Staff Subcommittee on Electricity and Electric Reliability
Do Your Utilities Need Grid Modernization to Integrate Distributed Generation?
Grid Modernization to Integrate Distributed Generation?

Moderator: Kim Jones, North Carolina

Speakers:
Anda Ray and Barbara Tyran, EPRI
Joe Paladino, DOE
Paul DeMartini, Newport Consulting Group
Our Energy Future: *Integrated Energy Network*

Anda Ray, Barbara Tyran

SVP, External Relations and Technical Resources
Executive Director, Government & External Relations

**NARUC Summer Policy Summit**
San Diego, CA
July 16, 2017
Our Members…

- 450+ participants in more than 30 countries
- EPRI members generate approximately 90% of the electricity in the United States
- International funding of nearly 30% of EPRI’s electric utility research, development, and demonstration funding

Our Advisors…

- Public Utilities Commissioners
- Wall Street and Academia
- Consumer Advocate
- Academia
- Business and Government Leaders
The Integrated Energy Network Builds upon Decades of EPRI Thought Leadership

PRISM: Portfolio for Clean Generation

Energy Efficiency

Flexible, Resilient, and Connected Power System

Connected Customers

Integrated Grid

2016-2017

THE INTEGRATED ENERGY NETWORK
The Integrated Grid Platform

Reliability, Connectivity and Flexibility – realizing the full value of the Integrated Grid.

EPRI 2015 Report
DSOs – an emerging role evolving towards *information hubs* to facilitate retail markets that allow customers to choose their supplier and allow suppliers to offer options and services best tailored to customer needs.
A Smart City...

...Uses communication networks, wireless sensor, technology and intelligent data management to make decisions in real time about infrastructure needs and services delivery.
Today Smart Cities Becoming a Reality

Malmö, Sweden
Songdo, South Korea
Columbus, Ohio

LIVEABILITY
WORKABILITY
SUSTAINABILITY
The Role of the Digital Utility in Smart Cities
The Digital Utility

Enabling Responsiveness and Commercial Operation

Integrating Advances in Information Communications Technologies

Enabling Protection of Privacy and Data

Enabling Efficient Asset Performance

Enabling and Protecting the Workforce

Enabling Customer and Delivery Services
Potential Effects of the Sharing Economy
Digital Technology Growth Out Paces Other Technologies

600 Million
Smart Meters already connected

20,000,000,000
By 2025

Every 10 Seconds
Data collected

Terabytes per day
Modern Power Plants produce

$1.3 trillion Worldwide value 2025

Less than 2% analyzed today
The Integrated Energy Network: 
Connecting Customers to Reliable, Safe, Affordable and Cleaner Energy

- **Improves Reliability**
  - Integration enables quick assessment, containment, and rapid response

- **Promotes Economic Efficiency, Energy Efficiency, and Cleaner energy**
  - Integration makes possible a wide array of efficient, affordable, cleaner energy options

- **Expands Customer Choice and Enhances Value**
  - Digitalization of energy provides both near-term and unforeseeable opportunities

+ Cross-cutting Issues
The “Internet of Things” Connectivity

26 billion devices will be connected to the internet of things by 2020 – including home automation, integrated grid, smart cities, transportation, space conditioning and lighting.
The Integrated Energy Network: Connecting Customers to Reliable, Safe, Affordable and Cleaner Energy

- Improves Reliability
  - Promotes Cleaner Energy and Efficient Electrification
    - Provides Economic Efficiencies
      - Expands Customer Choice and Enhances Value
Big Shifts to the Digital Utility: “Eyes Wide Open”
The Integrated Energy Network requires rethinking “energy”

Electric, gas, transport, and water systems are increasingly interdependent

Advances in wireless connected technologies will be instrumental in integrating energy systems.

Efficient electrification play essential roles in the future energy system

Integrated (electric) Grid essential to enable to the Integrated Energy Network by enabling customers to use, produce and store electricity the way they desire.

Innovation is needed in technology, policy, regulation, business models and market designs to effect an efficient transformation

Global collaboration in innovation necessary
Together...Shaping the Future of Electricity
Considerations for a Modern Distribution Grid

A Collaboration with State Commissions & Industry to Frame Grid Modernization

NARUC Summer Meetings

July 16, 2017
Overview

**Origin:**
Initiated by CA and NY, plus DC, HI & MN commissions to examine what is needed to develop a next generation distribution system platform (DSPx)

**Objective:**
Provide guidance to facilitate grid modernization conversations around 2 important questions:

1) *What considerations are of particular importance within a grid modernization decision process?*

2) *What considerations should be given to timing and pace for states beginning to consider grid modernization?*
Grid Modernization Strategies

3 strategic concepts are generally considered:

• **Adopt technology innovations to increase customer value, system reliability, resilience & security**

• **Enable customer choice & DER integration**

• **Enable opportunities for DER to provide grid services which in turn will create customer value through system efficiencies**

Note: It is important to not confuse business model questions with those related to the cyber-physical distribution system and the modernization that is required irrespective of who may develop and aggregate DERs, or who may operate the grid.
DSPx explored rational approaches for moving from Stage 1 to 2 over the next 5 years. These include maintaining traditional grid functions (reliability, security, efficiency), plus enabling DER integration at scale and operational value realization.
Modern Distribution Grid Report

A rigorous architectural approach to support development of grid modernization strategies and implementation plans based on best practices

**Volume I:** Maps Grid Modernization Functionality to Objectives
- Grid architectural approach that maps grid modernization functionality to state objectives within a planning, grid operations & market operations framework
  - Enables evaluation of functionality required to meet a specific objective

**Volume II:** Assessment of Grid Technology Maturity
- Assessment of the readiness of advanced grid technology for implementation to enable functionality and objectives identified in Volume I.
  - Enables evaluation of technology readiness for implementation

**Volume III:** Implementation Decision Guide
- Decision criteria and considerations related to developing a grid modernization strategy and implementation roadmap with examples to illustrate application
  - Enables development & evaluation of grid modernization strategies and roadmaps for implementation
State Objectives are Fairly Consistent

Leading to grid properties enabling DER utilization – though timing, scale and scope are different

<table>
<thead>
<tr>
<th>Objectives</th>
<th>CA</th>
<th>DC</th>
<th>FL</th>
<th>HI</th>
<th>IL</th>
<th>MA</th>
<th>MN</th>
<th>NC</th>
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Modern Grid Evolution

Needs & objectives drive grid capabilities and corresponding enabling business functionality and technology

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<thead>
<tr>
<th>Functions</th>
<th>Grid Capabilities</th>
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<th>DER Integration</th>
<th>DER Utilization</th>
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<tr>
<td></td>
<td>Reliability, Safety &amp; Operational Efficiency</td>
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<td>Market Operations</td>
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<td>Planning</td>
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Integrated Planning Considerations

Integrated planning and analysis needed within and across the transmission, distribution and customer/3rd party domains

From “Integrated Distribution Planning”, August 2016, prepared for the MN PUC, ICF International
Architecture Manages Complexity

The engineering issues associated with the scale and scope of dynamic resources envisioned in policy objectives for grid modernization requires a holistic architectural approach.

So, pick-up a pencil

Before trying to hang windows
Architectural Considerations

• Separate core infrastructure layers from modular applications:
• Communications in particular should be treated as a foundational infrastructure layer;
• Grid sensing and automation should be included
Platform Considerations

Core components are foundational; applications layer on this foundation as additional functionality is needed.

From DSPx, Volume 3 – Decision Guide, under review
Pace & scope of investments are driven by customer needs & policy objectives. Proportional deployment to align with customer value.
Cost Effectiveness Considerations

Grid modernization investments fall into several categories that may be evaluated under different methods for equitable attribution.

<table>
<thead>
<tr>
<th>No.</th>
<th>Expenditure Purpose</th>
<th>Methodology</th>
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<tbody>
<tr>
<td>1</td>
<td>Grid expenditures to replace aging infrastructure, new customer service connections, relocation of infrastructures for roadwork or the like, and storm damage repairs.</td>
<td>Least cost, best-fit or other traditional method recognizing the opportunity to avoid replacing like-for-like and instead incorporate new technology.</td>
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<td>2</td>
<td>Grid expenditures that will be paid for directly by customers participating in DER programs via a self-supporting margin neutral opt-in DER tariff, or as part of project specific incremental interconnection costs, for example.</td>
<td>These are “opt-in” or self-supporting costs, or costs that only benefit a customer’s project and do not require regulatory benefit-cost justification.</td>
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<td>3</td>
<td>Grid expenditures required to maintain reliable operations in a grid with much higher levels of distributed resources connected behind and in front of the customer meter that may be socialized across all customers.</td>
<td>Least cost, best-fit for core platform, or Traditional Utility Cost-Customer Benefit for “applications”</td>
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<td>4</td>
<td>Grid expenditures not paid for by customers adopting DERs or merchant DER developers (e.g., community solar or DERs for bulk power services) and not required for safety or reliability but are proposed to enable public policy and/or incremental system and societal benefits for all customers.</td>
<td>Integrated Power System &amp; Societal Benefit-Cost (e.g., EPRI and NY REV BCA)</td>
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</table>

From Modern Distribution Grid Volume III – Decision Guide, under review
1. Identify Customer Needs & Societal Objectives
2. Identify Capabilities & Functionality Needed
3. Develop a Grid Architecture
4. Develop Related Designs
5. Select Appropriate Grid Technologies
6. Develop a Roadmap aligned to Pace & Scope of Needs
7. Implement Proportionally to Customer Value
Thank You

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References:

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