smart Grid R&D Program

- Renewable and distributed systems integration
- Longer-term R&D
  - Microgrids
  - Multi-Year Program Plan implementation

Recovery Act Smart Grid Development

$4.5 Billion for Grid Modernization in Recovery Act Funding



Amounts are in billion US Dollars

- Title XIII – Smart Grid, Energy Independence and Security Act of 2007
  - $620M for demonstration projects (Section 1304)
  - $3.375B for matching for deployment (Section 1306)

SEE: http://www.energy.gov/recovery

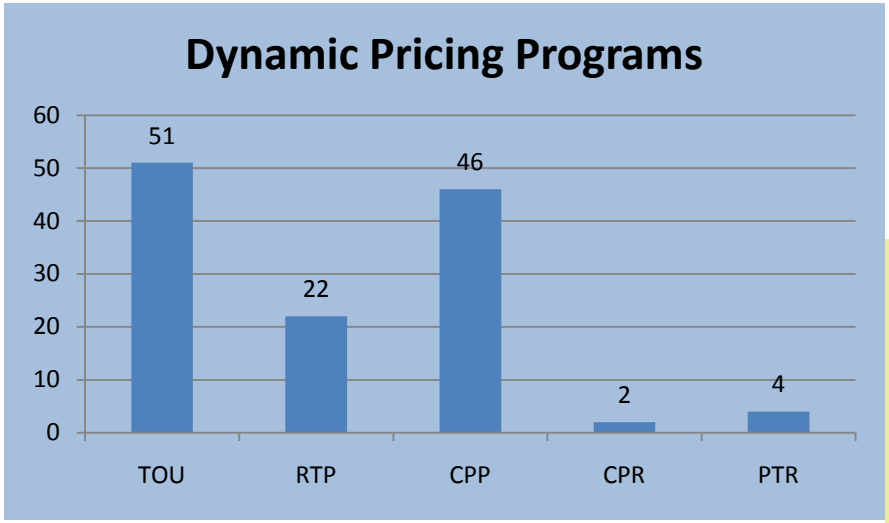
Recovery Act: Smart Grid Investment Grants

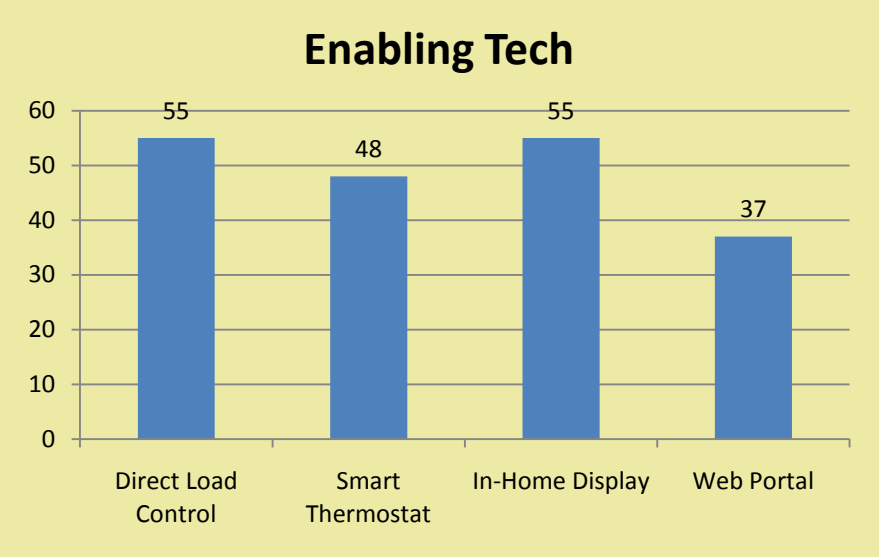
(100 projects: $3.4B Federal; $4.7B non-Federal)

Smart Grid Systems and Equipment	Numbers of Units (self-reported estimates)	Improvements	Impacts
Networked Phasor Measurement Units	877	• *Near-nationwide coverage* • *6X the 166 existing networked PMUs*	*Enhanced situational awareness and electric system reliability and resiliency*
Smart Transformers	205,983	• *Enables preventative maintenance*	
Automated Substations	671	• *5% of 12,466 transmission and distribution substations in U.S.*	
Load Control Devices	176,814	• *Enables peak demand reductions*	*1444 MWs of peak demand reduction per year* (self-reported estimates)
Smart Thermostats	170,218	• *Enables peak demand reductions*	
Smart Meters	18,179,912	• *13% of the 142 million customers in the U.S.*	*Transformational changes in consumer behavior and energy consumption*
In-Home Display Units	1,183, 265	• *Enables customer empowerment*	
PHEVs / Charging Stations	12 / 100	• *Accelerates market entry*	*Begins the path toward energy independence*

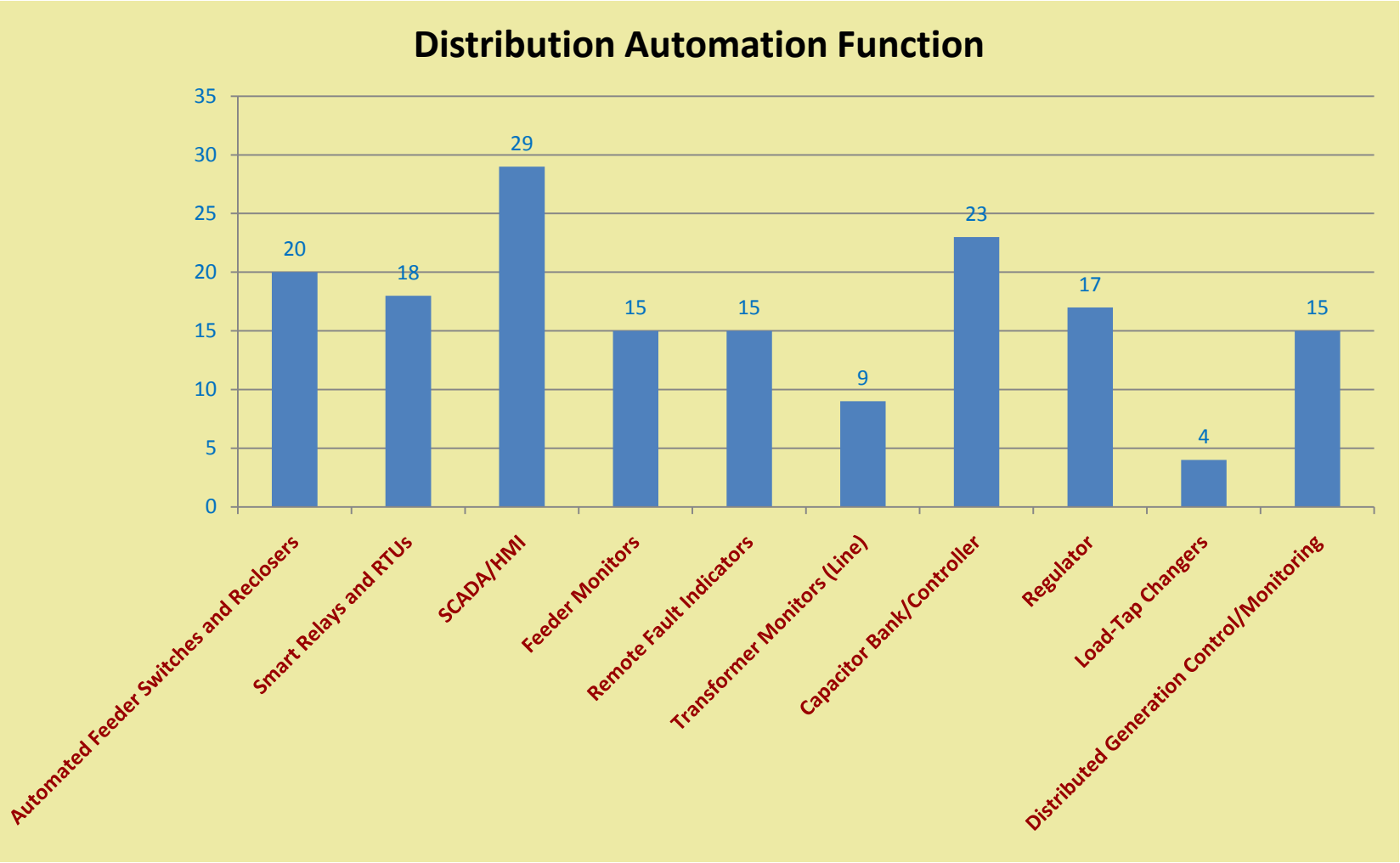
SGIG: AMI & Customer Systems

Number of SGIG projects offering individual dynamic pricing programs and enabling technologies

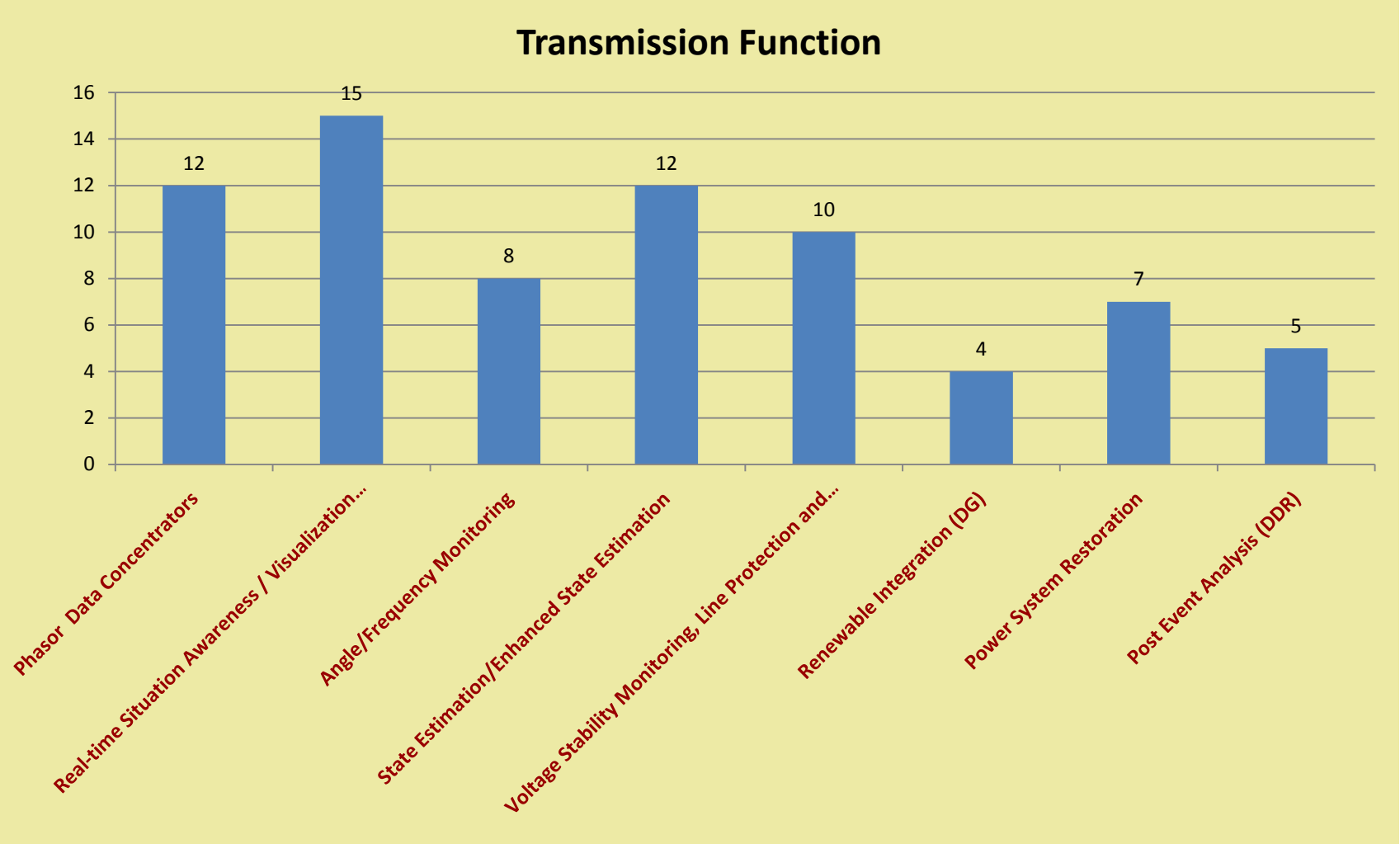




SGIG: Distribution Automation



SGIG: Transmission System



Accelerating Smart Grid Interoperability Standards Development

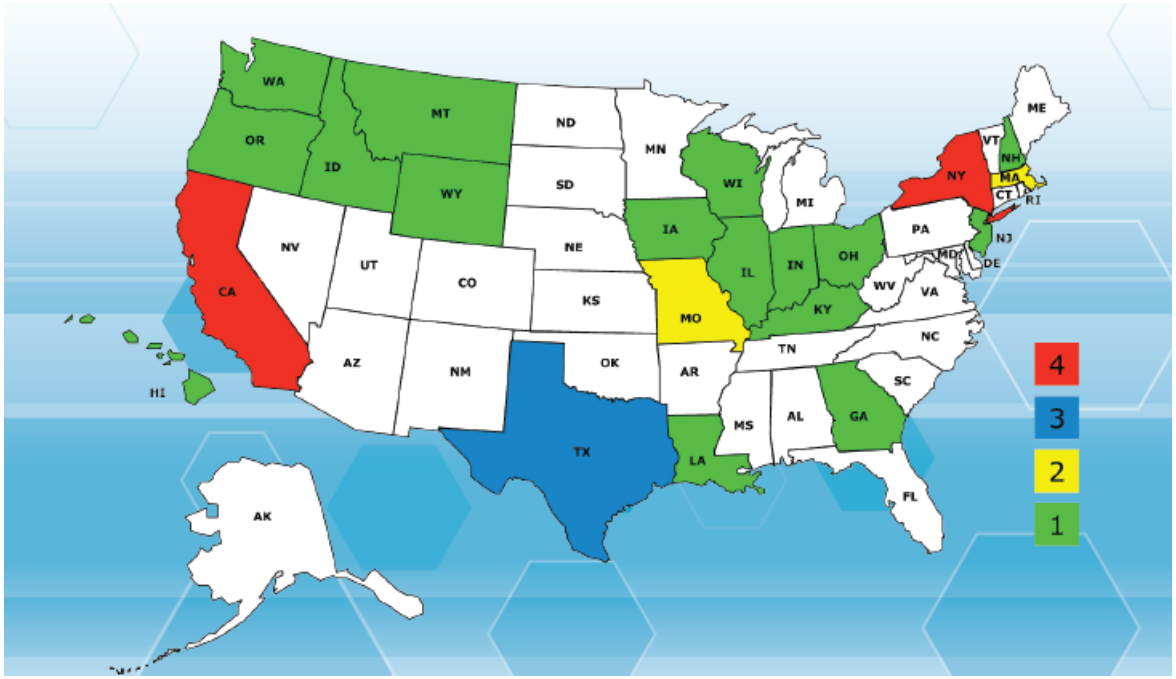
Through close work with DOE and over 600 stakeholders, the NIST Smart Grid Interoperability Standards Program has:

- 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

Recovery Act: Smart Grid Regional Demonstrations

($435M Federal; $877M non-Federal)

16 Awards Support Projects in 21 States



- ***Demonstrate*** **cutting edge SG technology (including integration of renewables)**
- **Prove ability/ ease to replicate**
- **Show benefits (with actual data)**
- **Validate business models**
- **Address regulatory and scalability issues**

Examples of Smart Grid Regional Demonstrations

AEP Ohio's gridSMART is demonstrating a secure, interoperable, and integrated smart grid infrastructure for 110,000 consumers, with integrated Volt-VAR control, distribution automation, AMI, home area network, PEVs, smart appliances, community energy storage, NaS battery, and renewable generation.

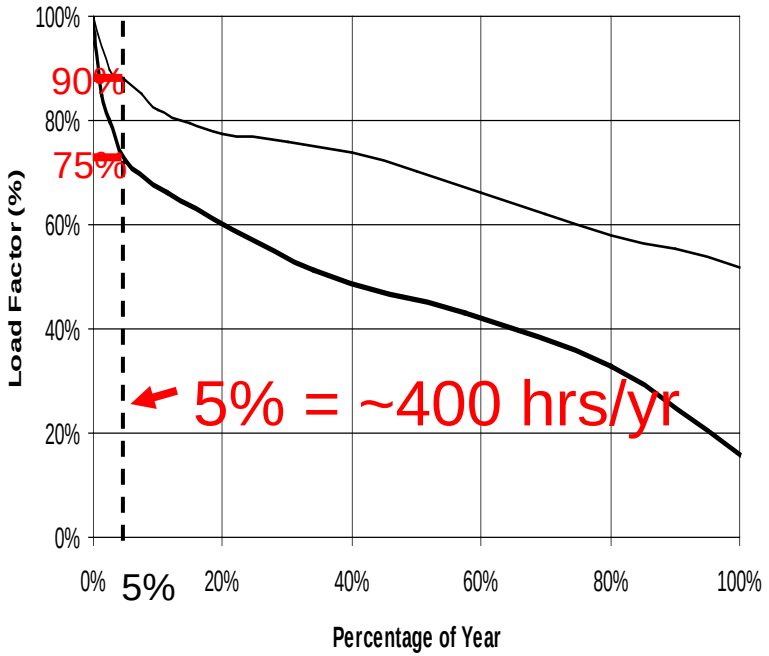
The Pecan Street Project in Austin, Texas, is developing an Energy Internet microgrid in a large mixed-use infill Brownfield) development. The microgrid will integrate clean energy generation, smart grid water systems, distributed storage, smart appliances, PEVs, and AMI with pricing models for 1,000 residences and 75 businesses.

Smart Grid R&D Base Program Ongoing and Planned Activities

Renewable and Distributed Systems Integration

- Objective:
  To encourage use of distributed resources to provide power during peak load periods (minimum of 15% reduction in peak load on distribution feeder or substation) and for other functions/services
- Projects are either microgrids or are developing technologies that will advance microgrids
- Systems must be capable of operating in both grid parallel and islanded modes
- $55 million of DOE funds over five years (total value of awards will exceed $100 million, including participant cost share)

Lower Peak Demand Reduces Infrastructure Investments



25% of distribution & 10% of generation assets (transmission is similar), worth 100s of billions of US dollars, are needed less than 400 hrs/year!

Renewable and Distributed Systems Integration for Peak Load Reduction

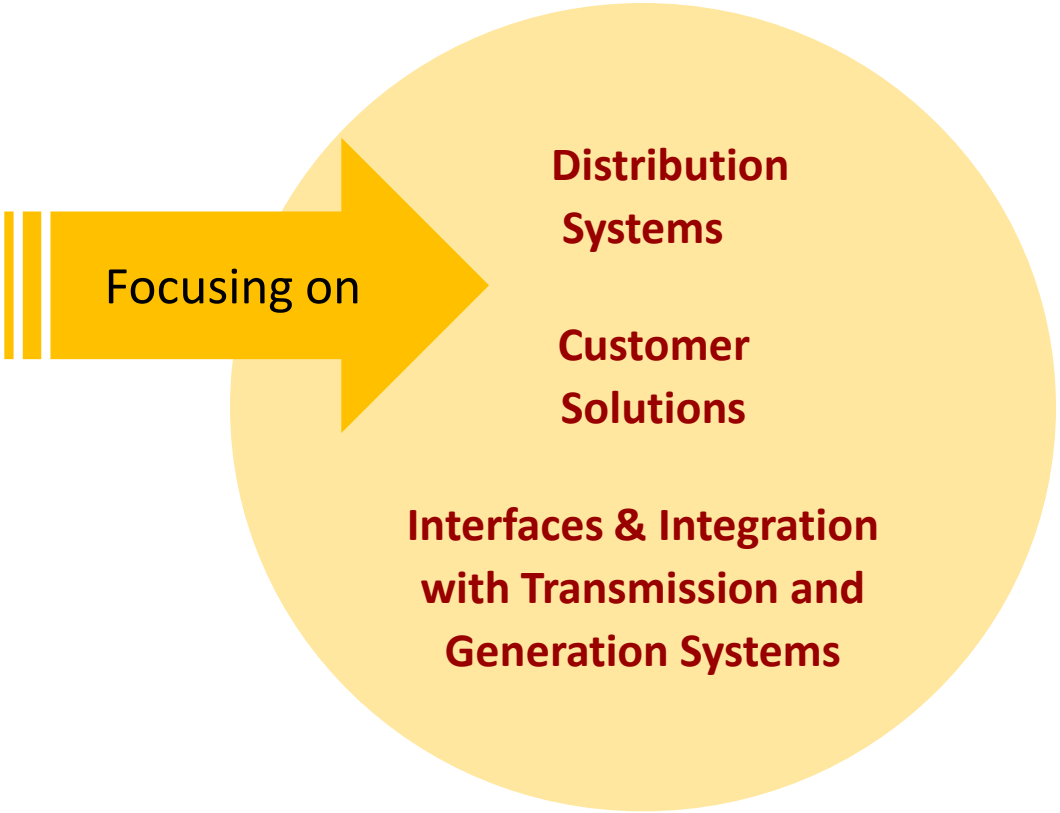
- **Chevron Energy Solutions**—CERTS Microgrid Demo at the Santa Rita Jail - large-scale energy storage, PV, fuel cell
- **SDG&E**—Beach Cities Microgrid - demand response, storage, outage management system, automated distribution control, AMI
- **U of HI**—Transmission Congestion Relief, Maui - intermittency management system, demand response, wind turbines, dynamic simulations modeling
- **UNLV**—"Hybrid" Homes - Dramatic Residential Demand Reduction in the Desert Southwest - PV, advanced meters, in-home dashboard, automated demand response, storage
- **ATK** Space System—Powering a Defense Company with Renewables - Hydro-turbines, compressed air storage, solar thermal, wind turbines, waste heat recovery system
- **City of Fort Collins**—Mixed Distributed Resources - PV, bio-fuel CHP, thermal storage, fuel cell, microturbines, PHEV, demand response

- **Illinois Institute of Technology**—The Perfect Power Prototype - advanced meters, intelligent system controller, gas fired generators, demand response controller, uninterruptable power supply, energy storage
- **Allegheny Power**—WV Super Circuit Demonstrating the Reliability Benefits of Dynamic Feeder Reconfiguration - biodiesel combustion engine, microturbine, PV, energy storage, advanced wireless communications, dynamic feeder reconfiguration
- **ConEd**—Interoperability of Demand Response Resources - demand response, PHEVs, fuel cell, combustion engines, intelligent islanding, dynamic reconfiguration, and fault isolation

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

R&D Areas

- Standards & Best Practices
- Technology Development
- Modeling
- Analysis
- Evaluation & Demonstrations



Smart Grid R&D MYPP Development & Implementation

MYPP to guide Smart Grid R&D investments with staged development process

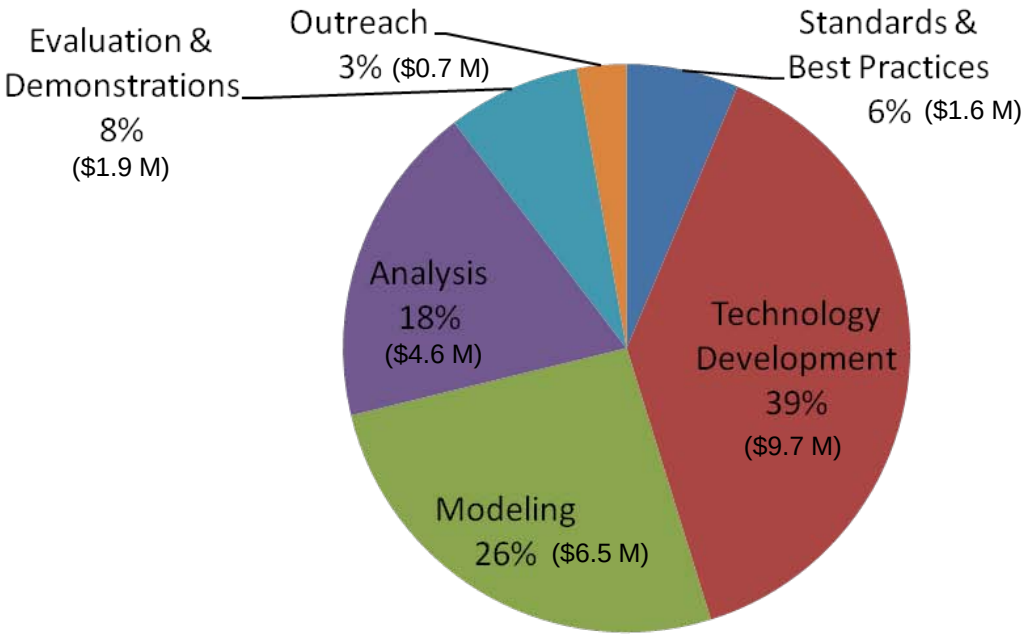
- Meeting in October 2009 involving national labs
- Stakeholder Roundtable Meeting in December 2009
- Public comment in March-April 2010

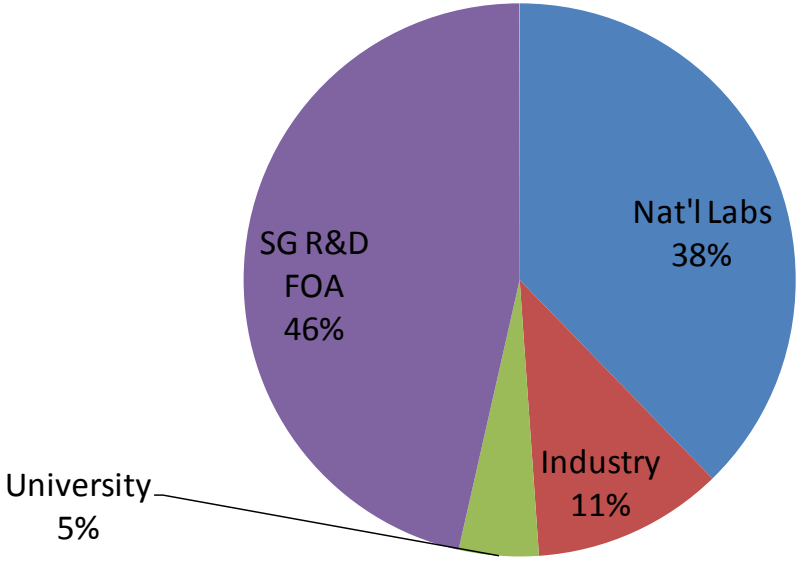
MYPP implementation

- Funding opportunity announcement for private sector-led projects (5 awards expected in October 2010 with estimated $20M DOE funding over 5 years)
- Program review of national lab R&D in June
- Peer review of all R&D projects in November

FY 2010 Funding by SG R&D Area & by Sector

FY10 Budget: $25 M
(excludes PE, crosscut, SBIR/STTR)





FY 2011 Program Planning

$34.8M - $39.2M in FY11

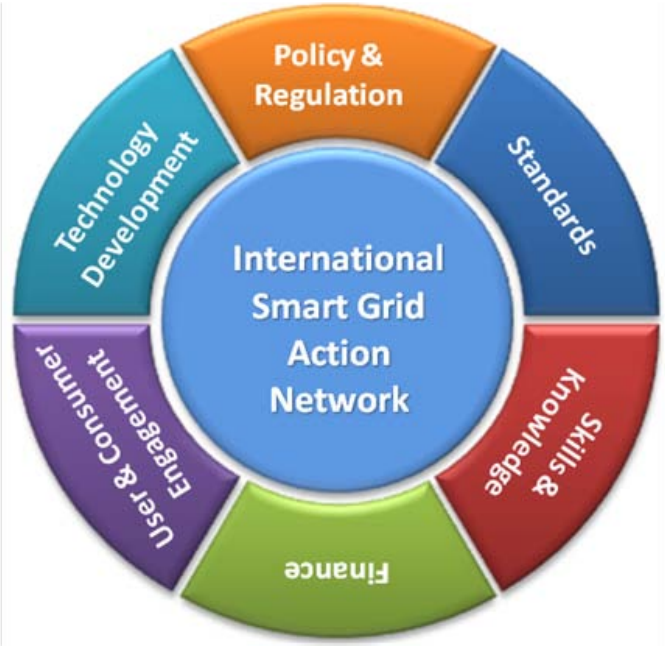
- Smart Grid R&D, $24.8M - $29.2M
  - ~$10M planned for continued funding to AOPs for support of MYPP high-priority tasks
  - ~$10M planned for the final year funding of the FY10 FOA projects
  - ~$2.5M for crosscut, analysis, SBIR/STTR, etc.
  - ~$2M - $6M for new, competitively awarded projects potentially in the following areas
    - Simulation of impacts of PEV charging scenarios on prototypical feeder circuits
    - Field demonstrations of PEV charging scenarios to test, refine, and validate simulation models
    - Microgrid development and demonstration
- Power Electronics, $10M

Outyear Program Planning

- Addressing heightened needs for critical smart grid communications & controls to manage increasing variability from higher penetration of:
  - Renewable energy generation
  - PEVs
  - Demand response and load management
- **Technology pathway:** Integration of smart grid technology, advanced distribution architecture, and modeling and simulation to meet resource management needs for progressive penetration levels of:
  - Renewable energy generation (15-30%)
  - PEVs (combinations of circuit loading and rating, charging scenarios, etc.)
  - Demand response and load management (15-25%)
  - Combinations of the above
- Launch integration development at prototypical feeders under high-penetration use cases

International Smart Grid Action Network (ISGAN)

Representatives met for first time during GridWise Global Forum in September



Developing a portfolio
of projects across
five key engagement areas
with distributed leadership

First project:
Global Smart Grid Inventory

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For more Smart Grid information:

OE: www.oe.energy.gov

Smart Grid: www.smartgrid.gov

Smart Grid Task Force: www.oe.energy.gov/smartgrid_taskforce.htm