The Microgrid Phenomenon

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Recent microgrid capacity growth has been at the rate of 39% per year in North America and 58% globally.
Who Is Building Microgrids in the U.S.?

- Islands / Remote Locations: 21%
- Commercial / Industrial: 14%
- Cities / Community / Public Institutions: 12%
- Utilities: 12%
- Military Installations: 13%
- Universities / Research Facilities / Hospitals: 28%

Source Data: Navigant Research
Utility Involvement in Microgrid Projects is Growing Rapidly

Utility Involvement in U.S. Microgrid Projects

U.S. Microgrid Projects as of 2016 2Q

- Community: 21%, Other: 0%
- Institutional Campus: 9%, Utility Involvement: 9%
- Commercial/Industrial: 27%, Utility Involvement: 8%
- Military: 8%, Utility Involvement: 0%
- Remote: 34%, Utility Involvement: 34%
- Direct Current: 0%
Benefits for Utilities

• Improved system reliability
• New source of ancillary services
• Reduced needs for capital infrastructure investment
• Greater capacity to accommodate intermittent renewable resources
• Ownership provides new revenue stream
Benefits of Utility Involvement

1. Systems would be less encumbered by legal and regulatory uncertainty / could be deployed within the current regulatory framework
2. Uninhibited customer recruitment and participation would allow DERs to be optimally sized
3. Cost savings by avoidance of duplicate wires investment
4. Able to leverage utility’s knowledge and expertise to strategically locate microgrids and maximize overall value to grid
5. Utility ownership will prevent arbitrary cessation of operations and abusive or deceptive business practices
Potential Areas for Partnering

- Interconnection Facilities
- System Design
- Project Financing
- Microgrid Management
Case Example: St. Paul Island Alaska

• The Problem: High electricity costs and reliability issues at the island’s airport and accompanying industrial facility

• The Solution: TDX power installed a microgrid
  – A 225 kW wind turbine
  – Two 150 kW diesel generators

• The Mechanics:
  – Heat recovery from diesel generators used for space heating (CHP)
  – Excess wind energy diverted to secondary loads

Economics

• Costs:
  – $1 million (with no grants)
  – Incremental O&M: $60,000/year

• Benefits:
  – Reduced electricity charges: $200,000/year
  – Reduced diesel fuel costs
  – 99.9% system availability / less than 8 hours/year downtime
Case Example: Peña Station NEXT - Denver
A Public/Private Partnership

Five Core Elements

- 1 MW / 2 MWh Lithium ion battery system
- 1.6 MW carport solar PV
- 259 kV rooftop solar PV
- Panasonic’s Denver operations hub building (serves as initial anchor load)
- Switching and control systems

Benefits/Services

- Solar grid integration
- Grid peak demand reduction
- Energy arbitrage
- Frequency regulation
- Resilience through backup power

Intended as pilot project under Xcel Energy’s $10.3 million battery demonstration project.

Other stakeholders:
- Younicos (advanced energy storage solution provider)
- City and county of Denver and Denver International Airport
- L.C. Fulenwider, Inc. (real estate developer)
- Panasonic (anchor corporate tenant)
Case Example: Potsdam, NY

- **The Problem:** Intense storms producing multiple-day outages
- **The Solution:** Potsdam resiliency microgrid serving critical facilities
- **Major Stakeholders:**
  - Clarkson University
  - SUNY Potsdam
  - Village of Potsdam Offices
  - Canton-Potsdam Hospital
- **Funding**
  - DOE: $1.2 million
  - GE: $300,000
  - NYSERDA: $381,000
Potsdam, NY Microgrid
Value Flow

Partners

Distributed Generators
(partners and technologies TBD)

Utility

nationalgrid

Microgrid Participants

Microgrid Participants
e.g. Hospital, Bank, Grocery/Pharmacy, Gas Station, etc.

Microgrid Participants with Customer DG
e.g. Village (PD, FD, Water treatment, etc.)

Other Beneficiaries

County
Town
Village

Service fees (> O&M)
Rate of return on investment

Resiliency, community engagement

Growth via expanded market
Case Example: Marine Corps Air Station Yuma

- Owned, Operated, and Maintained by Arizona Public Service
- Will provide 100% of facility’s electricity requirements during general outage
- Provides grid stabilization and peaking power to general grid during regular operations

- Project site covers 1 acre of land
- 22 MW generating capacity
- Currently powered by diesel engines, but built to accommodate solar and energy storage
APS Microgrid Projects

**Military Base**
- 22MW Tier 4 diesel generation
- In service December 2016
- 26 Autonomous Frequency Response events since February 2017
- 1 dispatch for capacity event
- Capable of adding energy storage and solar PV in future

**Data Center**
- 11MW Tier 4 diesel generation; Integrated UPS (Phase 1)
- In service December 2016
- 17 Autonomous Frequency Response events since April 2017
- 1 dispatch for capacity event
- Capable of adding solar PV and additional energy storage capacity
- DC has requested to begin Phase 2 planning (Add 22MW)
- DC full build out will be ~60MW
Case Example: Green Mountain Power, Stafford Hills, Vermont

- Built on a brownfield site as part of an urban revitalization effort in Rutland City, Vermont.
- Solar plus storage microgrid.
- 2 MW of solar panels
- 2.4 MWh battery
Green Mountain Power, Addison County
Virtual Power Plant, Vermont

• GMP is a partner in this project.
• GMP installed solar plus storage microgrids on 14 homes – free of charge.
• The microgrids were installed for low-income tenants.
• GMP aggregates home microgrids into a virtual power plant that it can discharge during periods of high demand.
• Project Goal – lower the transmission and capacity charges it pays to ISO New England & ease costs for low-income customers.
The Microgrid: A “Foul Weather” Friend!!

The Enchanted Rock microgrid kept 21 convenience stores and gas stations in the Houston area up and running during Hurricane Harvey.

A microgrid in St. Croix is still providing power after much devastation and general outages in the aftermath of Hurricanes Harvey, Irma, and Maria.

Microgrids in Haiti facilitated restoration of power after Hurricanes Irma and Matthew.

APS’s two microgrids (Yuma Station and Aligned Data Centers) provided much needed peaking power during the heat wave in Phoenix last June.
Microgrid Issues for Utilities

- **Maximize stakeholder involvement** in design and subsequent phases of the project
- **“Level playing field”** for ownership of distributed energy resources
- **Cost recovery**: when is recovery through base rates justified?
- **Justification** of microgrid when reliability benefits provided by it are not least cost
- **Fully utilize available financing sources** (e.g., grants, prizes)
Private capital providers for microgrids must get a return on their investment, but microgrid users must have an incentive to be part of one.
Thank You!

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