Business Case for Microgrids

Modern Grid Partners  |  5.8.2017  |  CONFIDENTIAL
Modern Grid Partners

WHO WE ARE

We are your trusted advisor and grid experts!
- Our mission is to help utilities embrace grid modernization
- Our team brings decades of industry knowledge, experience and dedication to help utilities succeed in an ever-changing and evolving industry
- We develop the operational and organizational solutions to get you to your goal

WHAT WE OFFER

Complex Smart Grid Needs, AMI, GIS, OMS, DMS, CIS, MDM, EMS, and more!
- Business Case Development
- Customer Experience / Stakeholder Engagement
- Executive Advisory
- Grid Modernization Strategy
- IT/OT Transformation
- Metering and Meter-to-Cash Optimization
- Network Design + Build
- Program / Project Management
- Systems Implementation
- Telecommunications

OUR CUSTOMERS + PARTNERS

Organizations We Support
Expensive infrastructure upgrades...

Extreme weather events...

Critical service needs...

Unpredictable costs, increasing extreme weather due to climate change, and the need for critical services every day and in cases of emergency means we need local, reliable, and resilient power.
High delivery costs shows a need for local power resources in the Northeast

- Northeast transmission costs are double the costs in the rest of the country because we have less transmission installed compared to other independent system operator (ISO) or regional transmission operator (RTO) regions.

Forecast of Northeast Power and Average U.S. Electricity Price Components (2015-2025, $/MWh)

ISO/RTO Region Statistics, at the end of 2014

<table>
<thead>
<tr>
<th>ISO/RTO</th>
<th>Installed Generation (MW)</th>
<th>Transmission (miles)</th>
<th>Population (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAISO</td>
<td>57,124</td>
<td>26,000</td>
<td>30</td>
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<tr>
<td>ISO-NE</td>
<td>31,000</td>
<td>8,600</td>
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<tr>
<td>MISO</td>
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<td>NYISO</td>
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<td>11,086</td>
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<tr>
<td>PJM</td>
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<td>61</td>
</tr>
<tr>
<td>SPP</td>
<td>58,982</td>
<td>50,575</td>
<td>15</td>
</tr>
</tbody>
</table>

Data Source: 2015 ISO/RTO Metrics Report

Data Source: EIA 2017 Annual Energy Outlook
Traditional and localized solutions to meet future energy needs

- Microgrids can provide a framework to manage demand reduction measures and local generation and storage.

How do we meet this future need?

Traditional Solution
- ETC.
- POLES
- WIRES
- TRANSMISSION UPGRADES
- CENTRALIZED GENERATION

Localized Solution
- ETC.
- STORAGE
- GENERATION
- DEMAND RESPONSE
- ENERGY EFFICIENCY

Can be supported with a microgrid!
Microgrids connect resources, users, and the utility grid

“A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island mode.”

- US DOE Microgrid Exchange Group, October 2010
Microgrids are already deployed and concentrated where transmission is needed

- As of 2015 124 microgrids were in operation across the U.S. with a total generation capacity of 1,169 MW.

- 48% of microgrids are in the Northeast (29%) and West Coast (19%) states

- States with the most microgrids
  - California (23)
  - Alaska (12)
  - New York (10)
  - Hawaii (8)

- Northeast states funding microgrids
  - Connecticut, $48 million for 11 projects in 2012
  - New York, $40 million for 83 feasibility studies in 2016
  - Massachusetts, TBD in Summer 2017

- Additional Maine microgrid announced in 2016
  - $12.4 million collaboration between Emera Maine, Nova Scotia Power, Toronto Hydro, Opus One Solutions, Advanced Microgrid Solutions, and Ryerson University

Image Source: Greentech Media Research North American Microgrids 2015
Microgrids provide value to many stakeholders

- Industrial and commercial users have greater power reliability
- All users reduce outage duration
- All users can be suppliers or users
- Increased resilience during major storms
- Increased reliability for municipal services and commercial areas
- Potential carbon emissions reduction
- Reduced capital costs for transmission upgrades and expansion
- Reduced capital costs for distribution upgrades and expansion
- Potential storm restoration cost reduction
- Generators can sell electricity within microgrid
- Equipment vendors have a market for generation, storage, controls, etc.
- Local electricians can install equipment for customers
- Developers can integrate solutions, manage project partners
- Financers can provide debt financing, building loans
- Meet goals for grid modernization, reliability, renewables integration, storage integration, EV network deployment, energy efficiency and demand response
- Potential to reduce rate payer costs

Microgrids are a venue for suppliers to provide services and products, and are a means for utilities and regulators to meet performance goals.
Detailed planning and engagement ensure microgrid success

- Engage the utility and end users early, define goals to be met by microgrid-enabled products and services.

- Define interconnection point of common coupling
- Provide electricity usage and pricing baseline data
- Provide generation, storage, efficiency baseline data
- Collaborate for grid performance and security

- Define incentives for microgrid adoption
- Reduce barriers for transactions within a microgrid
- Review deployment to ensure policy goals and public benefits are achieved

- Manage program and procurement
- Supply equipment and systems
- Install and integrate equipment and systems
- Operate microgrid as owner or partner with others

- Identify critical neighborhoods and services
- Define how much everyday and emergency load to be served
- Provide electricity usage baseline data
- Provide generation, storage, efficiency baseline data
Develop services to meet community needs by matching supply and demand

- Microgrids can build upon a community’s existing energy technology portfolio to enhance performance.

- Microgrids are about serving local demand, and not about geographic or capacity size

- Define critical service and their energy usage
  - City or Town Hall, Police, Fire
  - Community centers
  - Telecommunications center
  - Senior centers, assisted living, hospitals
  - Department of Public Works, Water, Fuel
  - Pharmacy and other Commercial

- Identify existing and potential new resources
  - Distribution Automation (e.g., Supervisory Control and Distribution Automation (SCADA), feeder monitors, automatic switches)
  - Generation (e.g., Solar PV, fuel cell, diesel generator, microturbine)
  - Energy Storage
  - Combined Heat & Power (CHP)

- Define microgrid nodes
Microgrid nodes provide everyday and emergency power

- Each microgrid node has its own controller, and a point of common contact that can be controlled by a larger Network Operating Center and utility network controls.

- Microgrid node capabilities
  - Dispatch energy and capacity resources
  - Monitor power quality and potential faults
  - Serve as platform for customer-to-customer transactions

- Regulatory considerations
  - Rate structure
  - Utility-like obligations for non-utilities
  - Asset ownership and risk of cross-subsidization
  - Allocation of monetizable and non-monetizable benefits
  - Financing options

- Technical considerations
  - Data availability
  - Existing network automation available
  - Coordination for islanded and grid-connected operations
  - Firmware, hardware, software coordination for multilayer-device communications and controls, advanced protection