



U.S. Department of Energy

Office of Electricity Delivery and Energy Reliability

How Smart Grid can Enable Electricity to be the Fuel of the Future

Presentation at SAE 2010 Government/Industry Meeting

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Smart Grid Task Force: Federal Coordination

Established under authorization of EISA 2007 to ensure awareness, coordination, and integration of the diverse smart grid activities in the Federal Government

Functions

- ✓ Serves as Federal focal point on all things “smart grid”
- ✓ Coordinates and integrates inter-governmental activities
- Collaborates on interoperability framework
- ✓ Leverages ARRA investments in smart grid
- ✓ Ensures awareness of Federal smart grid activities
- ✓ Collaborates with and supports the Electricity Advisory Committee

Member Organizations

DOE
FERC
DOC (NIST, ITA)
EPA
DHS
USDA
DoD
FCC

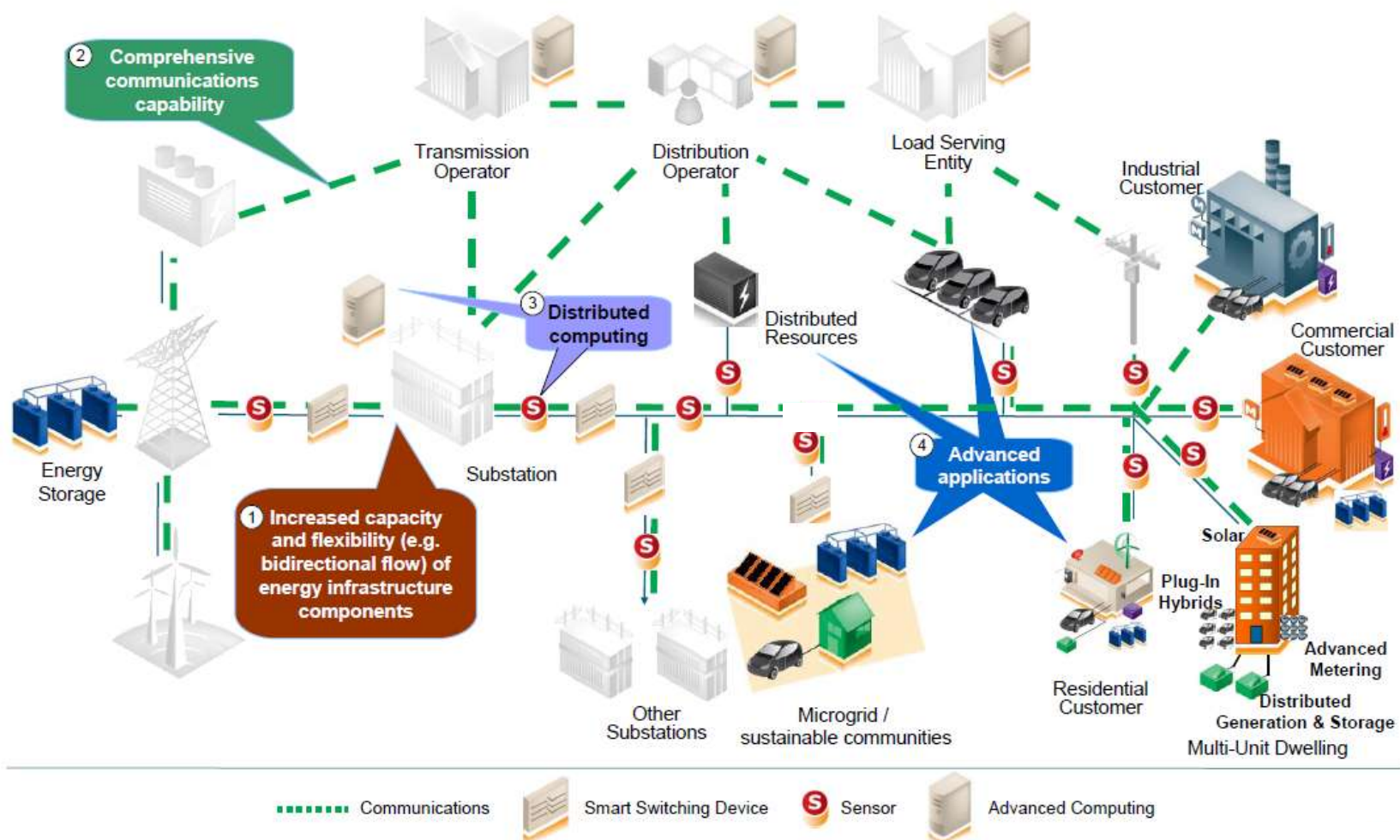
Website

www.smartgrid.gov

- ✓ Charter
- ✓ Presentations
- ✓ Publications
- ✓ Events



What is the Smart Grid?





Defining Smart Grid Characteristics

In 2005-2007, convened several regional stakeholder meetings to create a definition of a smart grid and define its value creation

Seven Defining Functions of the Smart Grid

- Enabling Informed Participation by Customers
- Accommodating All Generation and Storage Options
- Enabling New Products, Services, and Markets
- Providing the Power Quality for the Range of Needs in the 21st Century
- Optimizing Asset Utilization and Operating Efficiently
- Addressing Disturbances – Automated Prevention, Containment, and Restoration
- Operating Resiliently Against Physical and Cyber Attacks and Natural Disasters



SmartGrid Stakeholder Books: Defining the Opportunity



- ⬢ **RELEASE DATE:** September 2009
- ⬢ **INITIAL PRINT RUN:** 5,000 copies per title
- ⬢ **PURPOSE:** Enlighten consumer advocates, environmental groups, policymakers, regulators, technology providers and utilities to their roles and responsibilities in realizing the Smart Grid
- ⬢ **PERTINENT FACTS:**
 - Launched at GridWeek 2009
 - Available online at **smartgrid.gov** and **www.oe.energy.gov**



Metrics for Smart Grid Transformation toward Achieving the 7 Characteristics

Area Coordination

- Dynamic pricing
- Real-time data sharing
- Distributed resource interconnection policy
- Policy/regulatory progress

Distributed Energy Resources

- Load participation
- Microgrids
- Distributed generation
- Plug-in electric vehicles
- Grid-responsive load

Delivery (T&D) Infrastructure

- T&D system reliability
- T&D automation
- Advanced meters
- Advanced system measurement
- Capacity factors
- Generation, T&D efficiencies
- Dynamic line ratings

Information Networks & Finance

- Cyber security
- Open architecture/standards
- Venture capital investment

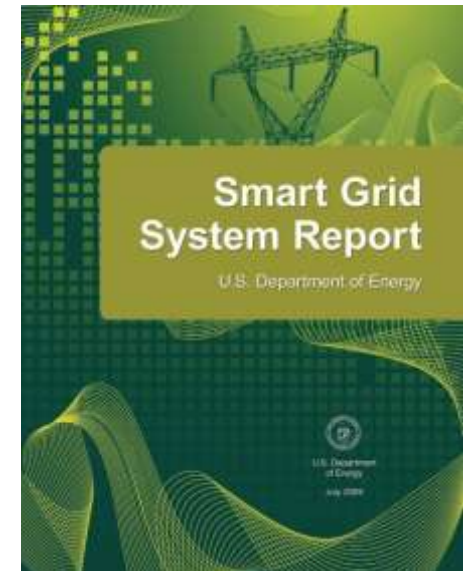
Indicators of smart grid deployment progress – not comprehensive measures

DOE Report to Congress, Stipulated under EISA Title XIII – Smart Grid

Smart Grid System Report, July 2009

(<http://www.smartgrid.gov>)

- **State of smart grid deployments**
 - Applying 20 metrics—
indicators of deployment progress by penetration levels or maturity levels
 - Metrics crosscutting smart grid scope areas and characteristics
- **Challenges to smart grid deployments**
 - Costs and their recovery
 - Interoperability standards
 - Technical barriers
 - Changing technologies and policies
- **Policy questions for future reports**
(every two years after this 1st report)





Recovery Act Smart Grid Funds: \$4.5 Billion

Office of Electricity Delivery and Energy Reliability	\$ Millions
Smart Grid Investment Grant Program; ≤3 years	\$3,400
Smaller projects, \$300K-\$20M	
Larger projects, \$20M-\$200M	
Smart Grid Demonstrations; 3-5 years	\$615
Regional Demonstrations, up to \$100M per project	
Grid-scale Energy Storage Demonstrations	
Interoperability Framework Development by NIST	\$10
Resource Assessment and Interconnection-Level Transmission Analysis and Planning	\$80
State Electricity Regulators Assistance	\$50
Enhancing State Government Energy Assurance Capabilities and Planning for Smart Grid Resiliency	\$55
Workforce Development	\$100



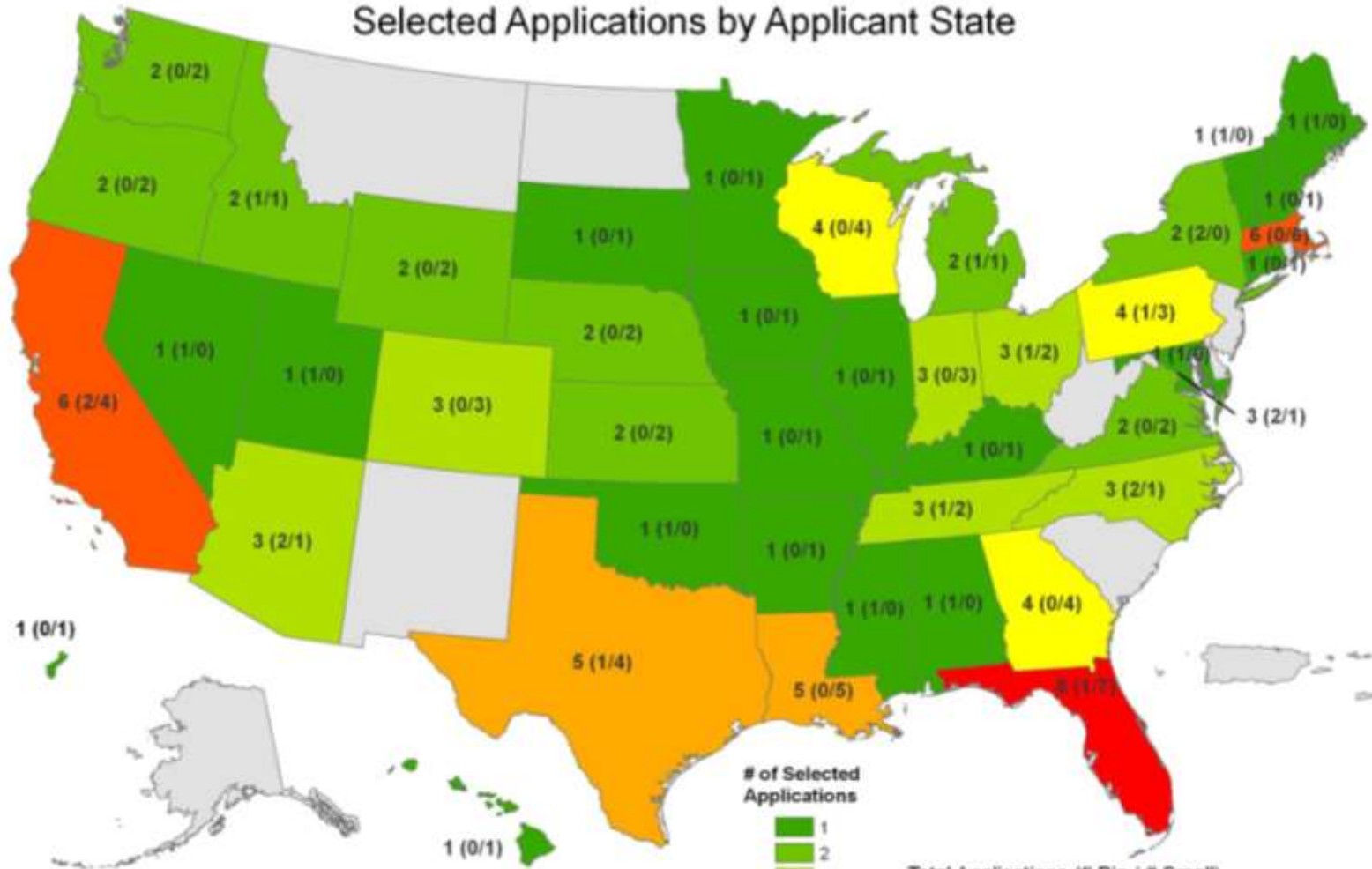
Recovery Act: Smart Grid Investment Grants

(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	<ul style="list-style-type: none"> • Near-nationwide coverage • 6X the 166 existing networked PMUs 	<p>Enhanced situational awareness and electric system reliability and resiliency</p>
Smart Transformers	205,983	<ul style="list-style-type: none"> • Enables preventative maintenance 	
Automated Substations	671	<ul style="list-style-type: none"> • 5% of 12,466 transmission and distribution substations in the U.S. 	
Load Control Devices	176,814	<ul style="list-style-type: none"> • Enables peak demand reductions 	<p>1444 MWs of peak demand reduction per year (self-reported estimates)</p>
Smart Thermostats	170,218	<ul style="list-style-type: none"> • Enables peak demand reductions 	
Smart Meters	18,179,912	<ul style="list-style-type: none"> • 13% of the 142 million customers in the U.S. 	<p>Transformational changes in consumer behavior and energy consumption</p>
In-Home Display Units	1,183, 265	<ul style="list-style-type: none"> • Enables customer empowerment 	
Vehicle Charging Stations	100	<ul style="list-style-type: none"> • Accelerates market entry 	<p>Begins the path toward energy independence</p>



Selected Applications by Applicant State



Total Applications (# Big / # Small)

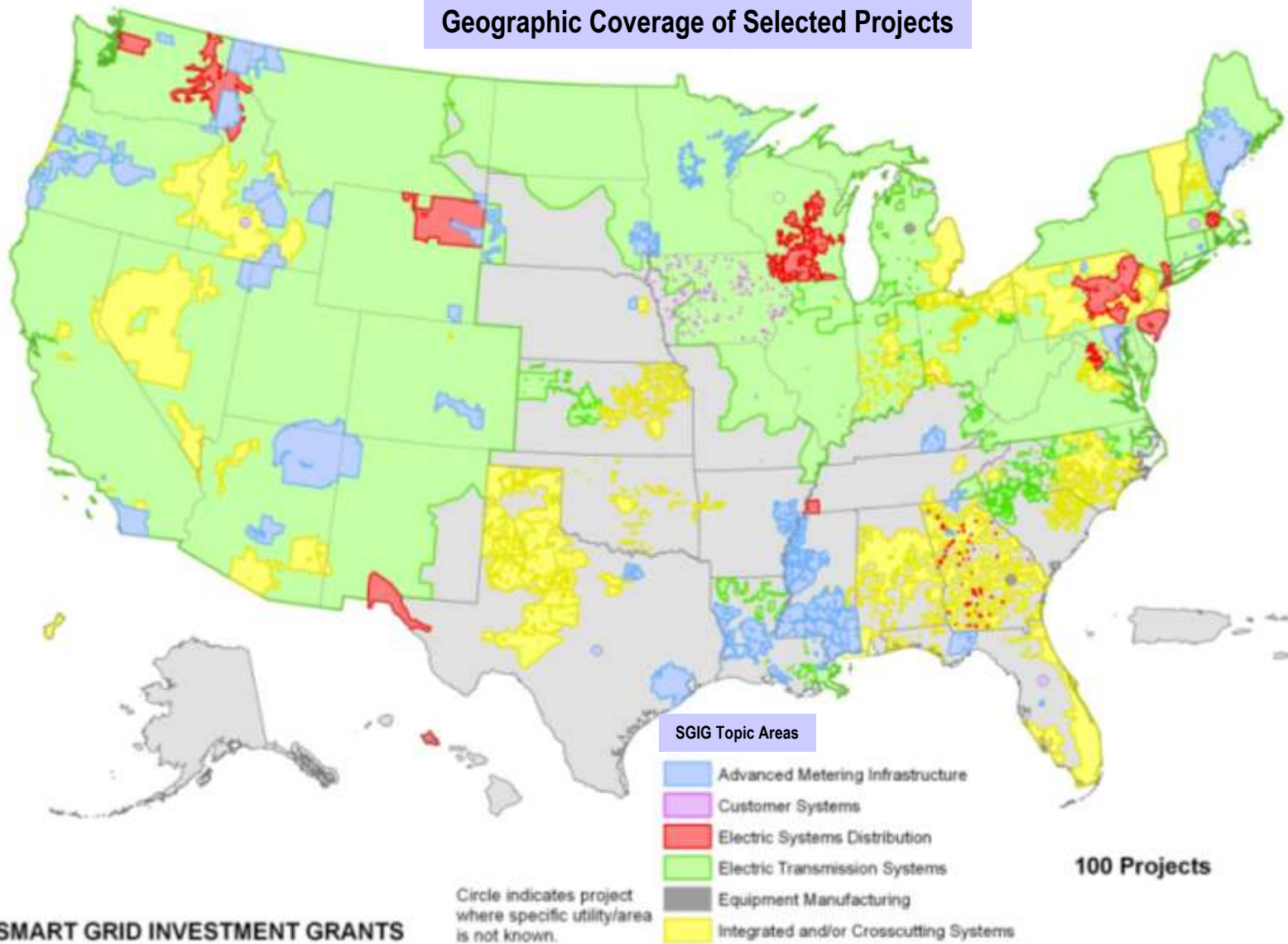
100 Total Applications (25 Big / 75 Small)

Small Application (<= \$20 Million Federal Funding)
 Big Application (>\$20 Million Federal Funding)

SMART GRID INVESTMENT GRANTS



Geographic Coverage of Selected Projects



SMART GRID INVESTMENT GRANTS

Circle indicates project where specific utility/area is not known.

SGIG Topic Areas

- Advanced Metering Infrastructure
- Customer Systems
- Electric Systems Distribution
- Electric Transmission Systems
- Equipment Manufacturing
- Integrated and/or Crosscutting Systems

100 Projects



Recovery Act: Smart Grid Demonstration Program (32 projects: \$620M Federal; \$1,028M non-Federal)

Smart Grid Demonstrations on a suite of technologies to validate performance and cost information for a proven use (business) case:

Regional demonstrations

- › Demonstration of technical/operational/business-model feasibility on a regional scale:
 - 8 NERC regions,
 - 27 eGrid subregions
 - co-ops or publicly owned utilities in the (sub)regions

Grid-scale energy storage demonstrations

- › Battery storage for utility load shifting or for wind farm operations
- › Frequency regulation ancillary services
- › Distributed energy storage for grid support
- › Compressed air energy storage (CAES)
- › Demonstration of promising energy storage technologies



Recovery Act: Smart Grid Standards Development

NIST having primary responsibility to coordinate development of protocols and model standards for interoperability of Smart Grid devices and systems

- **Phase 1:** Identified an initial set of existing consensus standards and develop a roadmap to fill gaps
 - Draft report, *NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0*, published in September for public comment
 - Identified ~80 existing standards that can be used now for smart grid development
 - Identified 14 high priority gaps plus cyber security in need for new or revised standards
 - Common object models for electric transportation
- **Phase 2:** Established public/private Standards Panel in December 2009 to provide ongoing recommendations for new/revised standards
- **Phase 3:** Initiate implementation of the testing and certification framework in 2010



DOE's Smart Grid R&D Engages Public/Private Partnerships

Partnerships

- Recovery Act: commercial applications and demonstrations of near-term technology
- Base Programs: R&D on longer-term technology
- International Coordination

Transformation

Dynamic Optimization of Grid Operations & Resources

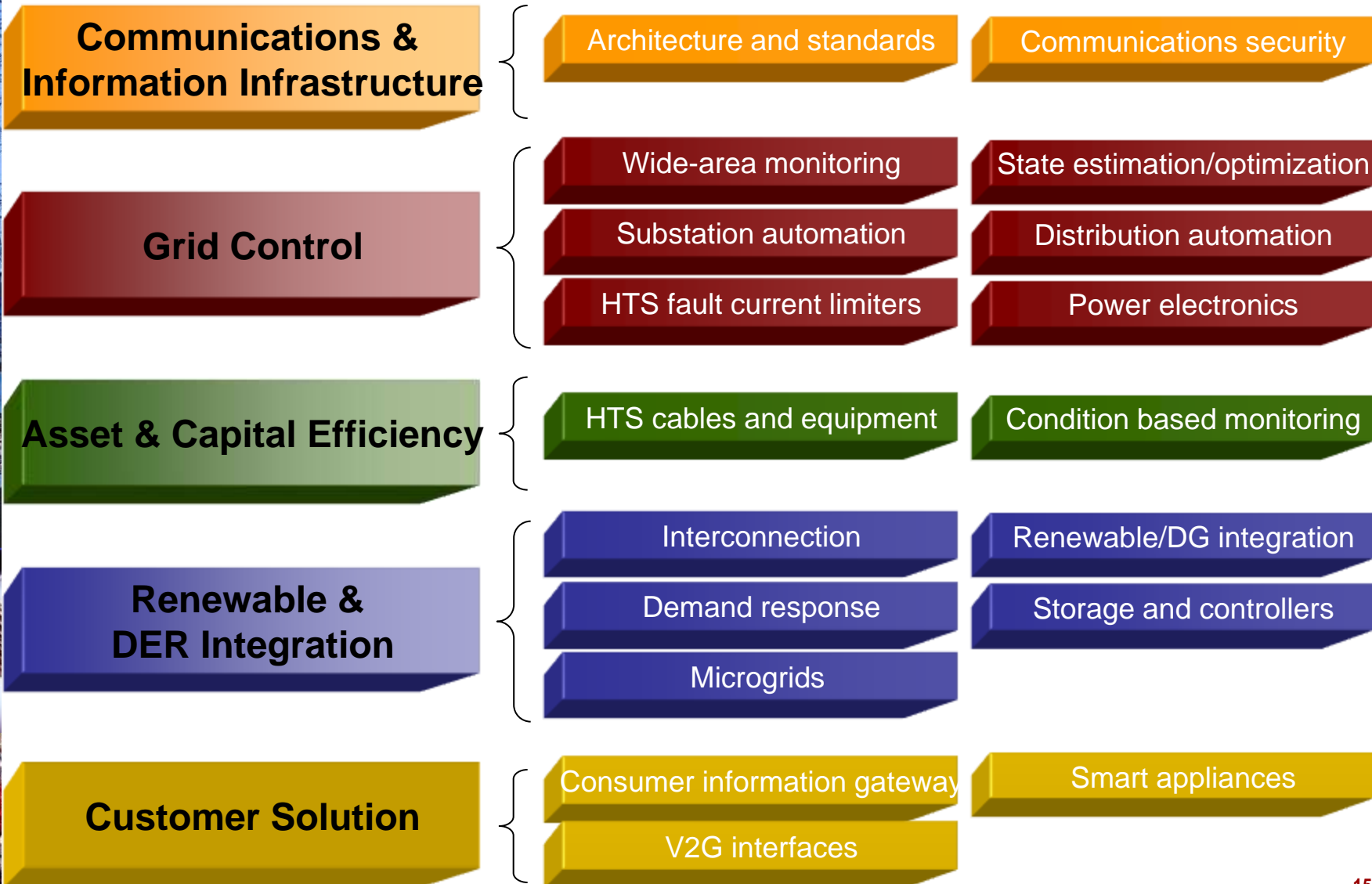
Demand Response and Consumer Participation

Outcomes

- Reduced Peak Load and Consumption
- Operational Efficiency
- Grid Reliability and Resilience
- More Distributed and Renewable Energy
- Lower Carbon Dioxide Emissions
- Enhanced Economic Productivity



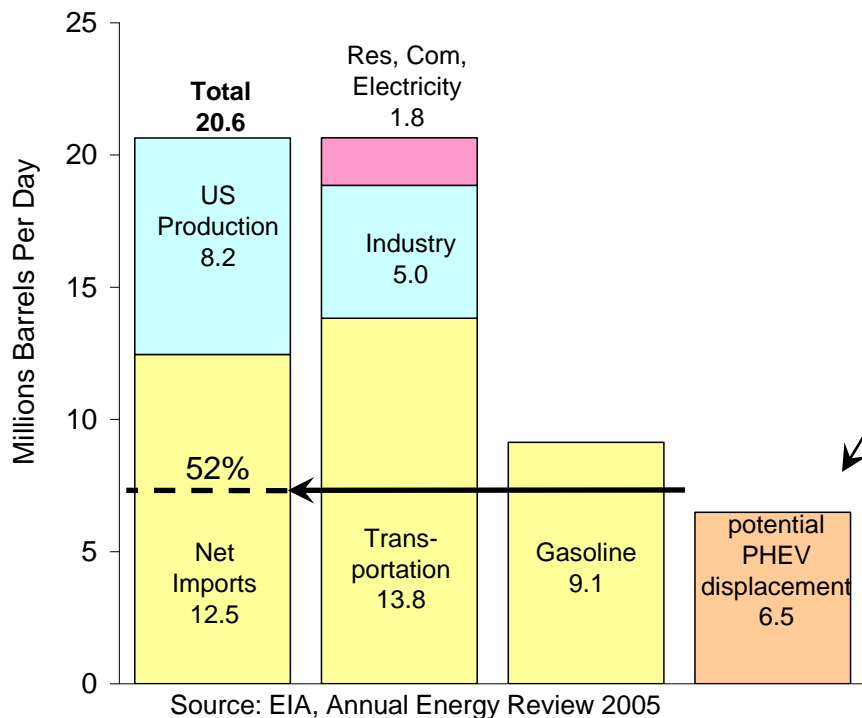
OE's Smart Grid Technology Areas





Preparing for PHEVs

- **The idle capacity** of the U.S. grid **could supply 73%** of the energy needs of today's cars, SUVs, pickup trucks, and vans (158 million vehicles)...
- **without adding generation or transmission if vehicles are charged off peak**
- Smart Chargers – enabled by the Smart Grid – will help manage this new energy device to avoid any unintended consequences on the infrastructure



- Potential to displace 52% of net oil imports (6.7 MMbpd)
- More sales + same infrastructure = downward pressure on rates
- Reduces CO₂ emissions by 27%
- Emissions move from tailpipes to smokestacks (and base load plants) ... cheaper to clean up
- Introduces vast electricity storage potential for the grid



Smart Appliances

Olympic Peninsula GridWise Demonstration

- Explored how consumers respond to real-time pricing
- Tested smart appliances in 112 homes for one year
- Real-time, two-way market with real cash incentives

Grid Friendly™ Appliance Demonstration

- Tested device response to stress on grid and consumer acceptance of device in appliances
- Installed in 150 dryers for one year





International Collaboration

- **Technology Action Plan on Smart Grids**
 - Supported development of the plan for the Major Economies Forum on Energy and Climate
 - Devising the US plan to support implementation of TAP recommendations
- **International Smart Grid Forums**
 - Summits held at GridWeeks 2009 and 2008
 - GridWise® Global Forum, September 2010
- **SGMM for global stewardship to manage and accelerate smart grid deployments**
- **Smart Grid Information Clearinghouse development**
 - Potentially serving as a central repository of data and information for smart grid projects in the US and globally
- **Individual collaborations**
 - ENARD, EU, China, Japan, Korea, Australia



SmartGrid.gov: Online Presence

- **LAUNCH DATE:** January 2010
- **URL:** SmartGrid.gov
- **PURPOSE:** Provide credible and objective information about the Smart Grid and related activities
- **PERTINENT FACTS:**
 - A portal into government wide Smart Grid activities
 - An online venue where non-technical knowledge transfer can occur and broader understanding for the Smart Grid can be established





Contact Information

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For more Smart Grid Information:

OE: www.oe.energy.gov

Smart Grid: www.smartgrid.gov

Smart Grid Task Force: www.smartgrid.gov