

ROADMAP FOR NEW YORK STATE SMART GRID IMPLEMENTATION

A Shared Strategy for a “Smarter” Smart Grid

Vision Statement

The Smart Grid Vision for New York State is to facilitate a comprehensive, coordinated and collaborative approach to ensure the most efficient, effective, and secure implementation that meets the energy needs of the citizens, businesses and other consumers in New York. The Smart Grid will be built upon three key components, Customer Enablement, Grid Enhancements and Diverse Supply Integration and focus on meeting the state’s challenges of energy efficiency, reliability, renewable growth and economic development. An effective implementation will result in higher levels of customer satisfaction, improved reliability, greater energy efficiency and a more timely achievement of renewable portfolio standards.

Purpose and Background

While many definitions and visions of the Smart Grid exist in the marketplace, it is critically important to understand which components mean most to the State of New York and its various stakeholders. While each of the stakeholders will continue to have individual definitions and visions, it is important to bring key elements of those together to assist with addressing key issues such as interoperability and security.

The DOE definition continues to be a useful starting point. The key components of this definition include: Transmission Automation, Distribution Automation, System Coordination Situation Assessment, Renewables Integration, Systems Operations, Demand Participation Signals and Options, Energy Efficiency, Smart Appliances, PHEVs, Storage and Distributed Generation and Storage. These components are meant to accomplish the following objectives:

- Enable informed participation by the customer
- Accommodate all generation and storage options
- Enable new products, services, and markets
- Provide power quality for the digital economy
- Optimize assets and operate efficiently
- Anticipate and respond to system disturbances
- Operate resiliently against attack and natural disaster

Key Drivers and Challenges in the State of New York

The assurance of adequate quantity, quality, reliability and security of power through out the state represent the key drivers for a Smart Grid in the State of New York. In addition to these overarching drivers, the State has certain key challenges, which include:

Energy Management: Improving energy efficiency, reducing peak demand and reducing greenhouse gas emissions

Reliability: Reducing outage frequency and duration; maintaining system security

Renewables: Integrating new and distributed sources of supply

Economic Development: Creating employment opportunities

The vision for Smart Grid in New York State is to address these drivers and challenges through a representative workgroup of electricity sector stakeholders from industry, state government and academia—the New York Smart Grid Consortium (NYSGC). The result will be increased collective value for the entire energy chain and its key individual stakeholders. Based on the current economic pressures facing the state, we also recognize that an underlying assumption to meeting the many challenges of Smart Grid implementation in New York is balancing the costs with the customer’s ability to help pay for them.

2009 New York State Energy Plan

Significant progress has been made by New York State agencies toward the development of a statewide energy plan. The 2009 Energy Plan envisions a state economy driven by a clean energy sector. The Plan, which is currently in draft form and will be finalized in Fall 2009, presents an integrated planning framework within which energy policy decisions can be made to address the state’s key energy challenges and achieve its clean energy vision. Several relevant focus areas of the Plan include:

- Growing the state’s clean energy sector to expand economic development opportunities, create local jobs and make the state more energy independent.
- Addressing climate change through a commitment to improve energy efficiency and invest in renewable generation.
- Targeting the increased market penetration and use of electric vehicles.
- Modernizing, expanding and improving the efficiency of the bulk transmission grid with emphasis on Smart Grid technologies.

Clearly, the implementation of this Plan will enable the state and its various stakeholders to formulate and carry out a statewide vision to ensure the most efficient and effective implementation of a Smart Grid.

Key Stakeholders and Roles

A distinguishing aspect of the NYSGC is that it involves a very diverse set of New York State stakeholders working together on a broad vision for the implementation of a Smart Grid in the State. This diverse and representative group includes the owners of the major transmission and distribution (T&D) facilities in NY; utilities and government authorities; the New York Independent System Operator (NYISO); communication companies; NYS government policy makers, including utility regulators and cyber

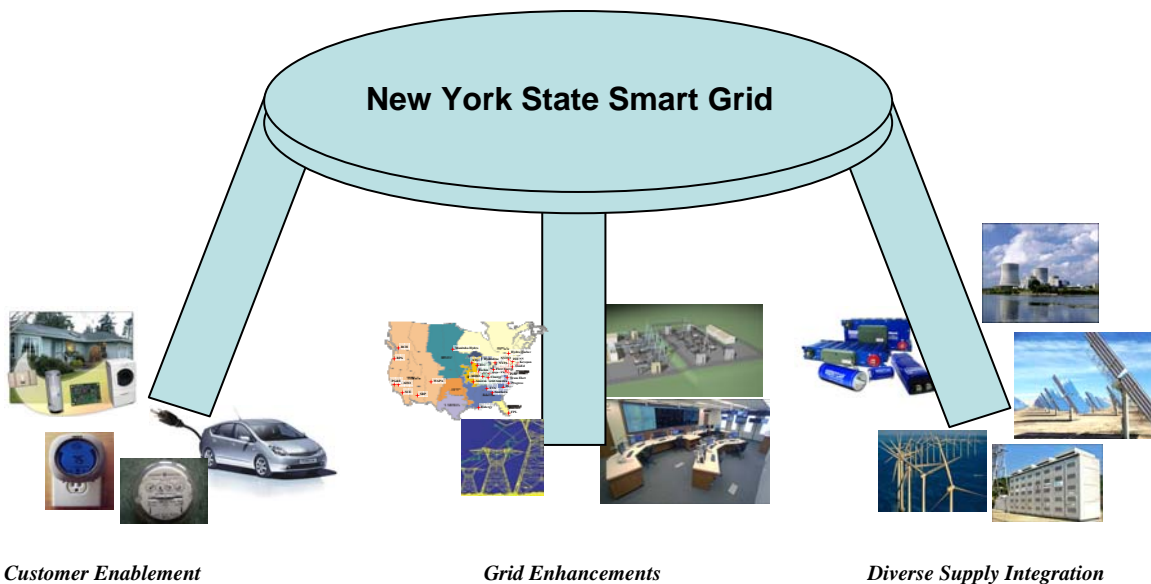
security officials; grid technology researchers, including universities and the Brookhaven National Laboratory; and other representatives from the power industry, including generation companies and other independent power providers, as well as industrial representatives. Agreement on a common vision allows all stakeholders to understand their roles, responsibilities, and opportunities in a strategy towards realizing a New York State Smart Grid. Further, it provides them the confidence to make investments they know will be relevant over the long-term. A NYS Roadmap thus makes the prospect for a successful rollout of a New York State Smart Grid much more favorable. The table below summarizes how key stakeholders play significant roles in working together on key topics toward a Smart Grid implementation in New York.

	Grid Operations	Value Chain Integration	Technology	Work and Asset Management	Customer Management and Experience
Customer (residential and commercial)	Market based funding and implementation of key devices inside the premise	Acceptance of new communication infrastructure inside the premise	Understand the information available and make appropriate decisions	Participation in identification of key value drivers	Participate in selection of key presentation media
Regulators/ Policy Makers	Revised regulatory mechanisms for funding Incentive policies to drive initial adoption Communication to all stakeholders	Facilitate efforts among key providers and stakeholders Identify mechanisms to continue funding beyond stimulus funding	Revised regulatory mechanisms for funding	Implement policies to open up information flow	Communication with ratepayers (consumer)
Service providers (technology/ communications/devices/ energy management)	Investment in innovation Acceptance of open standards Collaboration	Investment in innovation Acceptance of open standards Collaboration across value chain	Provide key integration solutions	Bring solutions to the market	New entrants provide new services Identify new services to provide to customers
Utility Industry Players (IOU's/ISO/State Agencies)	Evaluate and invest in key devices Move beyond pilots into gradual roll-out of capabilities	Leverage existing information infrastructure for Smart Grid	Provide market mechanism Provide access to key information Identify and set priorities	Implement key areas of improvement Transform existing business through improvement in processes and culture	Provide open access to information to allow new entrants into the market Provide access to information to customers to make better choices in energy usage Provide capability for customers to manage their own load better.
National Labs and Academic Institutions	Sensors and control technologies Visualization tools and techniques Monitoring and control algorithms	Assist in development of standards Research and analyze industry trends and perform direction setting	Provide innovation surrounding key integration technologies	Develop information technology tools	Customer segmentation statistical analysis Design Grid-Friendly Appliances

Another compelling feature of this proposal is that New York State is an ideal laboratory for national Smart Grid implementation since the State represents a microcosm of U.S. grid challenges. For example, upstate New York has widely distributed power consumers and access to generation from diverse sources such as hydro, nuclear, and wind. Conversely, downstate faces the nation’s most serious congestion and capacity challenges due to great difficulty in adding new generation or transmission capability. Also, the heavily populated downstate area is environmentally challenged to comply with National Ambient Air Quality Standards. The New York Smart Grid Consortium represents a path to addressing some of the most difficult challenges of Smart Grid implementation and one of the greatest opportunities for significant impact if successful. The key element to successful implementation is agreement on the vision and standards for interoperability and communications, and why the coordination that this proposal brings among the State’s diverse stakeholders is important.

Key Components of the New York State Smart Grid

The optimal Smart Grid implementation for New York State would be built upon three key components, *Customer Enablement*, *Grid Enhancements* and *Diverse Supply Integration*.



Customer Enablement: Enabling the customer represents an important aspect of developing the New York State Smart Grid. Providing the consumer with adequate and timely information and options and educating and encouraging customers to make informed decisions, which not only benefit themselves, but also are consistent with statewide energy policies, presents the key criteria for this enablement. In effect, the customer becomes an active participant within the grid instead of being a passive user of electric services. This enablement will result in increased customer satisfaction and individual consumer energy efficiency.

Grid Enhancements: The grid is the connection point between the consumer and electricity suppliers and other key stakeholders. In addition to delivering a reliable supply of electricity to consumers at reasonable costs, the security of the grid (**both** Physical and Cyber) continues to be of national concern. An effective grid of the future needs to focus on sensors, controls, Volt/VAR management in addition to the required intelligence and tools which enable effective management of it. Additionally, the operational systems of the grid will require further enhancements and integration with the new intelligence generated by these devices. These tools, designed to achieve optimal use of the grid, must also minimize the cost of energy over the longer term. These enhancements will result in cost efficiencies and improved outage management.

Diverse Supply Integration: The supply portfolio of the future will continue to evolve. Newer types of generation tend to be rather intermittent and unpredictable and will most likely be distributed throughout the grid. Integrating these diverse sources of supply into the grid requires a combination of solutions including energy storage, demand response and advanced analytics. This integration will allow for the more timely achievement of renewable portfolio standards and other distributed energy sources.

The implementation of a Smart Grid vision along these three pillars provides the framework for the transformation of the entire energy value chain.

Key Implementation Considerations and Decisions

While many implementation considerations exist at the individual stakeholder and project level, certain key considerations and decisions need attention at the statewide level:

Security: As this continues to be one of the main areas of focus of policymakers and other key stakeholders, the NYS Roadmap needs to discuss the minimal levels of security required and the most pivotal aspects that will be implemented from a physical and cyber perspective. While individual stakeholders will be responsible for direct security implementation, the vision needs to provide assurance that overall risks have been adequately considered and effectively managed.

Communications: As demonstrated in past Smart Grid projects, the communications strategy provides one of the most important underpinnings of a successful and flexible implementation. At its core, the Smart Grid represents a series of “data exchanges” from the device to the home gateway (meter), from the home gateway to the collector, from other sensors to the collector, from the collector to the substation and from the substation to the home office. Additionally, there will be data exchanges to various other stakeholders utilizing a number of different media. While it is not practical or necessary to mandate specific standards or modes of communication for all of these exchange points, the statewide vision needs to ensure that this end-to-end network does not become

a closed, proprietary network that will be rendered obsolete as new applications are implemented.

Interoperability: The vision needs to allow for open communications and operations among the various components of the Smart Grid regardless of which entities are implementing the individual projects. Without some level of interoperability, the full benefits of a Smart Grid will not be realized. Again, this is not an area where detailed standards should be mandated, but minimal levels of openness at key connection points should be detailed. These types of decisions will allow for more effective competition and result in faster adoption on many different levels.

Rollout Plan: Once the comprehensive list of potential projects has been completed, common concepts should surface within the overarching rollout strategy. These will include the extent to which various technologies need to be piloted in the state, whether or not certain concepts are tested in an end-to-end scenario (i.e. Smart City) and how to reconcile the interests of the individual stakeholders with the overall New York State benefit.

Path Forward

This document represents a framework that provides the starting point for each of the working groups and will be revisited as each of the working groups develop their own proposals. The key next steps are to:

1. Develop fundamental quantitative and qualitative performance metrics based on each workgroup's set of projects;
2. Update key considerations based on individual project considerations; and
3. Integrate the Roadmap's vision into overall the State's stimulus proposal.

The NYSGC and the NYS Roadmap represent a trusted public/private partnership for tackling the difficult challenges core to the State's transition to a "smarter" grid

NYS

SmartGrid
Consortium

NYSERDA STAKEHOLDER CONSULTATION

February 11, 2011

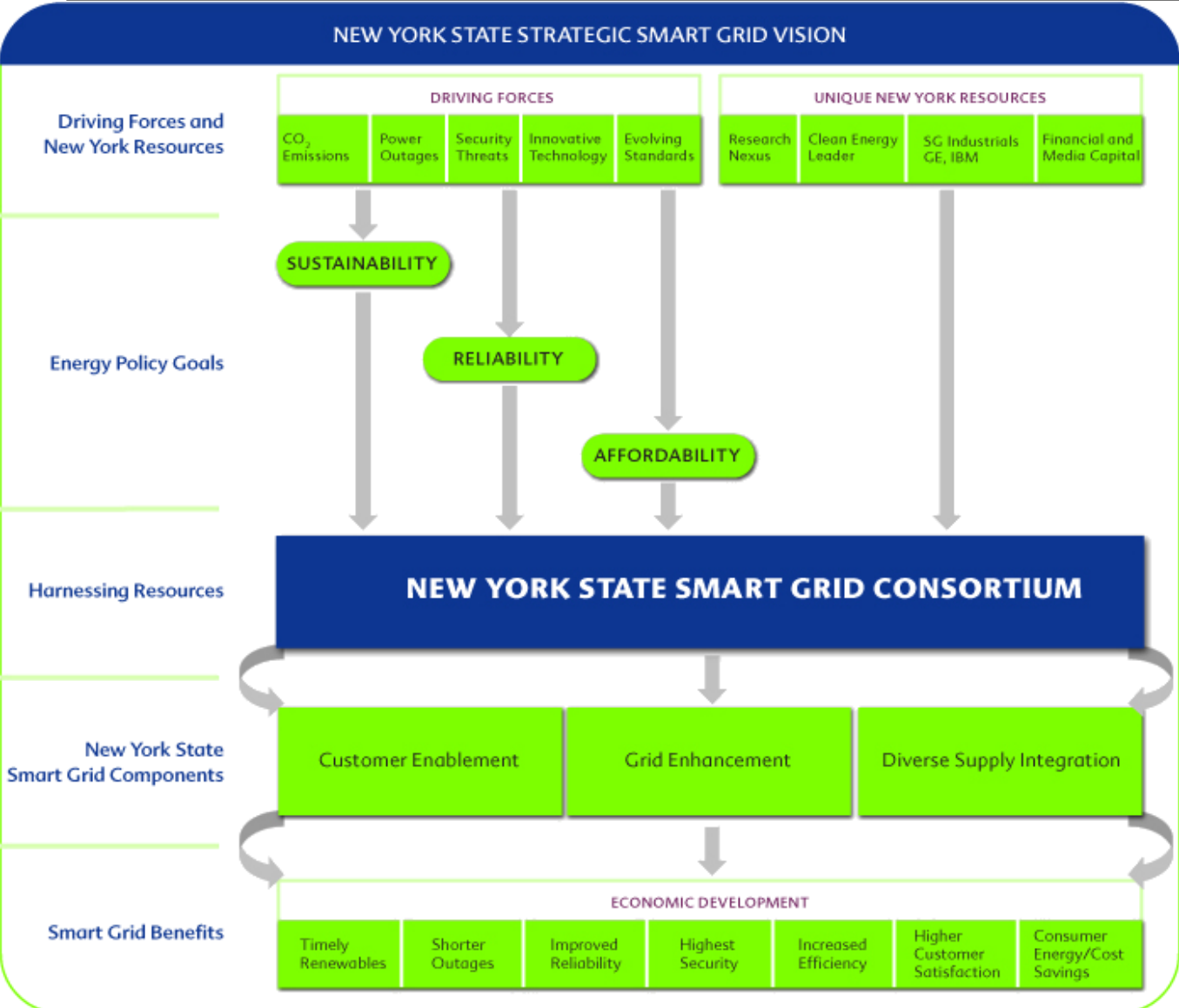


NYS Smart Grid Vision



One of the most promising ways we can empower customers to lower their energy costs while achieving greater energy efficiency is what has come to be known as the "smart grid".

Andrew M. Cuomo, Governor of New York



- Utilities:**
- NY Power Authority
 - LI Power Authority
 - Con Edison
 - National Grid
 - NYSEG
 - NYISO

- Government:**
- NYSERDA
 - NYSTAR
 - Public Service Commission

- Industry:**
- General Electric
 - IBM
 - Computer Associates

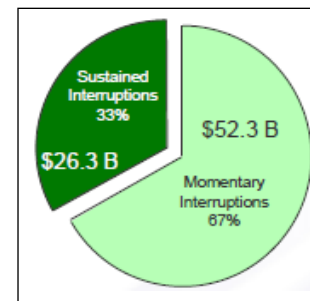
- Research:**
- SUNY
 - Advanced Energy Center
 - Brookhaven National Lab
 - Syracuse University
 - RIT
 - University of Rochester
 - Clarkson
 - NYU Polytechnic
 - CUNY

- Consumers:**
- NY Energy Consumers Council
 - NY Business Council

Why does New York need a Smart Electric Grid?

Sustainability

- All scenarios toward an 80% carbon reduction involve significant increases in electricity utilization (e.g. replacing oil in light vehicle transportation with electric vehicles) → opportunity for greater efficiency but will require best available technology to accommodate new resources of low carbon energy, storage, and demand management.
- Better information management from smart grid technologies offers the opportunity to reduce system losses in the transmission and distribution network, resulting in reduced overall demand and load by 1-2%



\$79B economic loss (US)

Reliability

- Interruptions have a significant impact on economy
- Power quality and reliability, as well as cost, drive investment decisions in the 21st century economy



0.07 second outage → 20% chip reduction for 2 months

Affordability

- Innovation is the historically proven mechanism of truly lowering the cost of energy long term. Commodity price fluctuations can impact short term pricing but do not offer long term solutions
- Innovation drives economic growth

The Opportunity

There is a significant cost/benefit advantage to smart grid

- \$7.2 billion invested in Smart Grid over the next decade would result in savings and avoided costs of \$18.9 billion to New York State ratepayers (Smart Grid Roadmap for the State of New York, New York State Smart Grid Consortium, Sept. 2010)

Utilities are already investing very significant amounts every year in their electric systems

- “Smart Grid Ready Investments”: New York needs to make the case to leverage the utility investments and assure they are compatible with the emerging smart grid
- “Business As Usual Investments” have the potential to perpetuate non-compatible infrastructure that is expected to serve for decades.

New York has an opportunity to reduce business risk throughout the energy value chain

- A roadmap with stakeholder consensus can reduce business risks
 - Reduced risk for the utilities, regulators, and consumers of an ineffective system
 - Reduced risk on electric system reliability for New York businesses
 - End-user buy-in up front reduces risk along the development pipeline and will stimulate investment in innovation consistent with the roadmap

Roles

NYS Smart Grid Consortium

- **Determine and articulate value of smart grid research and development efforts which support system investment**
- **Unified voice on smart grid issues for membership and external stakeholders**
- **Advisory group to NYSERDA to provide input from electric grid stakeholders on Smart Grid investments**
- **Owns NYS Smart Grid Roadmap, continuous updates/refinement**

NYSERDA

- **Administration of investments**
- **Review of projects/proposals**
- **Establish performance measures**
- **Interface with regulators**
- **Offers key source of policy input for policy makers and regulators**
- **Monitor progress toward goals**

The Consortium

The NYS Smart Grid Consortium meets regularly, addressing challenges and opportunities and driving consensus between utilities, research institutions, and technology companies.

The current membership includes:

Advanced Energy Research and Technology Center (AERTC)*, Brookhaven National Laboratories*, Business Council of New York State, City University of New York (CUNY), Clarkson University, CA Technologies, Consolidated Edison (ConEd)*, General Electric*, IBM*, Long Island Power Authority (LIPA)*, National Grid*, New York City Department of Environmental Protection, New York Energy Consumers Council, New York Independent System Operator (NYISO)*, New York Power Authority (NYPA)*, New York State Energy Research and Development Authority (NYSERDA)*, New York State Foundation for Science, Technology and Innovation (NYSTAR)*, New York State Governor's Office, New York State Public Service Commission*, Polytechnic Institute of New York University, Rochester Institute of Technology (RIT), State University of New York at Stony Brook*, Syracuse University, University of Rochester

New York Opportunity for Technology Leadership

NY Resources/Uniqueness: A Nexus of Information and Electric Grid Technology/Leadership

- World-leading industrial R&D presence
- World-class university system plus a national laboratory
- NYSERDA, the nations most effective state energy entity
- NYS Smart Grid Consortium, a unique alignment of stakeholders

Electric grid: Enabler of a Cleaner Energy Mix

- Much of the present grid is not optimally efficient, increasing costs for businesses and consumers, and limiting the market for renewables and other energy management technologies

Opportunity of Smarter Grid

- Will enable the broad adoption of clean energy technologies, which will create new markets and businesses, increase energy security, and lower environmental impacts from energy use
- Energy technology commercialization depends on investment throughout the technology pipeline

Take advantage of the “Clean Energy” and “Green-Tech” Opportunity

- Keys include incentives for manufacturing, support for manufacturing innovation, workforce development, entrepreneurship, & research and development
- Real jobs are created by attracting new “clean energy” and green-tech” manufacturing to NYS & fostering the development of clean energy and green-tech start-ups here in NYS

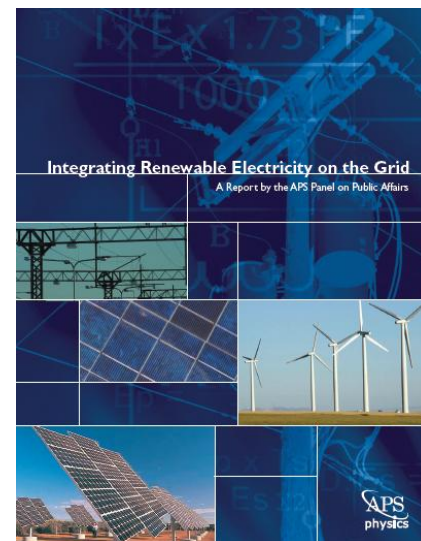
The Technical Challenges

Integration of Diverse Renewable and Distributed Generation Resources

- Intermittency: the output of wind and solar generation sources, as well as combined heat and power, can vary greatly
 - At large scale integration we need better forecasting, load balancing, integration of storage, and devices to control power quality.

Grid Enhancement

- New York utilities are investing in Smart Grid technology now, but have an urgent need for more research and development to meet modern power demands and reliability.
- Some Smart Grid Technology can enhance the infrastructure at marginal cost
 - An information opportunity, e.g. “Smart” sensors to better understand where issues arise
 - NERC: “Smart grid technologies will change the character of the distribution system”
- Microgrid technology offers opportunities for efficiency and cost management



Customer Enablement

- Enhancing reliability, reducing energy cost for the consumer, and empowering consumers to make decisions about their energy use and costs are the goals driving Smart Grid technology innovation

The Economic and Policy Challenges

NY Transmission and Distribution infrastructure represents a massive investment which forms the backbone for a 21st century system meeting current and future demands. However:

- All forms of infrastructure investment put pressure on rates during a period of economic challenge
- Compelling case for smart grid investment has not yet received widespread acceptance from Regulators and policy makers
 - Historically inconsistent definition of smart grid
 - Lack of a clear compelling national roadmap for implementation
- Inadequate understanding of cost/benefit equation for smart grid
 - Few analyses existing and poor communication of results
- Implementation will require a novel public-private partnership whose value is not yet fully recognized
- Creating a collective effort requires strong coordination

The Overarching Challenge: Exploit NY's technology leadership to bring energy and information technology to create a smarter electric grid

How to do it? : Taking Advantage of New York's Unique Assets



- **Integrated Voice of Grid Stakeholders**
- **Articulated Vision for NY Smart Grid**
- **World-Class Research and Academic Institutions**
- **Leading Companies in Energy and Information Technologies**



- **Strong Track Record of Supporting Innovation that Produces Value**
- **Manager of Publicly Funded Investment**
- **Resource for Information and Analysis on New York Energy Issues**
- **Contribute to New York State Policy Formulation**

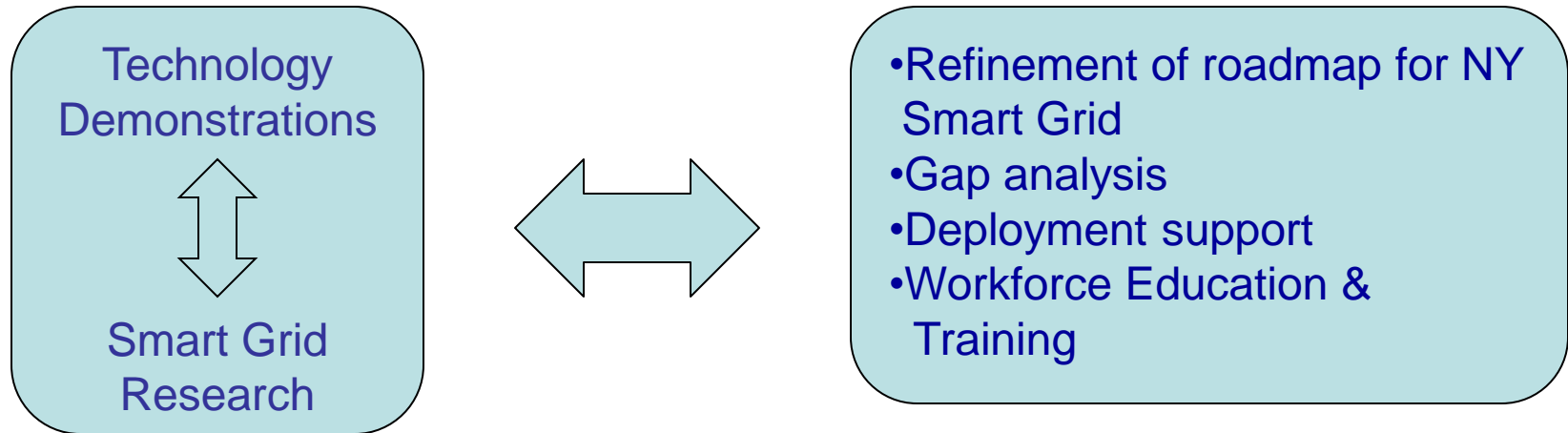
Common Goal: Enabling the NY Smart Grid
Sustainable, Reliable, Cost Effective

Tasks:

- **Agree on Strategy**
- **Agree on Roles**
- **Drive Investment**

Strategy

STRATEGY FOR TECHNICAL CHALLENGE MITIGATION



ECONOMIC/POLICY CHALLENGE MITIGATION

- Investments to leverage federal opportunities
- Investments to enable utility smart grid investments
- Refinement and communication of cost/benefit analyses
- Establish credible measures to evaluate progress toward goals

NYS Smart Grid Consortium Investment Examples

POTENTIAL CONSORTIUM PRIORITY PROJECTS

1. Ongoing NYS Smart Grid Roadmap Development/Communication

- Roadmap reduces risk across a broad spectrum
 - Utility makes confident investments in infrastructure
 - Manufacturers and systems integrators have clear targets and customers
 - Consumers know what to buy and when they can use devices
 - Avoid incompatibility issues
- Prioritization
 - Roadmap provides clarity on evaluation of projects for investment
- Roadmap also serves as a policy tool to help decision-makers

2. Smart Grid Demonstration Centers

- Technical mitigation
 - “Prove” operational effectiveness and reliability of technologies
- Economic/Policy mitigation
 - “Prove” value of technologies

NYS Smart Grid Consortium Investment Examples

POTENTIAL CONSORTIUM RESEARCH & DEVELOPMENT PRIORITIES

R & D OPPORTUNITIES

The Consortium offers an opportunity to offer consensus positions on R & D opportunities with immediate impact on system function with clear benefit to utility customers.

Two such examples include:

- **Real Time Data Access:** reliability, efficiency and a shifting market for generation sources all drive a need for more data in real time. This is perhaps the most obvious convergence of information technology and energy technology, and offers real results in the near term.
- **Smart appliances and the Grid:** the proliferation of new generation “smart” appliances and the impact this technology has on the system must be understood . Utilities must understand what consumers are running and when to balance the system.

NYS Smart Grid Consortium Investment Examples

POTENTIAL CONSORTIUM RESEARCH & DEVELOPMENT PRIORITIES

R & D OPPORTUNITIES (continued)

More broadly, energy costs in New York State are significant. Efforts to shift the energy mix to lower carbon sources of power continue, but the best solution remains energy efficiency. The need to accelerate our understanding of how smart grid technology can practically impact energy efficiency, reducing energy consumption and costs to the consumer, is urgent given current economic conditions and commodity cost.

Another potential opportunity would be a university campus or multi-university campus pilot program for Smart Grid technologies.

Projects Must Consider NYSERDA Investment Criteria

1. Ability to make meaningful and measureable progress on objectives
2. Critical mass and resources needed to execute programs exists
3. Likely co-funding/leveraging
4. Availability of other sources of funds
5. Potential return on investment
6. Overall portfolio balance [both sector and risk]

Immediate Opportunities To Meet NYSERDAs Goals

Consortium members offer shovel-ready projects which could :

- **Benefit utility system and ratepayers**
- **Reduce energy use and demand**
- **Increase safety and reliability**
- **Providing reduced wholesale energy prices**

Stimulate Economic Development and Create Jobs in NY State

Reduce Environmental Impacts of Energy Production and Use

COMPLYING with the PSC Order: “in an area of critical concern where knowledge, funding, activity, or the technology is not adequate”