



U.S. Department of Energy

Office of Electricity Delivery and Energy Reliability

Smart Grid Development by the U.S. Department of Energy

**Presented at the 4th International Conference
on Integration of Renewable and Distributed
Energy Resources**

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Presentation Outline

- Smart Grid Program Vision, Goals, Applications, and Value
- DOE Programs Addressing Smart Grid Development
 - Recovery Act Programs
 - Smart Grid R&D Base Program
- International Coordination

Smart Grid Program Vision and Goals

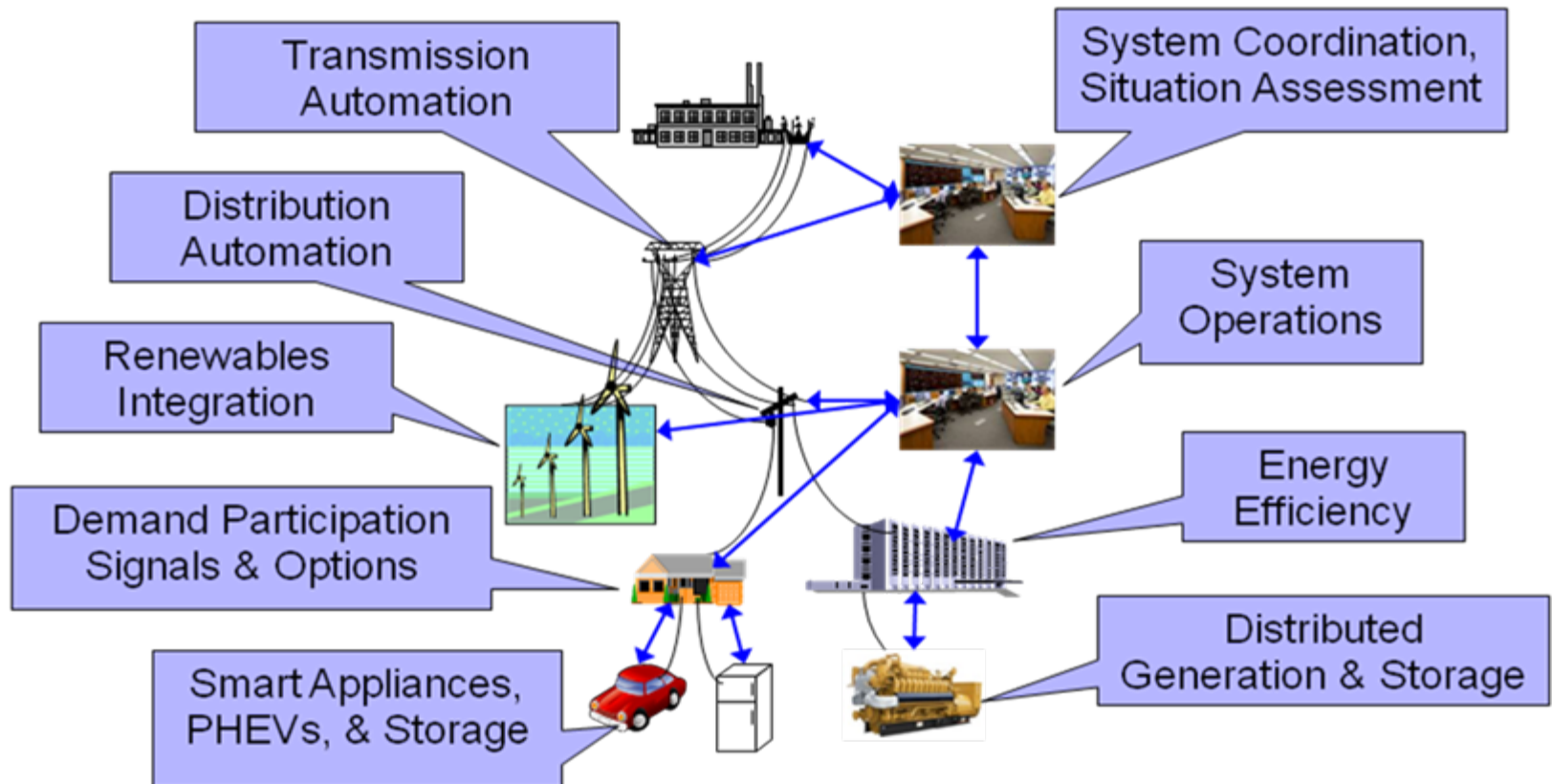
Vision

By 2030, the power grid has evolved into an intelligent energy delivery system that supports plug-and-play integration of dispatchable and intermittent low-carbon energy sources, and provides a platform for consumer engagement in load management, national energy independence, innovation, entrepreneurship, and economic security...

Goals

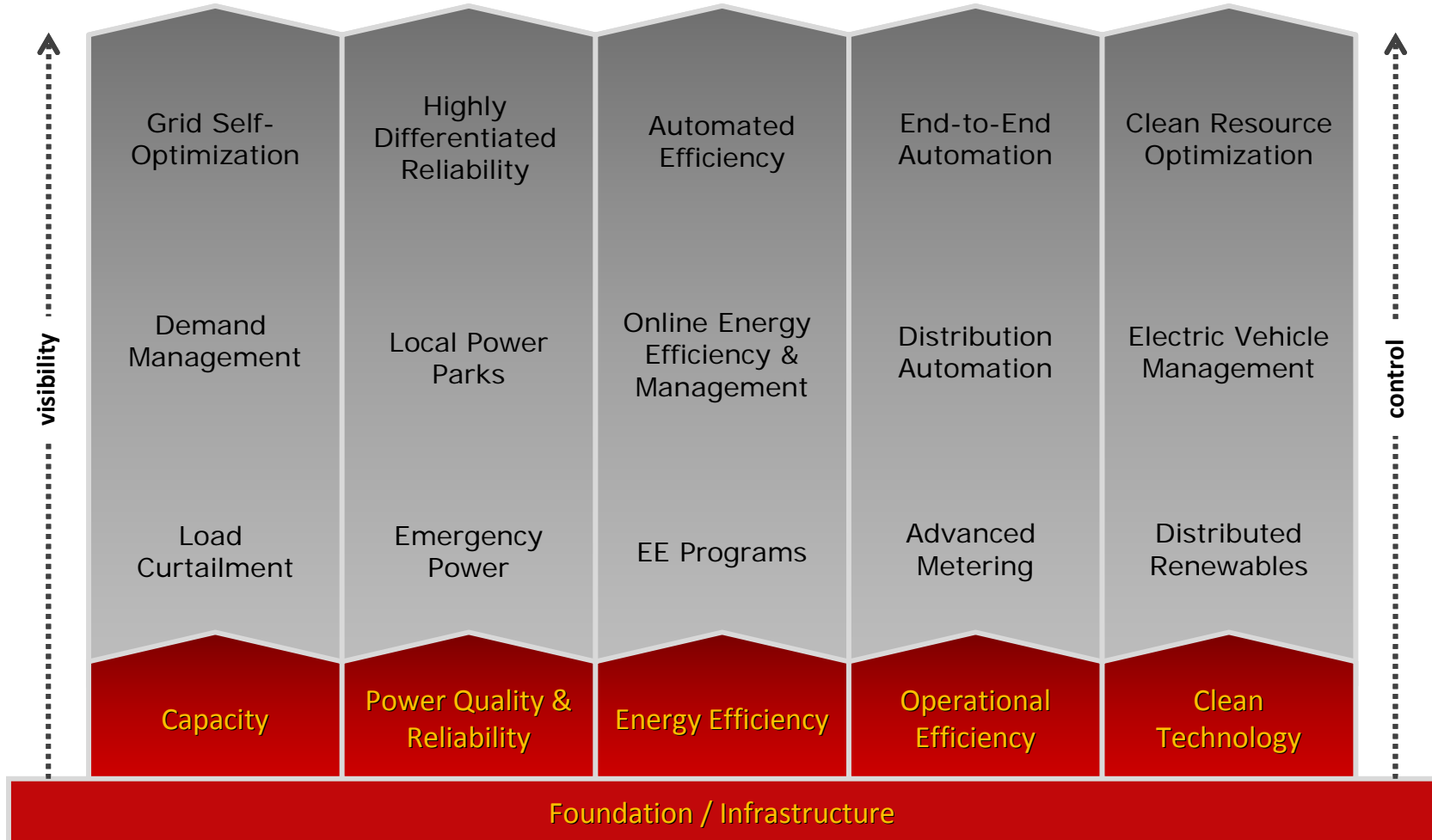
- Dynamically optimize grid operations and resources
- Fully integrate demand response and consumer participation into grid resource planning and operations

Smart Grid Applications: Operational Strategies that Utilize Smart Grid Assets to Create Values



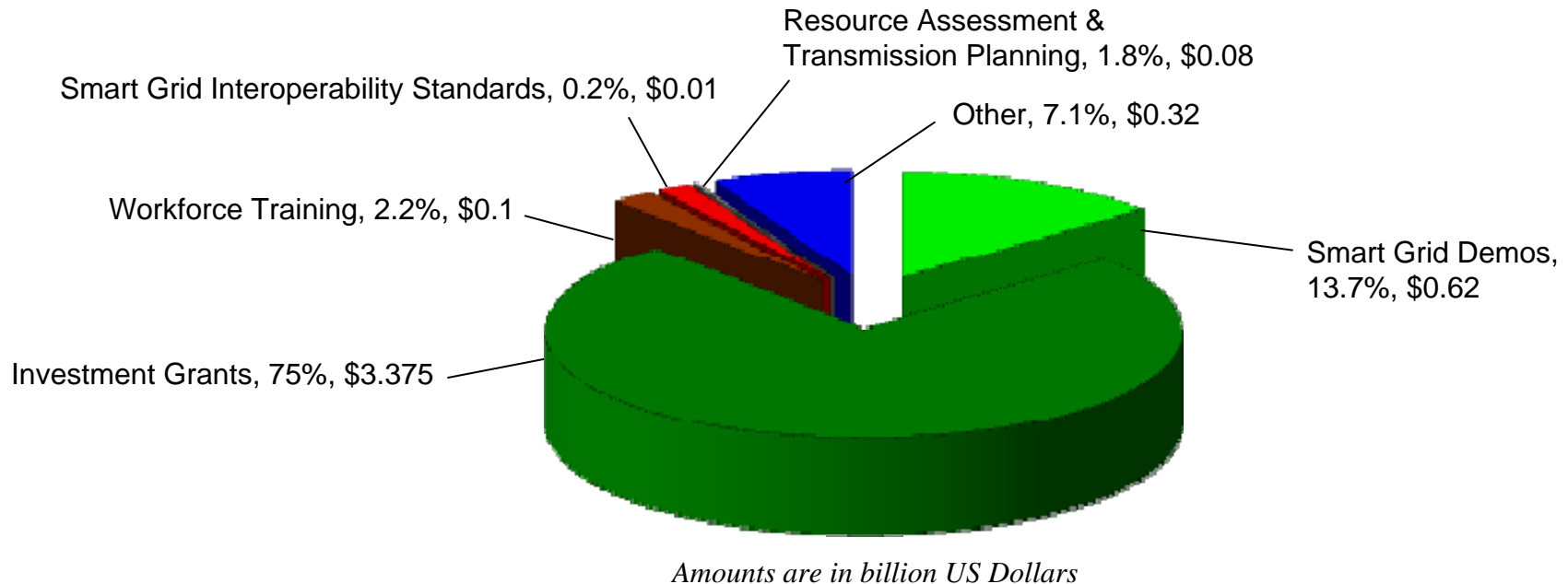
Smart Grid Value Creation

21st Century Smart Grid



Recovery Act Smart Grid Development

\$4.5 Billion for Grid Modernization in Recovery Act Funding



- 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>

SGIG Systems and Equipment

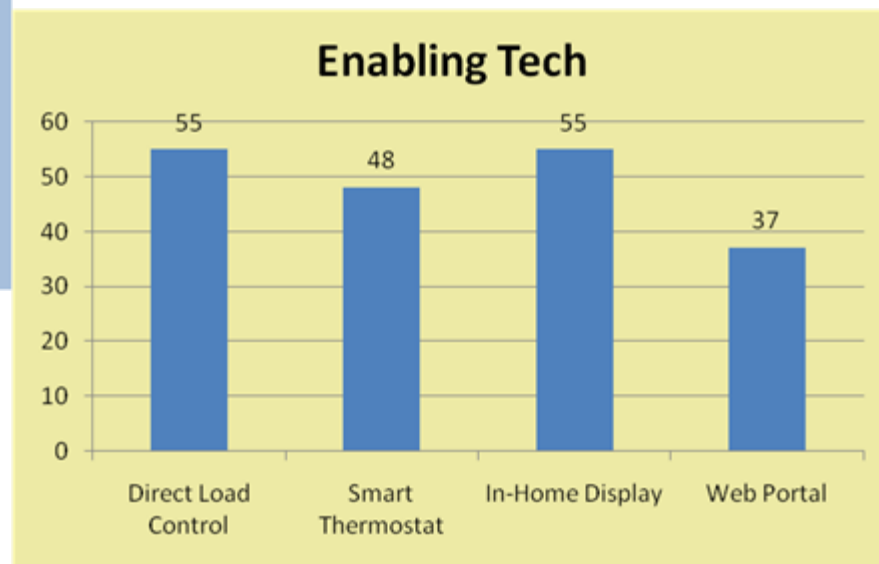
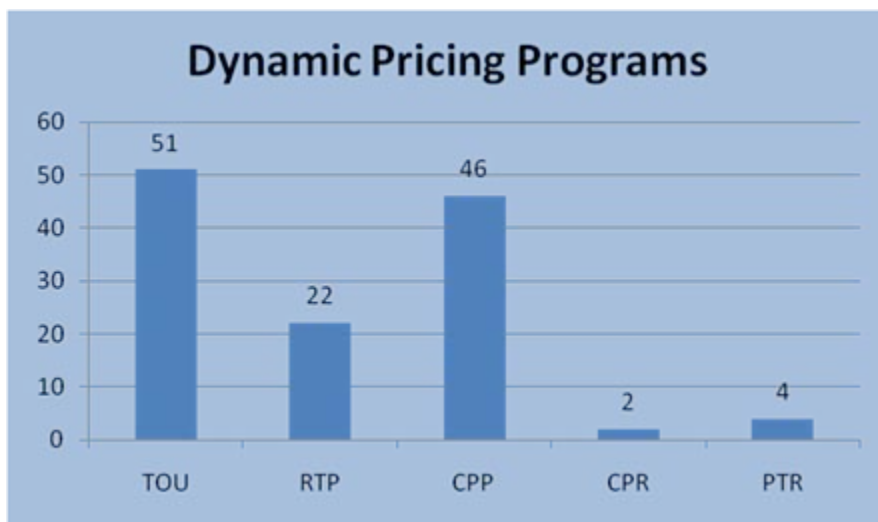
Smart Grid Systems and Equipment	Numbers of Units (self-reported estimates)	Improvements	Impacts
Networked Phasor Measurement Units	877	<ul style="list-style-type: none"> • <i>Near-nationwide coverage</i> • <i>6X the 166 existing networked PMUs</i> 	<p><i>Enhanced situational awareness and electric system reliability and resiliency</i></p>
Smart Transformers	205,983	<ul style="list-style-type: none"> • <i>Enables preventative maintenance</i> 	
Automated Substations	671	<ul style="list-style-type: none"> • <i>5% of 12,466 transmission and distribution substations in the U.S.</i> 	
Load Control Devices	210,814	<ul style="list-style-type: none"> • <i>Enables peak demand reductions</i> 	<p><i>1484 MWs of peak demand reduction per year (self-reported estimates)</i></p>
Smart Thermostats	170,218	<ul style="list-style-type: none"> • <i>Enables peak demand reductions</i> 	
Smart Meters	18,179,912	<ul style="list-style-type: none"> • <i>13% of the 142 million customers in the U.S.</i> 	<p><i>Transformational changes in consumer behavior and energy consumption</i></p>
In-Home Display Units	1,207,912	<ul style="list-style-type: none"> • <i>Enables customer empowerment</i> 	
PHEVs/Charging Stations	12/100	<ul style="list-style-type: none"> • <i>Accelerates market entry</i> 	<p><i>Begins the path toward energy independence</i></p>

Summary of SGIG Selections

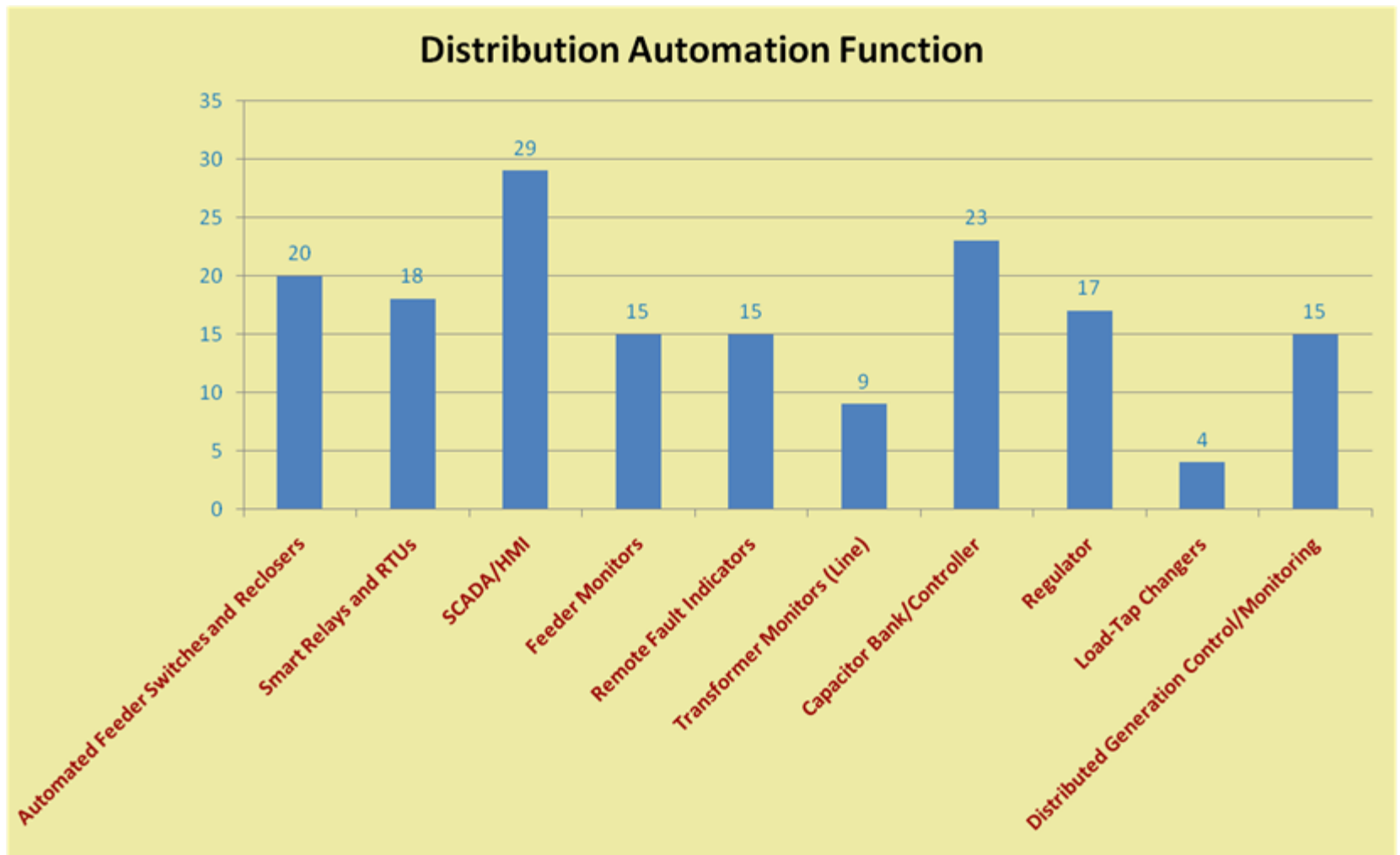
Topic Area	Number of Applications Selected/ Conforming	Federal Funding (\$)	Applicant Funding (\$)	Applicant Cost Share (%)
Equipment Manufacturing	2	25,786,501	26,222,777	50.42
Customer Systems	5	32,001,427	34,532,631	51.90
Advanced Metering Infrastructure	30	812,560,156	1,185,251,897	59.33
Electric Distribution	13	254,226,457	257,474,318	50.32
Electric Transmission	10	152,708,730	155,305,701	50.42
Integrated and Crosscutting	39	2,147,655,052	2,778,171,612	56.40
Total	99/389	3,424,938,323	4,436,958,936	56.44

SGIG: AMI & Customer Systems

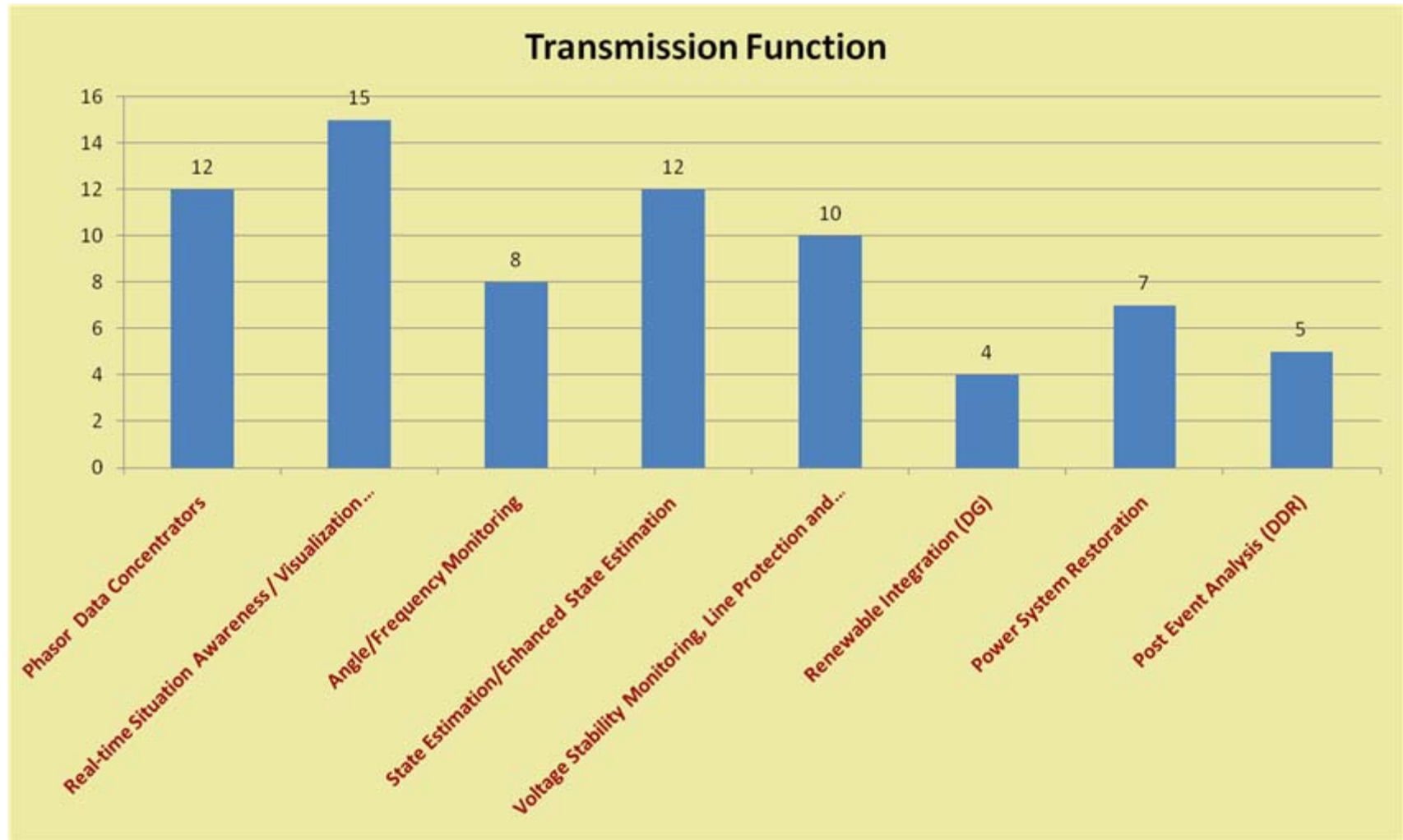
Number of SGIG projects offering individual dynamic pricing programs and enabling technologies



SGIG: Distribution Automation



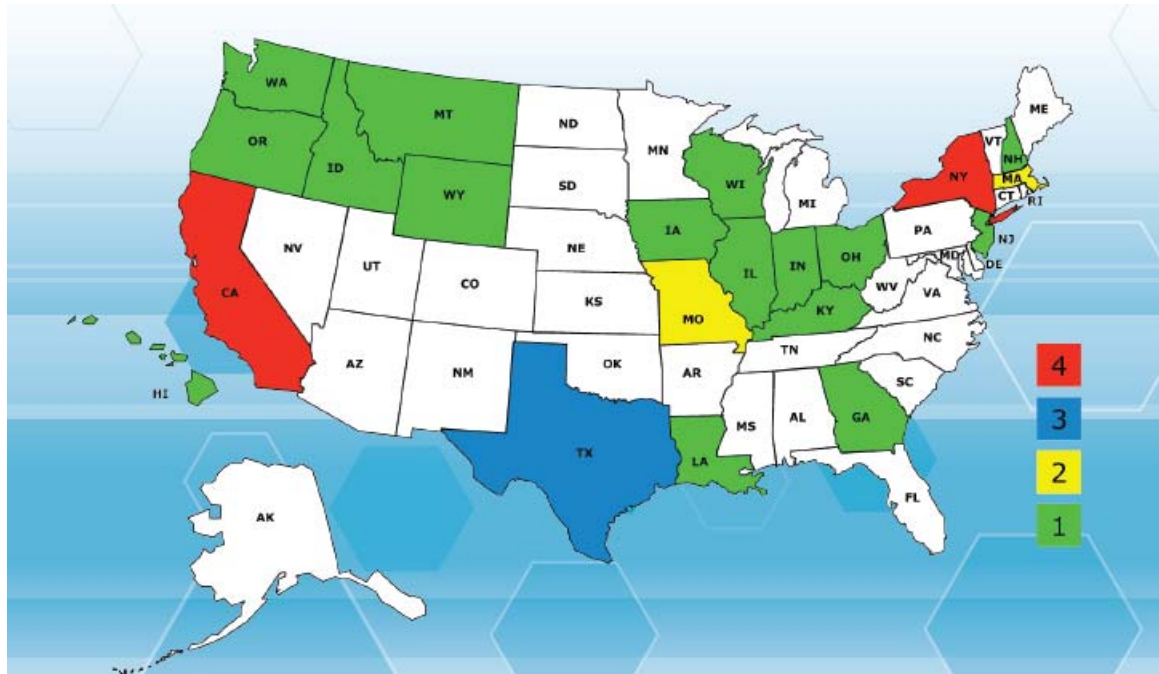
SGIG: Transmission System



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.



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



NIST



SGIG Status

- All projects are underway
- 2.1 million meters installed through August
- 1400+ jobs created or retained through June
- Through August, \$270M in federal funds paid out



Smart Grid R&D Base Program Ongoing and Planned Activities

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

R&D Areas

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

Focusing on



Distribution
Systems

Customer
Solutions

Interfaces & Integration
with Transmission and
Generation Systems

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 announced in November 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

Smart Grid RD&D FOA Topic Areas of Interest

#1: Integrated Distribution Management Systems for Distribution Automation

- Enhance interoperability/communications between utility management systems/databases and distribution engineering modeling and analysis tools
- Advance the capability of distribution engineering tools to model Smart Grid operations

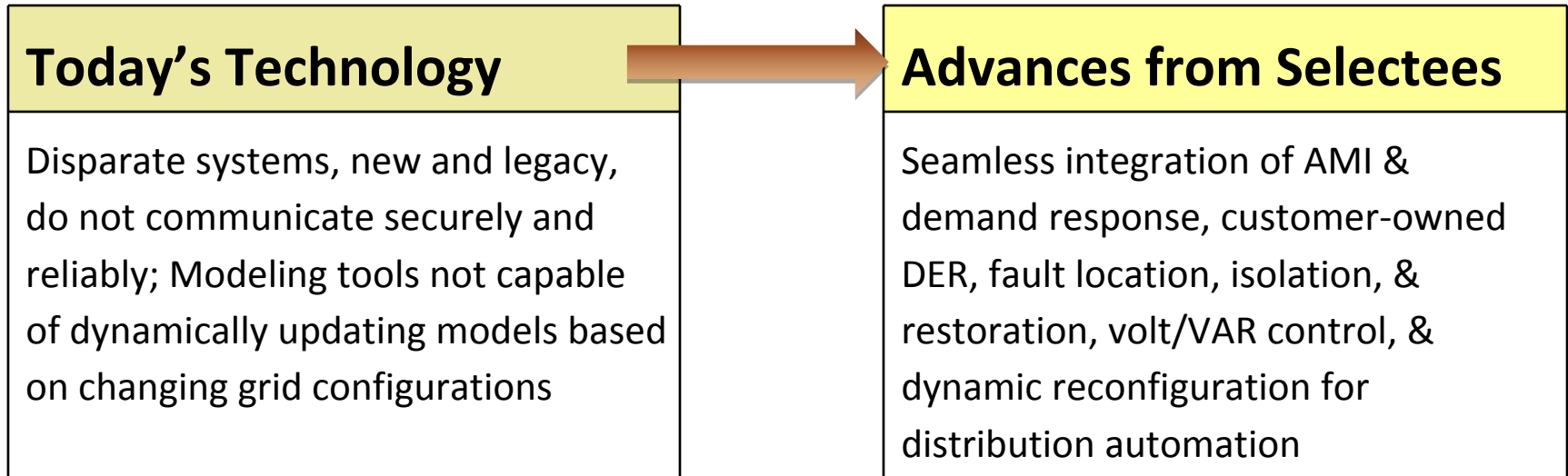
#2: Advanced Sensing, Monitoring, and Control Technologies for Enhanced Asset Utilization and Grid Reliability

- (2A) Prognostic health management (transformers, circuit breakers, cables/conductors, etc.)
- (2B) Distribution system sensing

#3: Voltage Regulation and Overvoltage Protection for High Penetration of Renewable Generation

- (3A) Voltage Regulation
- (3B) Overvoltage Protection

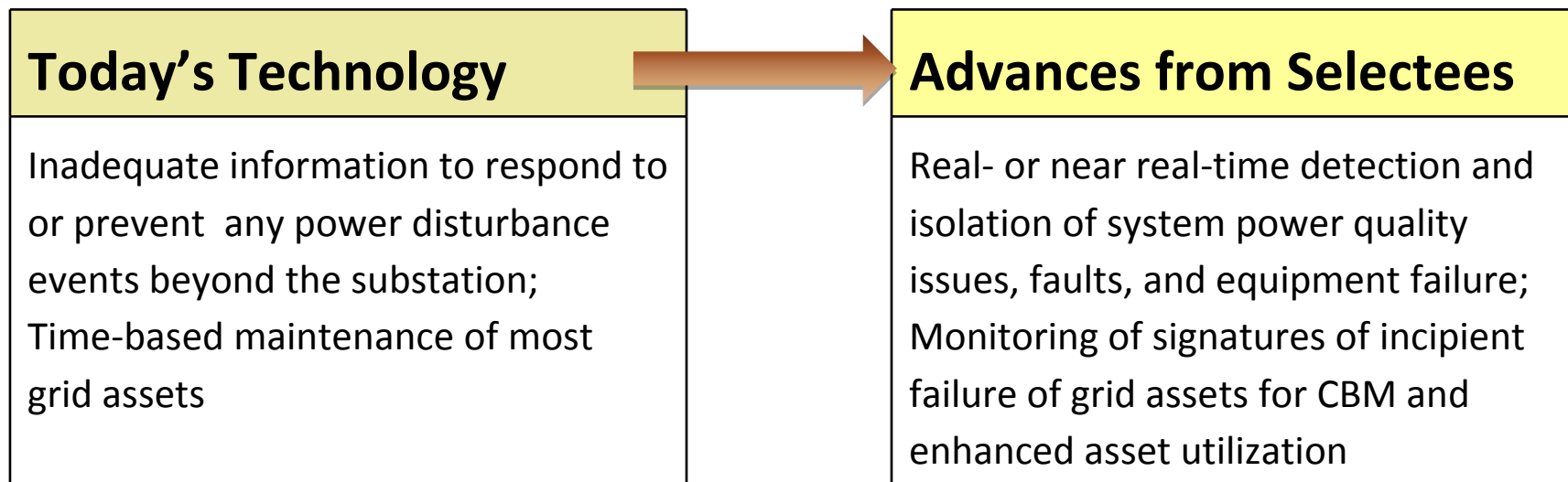
Summary of Two Selections: Integrated Distribution Management System



Significance of Selected Projects

- **Boeing:** Core integration platform built on \$500M of military hardened middleware software designed to be interoperable with a vast array of systems and to meet the highest security standards
- **AREVA:** Adding new capabilities of consumer enablement and integration of DER (DG, ES, PEVs, and DR) to a commercially proven IDMS platform, while combining model-based analysis with measurement analysis

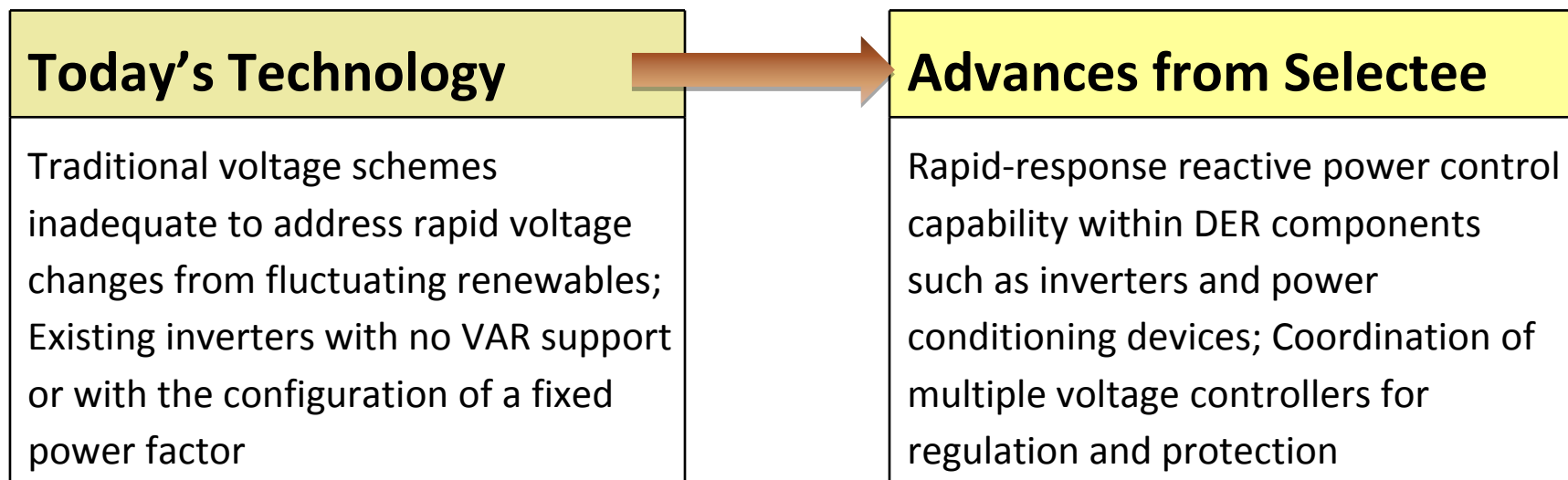
Summary of Two Selections: Sensing, Monitoring, & Control



Significance of Selected Projects

- **ABB:** Extending SCADA beyond substation w. distributed intelligence into every system/device with an integral means for communications
- **On-Ramp Wireless:** Communication solutions for extremely challenging RF propagation environments, including below ground, pad mount, and vault locations

Summary of One Selection: Voltage Regulation & Overvoltage Protection



Significance of Selected Project

- **Varentec:** Patented technology, integrated dynamic VAR compensators w. battery ESS, for fast voltage regulation at 200Hz providing real power and VAR support for grid operations (1MVA, 13.8kV)

Smart Grid Information Clearinghouse

Designed to serve as the **first stop-shop** for smart grid related information and the **essential gateway** to connect the community to various information sources

- Released SGIC web portal, <http://www.sgicclearinghouse.org>, by Virginia Tech in September
 - >200 smart grid projects in the U.S.
 - >50 smart grid projects overseas
 - >1,000 smart grid-related documents and multimedia (use cases, c/b analyses, business cases, legislation/regulation, standards, and technologies and vendors)
- Platform for direct sharing and dissemination of relevant smart grid information around the world

Smartgrid.gov Website

- Educate and inform the public and other key audiences about the benefits and components of the future smart grid
- Serve as the central source of credible, objective information about the smart grid and government-funded smart grid projects and initiatives
- Engage the public in smart-grid related conversations by providing ample opportunities for interaction and feedback
- Convey the results of ARRA smart grid projects to the public

The screenshot shows the SmartGrid.gov website homepage. At the top left is the logo "smartgrid.gov" with a stylized 'g'. To the right are links for "Bookmark & Share" and a search bar with "Search Help" and a play button icon. A vertical navigation menu on the left lists: About SmartGrid.gov, Basics, Technologies, Standards, Projects, News, Resources, and Contacts. The main content area features a large background image of a city at night with glowing lines representing smart grid infrastructure. Below this is a text block: "SmartGrid.gov is a resource for information about the Smart Grid and government-sponsored Smart Grid projects." Three main sections are highlighted with orange and blue headers: "National Broadband Plan" (with a goal 6 description and a link to learn more), "Smart Grid Projects" (with a photo of hands plugging a cable and a link to read on), and "Breaking News" (with two news items dated April 8, 2010 and March 10, 2010, each with a link to read on). At the bottom, there are links for "Manage Your Projects Online" and "RECOVERY ACT SMART GRID PROJECT TEAMS", followed by footer text: "SmartGrid.gov Home | Contacts | Web Site Policies | Security & Privacy | FOIA | USA.gov. SmartGrid.gov is a product of the Federal Smart Grid Task Force. Content Last Updated: 05/03/10."

International Coordination: International Smart Grid Action Network (ISGAN)

To accelerate the development and deployment of smarter electric grids around the world –15 countries and European commission participating to date



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

**First project:
Global Smart Grid Inventory**

US-EU Energy Council – Technology Working Group

Led by Directorate General Research and Innovation of the EC and the U.S. DOE to leverage RD&D budgets and laboratory expertise on both sides to accelerate clean energy development:

- **Smart Grid Technologies** being one of the 10 areas for RD&D cooperation
 - Grid integration of distributed renewable energy sources
 - Demand response and storage
 - Technical standards for smart grids technologies
- Held an **EU-US Workshop** on Assessment Methodologies for Smart Grid Advances, Benefits, and Impacts



Contact Information

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Smart Grid: smartgrid.gov