

Grid Modernization – The Way Forward

Good morning Chair Berwick and fellow Commissioners, Mr. Raab and Mr. Woolf, as well as all the participants gathered here today. My name is Cheri Warren from National Grid, I am the Vice President for Electric Asset Management.

Slide - Investment

My team and I invest c.\$1B on behalf of customers with about \$350M in MA each year. We develop the plans, strategies, and data analytics to ensure the right investment for customers.

My comments will address National Grid's thoughts about the importance of this docket, our modernization efforts to-date and our thinking for future grid modernization. We are pleased that the Department has opened this essential docket. Much of the infrastructure we build today will be powering people's lives for the next 40 to 60 years.

Slide – Start with customer and work backwards

Grid modernization encompasses many concepts, but I am convinced that if you start with the customer and work backwards you will find the way forward in grid modernization. Fundamentally, it is about transforming our grid from the approach developed in the late 1800's to meet innovation in business and to light people's homes into to what is needed to fuel today and tomorrow's economy. Central generation to bring power one-way to customers was the most economic way of electrifying the nation in the early days and that system has largely persisted through today.

Slide – MA infrastructure

Fast forward to the late 1960s and early 70s ... our customers were very different. They typically had one phone that was hard wired in their homes, light was provided by Edison's

incandescent bulbs, most homes had one iron, one tube based TV and one hot water heater – mostly resistive loads. Weather was less volatile and power quality was yet to be invented because there were no digital loads.

Our one-way grid met their needs.

Contrast that with today's customers who are connected 24x7. In many cases, each person has individual phones, ipads or tablets, computers, and TVs. Lighting comes from LED, CLF and incandescent bulbs. Loads have fundamentally changed to be predominantly digital. And behaviors are fundamentally different. Texting not calling is the norm for many. And people are comfortable with technology. They want ultimate convenience while at the same time are committed to a circular economy. More than any other group of people, they will choose to be greener because they “know” it's the right thing to do for the long run. These facts should have profound effect on the grid we begin to build now and in the coming years.

Our customers only use a few loads you might recognize from the 60s. The grid, however, has not changed nearly as much as customers. Much of the distribution equipment is the same as it was; namely poles and wire with a design to provide one-way power flow from centralized generation to customers. The biggest technology changes have come in the form of distribution and substation automation with some limited two-way communications.

Slides DG x2

And yes, we have connected some renewable generation to the existing distribution system, but in many cases this addition becomes a complexity to a grid that was not designed to handle multi-directional power flow.

Slide - reliability

The measurements we use to determine what if we've met customers' needs must change as well. Using performance of the "average customer" with metrics like SAIFI and SAIDI is no longer good enough.

Slide CEMI

We need customer based metrics like CEMI that tell us what individual customers are experiencing. And like our customer's electronic devices, we are now facing a time when technological obsolescence of grid equipment is a factor in our capital investment strategy. We hope the Collaborative can agree on the need to recognize obsolescence in recommendations in this docket.

Slide - Convergence

Imagine a future driven by customers. It's quite conceivable that devices will be powered-on-demand via direct connect solar or inductive charging; businesses and homes powered with DC to take advantage of renewable generation, storage, and microgrids thereby reducing losses. Many people will drive electric vehicles, have rooftop or community renewable generation & storage, and live in homes that have been optimized for energy performance. Many agree that the vast majority will live in Smart cities. Devices that help us live our daily lives will be built in the most energy efficient way possible while delivering services we can't even conceive of today. Think Ipad. In this future, the grid will require fundamentally different designs and controls. Designs that will

- allow multiple-way power flows so everything can be connected,
- use bigger wire and different core materials,
- take advantage of two-way communication flow that will not only provide the grid with true self-healing capability but will give our customers choice,

- have real-time sensors to provide grid health so devices can be changed before they fail, and
- enable decision making based integrated information coming from grid devices, web cams, social media like twitter, weather systems, and other public information.

This will be the era of convergence. It will lead to significantly better reliability, power quality, value based service, and customers who feel the full value from energy. The grid must be transformed to meet the evolving societal needs at our customers pace.

So where are we today and how do we achieve the vision for tomorrow? We have done much on our grid to continue to modernize where the biggest impacts can be made while being mindful of the overall investment and ultimate cost to get us where we as a society want to be.

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Over the past 10 years we have focused on ensuring the NE bulk transmission system is revitalized.

Slide GIS

Many of our transmission substations are state-of-the-art gas insulation substations. We have begun the journey to add control to all our substations as well.

Slide PMUs

We are engaged with the ISO in the DOE phasor measurement project. National Grid has and continues to be a leader in vegetation research to better understand how trees cause faults and how to minimize and possibly prevent them. This work has led to a significant change in our hazard tree removal practices that positively impacts reliability. We are working with MIT to develop models to better predict weather impact ahead of and during storms.

Slide AI

We are always looking to invest in new or emerging technologies and to lead across the industry. We are Partners on the Smart Cities Council, helping to develop a Smart City readiness guide.

Slide Sustainability Hub

We are leading in customer engagement using the appreciative inquiry technique for EE and Smartgrid. One outcome is a sustainability hub for deep customer engagement in Worcester.

Slide SG

We are also doing a Smartgrid pilot that will test advance distribution automation as well as customer engagement.

Slide Solar

We have installed 5 MW of regulated solar on our system.

Slide Spacer

While we have used spacer cable on the distribution system for many years, we plan to install 69 kV spacer cable for the first time between the communities of Hampden and East Long Meadow to improve performance during storms.

Slide REP

In 2011, we delivered a five year feeder reliability program designed to improve reliability. Assets were replaced, additional reclosers were installed and enhanced hazard trees removed. What has rightly been a shared vision on keeping costs low for consumers, has led to a grid that is meeting customer needs, for the most part, but has only taken small steps toward a modernized design.

Getting to the future will require real-time information for utilities and customers to enable choice about energy use and energy sources. Utilities will use real-time information to 1) enable better operational decisions, 2) to inform new system designs and planning models thereby bringing fewer interruptions and better digital device performance, and 3) to make better capital investment choice; choices between replacing assets in poor condition with in-kind assets or adding more robust and/or smarter devices. While there are some levels of automation already implemented in the Commonwealth, the next generation automation technology will truly provide grid self-healing where power is restored autonomously providing **the infrastructure is not damaged**. The next generation of grid automation, made possible by two-way communication, will be essential to achieving societal expectations.

Partnerships will be key; in fact, partnerships with many of you in the room. As we build the energy backbone to underpin the MA economy, many of you will have a role in meeting customer's needs.

Slide Minor Storm hardening

Grid modernization will also bring better performance during these times of increasing storm intensity and frequency. The designs that had withstood typical NE weather are proving to be outdated as we see more severe minor storms and even storms like Irene and Sandy. Stronger wire and larger poles, different designs, combined with different construction will be a start; working with manufacturers to develop storm hardened equipment will be part of the equation;

Slide new technology

couple that with better real-time information and some local generation/storage options and customers will see a whole new experience during storm events.

And customers need different price options that can lead to more efficient energy use. At the same time, pricing options should allow fair cost recovery for the modern grid investment from all customers who use the grid directly or rely on it for security. All customers from low income to high energy use businesses should have access to alternative rate plans based on market commodity prices. However, this docket should consider the possibility for tariffs that are based on customer value. Value is derived from customer actions such as heating; refrigeration; light; entertainment, etc. Exploring what is meaningful to customers should be a fundamental part of the efforts in this docket.

The Company believes the Collaborative should consider whether regulatory precedent should evolve, and to what degree, to meet short-term and long-term customer expectations. The speed of business is out of synch with the speed of regulation and the speed of utility infrastructure delivery. Is it necessary to adjust regulatory model in MA to balance the evolving customer expectations, technological opportunities and implementation costs? Without fundamental infrastructure, it is difficult to envision the economic growth that the Commonwealth needs to provide to its citizens. These investments are worth making.

I want to leave you with a few thoughts today:

- Customer expectations are and will continue to change
- The grid needs to be resilient enough to provide
- Customer choice is dependent on two-way power and communication flow (especially during storms or weather events).
- The economy needs the right infrastructure to accelerate
- Partnership is key

- Customers need a regulatory framework that addresses the need to invest in grid modernization and promote innovation to meet both today and tomorrow's expectations
- Customers need rate designs that send better price signals and speak to them in their language. They need to know what they are spending and how they can reduce that spend in near real-time
- Grid modernization needs to be focused on the fundamental design and system changes

Slide on questions

As such, National Grid is excited to be a part of this essential docket and are looking forward to defining the art of the possible with all of you. Thank you.