

November 7, 2011



Office of Electricity
Delivery & Energy
Reliability

ANALYSIS AND REPORTING OF METRICS AND BENEFITS FOR ARRA SMART GRID PROJECTS



Joe Paladino – EU/US Meeting



Objectives

Elements

What we are trying to accomplish

Technology Deployment and Impact

- Correlate technology, enhanced grid function and capability, costs, and benefits
- Report on consumer response, acceptance and retention in externally-valid pricing studies

Communicating Results

- Show correlations and analysis approach on smartgrid.gov
- Provide anecdotes, not just evidence

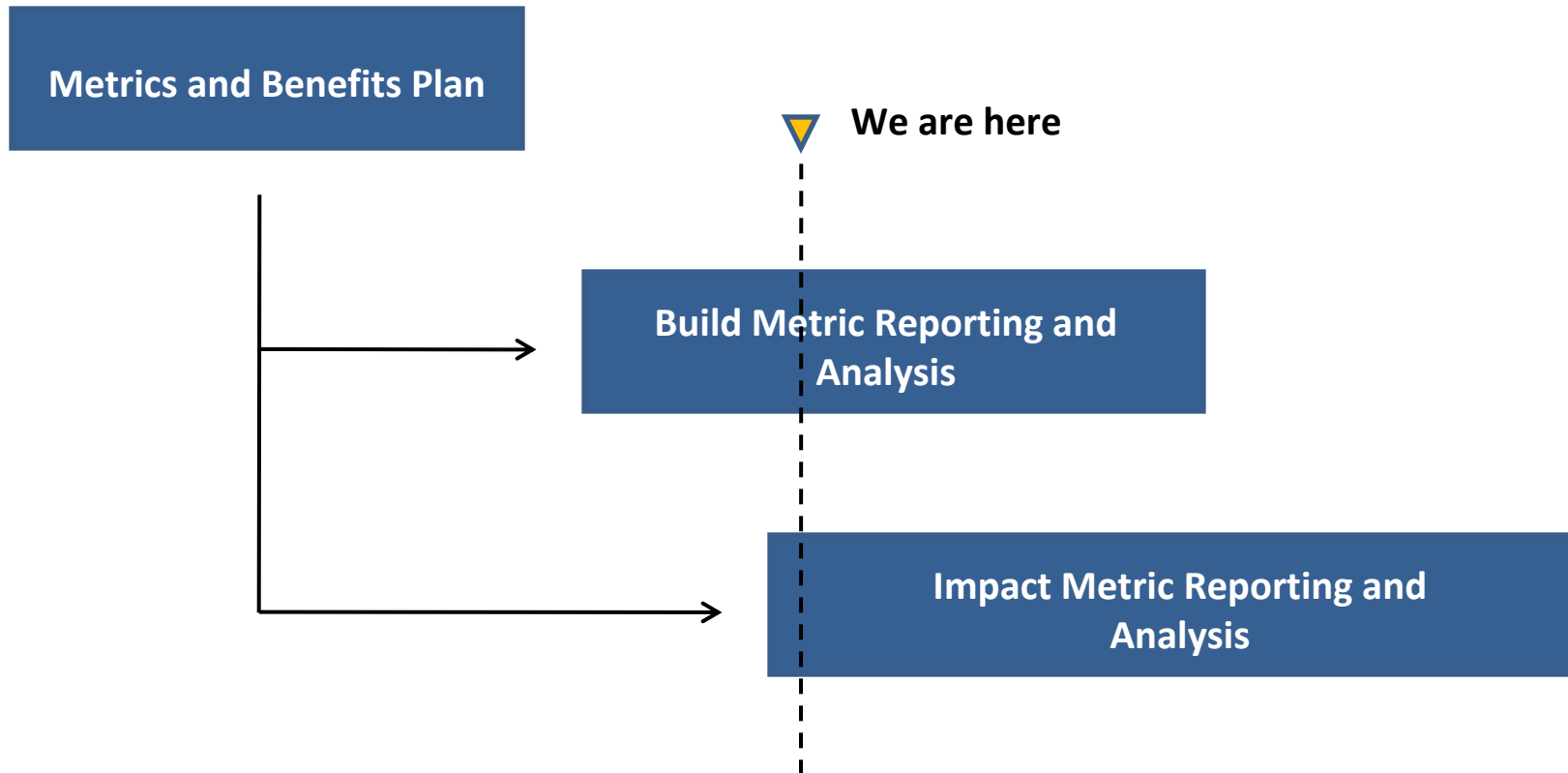
Engaging Stakeholders

- Share analytical framework and results (how technology → benefit)
- Share how consumers behave to pricing and technology options
- Encourage peer-to-peer exchange



Where We Are

The DOE Metrics and Benefits work is transitioning into the reporting and analysis of impact metrics. Build metric reporting and analysis will continue.





DOE Analytical Approach

What are Smart Grid technologies?

What does the Smart Grid do?

How does it do that?

What "goodness" results?

What is the goodness worth?



Example	<ul style="list-style-type: none"> • Capacitor controls • Distribution Management System 	Automatic Voltage and VAR Control	Improves feeder voltage regulation	Reduced feeder losses worth \$60 per MWh	\$6000
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Six Primary Analysis Focus Areas

Among the numerous smart grid projects six main topics have emerged, each of which presents an opportunity for analysis across projects.

Peak Demand and Electricity Consumption

- Advanced Metering Infrastructure
- Pricing Programs and Customer Devices
- Direct Load Control

Operations and Maintenance Savings from Advanced Metering

- Meter Reading
- Service changes
- Outage management

Distribution System Reliability

- Feeder switching
- Monitoring and health sensors

Energy Efficiency in Distribution Systems

- Voltage optimization
- Conservation voltage reduction
- Line losses

Operations and Maintenance Savings from Distribution Automation

- Automated and remote operations
- Operational Efficiency

Transmission System Operations and Reliability

- Application of synchrophasor technology for wide area monitoring, visualization and control



Peak Demand and Electricity Consumption

How and to what extent does advanced metering infrastructure (AMI), customer systems, and pricing programs, as well as demand load control, affect peak and overall demand reduction?

Analysis Objectives:

- Evaluate the influence of smart meters, pricing information, customer devices such as programmable controllable thermostats, in-home displays, and direct load control devices, on:
 - Change in peak demand;
 - Peak shift; and
 - Electricity conservation.
- Quantify how changes in electricity usage patterns and pricing affect consumer electricity bills, fuel mix for electricity generation, and power plant emissions.



Operations and Maintenance Savings from Advanced Metering

How and to what extent does advanced metering infrastructure (AMI) reduce costs and improve operations?

Analysis Objectives:

- Determine the amount of savings in operations and maintenance costs that are achieved by the application of AMI, including supporting communications and data management systems.
- Understand the contribution of different technologies and meter functionality to improved operations.



Distribution System Reliability

How and to what extent does smart grid technology improve distribution system reliability, e.g., by reducing outage duration and the number of customers affected?

Analysis Objectives:

- Determine the reduction in outage duration and scope within distribution systems through the application of technology used to identify outages and reconfigure faulted segments of distribution feeders.
- Determine the effect on reliability from equipment health monitoring technology.
- Determine what technology configurations are most important for delivering measurable results.



Energy Efficiency in Distribution Systems

How and to what extent do combinations of assets reduce energy consumption and losses within distribution systems?

Analysis Objectives:

- Determine the improvement in energy efficiency from the application of technology used to optimize circuit voltage and implement conservation voltage reduction.
- Determine what technology configurations are most important for delivering measurable results.
- Quantify the value of energy and capacity savings for utilities, electricity savings for customers, and lower emissions.



Operations and Maintenance Savings from Distribution Automation

How and to what extent does distribution automation technology reduce costs and improve operations?

Analysis Objectives:

- Determine the amount of savings in operations and maintenance costs that are achieved by the application of technologies used to automate distribution systems.
- Understand the contribution of different technologies and the enhanced capability they provide for improving operations.



Transmission System Operations and Reliability

How and to what extent does synchrophasor technology improve the operation and reliability of the transmission system?

Analysis Objectives:

- Determine the extent to which the transmission system is observed with synchrophasor technology.
- Determine how the technology is changing control room operations.
- Determine how grid reliability and security are being improved as a result.
- Determine improvements in energy efficiency.



Additional Slides



Build Metric Analysis

To describe what technologies are being deployed, how they are being configured and what additional capability (functionality) they provide, as well as present their associated costs and the extent to which they are being deployed.

	2010	2011	2012	2013	2014	2015	2016
Technology Configurations			▲ 15Dec11				
Interim Report – AMI and Customer Systems			▲ 1Mar12				
Interim Report – T&D; update on AMI & CS				▲ 30Sept12			
Interim Report – Pricing programs; update on T&D, AMI & CS				▲ 30Mar13			
Final Report					▲ 30Sept13		



Impact Metric and Benefits Analysis

	2010	2011	2012	2013	2014	2015	2016
Initial Focus Area Webinars			Completed 15Nov11				
Additional Focus Area Webinars and Meetings			As needed				
Initial Impact Metric Report •Energy efficiency in DA •O&M (AMI and DA) •Synchrophasor technology			1Mar12				
Initial Impact Metric Report •Peak Load and energy consumption •Reliability			1Apr12				
Semi-Annual Impact Reports				Mar/Sept thru 2015			
Documentation of Analytical Methodology			throughout			Final 6Jun15	
SGIG/SGDP Program Impact Reports							Final Jul16



Consumer Behavior Studies

To provide externally valid results from pilot projects that examine the influence of variable rates, technology, and education on consumer behavior, specifically to understand the factors that influence the acceptance, response and retention rates of customers with respect to alternative rate policies

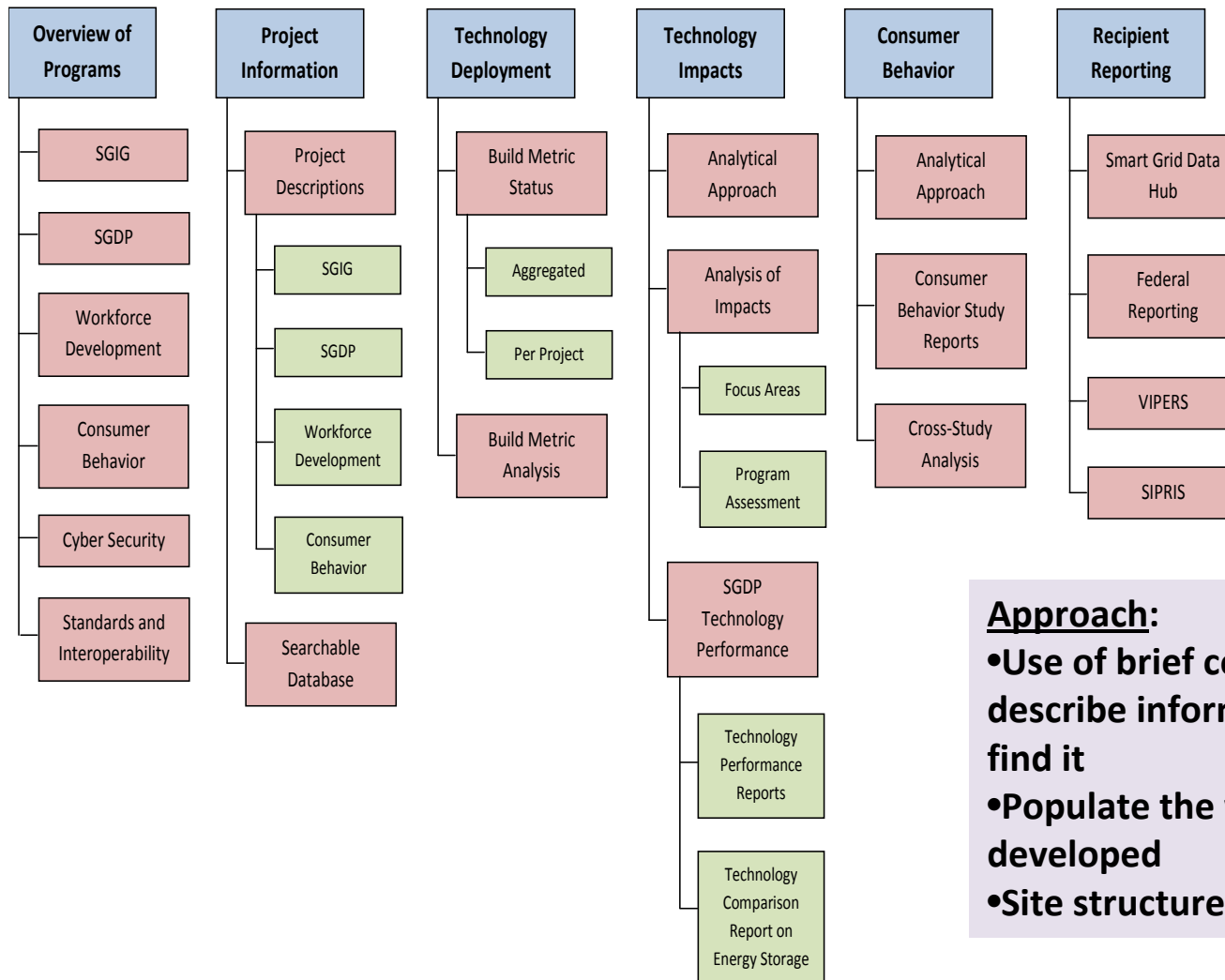




Engaging Stakeholders

Key stakeholder groups include NARUC (and the PUCs), APPA, NRECA, EEI, consumer advocates AND the recipients

	2010	2011	2012	2013	2014	2015	2016
Advancing a Common Analytical Framework		framework development		→	business case support		
Sharing Results		technology applications		→	impacts/benefits		



Approach:

- Use of brief content and graphics to describe information and where to find it
- Populate the website as content is developed
- Site structure in place by Jan 2012