September 24, 2013

Office of Electricity Delivery & Energy Reliability

Results and Findings from the ARRA-Funded Smart Grid Projects

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U.S. Department of Energy
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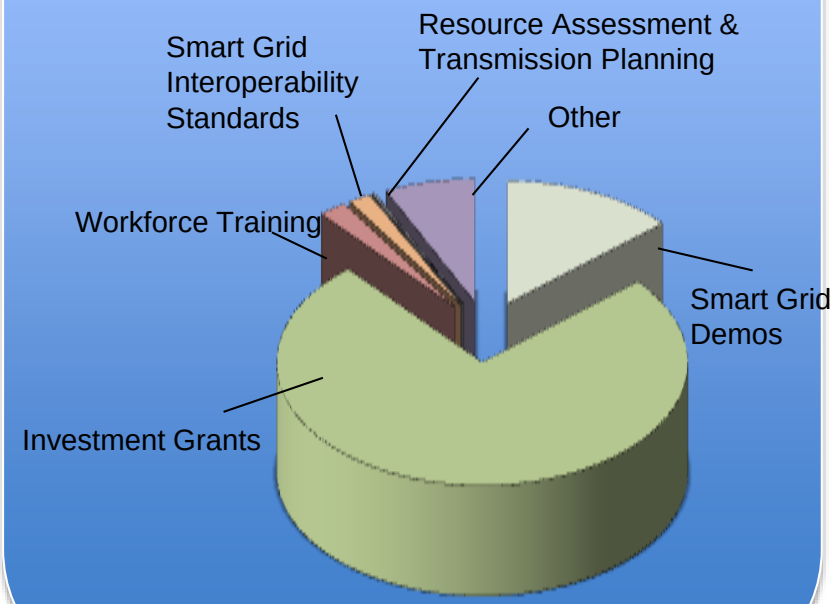
September 22-25, 2013
Chicago, IL

Recovery Act Smart Grid Programs

Recovery Act Smart Grid Programs

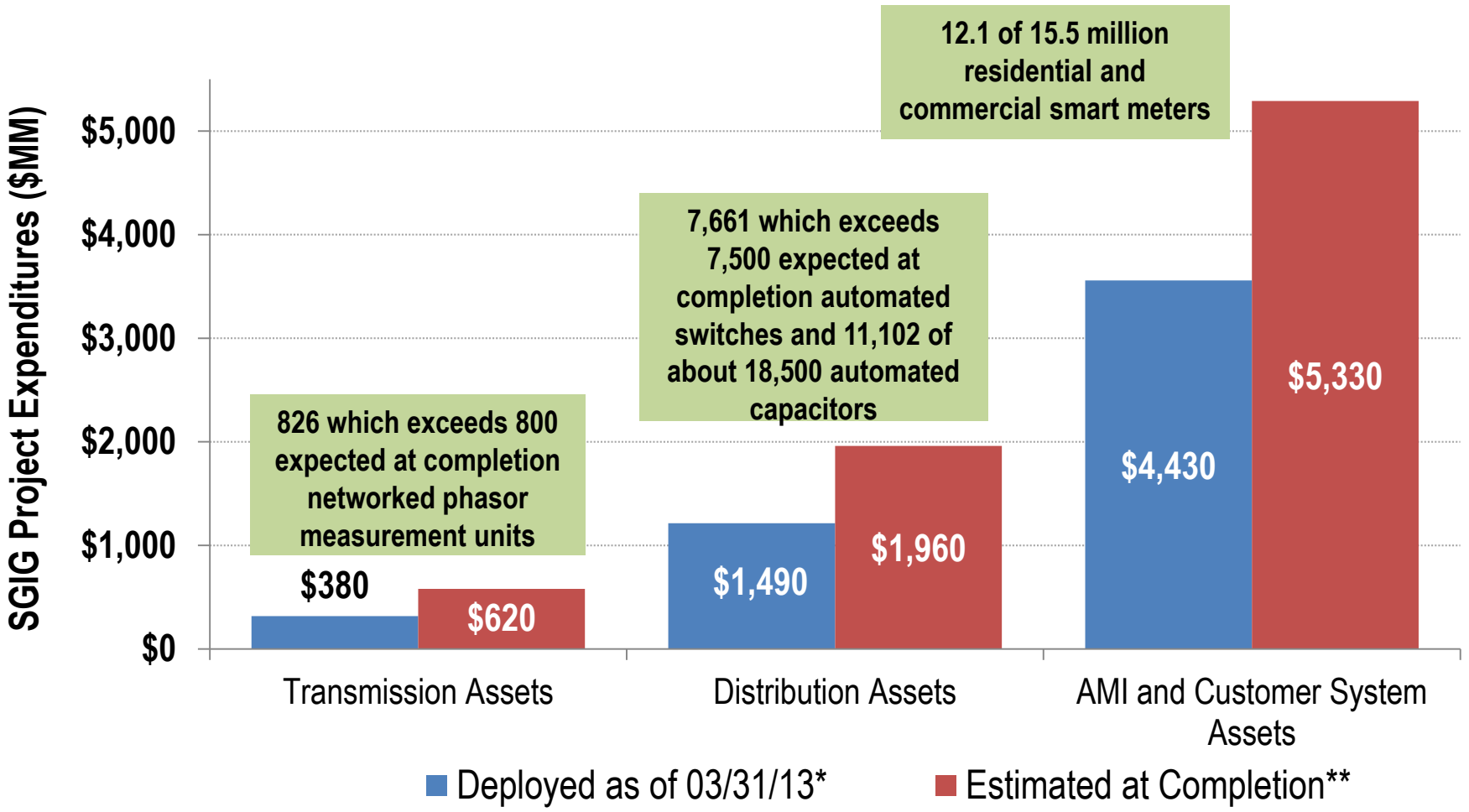
- Smart Grid Investment Grants (SGIG)*
  - $3.4 billion
- Smart Grid Regional Demonstrations (SGDP)*
  - $620 million
- Workforce Training
  - $100 million
- Interconnection-wide Transmission Planning and Resource Analysis
  - $80 million
- Interoperability Standards (with NIST)
  - $12 million
- Other
  - Technical Assistance to States ($44 million)
  - Local Energy Assurance Planning ($10 million)

One-time Appropriation
$4.5B of Recovery Act Funds



Originally authorized by the Energy Infrastructure Security Act 2007, EISA 1306 and EISA 1304

SGIG Deployment Status

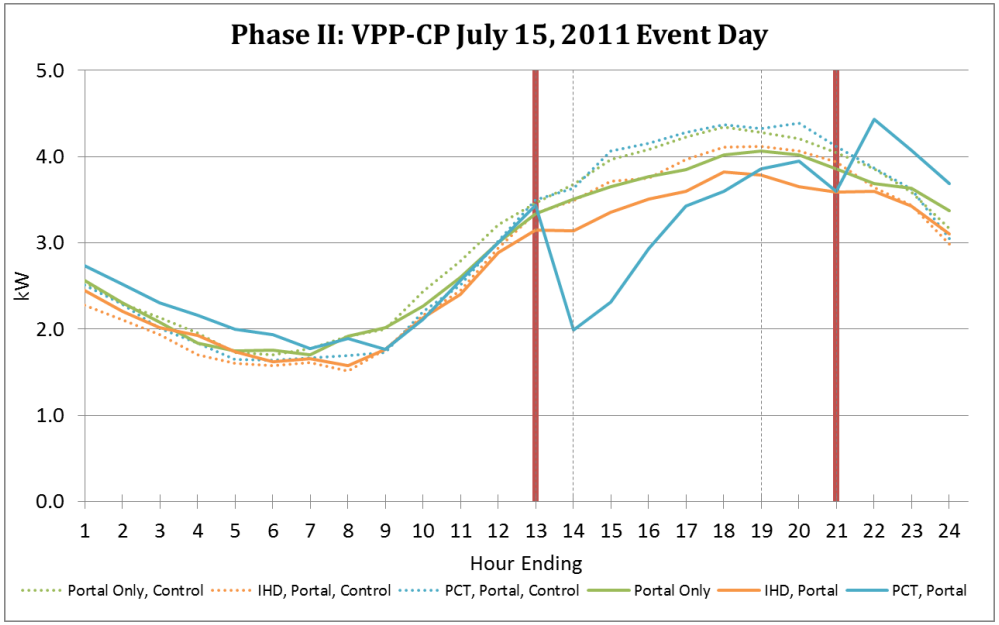


*Number of entities: 99
Updated on September 5, 2013

Applications and Benefits Matrix

Benefits	Smart Grid Technology Applications					
	Consumer-Based Demand Management Programs (AMI-Enabled)	Advanced Metering Infrastructure (AMI) Applied to Operations	Fault Location, Isolation and Service Restoration	Equipment Health Monitoring	Improved Volt/VAR Management	Synchrophasor Technology Applications
	• Time-based pricing • Customer devices (information and control systems) • Direct load control (does not require AMI)	• Meter services • Outage management • Volt-VAR management • Tamper detection • Back-Office systems support (e.g., billing and customer service)	• Automated feeder switching • Fault location • AMI and outage management	• Condition-based maintenance • Stress reduction on equipment	• Peak demand reduction • Conservation Voltage Reduction • Reactive power compensation	• Real-time and off-line applications
Capital expenditure reduction – enhanced utilization of G,T & D assets	✓			✓	✓	✓
Energy use reduction	✓	✓	✓		✓	✓
Reliability improvements		✓	✓	✓		✓
O&M cost savings		✓	✓	✓		
Reduced electricity costs to consumers	✓				✓	
Lower pollutant emissions	✓	✓	✓		✓	✓
Enhanced system flexibility – to meet resiliency needs and accommodate all generation and demand resources	✓	✓	✓	✓	✓	✓

CBS Project Evaluation Results: *OG&E*



	Residential VPP-CP (¢/kWh)	Number of days in summer 2011 at each price level
Low and off-peak	4.5¢ per kWh	63
Standard	11.3¢ per kWh	25
High	23.0¢ per kWh	28
Critical	46.0¢ per kWh	6
Critical Event	46.0¢ per kWh	7 (included in the above)

- Evaluation estimated average peak demand reduction of 1.3 kW/customer
- Based on study results, rolling out VPP- CP system-wide with participation goal of 20% by Dec. '14
- Study results show value in continuing to provide PCTs for free (2012) or discounted to join rate
- 70,000 customers (~10% of res. class) enrolled in VPP-CP rate as of July 2013 with high satisfaction

Value of Service from Improvements in Reliability

Selected example from an SGIG project reporting initial results

1 project involving 230 automated feeder switches on 75 circuits in an urban area

From Apr 1 – Sep 30 2011

SAIDI improved 24%; average outage duration decreased from 72.3 to 54.6 minutes (17.7 minutes)

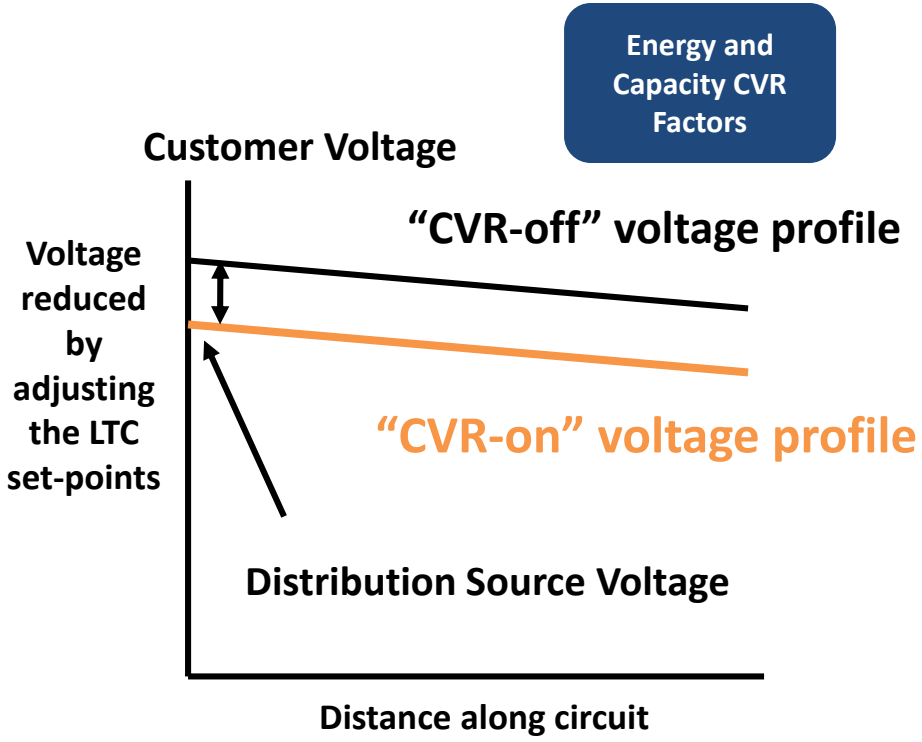
Estimated Average Customer Interruption Costs US 2008$ by Customer Type and Duration						
Customer Type	**Interruption Cost Summer Weekday**	**Interruption Duration**				
		Momentary	**30 mins**	**1 hr**	**4 hr**	**8 hr**
Large C&I	**Cost Per Average kWh**	**$173**	**$38**	**$25**	**$18**	**$14**
Small C&I	**Cost Per Average kWh**	**$2,401**	**$556**	**$373**	**$307**	**$272**
Residential	**Cost Per Average kWh**	**$21.6**	**$4.4**	**$2.6**	**$1.3**	**$0.9**

Sullivan J, Michael, 2009 *Estimated Value of Service Reliability for Electric Utility Customers in the US*, xxi

Estimated monetary value of this improvement in reliability based on value-of-service data is $21 million

Applying Volt/VAR Optimization to Improve Energy Efficency

Conservation voltage reduction (CVR) reduces customer voltages along a distribution feeder for lowering peak demands and overall energy consumption



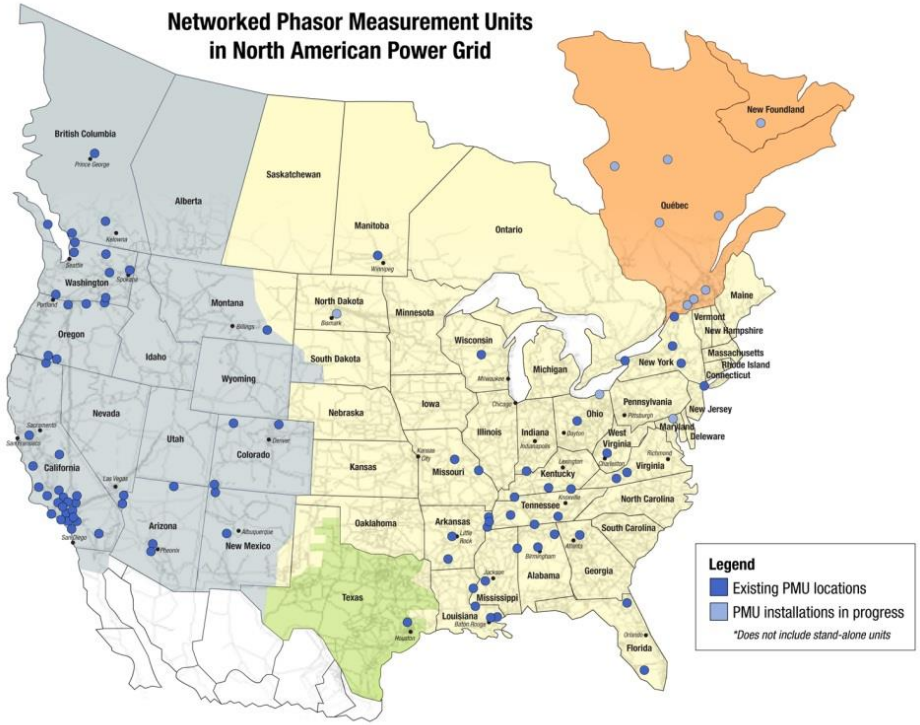
Example Using SGIG Project Data

Results averaged across 11 circuits	% Reductions	Potential savings for a 7 MW peak circuit with 53% load factor	
Customer Energy Reduction	2.9%	943 MWh/year	$75,440 (at $.08/kWh)
Peak Demand Reduction	3%	210 kW	Defer construction of peaking plants

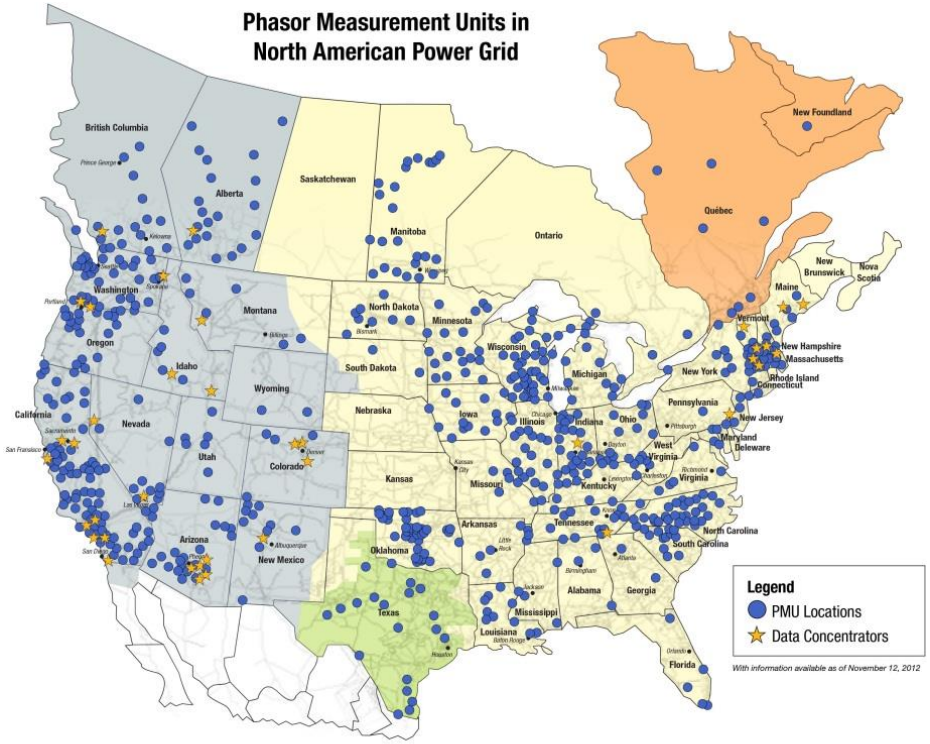
Synchrophasor Technology for Transmission System Operations

DOE and NERC/NASPI are working together closely with industry to enable wide area time-synchronized measurements that will enhance the reliability of the electric power grid through improved situational awareness and other applications

April 2007

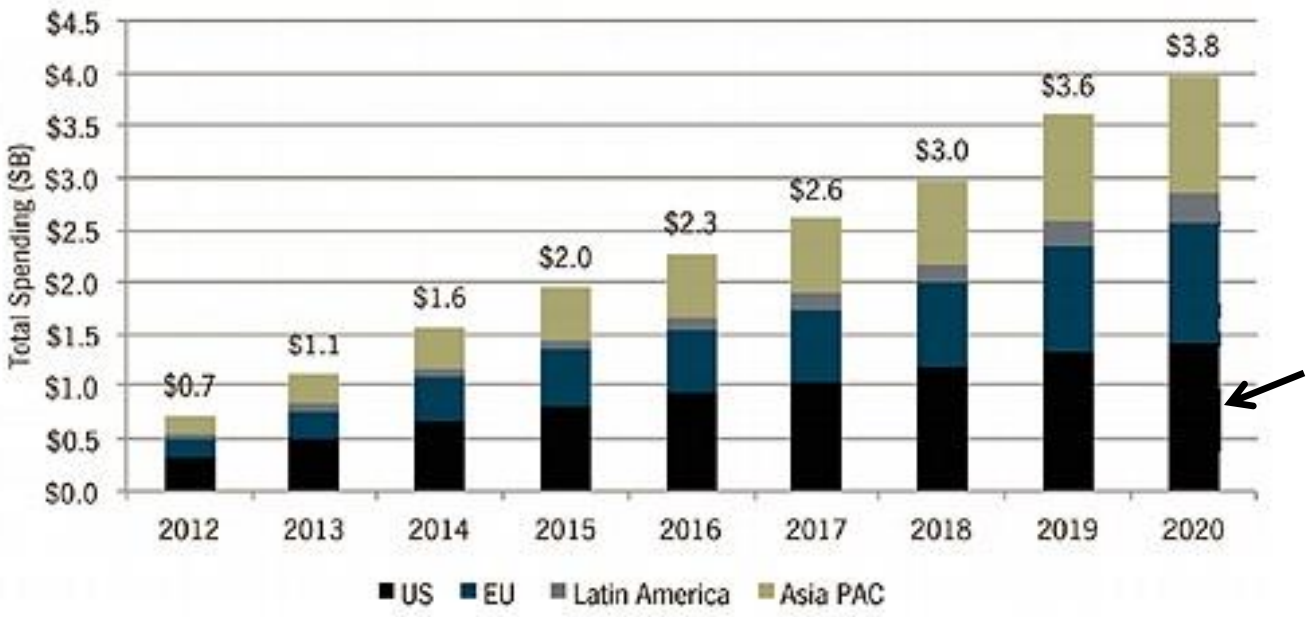


November 2012



Growth in Utility Data Analytics

FIGURE: Global Utility Analytics Spending, 2012-2020



Spending in US at $1.4 billion in 2020

Provides utilities ability to track, visualize and predict:

- **Asset management**
- **Outage management**
- **Mobile workforce management**
- **Customer behavior**
- **Power flow management (real-time balancing)**

FIGURE: Leading Vendors in Soft Grid

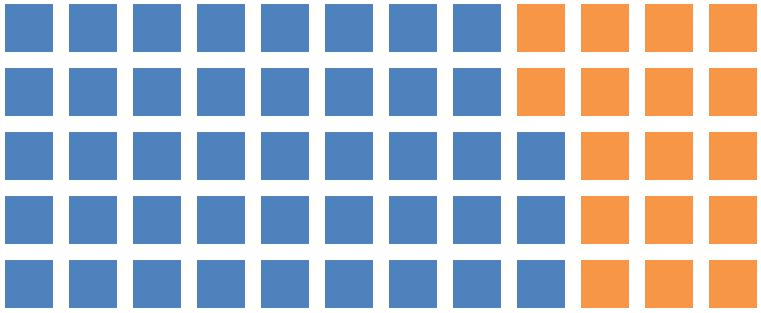
Source: "The Soft Grid 2013-2020: Big Data & Utility Analytics for Smart Grid," GTM Research

Grid Modernization Investments

SGIG projects *accelerate* industry investment to achieve a modern grid

ARRA Spending **$7.8 billion with cost share to be spent through 2015**

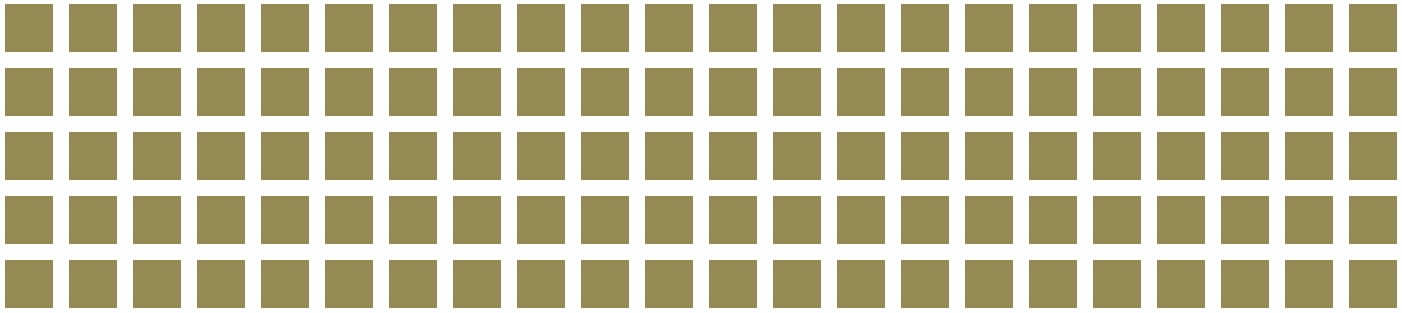
EPRI Estimate



$338 - $476 billion needed through 2030

EPRI. Estimating the costs and benefits of the smart grid: A preliminary estimate of the investment requirements and the resultant benefits of a fully functioning smart grid. EPRI, Palo Alto, CA; 2011.

Brattle Group Estimate



$880 billion needed through 2030

Chupka, M.W. Earle, R., Fox-Penner, P., Hledik, R. Transforming America's power industry: The investment challenge 2010 – 2030. Edison Electric Institute, Washington D.C.,: 2008.

For More Information

Contact: joseph.paladino@hq.doe.gov

Websites: www.oe.energy.gov
www.smartgrid.gov

Reports:

SGIG Progress Report (July 2012)
Peak Demand Reductions – Initial Results (December 2012)
AMI O&M Savings – Initial Results (December 2012)
Reliability Improvements – Initial Results (December 2012)
Voltage Optimization – Initial Results (December 2012)
Economic Impact (April 2013)
Customer Enrollment Patterns in Time-Based Rate Programs (June 2013)
Synchrophasor Technologies and Their Deployment in Recovery Act Smart Grid Programs (August 2013)

All reports are downloadable from:

http://www.smartgrid.gov/all/news/department_energy_releases_smart_grid_impact_reports