NYS SmartGrid Consortium

Robert B. Catell
Chairman

November 1, 2010

Dr. Steven Chu
U.S. Department of Energy
Office of Electricity Delivery and Energy Reliability, Department of Energy
1000 Independence Avenue, SW
Room 8H033,
Washington, DC20585

Re: Smart Grid RFI: Addressing Policy and Logistical Challenges.

Dear Steven:

The New York State Smart Grid Consortium ("Consortium") appreciates the opportunity to provide commentary on the Smart Grid RFI "Addressing Policy and Logistical Challenges." Please find attached the Consortium formal response to the DOE RFI questions as well as the NYS Smart Grid Roadmap which is referenced throughout. We strongly believe that while our response is largely based on recent work performed for New York State, the analysis and recommendations we have provided will be extremely applicable in other areas across the nation as we all come together to successfully deploy a "smarter" grid.

Please call if you have any questions.

Sincerely,

[signature]

RBC/ah

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November 1, 2010

Response of:
New York State Smart Grid Consortium

DOE SMART GRID RFI: ADDRESSING POLICY AND LOGISTICAL CHALLENGES

I. INTRODUCTION

The New York State Smart Grid Consortium ("Consortium") is a not-for-profit 501(c)6 organization formed in July 2009 to address many of the same issues being examined in this proceeding[1]. It represents a unique public-private partnership of largely New York State utilities, authorities, universities, industrial companies, and institutions and research organizations which came together in a collaborative manner to facilitate the development of a Smart Grid in the state and nation.

The early, formative discussions within the Consortium were energized and accelerated by the opportunities afforded by the American Recovery and Reinvestment Act of 2009 (ARRA) and the U.S. Department of Energy's (DOE) Federal Stimulus Smart Grid Investment Grant Program and its Smart Grid Demonstration program.

[1] Its membership includes: Advanced Energy Research and Technology Center (AERTC), Brookhaven National Laboratory, CA Technologies, Central Hudson Gas and Electric, City of New York, City University of New York (CUNY), Clarkson University, Consolidated Edison, General Electric, IBM, Long Island Power Authority, National Grid, New York Department of Public Service, New York Independent System Operator, New York Power Authority, New York State Business Council, New York State Electric and Gas, 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, Polytechnic Institute of New York University, Rochester Gas and Electric, Rochester Institute of Technology, State University of New York at Stony Brook, and University of Rochester. See http://nyssmartgrid.com.

The Consortium appreciates the opportunity to provide DOE with a response to Smart Grid RFI *“Addressing Policy and Logistical Challenges”*. Our response is based on some of the work done to date by the Consortium described below.

The Consortium commissioned KEMA/DeSola to develop a Benefits/Cost whitepaper on smart grid deployment in the state of New York. After sharing the initial whitepaper with its membership, work began on the development of a “Roadmap” to provide a framework for cost benefit decision making and a methodology to prioritize smart grid investments.

The Roadmap takes into consideration and is very sensitive to the smart grid experiences in other states. These experiences have been included in crafting, developing, and researching the Consortium’s Roadmap. This Roadmap provides much of the background to many of the responses to the questions in this RFI.

The Roadmap assesses the broad economic, customer and social impacts to New York from a methodical, evolutionary deployment of smart grid technologies. This unique statewide analysis factors in all practical smart grid technologies and applications, and considers all the potential consequences over the next decade. The Roadmap is attached.

The Consortium’s Roadmap:

1) Analyzes the relative costs, benefits, and priorities of the various smart grid technologies, business models, and policies in some detail including how different types of customers and geographic regions benefit;

2) Describes all of the assumptions and calculations in the analysis of full statewide costs and benefits of a New York Smart Grid, including the use of an interactive model to assess the relationships between investments and savings;

3) Analyzes savings to consumers that will accrue from direct impacts on T&D rates; on energy usage and on energy market peak prices; and from other economic benefits that directly flow to consumers;

4) Identifies less direct benefits such as environmental impacts and economic development; and

5) Models the interaction of all components of the energy system that will be impacted by a "smart grid."

Our response to the RFI, as well as additional issues for the DOE to consider, are presented on the following pages. We selected the questions that were informed by the work already completed by the Consortium rather than all questions. We feel that while our response is based largely upon work completed for New York State, we strongly believe that its applications can be applied in a much broader context to other areas. Furthermore we also believe that organizations such as NYSERDA and our own Consortium among others can serve as a model for other states as we look to effectively deploy the smart grid across the nation.

II. CONSORTIUM RESPONSE TO DOE RFI QUESTIONS

1) Definition and Scope

Questions to be responded to:

- How to define the smart grid?
- What significant policy challenges are likely to remain unaddressed if we employ Title XIII's definition?
- If the definition is overly broad, what policy risks emerge as a result?
- Comments on the geographic scope of standardization and interconnection of smart grid technologies. Should smart grid technologies be connected or use the same communications standard across a utility, state, or region?
- How does this vary between transmission, distribution, and customer-level standard? For example, is there need to go beyond ongoing standards development efforts to choose one consumer-facing device networking standard for states or regions so that consumers can take their smart appliances when they move and stores' smart appliance will work in more than one service area?

Smart Grid Scope and Definition

Smart Grid means many things to many people today. It is not a "one size fits all" technology and must be adapted and configured for each region, state, and power utility. Smart Grid is a vision for the electric delivery system of the future. One such vision was developed by the Consortium in order to evaluate the potential costs and benefits of alternative Smart Grid implementation scenarios. This section describes a vision of how the electrical grid will become “Smart” to meet future challenges.

The electric grid, as we currently know it, is very much the same infrastructure that has been in place for the last 50+ years. It transports electricity from centralized points of large-scale generation sources over delivery transmission and distribution networks to consumers. The transmission system delivers electricity from power plants to distribution substations, while the distribution system delivers electricity from those substations to consumers. The flow of energy and information is predominately static and one directional, from the generators to the consumer, limiting the proactive participation of consumers.

The existing grid [Exhibit 1] will be challenged by the need to integrate high levels of renewable resources - the successful development of a “Smart Grid” will dramatically enhance the way we interact and use energy moving forward.

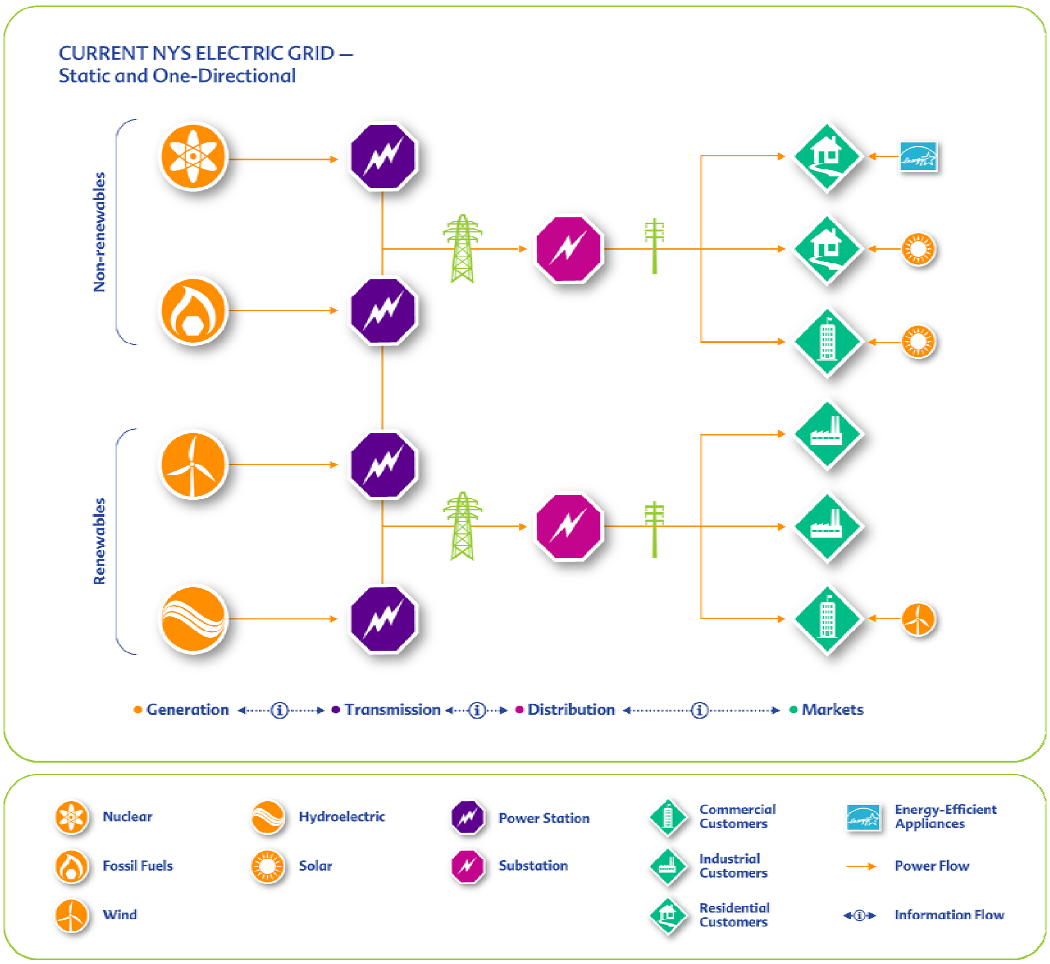

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Exhibit 1 – Current NYS Electric Grid

The Consortium believes that a modern integrated Smart Grid will provide an entirely transformed electrical infrastructure. It will embody a network of devices as vast, interconnected, automated, and interactive as the Internet [see Exhibit 2 on next page].

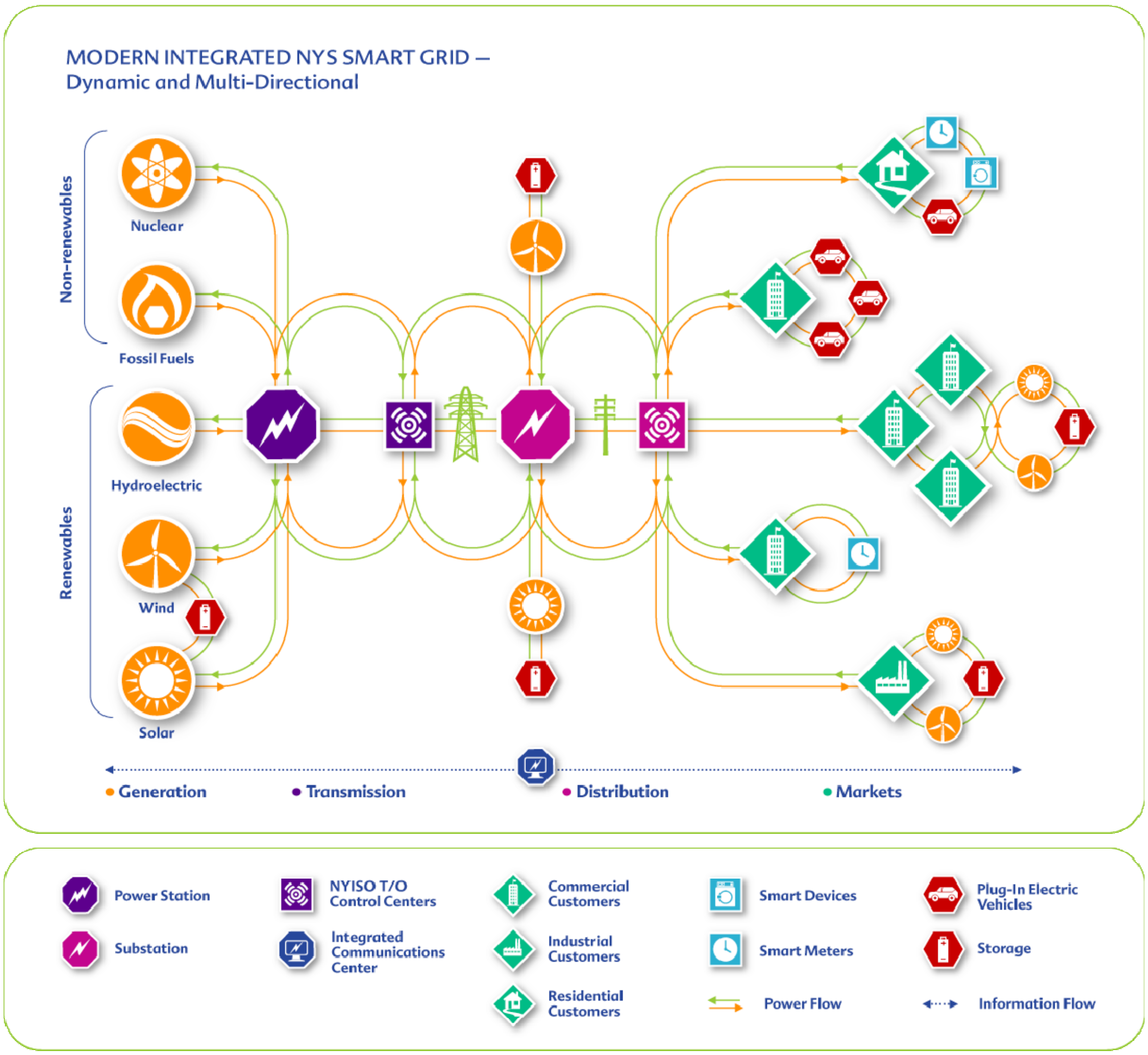

Exhibit 2 – NYS Smart Grid Vision

The Consortium believes the fully implemented and realized Smart Grid will benefit many stakeholders – the public as consumers, homeowners, rate payers, as well as employees, businesses and institutions.

Smart Grid will, of course, also help utilities with the basics – reducing energy losses, managing their assets better, increasing work force productivity, improving service reliability, and saving money.

Smart Grid will ultimately change the nature of the relationship between consumers, regulators, and utilities for the better. With enabled consumers making independent decisions, and many new businesses developing and offering products to the consumer, the regulators' role will transform – they will need to more closely follow consumer's wishes (made apparent in the marketplace) and ensure a fair and transparent market.

While the Consortium has focused most of its attention on modernizing the electric grid it believes that natural gas will play a significant role in the future of the smart energy grid. Natural gas is the cleanest fossil fuel, and there is an abundant domestic supply. Its use in reducing our dependence on imported oil, distributed generation, repowering of older generating plants and new combined cycle power plants for base load and to handle peaks and the intermittent nature of renewable resources as well as for combined heat and power systems will provide economic benefits to the consumer and provide environmental benefits as well. Smart Grid technologies such as Advanced Metering will provide operational benefits and information to gas utilities and customers just as will be the case on the electric side.

Standards will be necessary for all of these technologies to work successfully. National standards for technology such as security and interoperability are to be preferred; regional standards for implementation will allow flexibility to accommodate geographic and economic variations.

2) Interactions With and Implications for Consumers

Questions to be responded to:

- For consumers, what are the most important applications of the smart grid? What are the implications, costs and benefits of these applications? What new services enabled by the smart grid would customers see as beneficial? What approaches have helped pave the way for smart grid deployments that deliver these benefits or have the promise to do so in the future?
- How well do customers understand and respond to pricing options, direct load control or other opportunities to save by changing when they use power? What evidence is available about their response? To what extent have specific consumer education programs been effective? What tools (e.g. education, incentives, and automation) increase impacts on power consumption behavior? What are reasonable expectations about how these programs could reshape consumer power usage?
- To what extent might existing consumer incentives, knowledge and decision-making patterns create barriers to the adoption or effective use of smart grid technologies? For instance, are there behavioral barriers to the adoption and effective use of information feedback systems, demand response, energy management and home automation technologies? What are the best ways to address these barriers? Are steps necessary to make participation easier and more convenient, increase benefits to consumers, reduce risks, or otherwise better serve customers? Moreover, what role do factors like the trust, consumer control, and civic participation play in shaping consumer participation in demand response, time-varying pricing, and energy efficiency programs? How do these factors relate to other factors like consumer education, marketing and monthly savings opportunities?
- How should combinations of education, technology, incentives, feedback and decision structure be used to help residential and small commercial customers make smarter, better informed choices? What steps are underway to identify the best combinations for different segments of the residential and commercial market?
- Are education or communications campaigns necessary to inform customers prior to deploying smart grid applications? If so, what would these campaigns look like and who should deploy them? Which related education or public relations campaigns might be attractive models?
- What should federal and state energy policymakers know about social norms (e.g. the use of feedback that compares a customers' use to his neighbors) and habit formation? What are the important lessons from efforts to persuade people to recycle or engage in other environmentally friendly activity? What are the implications of these insights for determining which tasks are best automated and which should be subject to consumer control? When is it appropriate to use social norm based tools?
- How should insights about consumer decision-making be incorporated into federal-state collaborative efforts such as the Federal Energy Regulatory Commission's (FERC) National Action Plan on Demand Response? Interaction with Large Commercial and Industrial Customers Large commercial and industrial customers behave differently than residential consumers and small businesses. They regularly use sophisticated strategies to maximize their energy efficiency, to save money and to assure reliable business operations. Indeed, some already are or others are seeking to participate directly in wholesale energy and ancillary services markets. Please identify benefits from, and challenges to, smart grid deployment that might be unique to this part of the market and lessons that can be carried over to the residential and small business market. Please identify unmet smart grid infrastructure or policy needs for large customers.

Key Smart Grid Applications – Associated Implications, Costs and Benefits

The Consortium believes that the Smart Grid can become the enabling technology infrastructure which will make it possible for New York State and the nation to achieve its overarching energy goals while providing a platform which will accelerate the introduction of many new products therein creating a multitude of new companies and thousands of new jobs.

Enabling the customer represents an important aspect of developing the New York State Smart Grid. Providing the customer with adequate and timely information and options will encourage them to make informed decisions. The options will come in the form of pricing that more closely reflects the cost to deliver energy (Demand Response, time of day, variable), simple, interoperable equipment (AMI, smart devices, DG, storage, PHEV) and network automation to manage their energy costs. These decisions will benefit customers and be aligned with state energy policy goals. In essence, the customer becomes an active participant within the grid instead of being a passive user of electric services. Key benefits from customer enablement are the bill reductions from conservation impacts and the shifting of peak load which will benefit all consumers. Another benefit will be increased flexibility in the use of on-site renewable energy which supports the NY State Energy Plan goals for renewables.

- All commercial and industrial customers should have AMI and should have access to time differentiated prices.
- AMI for these customers should be implemented as cost effectively as possible including the possible use of public networks where coverage is adequate and providing that the necessary security and performance requirements can be addressed
- Utilities and other providers will provide commercial and industrial customers with options to take advantage of time differentiated prices.
- Suburban residential customers with average and above average usage should have AMI. Use of the public internet for AMI communications for these customers has potential economic benefits in reduced costs provided that security and performance requirements can be met.

- Residential customers should have access to time differentiated prices on an opt-in basis.
- Utilities and other providers should provide residential customers with options to take advantage of time differentiated prices.

Many companies, anticipating Smart Grid, are developing new products for consumers and businesses that are anticipated to be "Smart Grid enabled" – able to make use of energy price and availability information to perform their purpose at lowest cost by interacting with the power system intelligently. These include clothes dryers, washers, microwaves, heat pumps, hot water heaters, and other devices.

They also include a new generation of smart building automation systems that manage the HVAC and other systems in large buildings – these can act as miniature power system operators and energy traders, integrating in building distributed generation, energy storage, and energy usage for best comfort and economics.

No one knows today how these products will fare in the marketplace or what use customers will put them to – but they all signal a belief on the part of leading industries that the Smart Grid is coming and will enable vastly expanded customer choice – which in turn will lead to more product and business innovation. We do not know at this time exactly who will develop and sell these products to customers but if we experience only a small degree of the innovation experienced in the telecommunications sector we will well along the way to transforming today's electric grid.

Pricing Options

The analysis conducted for the Roadmap clearly illustrates the large potential benefits of time based pricing and other related customer activities. The research on this topic however is not conclusive. Specific areas that need further exploration include:

- Role of enabling technologies such as displays or behavioral programs.
- Test new rate options and different ways of opting in (as well as opt-out).
- Explore the role of dynamic pricing in encouraging adoption of distributed renewable generation and other distributed resources.

- Research on the future potential roles of retailers and other non regulated firms in developing services related to AMI and Demand Response as participants in real time energy and ancillaries markets in addition to today's capacity markets. Also analyze closely the differences in adoption, practicality, and effectiveness of aggregator based operations versus autonomous price response by consumers.
- Research on the actual pricing options large Commercial & Industrial (C&I) customers receive from retailers and what that actually means as it relates to the impact of AMI for these customers.
- Additional research to confirm the estimates of benefits suggested by the Benefits/Cost analysis.

Other research areas to consider:

The Roadmap explored voluntary dynamic pricing for all customer classes on an "opt in" basis linked to planned installation of AMI infrastructure in their locale. The Benefits/Cost analysis used an estimate that 80% of the benefits of AMI and dynamic pricing for all classes can be obtained when 30% of the customers able to save the most decide to opt in. (This is a calibration for a more sophisticated non-linear model that relates peak shaving amounts and savings to opt-in penetration) This estimate is consistent with some reports from various pilots but should be taken as an illustrative example for the overall computations. All customers benefit as peak load and prices are reduced for all; some of the broader savings can be used to fund additional incentives for customers that opt in accelerating the process and increasing the overall benefits. How varying the incentives can affect opt in penetration and overall net benefits after the cost of incentives is explored and presented further in the Roadmap document which is attached.

There is a lack of sufficient data with respect to the questions of what penetration of voluntary opt-in achieves what percentage of maximum benefits, and what specific levels of incentives are necessary or cost effective in reaching that penetration. Note that the problem is dynamic in that penetration rates significantly affect benefits over time.

Consumer Adoption Barriers

The use of dynamic pricing (varying on an hourly or other real time basis with actual wholesale prices) is a difficult one. Today in NY, it is prohibited to expose residential customers to real time prices. C&I customers are required to have mandatory hourly pricing above certain thresholds in energy usage. It is believed, however, that many if not all C&I customers pay a small premium to reduce this exposure by signing up for energy contracts with competitive retailers. It is impossible to know today what final exposure C&I customers have to real time wholesale price volatility on an overall basis. To be conservative the baseline scenario assumed that a high % of these customers would not be impacted by AMI. The NY ISO and the Brattle Group performed a study exploring the impact of consumer price elasticity on market prices and reported that the state wholesale energy bill in total would be reduced by $171,000,000 or about 1.5% were all customers to be exposed to real time pricing.

The following paragraphs are excerpted from the roadmap analysis of the economics of dynamic pricing in the NY environment:

> *Extending Dynamic Pricing to Residential Consumers has two significant benefits over the base case (as presented in the benefits/cost analysis in the Roadmap). First, the state wide energy bill savings due to peak shaving and market price effects increases from $67M to $465 M. (The bar for $67M "disappears" from the waterfall chart at this scale). Note that in both these cases, it is assumed that a high % of C&I customers are already subject to dynamic pricing BUT have hedged that exposure with "full requirements retail contracts" or the like. Thus the benefits of extending dynamic pricing to all customers are largely derived from extending it to residential customers so long as the hedging behavior is continued.*
>
> *The market price energy savings has two components: peak shaving by residential customers and a market price savings arising from increased Distributed Energy Resources (DER) penetration to residential customers. This latter figure is very non-linear based on the MW of DER deployed by all customers, residential and commercial. For instance, in the base case 1300 MW of DER by commercial customers – incremental due to dynamic pricing – generates $8M of savings in 2025; but adding 1100 MW of residential Photovoltaic(PV) to that total will increase 2025*

savings dramatically to $73M. This is a function of the "S" shaped market price impact of peak shaving, and also the expected high correlation of PV adoption with downstate high Location-Based Marginal Pricing (LBMP) prices.

The larger financial benefit by far is the decrease in distribution capital expenditures from $1.232B avoided to $2.192B avoided, thanks to residential peak shaving. This shows up in consumer benefits as a savings in T&D rates.

It is our view that these benefits can be achieved not just in New York but nationwide.

Equally sizable impacts of Dynamic Pricing would accrue if C&I customers were not able to economically hedge their exposure to real time pricing. This hedging avoids the market price savings but results in peaking generation continuing to provide energy at peak and defeats one objective of the state energy plan. Note, however, that the % of C&I customers who are hedged today is an assumption currently not validated from any available data. While the fraction of C&I customers not on hourly pricing today is relatively small (assumed 25% urban and 50% suburban) they are also assumed to be more sensitive to prices than urban residential customers – thus the overall impacts are similar.

The Roadmap clearly identifies the impact of altered consumer energy consumption patterns as the greatest single benefit of Smart Grid, via a number of mechanisms. It also demonstrates that getting the level of opt-in incentives and consumer outreach "right" is critical. While the quantitative figures used in the roadmap are of an order of those reported in other studies, the amount of hard information about how consumers of different classes will react is quite limited. That consumers will behave differently based on geography, climate, lifestyle, and the like is certain. Therefore, design of these programs requires solid research and analysis of pilot program data on an ongoing basis and it is likely that a "one size fits all" approach in as diverse a state as NY, let alone the country will be far from optimal. In particular, the benefits of AMI and dynamic pricing in a high rise urban environment will be very different than those expected in a typical suburban geography.

Education and Communications

Education and Communications are critical to ensuring active customer engagement in the smart grid. Currently the term smart grid means many different things to many people. It is currently extremely difficult to gauge what people know and don't know, but one thing is for sure, confusion and skepticism to some extent definitely exists.

Market Research and Customer Feedback / Responsiveness are terms that are too often missing from the Smart Grid dialogue. In addition to "educating" consumers it is imperative that the federal government, the states, and the utilities undertake relevant market research to understand in detail the product, functionality, and economic issues that lead to consumer acceptance vs. rejection.

In order to maximize the effective deployment of the smart grid, a single context needs to be established and proactively shared with consumers beyond ratepayers. Only by developing straightforward and informative education and outreach programs, designed specifically to each audience - from key decision makers to society at large - can we hope to build enough support and buy-in to successfully implement the smart grid.

Our approach to this would be to develop an education and outreach program that initially builds upon the recent work developed by the Consortium including the Strategic Smart Grid Vision, Benefits/Cost Analysis and corresponding Strategic Roadmap. Using this material as a foundation, a curriculum could be developed through resources from other areas that would effectively paint the picture of what the evolution of the current power grid (both electric and gas) would look like, say 15 years down the road, and how it would ultimately impact customers from a benefit/cost standpoint.

This program would be built and rolled-out at the grass roots level, where smart grid advocates can share the vision/definition, and associated tangible and intangible benefits/costs with society at large, from children in schools to adults of all ages. These smart grid advocates could be new hires spurring economic development (smart grid advocates, curriculum developers, etc.). They could speak at schools or local community groups helping to build awareness with current and future participants and beneficiaries of the smart gird.

This program could be sponsored by the Consortium at the local level and either supported or endorsed by the DOE at the federal level, with input and resources provided from members across the value chain, from utilities to commercial institutions to consumer groups. Funding for these programs could potentially come from the public and private sectors, but more time and resources need to be dedicated to fully develop this programmatic approach and we would recommend that funding be provided to explore this idea further.

Large C&I

C&I customers are not likely targets for Home Automation, Smart Appliances, or the other small consumer focused elements of Smart Grid. AMI, while it may provide the utility with hourly or sub hourly usage, is not the "gateway" or information appliance for these clients. Building to Grid (B2G) technologies and standards such as ADR are far more important in this sector. C&I customers evaluate participation decisions as a business decision where their primary business is an overriding constraint – not to be disrupted. Demand response in the C&I sector is an economic decision attractive so long as the primary business and profitability are not threatened.

Residential

Residential consumers are trading off "life style" vs. economics in most cases. These are less amenable to cost benefit analysis and have to be "sold" and maintained on intangible grounds such as supporting clean energy, safety, reliability, conservation, and so on.

3) Assessing and Allocating Costs and Benefits

Questions to be responded to:

- How should the benefits of smart grid investments be quantified? What criteria and processes should regulators use when considering the value of smart grid applications?
- When will the benefits and costs of smart grid investments be typically realized for consumers? How should uncertainty about whether smart grid implementations will deliver on their potential to avoid other generation, transmission and distribution investments affect the calculation of benefits and decisions about risk sharing? How should the costs and benefits of enabling devices (e.g. programmable communicating thermostats, in home displays, home area networks (HAN), or smart appliances) factor into regulatory assessments of smart grid projects? If these applications are described as benefits to sell the projects, should the costs also be factored into the cost/benefit analysis? Pull more from the to
- How does the notion that only some customers might opt in to consumer-facing smart grid programs affect the costs and benefits of AMI deployments?
- How do the costs and benefits of upgrading existing AMR technology compare with installing new AMI technology?
- How does the magnitude and certainty of the cost effectiveness of other approaches like direct load management that pay consumers to give the utility the right to temporarily turn off air conditioners or other equipment during peak demand periods compare to that of AMI or other smart grid programs?
- How likely are significant cost overruns? What can regulators do to reduce the probability of significant cost overruns? How should cost overruns be addressed?
- With numerous energy efficiency and renewable energy programs across the country competing for ratepayer funding, how should State Commissions assess proposals to invest in smart grid projects where the benefits are more difficult to quantify and the costs are more uncertain?
- What are appropriate ways to track the progress of smart grid implementation efforts? What additional information about, for example, customer interactions should be collected from future pilots and program implementations? How are State Commissions studying smart grid and smart meter applications in pilots? In conducting pilots, what best practical approaches are emerging to better ascertain the benefits and costs of realistic options while protecting participants?
- How should the costs of smart grid technologies be allocated? To what degree should State Commissions try to ensure that the beneficiaries of smart grid capital expenditures carry the cost burdens? Which stakeholder(s) should bear the risks if expected benefits do not materialize? How should smart grid investments be aligned so customers' expectations are met?
- When should ratepayers have the right to opt out of receiving and paying for smart grid technologies or programs like meters, in home displays, or critical peak rebates? When do system-wide benefits justify uniform adoption of technological upgrades? How does the answer depend on the nature of the offering? How should regulators address customer segments that might not use smart grid technologies?
- How might consumer-side smart grid technologies, such as HANs, whether controlled by a central server or managed by consumers, programmable thermostats, or metering technology (whether AMR or AMI), or applications (such as dynamic pricing, peak time rebates, and remote disconnect) benefit, harm, or otherwise affect vulnerable populations? What steps could ensure acceptable outcomes for vulnerable populations?

Smart Grid Benefits / Costs

In its Roadmap, the Consortium included all benefits and costs of Smart Grid that it could define. As part of its work for the Consortium, KEMA developed a framework to assess the broad economic, customer and social impacts to NY from the deployment of Smart Grid technologies. This unique statewide analysis factored in all practical Smart Grid technologies and applications, and considered all the potential consequences over the next decade. By addressing the interactions between different components, and allowing input assumptions to vary, the model serves as a basis for considering different implementation scenarios. The timing of costs and benefits are linked, and reflects a reasonable prioritization. The benefits can be characterized in terms of overall uncertainty. The overall operational benefits are known and can be quantified easily such as the benefits of distribution automation. Other benefits are less certain such as reducing commodity costs and the potential savings from projected customer behavior. Societal benefits such as jobs are yet again at this point less know and hence less certain. This analysis showed that Smart Grid investments when looked at as whole are highly cost effective.

The Benefits/Cost Analysis illustrates in a compelling way that many of the most significant benefits of Smart Grid accrue to customers via reduced energy bills – both from volumetric effects (conservation) and price effects (peak shaving). The price effects are a result of the market operations at the NY ISO and the dollar figures given are net savings in wholesale LBMP costs. (In effect, these are the production costs at market prices saved via the market clearing / dispatch process) These benefits do not in general flow through the regulated T&D utility rate structure. Benefit cost analyses that only consider the T&D rate impacts will usually be favorable, but only marginally so, for many Smart Grid technologies. However, when the energy bill impacts are considered the benefits become strongly favorable.

Some Smart Grid technologies can be implemented by third parties, investors, consumers, or retailers. The Roadmap discusses this and the general desirability of seeing market forces select technologies and individual consumers elect to make investments based on their own perceived benefits and costs. However, some Smart Grid technologies – especially ones with reliability implications such as Substation Automation and Distribution Automation – are the province of the T&D utilities. Investments in these areas have to be the domain of the utilities. It is important that the Policy Makers understand the full benefits of these technologies even though they flow "around" and not "through" the utility rate structure. More details on the Benefits/Cost Analysis with an exploration of a number of alternative scenarios for Smart Grid deployment are provided as in the Roadmap attachment.

For each of the cost elements and quantifiable benefits of Smart Grid, projections were made for each of the years 2011-2025, and the total Net Present Value calculated. The results indicate that there are significant savings to be realized from Smart Grid, and a large positive relationship between total benefits and costs. Exhibits 3 and 4 show a high level waterfall chart of overall costs and benefits from Smart Grid on a Net Present Value basis over the period 2011 – 2025.

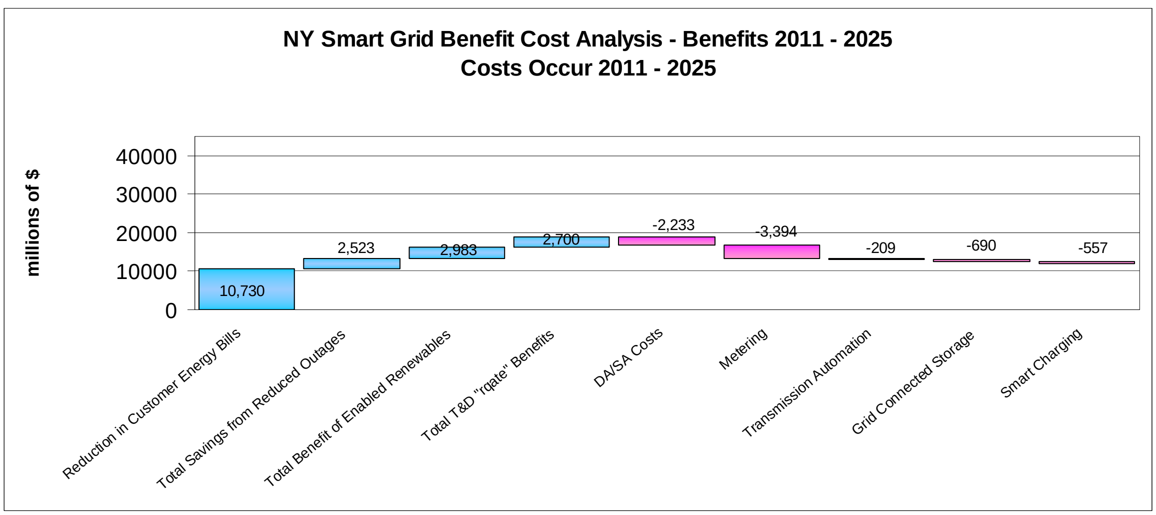

Exhibit 3 - Benefits 2011 – 2025 Cost Occur 2011 - 2025

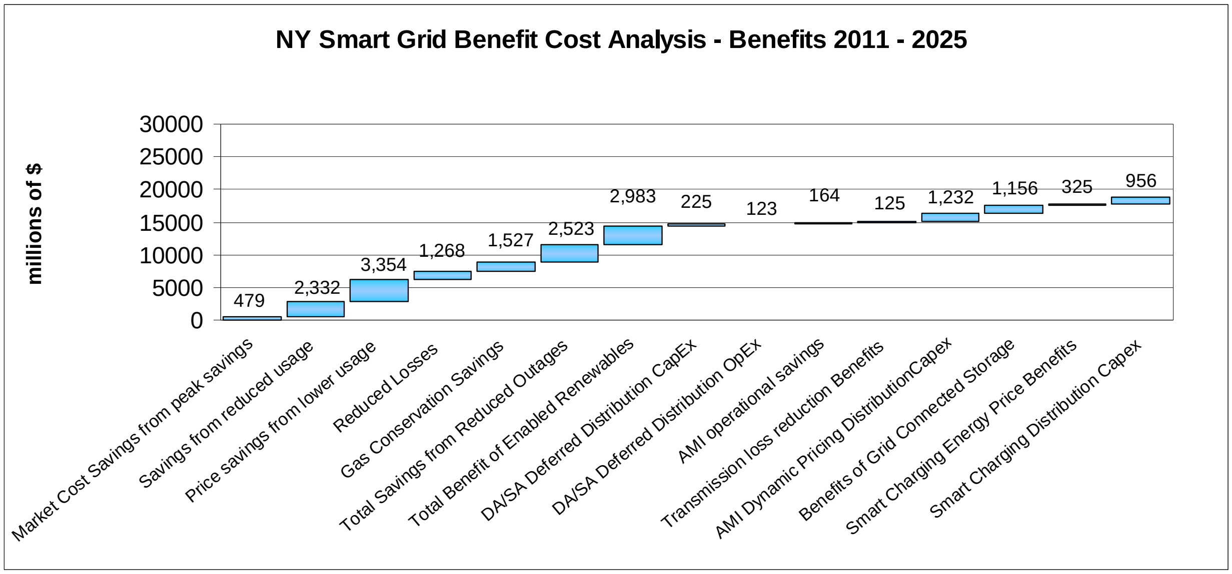

Exhibit 4 – Benefits 2011 - 2025

These benefits build up over time based on the different Smart Grid technology deployments in different hypothetical projects over time. Exhibits 5 - 7 show some of these cost and benefit buildups over the period.

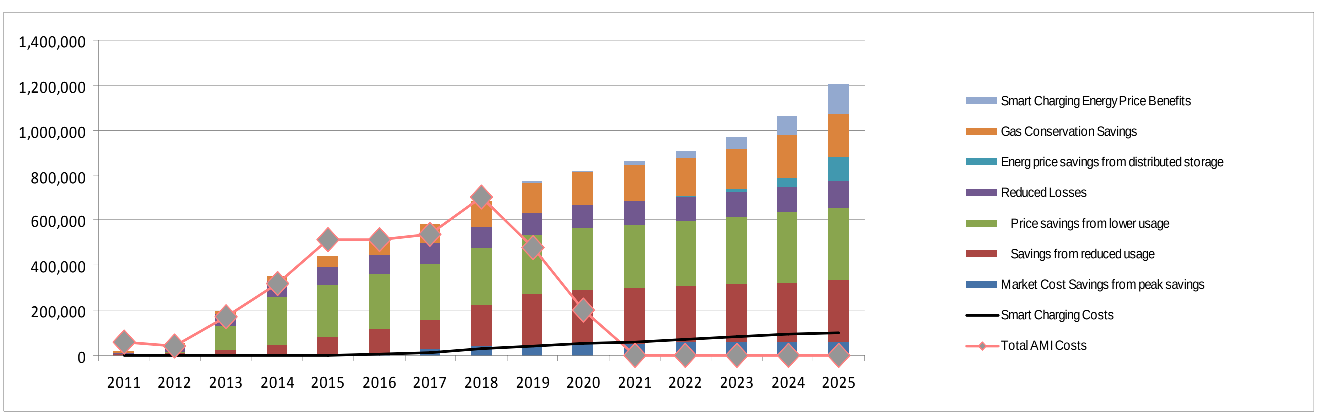

Exhibit 5 – Costs and Benefits Over Time

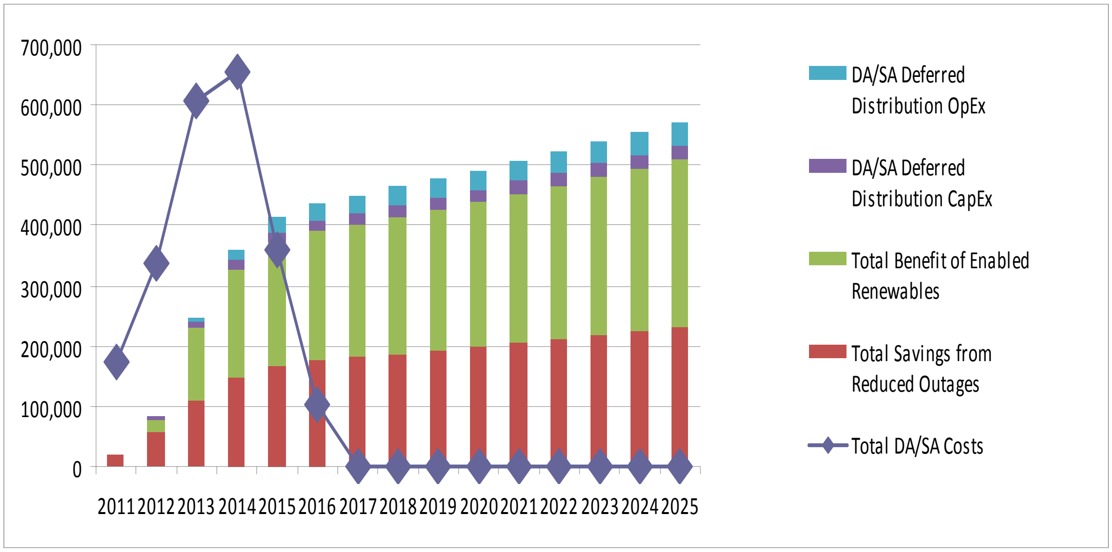

Exhibit 6 – Electric System Costs and Benefits Over time

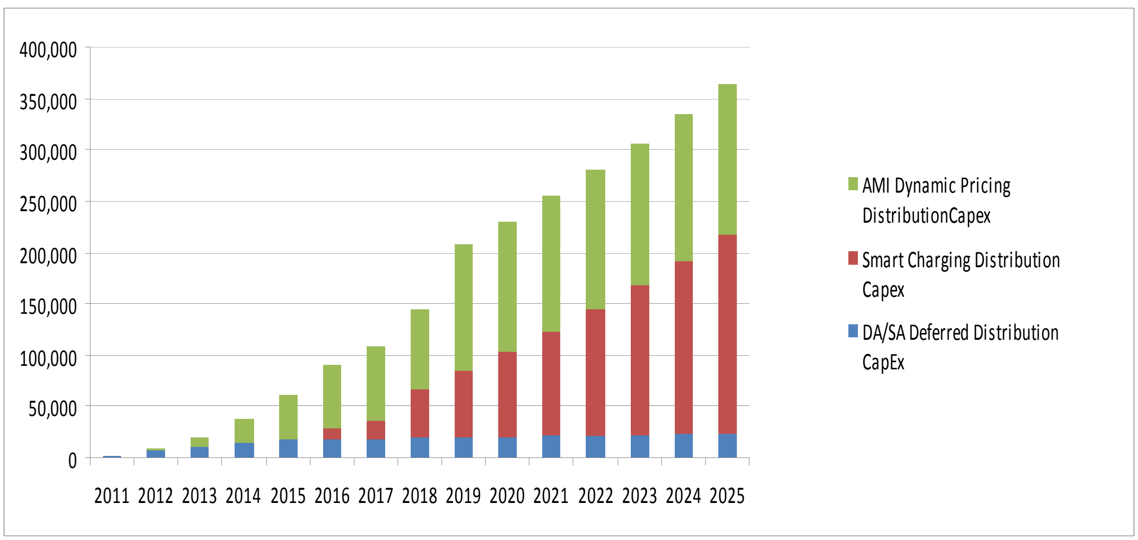

Exhibit 7 Customer Benefits over Time

The Benefits/Cost Analysis is extremely complex with interactions among the different technologies and business models deployed over time. It uses best estimates of current technology costs with moderate future cost reductions in some technologies, reflects current state policies with respect to residential dynamic pricing, and estimates of the current state of C&I customer retail supply and utility investment in T&D automation and Automatic Meter Reading (AMR). Even so, it is necessarily simplified as compared with an aggregation of detailed individual utility plans on the cost side. On the benefit side, the market price impacts in particular as well as consumer adoption rates are estimates based on a limited set of published reports and analyses as well as pilot project evaluations. Its results should be taken as illustrative and not as precise financial projections. However the results developed in this analysis strongly suggest that Smart Grid investments are highly beneficial to the utility system and society at large.

In particular, the Roadmap examined the economics of voluntary opt-in to dynamic pricing by consumers and the economics of different incentive levels aimed at increasing participation and building to critical mass more quickly. It became clear that finding the right level of incentive was critical – too little and the funds expended produced little benefits; too much and the excessive funds produced no additional benefits.

Exhibits 5-7 above present how the benefits and costs accrued overtime. As per the NYS Roadmap uncertainty could be modeled by different scenarios. This approach was used in our analysis and generally we found that Smart Grid was very cost beneficial under multiple scenarios. As we noted above, many smart grid benefits accrue other than through the regulated T&D structure. Quantifying these and reducing uncertainty requires sophisticated analyses. Additionally, alternative cost recovery and funding mechanisms that share risks between ratepayers and investors are one approach to easing the decision process. While these results are for New York; we anticipate similar results on a national scale.

Tracking

Results of Smart Grid implementation should be tracked as determined by State regulators or other regulations. In conducting pilots, what best practical approaches are emerging to better ascertain the benefits and costs of realistic options while protecting participants?

In pilots that include customers it is typical to track:

- Participation
- Savings associated with any load reduction activities – KW and KWH
- Valuing benefits based on saving
- Costs
- Process evaluation
- Monitoring of marketing activities
- Other benefits
- Overall benefits/cost

4) Utilities, Device Manufacturers and Energy Management Firms

Questions to be responded to:

- How can state regulators and the federal government best work together to achieve the benefits of a smart grid? For example, what are the most appropriate roles with respect to development, adoption and application of interoperability standards; supporting technology demonstrations and consumer behavior studies; and transferring lessons from one project to other smart grid projects?
- How can federal and state regulators work together to better coordinate wholesale and retail power markets and remove barriers to an effective smart grid (e.g. regional transmission organization require that all loads buy ''capacity'' to ensure the availability of power for them during peak demand periods, which makes sense for price insensitive loads but requires price sensitive loads to pay to ensure the availability of power they would never buy)?
- How will programs that use pricing, rebates, or load control to reduce consumption during scarcity periods affect the operations, efficiency, and competitiveness of wholesale power markets? Will other smart grid programs have important impacts on wholesale markets? Can policies improve these interactions?
- Do electric service providers have the right incentives to use smart grid technologies to help customers save energy or change load shapes given current regulatory structures?
- What is the potential for third-party firms to provide smart grid enabled products and services for use on either or both the consumer and utility side of the meter? In particular, are changes needed to the current standards or standard-setting process, level of access to the market, and deployment of networks that allow add-on products to access information about grid conditions? How should the interaction between third-party firms and regulated utilities be structured to maximize benefits to consumers and society?
- How should customer-facing equipment such as programmable communicating thermostats, feedback systems, energy management systems and home area networks be made available and financed? Are there consumers' behavior or incentive barriers to the market achieving efficient technology adoption levels without policy intervention?

Roles of Vendors, Manufacturers, Retailers, ESCO's and other parties

Smart Grid will enable many different customer interfaces; some of these may already be funded in existing energy efficiency or load control programs. Others may not be provided by utilities but by retail electric providers or other third party vendors. Specific barriers will vary by technology and method of implementation. What is currently lacking is information on large scale customer behavior experiments. This area is growing but still in an infancy stage. Suggestions are presented in our response to question 7.

State/Federal Cooperation

Information sharing and knowledge transfer are critical among local, regional and national players involved in developing and deploying the smart grid. As an example, the DOE's recently established, Web-based smart grid clearinghouse (http://www.sgiclearinghouse.org) provides a medium for gathering information on standards, use cases, training and best practices for smart grid technologies. The clearinghouse also collects information pertaining to application, research and development of smart grid technologies. The site provides a summary of technologies, projects and deployments, both in the United States and internationally.

The introduction of smart grid technologies will introduce additional layers of complexity in wholesale and retail power markets. These markets would benefit from federal and state cooperation to ensure sufficient capacity. Federal and state regulators have a set of tools available; some of these have been developed regionally by ISO/RTO, predominantly in the Northeast U.S. For example, each of the eastern Independent System Operators (ISOs) has developed reforms to the installed capacity (ICAP) mechanisms uses to achieve resource adequacy. The installed capacity market is the lynchpin of resource adequacy.

Demand Reduction Options and System Operations

Providing customers with adequate and timely information and options will encourage informed decision-making. These options will come in the form of pricing that more closely reflects the cost to deliver energy (e.g. Demand Response, time-of-day and variable pricing), simple, interoperable equipment (e.g. AMI, smart devices, DG, storage, PHEV) and network automation to manage their energy costs. These decisions will benefit customers and be aligned with state, regional and national energy policy goals. A key benefit of the smart grid is the impact of Demand Response or other new pricing options, namely conservation, price response and the associated energy and demand. In more detail, these benefits include:

- Customer bill reductions from conservation impacts and the shifting of peak load which will benefit all consumers;
- Reduced distribution capital expenditures arising from various peak shaving benefits of AMI, Smart Charging, distributed storage, and Distribution Automation/Substation Automation (DA/SA);

- Market price savings derived from peak shaving, distributed resources, distributed storage, conservation, and Smart Charging
- Energy savings from consumer conservation as a result of better information (gas and electric);
- Reduced utility operations expenses from AMI and Distribution/Substation Automation; and
- Increased penetration of Distributed Energy Resources (e.g., photovoltaic) as the economics of dynamic pricing make them more attractive

Costs involved to develop and widely deploy these measures will be dependent upon a number of unknown variables, such as the products and services that will be accepted by customers;, the speed of technology development, the speed of technology development of and market penetration of distributed and micro generation and storage, the speed at which proven Smart Grid technologies are deployed and the availability of capital to invest in Smart Grid.

In order to enable all of the benefits of the smart grid, jurisdictions will need to take a series of regulatory and legislative actions. This includes providing cost recovery for utilities for cost effective Smart Grid installations including T&D investments in demand response and storage technologies that mitigate congestion and locational reserve costs. The benefits from these technologies could be greater as other targeted applications are identified, but technology and application development is needed to realize these proposed effects. These T&D automation investments, in particular, will reap large benefits in integrating renewable and distributed energy resources at lower levels of additional investment in basic infrastructure. They also will be invaluable in accommodating significant numbers of electric vehicles.

Improvements in reliability that are well established benefits of these technologies have real economic benefits to consumers. These T&D automation investments include upgrades to Distribution, Transmission, and ISO control systems as necessary to exploit the new communications, monitoring, and control capabilities afforded by Smart Grid.

We believe there is a role for third parties, which depends on how the market is structured, whether vertically integrated or another structure. These entities should be entitled to have similar access to customer markets as the regulated utilities, where appropriate. The entity types may have different business models and sales methods, such as retail electric providers or demand response firms, but all would have equal access to sell their products and services to customers.

5) Long Term Issues: Managing a Grid With High Penetration of New Technologies

Questions to be responded to:

- What are the most promising ways to integrate large amounts of electric vehicles, photovoltaic cells, wind turbines, or inflexible nuclear plants? What approaches make sense to address the possibility that large numbers of other consumer devices that might simultaneously increase power consumption as soon as power prices drop? For instance, what is known about the viability of and tradeoffs between frequently updated prices and direct load control as approaches to help keep the system balanced? How do factors like the speed of optimization algorithms, demand for reliability and the availability of grid friendly appliances affect those trade-offs?
- What are these strategies' implications for competition among demand response, storage and fast reacting generation? What research is needed to identify and develop effective strategies to manage a grid that is evolving to, for example, have an increasing number of devices that can respond to grid conditions and to be increasingly reliant on variable renewable resources?
- What policies, if any, are necessary to ensure that technologies that can increase the efficiency of ancillary services provision can enter the market and compete on a level playing field?
- What policies, if any, are necessary to ensure that distributed generation and storage of thermal and electrical energy can compete with other supply and demand resources on a level playing field?
- What barriers exist to the deployment of grid infrastructure to enable electric vehicles? What policies are needed to address them?

Modernizing the Grid

As the Grid is modernized and as more technologies are added to the grid on the system itself, in generation and on the demand side; all components will need to be able to work together.

The grid connects the customer to generation, transmission and distribution in the electric power system. As the infrastructure is upgraded, it will provide significant opportunities to improve cost and reliability through advanced sensors and controls (e.g., PMU) designed to limit outages (self-healing, islanding), linked by integrated communications networks and managed by intelligent advanced systems and operations.

As grid enhancements provide a reliable supply of electricity at reasonable costs, they elevate security risks (cyber and physical) and the importance of managing them. Standards that are being developed by National Institute of Standards and Technology (NIST) with support from the GridWise Architecture Council will enable the safe and efficient operation of the Smart Grid.

The key benefits of upgrading the grid are increased reliability and reduced losses. Distribution Automation and Substation Automation are highly cost effective and are just the start. This is an area where there will be significant technological change over time.

The following are actions that will be needed to ensure the Smart Grid will modernize the grid:

- Implement Distribution Automation throughout the power system as part of ongoing utility maintenance and replacement.
- Implement Substation Automation throughout the power system on a similar basis.
- Provide cost recovery for these investments both as part of major rate case projects but also as part of normal asset replacement programs and targeted reliability improvement programs.
- Continue to monitor new technologies as they become available to make the Grid even more efficient.

New Technologies

Planners and policy makers will have to make decisions about market adaptations driven by new technologies and consumer behavior – including consumer investments in technologies – absent certainty about the future penetrations of different technologies and end usage. This has major implications for the way that the policy decisions are informed and reached. In particular, market structures and systems that are flexible and easily adapted to changes in the resource portfolio will fare better than less flexible environments. This means that the market rules, the ways that changes to the markets are taken up and implemented, and the systems that implement the markets and operations all require high degrees of adaptability and flexibility.

Little is known about the time dynamics of price response or indirect ADR. How these will affect bulk system operations and dynamics is not well understood, nor is it well understood how the time dynamics of price response will interact with intra hour and hourly energy markets. Dynamic price instability is not an expected adverse outcome, but simulations and research to better understand these issues are important before retail-wholesale design decisions are made and implemented.

Demand Response Strategies

Demand response – especially dispatchable demand response, autonomous price response by consumers to real time pricing, storage, fast generation, and other new technologies will all have roles to play in the future. The extent to which each participates in capacity, energy, and ancillary markets will vary regionally based on resource characteristics and load end use mixes. Market based environments that allow new or improved technologies to compete for these roles and to press for market adaptations to allow their value to be realized will find better outcomes than environments that attempt to centrally plan resource mixes in advance of technology evolution.

To the maximum extent possible, policy makers will need access to careful analyses of what proposed changes in operations and markets will do to future technology penetrations and usage, and conversely how altered technologies will affect operations and markets. Investment today in methodologies, tools, and simulations that inform operators, policy makers, and investors about potential outcomes will be essential.

Diverse Supply Integration

The energy supply portfolio will continue to evolve but several types of renewable generation (wind, solar) tend to be intermittent and less predictable. Incorporation of renewable energy sources into the electric power grid will require a combination of solutions including storage, demand response, and integrated control of distributed resources. This integration will facilitate a timelier and lower cost achievement of renewable portfolio standards.

The following are actions that will be needed to ensure the Smart Grid provides for diverse supply integration:

- Continue to support the development of large scale and customer side renewables plus other advanced distributed generation as technologies are proven.
- Explore utility ownership and or utility programs to promote customer side renewables
- Pilot storage technologies in combination with demand response and renewable technologies.
- Test use of public networks for AMI including testing cyber security and information / privacy aspects that can provide necessary monitoring of Distributed Energy Resources on a cost effective basis.

- Explore the economic linkage between dynamic pricing and increased distributed solar penetration.
- Address recovery mechanisms and incentives for utilities to invest in distributed storage; in particular how utilities can realize the time value gains from energy stored in distributed facilities and benefit consumers from the overall solution.
- Plan for Automatic Demand Response via Smart Buildings and Virtual Power Plants (integrated load side resources of distributed generation, storage, and demand management) as part of an overall solution, via utilities, aggregators, large end users, or on a fully autonomous basis responding to NY ISO price signals and able to supply ISO ancillary services and other new products as may evolve in the future.
- Plan for Electric Vehicle Smart Charging as a key component in providing increased demand response, and ancillary services.
- Structuring markets to encourage new capacity to be flexible will help integrate solar. Flexible generation that has shorter commitment times and lower cycling costs will be more valuable in an environment with high solar penetration.
- Combining solar with demand response can generate a more dynamic reliability product. For this to occur, rules and performance standards need to be established.
- Markets that are larger and more flexible and diverse provide opportunities for the integration of solar generation at a lower cost.
- Develop improved short-term weather forecasting capabilities, develop reliable models for the resulting wind and solar generation expectations, and develop approaches to integrate these into energy management systems for reliable and efficient grid operations utilizing these variable resources.

Generally this will require the distributed resources including demand resources will need to be treated in markets on an equivalent basis. Examples of this include: allowing these technologies in capacity markets; allowing aggregators to bundle supply and demand resources into markets as virtual power plants. Technology neutral market products and protocols are required; and in some cases (fast storage being a current example) new market products that best exploit the value of the technologies will be important. New York has developed and gotten approval for system regulation products tailored for fast storage and found these to be cost effective and beneficial.

Electric Vehicles

The following issues need to be addressed:

- Unreasonable expectations – Many buyers want the cars to exceed gas vehicles in reliability, performance and affordability.
- Range anxiety – Many electric vehicles will travel 100 miles between charges, but not known if that is acceptable to buyers
- Unfamiliarity with electric vehicles – Major manufacturers expected to advertise nationally, but smaller companies likely to market via the internet and not use dealerships to sell cars
- Availability – Nationwide distribution of batteries is likely to take a couple years
- Fear – Worry of electric shock when charging or when the car involved in an accident
- Cost - Average home charging installation anticipated to be $2,000 (not taking into account tax credits)
- Uncertain government support – Even though there is currently tax credits for purchasing electric vehicles and installing home charging units, it is unknown if these incentives will continue.
- Wholesale market price impacts if most EV owners "plug in" and begin charging in the early evening. The ISO RTO Council evaluated the impact of EV penetration and found this to be significant in some regions even at national penetrations of only 1 Million vehicles.
- The electric distribution system is very much at risk of requiring localized capacity upgrades triggered by level 2+ and level 3 charging – including distribution transformer upgrades as an imminent possibility.

Policies to address these issues include:

- Pilot EVs in combination with demand response and renewable technologies.
    - Teach consumers to charge their electric vehicles at night, during off-peak demand periods
- Research impact of EVs on Grid indifferent types of feeders in urban, suburban and rural environments
    - Infrastructure planners need to focus on how a large number of electric vehicles would drain the power grid in different environments
    - Municipalities should design electric vehicle strategies that align to their individual circumstances, but should also draw on lessons from other municipalities

- Address recovery mechanisms and incentives for utilities to invest in infrastructure for EVs; in particular how utilities can realize the time value gains from energy stored in the EVs and benefit consumers from the overall solution.
- Plan for Electric Vehicle Smart Charging as a key component in providing increased demand response, and ancillary services.
  - Infrastructure issues are likely to impede progress if government officials are not proactive in encouraging the implementation of charging stations in residences and elsewhere

7) Managing Transitions and Overall Question

Questions to be responded to:

- What are the best present-day strategies for transitioning from the status quo to an environment in which consumer-facing smart grid programs (e.g., alternative pricing structures and feedback) are common? What has been learned from different implementations? What lessons fall into the ''it would have been good to know that when we started'' category? What additional mechanisms, if any, would help share such lessons among key stakeholders quickly?
- Recognizing that most equipment on the electric grid, including meters, can last a decade or more, what cyber security, compatibility and integration issues affect legacy equipment and merit attention? What are some strategies for integrating legacy equipment into a robust, modernized grid? What strategies are appropriate for investing in equipment today that will be more valuable if it can delay obsolescence by integrating gracefully with future generations of technology?
- How will smart grid technologies change the business model for electric service providers, if at all? What are the implications of these changes?
- What are the costs and benefits of delaying investment in metering and other smart grid infrastructure while the technology and our understanding of it is rapidly evolving? How does that affect the choice of an appropriate time to invest?
- What policy changes would ensure that the U.S. maintains global competitiveness in smart grid technology and related businesses?
- What should be the priority areas for federally funded research that can support smart grid deployment?

Transitioning to the Smart Grid

In order to achieve a successful transition to a Smart Grid, it is necessary to prioritize investments and implement technologies in a sequence that achieves value early, but recognizes the practical constraints of the existing utility resources. The Consortium developed such a Roadmap for NY based upon the Benefits/Cost Analysis conducted by KEMA/DeSola which is described in greater detail in response to Topic #3 – Assessing and Allocating Costs and Benefits. Alternative scenarios in which technologies and policies were introduced at different times and different levels were evaluated.

What has become clear from Smart Grid pilots and implementations is that customer engagement is critical. Customers want choices, so allowing them to select among different paths for adjusting their usage to periods of low cost supply, renewable supply, (or not to adapt) including aggregators, retail energy supply companies, time of use tariffs, or autonomous price response will be a major benefit of smart grid. It will enable those consumers who can benefit from these paths to pick their best alternative and save on energy usage and cost, and in so doing they will help reduce peak market prices for all consumers.

The Smart Grid will provide customers with options to use energy differently. The options will come in the form of pricing that more closely reflects the cost to deliver energy (demand response, time of day, variable), simple, interoperable equipment (AMI, smart devices, DG, storage, PHEV) and network automation to manage their energy costs. This will be a major transition for customers and may require significant education and outreach to reach its full potential.

Reliability

Distribution automation and substation automation investments are most beneficial in terms of reducing outage times, facilitating renewable resource and distributed generation integration, and reducing T&D operating and capital expenses, and should be a priority. These are probably best handled via normal utility investment decisions outside any special Smart Grid processes. The Consortium stresses the importance of considering modern automation capabilities as part of normal asset replacement on a "like for like" basis which would reduce retrofit costs, accrue benefits more rapidly, and avoid stranded cost issues in the future.

Costs and Benefits of Delaying Smart Grid Investments

Although technologies are evolving in all aspects of Smart Grid, it is recommended that investments in T&D automation be made early so that the benefits of new applications may be realized as they are developed and installed. These T&D automation investments include upgrades to Distribution, Transmission, and ISO control systems as necessary to exploit the new communications, monitoring, and control capabilities afforded by Smart Grid. Cost recovery should be allowed for cost effective T&D automation investments in demand response and storage technologies that mitigate congestion and locational reserve costs. The benefits from these technologies could be greater as other targeted applications are identified, but technology and application development is needed to realize these proposed effects. These T&D automation investments, in particular, will reap large benefits in integrating renewable and distributed energy resources at lower levels of additional investment in basic infrastructure. They also will be invaluable in accommodating significant numbers of electric vehicles. Improvements in reliability that are well established benefits of these technologies have real economic benefits to consumers.

Potential Policy Changes

The US can be a global leader in the implementation of Smart Grid and Smart Grid industries. It is positioned to develop industry and technology clusters in each state or region which would provide significant economic benefits. As clusters develop, this will attract additional industry. The public and private universities must be seen as strategic partners in achieving our economic objectives through our technology and research leadership.

The following are actions that will be needed to ensure the Smart Grid provides long term economic benefits:

- Continue to support the collaboration between universities, industrials, and utilities such as the New York Smart Grid Consortium.
- Establish priorities for research, product and system testing and validation which can be augmented.
- Encourage utilities, industrial companies, governmental partners to invest in R&D, and communities to be early adopters and test bed partners.

III. SUMMARY

The New York Smart Grid Consortium thanks DOE for this opportunity to provide these comments. Smart Grid technologies will be a critical and cost effective component of our energy future and we appreciate DOE’s leadership.