



Working Group 1: New Technology Deployment and Grid Integration

Meeting No. 3 – Topic: Technology Development

January 30, 2018

MEETING SUMMARY

[Note: descriptions of presentations and discussion are condensed summaries and paraphrases]

Agenda Item I: Opening and Introductions

Working Group Leader Dr. Mohammad Shahidehpour welcomed participants, reviewed the meeting agenda and introduced the presenters: Mark Kelly of Caterpillar Inc., Chris Moris of Sunrun Inc., Mel Gehrs of Itron/Silver Springs Networks, Dr. Farnoosh Rahmatian of NuGrid Power Corp and discussion leader William Abolt of AECOM.

[All decks and materials subject to permission from presenters to be posted online; encapsulated presentations summarized below.]

Agenda Item II: Presentation by Mark Kelly *(Senior Technical Professional, Caterpillar Inc.)*



NextGrid WG1
-Caterpillar Inc..pdf

Technology Development of DER from a Supply Perspective:

- Purpose of supply chain is to build the “Value Stack” that enables consumption of electricity and/or reduces its cost. For end users the top 3 values are energy, power quality, reliability/resiliency. Other values are indirect to service and priced in as externalities.
- Legacy electric supply chain was provided largely by vertically integrated utilities, leveraging economies of scale and scope using central planning.
- Caterpillar is world’s largest manufacturer of generator sets and has been in distributed generation business for 75 years.

- Electric supply chain of the recent past shows shrinking economies of scale, introduction of competition, RTO/ISO creation, IT-enabled locational marginal pricing and competitive wholesale markets. Began to focus on integration of DG, PV, DR, TOU, CHP, EE, storage -- grid edge innovation and customer differentiated services reflecting different needs/metrics for power quality, reliability and other requirements at point of use.
- Another big driver of change in supply chain is decarbonization – both through regulatory policy and customer choice. Integration of intermittent resources pose power quality and reliability challenges.
- High costs can lead to “energy poverty,” making electricity less affordable and hurting companies competing in global markets.
- Emerging future supply chain includes much more storage and other DER, microgrids, advanced DR embedded in end-use devices.
- All leads to the question of possible need for distribution system operator (DSO, aka DPO, RSO) to unlock the future value chain through deployment of technology to allow markets to determine the most cost-effective solutions.

Agenda Item III: Presentation by Chris Moris (Sunrun, Inc.)



NextGrid

Presentation - 1.30.1

- SunRun is a leading residential PV company, operates in 22 states and hopes to enter the Illinois market. One product combines solar and battery storage to provide an intelligent, communicating, grid-connected, internet-accessible system storing 10-30kWh household energy; sold through long term lease or sale.
- As costs decline, adoption expected to quickly rise, particularly in areas with high electric rates such as \$.25 - \$.48 TOU rates typical in CA and HI
- Overall solar capacity expected to grow 10x between now and 2022; still in very small fraction of homes, though pockets with greater than 20% penetration exist (HI). Rest of U.S. less than 2%. *[Note: Illinois residential PV penetration is presently de minimis, but will grow through FEJA]*
- Value proposition to customer of solar/storage product includes backup in case of outage and ability to manage charge/discharge based on TOU pricing structures.
- Slide depicts typical home setup including solar panels, meter, hybrid smart DC inverter, bi-directional flows, battery pack. Allows consumption, input, output metering, automatic real-time condition-based decisions; potential for additional services such as DR, communication/coordination with utility to send signals to consumers; possible participation in wholesale markets.
- Must make it simple, transparent and easy for customers.

Agenda Item V: Presentation by Mel Gehrs (Itron/Silver Springs Network)

Smart Grid Evolution

- Itron merged with Silver Springs Network, provides smart grid technology to ComEd and many others.
- Smart Grid high on Gartner’s technology “hype cycle”; many new technology variants coming online: smart streetlights, line condition sensors, new analytics, IoT apps, urban networks.
- Three types of smart (IoT) devices will be deployed: Continuously powered devices such as smart meters, appliances; rechargeable devices such as mobile phones, cars, watches; and sensors and applications without recharging capability.
- ComEd – AMI deployment: almost 3.9 million meters, 6400 DA devices are producing significant reliability improvements (SAIDI, CAIFI).
- City of Chicago – LED smart streetlights under deployment in entire city of Chicago. Uses same Silver Springs Network technology as smart meters in overlapping networks.
- Emerging sensory and control technologies include:
 - pole tilt sensors – communicating conditions of poles, allowing advance knowledge for field personnel of inventory needed, where to ship, from, where to put them, etc. – can be solar powered.
 - Streetlights as a sensor platform – can communicate varied data such as street and sidewalk traffic, air quality, methane and radiation detection – other possibilities for 400,000 Chicago streetlights.
 - Smart circuit breakers can monitor and meter individual circuits, remote switching, wifi capability
 - Underground line sensors detect faults in manholes and underground feeders.
 - Distributed intelligence – moving analytics and applications from back office or cloud to inside the meter – can enable site and customer-specific analytics.
- Next Steps – keep testing and deploying where effective.

Agenda Item VI: Presentation by Dr. Farnoosh Rahmatian (President, NuGrid Power Corp; VP of Technical Activities, IEEE)



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State of the Art of Technology

- Electric grid is world’s largest machine – requires constant real-time balancing of supply/demand to avoid system collapse. Also requires planning, construction, integration, operation, maintenance; and now has markets – all have interactions.

- Many changes underway due to evolving technology, customer needs, demands. Bi-directional flows in distribution system and advent of cost-effective storage are key new developments. Need DER management systems.
- Speed of change is accelerating. Interactions of new technologies and applications have side effects that must be understood, because laws of physics don't change.
- IEEE - 17 tech committees focused on collaboration to address different aspects of power and energy challenges, develop standards (collaborate with NIST). Need for more active grid management, enhance system control through increased sensors, data, communications.
- Intelligence must be both distributed and central to optimize system dynamics and respond to changing expectations – operators need information from behind the meter.
- DOE reference model lays out distribution system schematic. [see slide]
- Key elements for any technology in electric power industry: safety first, efficacy, reliability, maintainability, serviceability, durability, interoperability and integration, standards, beneficial economics, training and familiarization.
- Risk management of tech introduction requires applied R&D to generate feedback loop (negative and positive) before any deployment – which should begin at pilot scale. (Synchrophasor example)

Agenda Item VII: Topic Discussion (led by William Abolt, Vice-President AECOM)

- **Topic 1:** Questions and discussion among the panel and participants about the policy and economic drivers of change, with these key points made:
 - Change is driven by societal forces to achieve evolving social goals, which require new technology.
 - Declining cost curves for new technology drive adoption.
 - Consumer choices about using energy in different ways and using different resources are key factors.
 - Pace of change accelerating.
 - Legislators made DER expansion in Illinois inevitable with FEJA.
 - Demands for different levels of quality, reliability, resiliency, will drive distributed solutions.
 - Need to get structure and regulations correct. Electric grid will remain highly regulated, but more exposure to market competition will result in innovation and lower costs.
- **Topic 2:** Questions and discussion among the panel and participants about the conditions for robust solar development, with these key points made:
 - Need certainty for economic value of long-term investments.
 - Most fundamental – clarity, transparency, consistency, right incentives in rates.

- In Illinois, a residential solar/storage system would need to be able to optimize for optional hourly wholesale market-based pricing.
- Time-variant rates must have enough spread to create value for storage. In Illinois, our PJM and MISO wholesale markets - as opposed to proxy markets in California - would produce a different set of challenges.
- If solar/storage system achieved high penetration level and made customers near-self-sufficient in energy but grid connected, would create challenge of how to fairly and fully cover fixed costs of the grid.
- California TOU rates mentioned between 25-48 cents – far higher than Illinois. But they don't have far higher LMP energy prices than PJM. Other factors add up to get high costs; CA also has duck curve due to increasing solar penetration.
- **Topic 3:** Questions and discussion among the panel and participants about physical and cyber security issues precipitated by new technologies introduced to the grid, with these key points made:
 - Security must be implemented from the ground up, at all phases, in order to be effective. Security layered on top and added over time, such as wifi, not as effective.
 - Root security embedded in single chip: a sock.
 - IEEE has new committee on system communication and cybersecurity. There are 24 layers of critical infrastructure, with electricity infrastructure at the top and the other 23 dependent on it.
 - Enforceable standards for physical and cyber security presently exist only at bulk level above 100kV. Several standards have been recommended – NERC 128 or 256, encompassing asymmetric encryption and other protocols, which all vendors follow.
- **Topic 4:** Questions and discussion among the panel and participants about regulatory policy to support DG and other DER, with these key points made:
 - Distribution systems state regulated so can expect many different approaches.
 - Need to get right mix between regulated and competitive activities to maximize benefits.
 - Effective competition stimulates DER innovation and finds cost-effective solutions.
 - No state or country has figured this out yet and put right set of policies in place.
 - It will take pilots and a learning process, as we are at a very early stage.
- **Topic 5:** Questions and discussion among the panel and participants about redundancy of communication networks, with these key points made:
 - Multiple networks – AMI, streetlights, cellular, others – may appear inefficient but may have different benefits.

- Redundancy is a business question more than technology question. Utilities trying to figure out how to become smart city network providers, which is what many cities want, when they have historically focused only on safe, reliable, metered electricity service.
- Regulations will have to be updated to create right incentives for new services. It's all about the economics of using the network for other applications.
- **Topic 6:** Questions and discussion among participants about baseline utility investments made to date, reference to utility presentations at last WG meeting, and need to focus on Illinois.

Final Comments of Presenters

- **Mel Gehrs:** Itron is committed to Illinois, which is in the forefront of deploying new technology, such as smart streetlights, and showing what it can do. Very low cost sensors – perhaps 50 cents – will open up new world of applications. Communications essential, but sensors will be king.
- **Chris Moris:** Initiatives like NextGrid are needed to shape the future. Many important questions need to be studied, such as who will cover cost of the grid. It exists for benefit of society and we must extract maximum value from it.
- **Farnoosh Rahmatian:** 400,000 engineers are a big pool to tap. Successful new technology deployment means looking at the grid in new ways. Lots of learning must take place.
- **Mark Kelly:** It's important to be engaged in this, even if may not be a perfect process. Biggest challenge will be policy – take the enormous technology knowledge here, boil it down to give policymakers something they can work with. Need to create space in the market for innovation and early adopters of emerging technologies.

Administrative Matters

- Dr. Shahidepour announced that the next working group meeting will feature presentations on electrification issues.