Lessons Learned from Energy Commission Microgrid Research Activities

California Energy Commission
California Energy Commission Major Research Programs

• **Electric Program Investment Charge (EPIC)—Administered by the CPUC**
  - Ratepayer-funded program to benefit ratepayers
  - Administered by the Energy Commission and three Investor Owned Utilities (PG&E, SCE, and SDG&E)
  - Energy Commission Program ~ $130 M/year

• **Natural Gas RD&D—Administered by the CPUC**
  - Approximately $24 M/year

• **Special Funds** (e.g., climate vulnerability, transportation research)
Clean-Energy Microgrid Status in California

• **Trends...**
  - Limited deployment
    - Most are Energy Commission research projects
  - R&D projects demonstrating value
    - Successful facility support during major storms and fires
    - Offer 4 – 8 hours of power during grid outage
    - 20%-40% reduction in energy costs
    - Grid support with reduced congestion, voltage regulation

• **...Challenges Remain**
  - High costs
    - Up front costs can be difficult for many site owners
  - Individually designed
    - Not matured to plug and play capability
  - Long implementation schedule
    - 18 – 36 months to full implementation
A Decade of Microgrid Research
Deploying the Largest Number of Installed Microgrids

39 microgrids | $90M invested | $71M match funding

- Increasing resiliency
- Maturing microgrid control technologies
- Learning best approaches to integrating multiple resources
- Sharing lessons learned and best practices
- Driving down costs and establishing deployment norms
Diverse Combination of Microgrid End Users

Critical Facilities
- Shelter
- Medical Center
- Fire Stations
- City Hall, Police HQ, and Community Centers
- Waste Water Treatment Plant
- Airport

Ports
- Distribution Center

Communities
- Digester
- Industrial
- City Hall, Police HQ, and Community Centers

Military
- City Hall, Police HQ, and Community Centers
- Waste Water Treatment Plant
- Airport

Industrial
- Distribution Center
Lessons Learned from Microgrid Research

• Currently microgrids are individually designed, implemented and managed
  • Site design and grid interconnection approval major time factor
• Interest in microgrids has expanded dramatically over the last few years
  • Public Safety Power Shutoffs major factor in California’s increased interest
• Business case for microgrids still under development
  • Up front cost a challenge for most end users
  • Full value and benefits provided by the microgrid still being defined
• Three main ownership models (Utility, Customer, Third Party)
Utility Owned Microgrid—Borrego Springs

- First large scale utility-owned microgrid
- Actually islands real customers
- Alternative service delivery model
- Proved advanced technologies for future applications
- Established a model to be used by other utilities both nationally and internationally
- Operation in a 100% renewable environment
Customer Managed Microgrid—Microgrid at Blue Lake Rancheria

Microgrid Design

Solar: 420 kW AC photovoltaic (PV) ground-mounted array

Energy Storage: 500 kW / 950 kWh lithium-ion (Li-ion) battery storage

Software & Controls: Siemens Spectrum Power 7 Microgrid Management System and Schweitzer Engineering Laboratories Protection Relays

Other Infrastructure: Purchased distribution system infrastructure to create a new point of common coupling with the grid, integrating six buildings into the microgrid behind one electric meter

Technology Integration: The Schatz Energy Research Center at Humboldt State University

UNIQUE PROJECT ASPECTS

- Critical facility serving as an American Red Cross designated shelter.
- Successfully islanded during several unplanned utility outages due to weather and nearby wildfires. The microgrid can deploy five levels of load shedding depending on the outage and system conditions.
- Achieving energy cost savings of 58% and demand charge savings of 42%.
- Plans to double the battery storage system, add solar PV, integrate more electric vehicle charging stations, and participate in demand response programs.
Microgrid Design

Solar: 115 kW total carport solar PV (38 kW at Fire Station 11, 43 kW each at Fire Stations 6 and 7)

Energy Storage: 110 kWh li-ion battery storage at each fire station (totaling 333 kWh)

Software & Controls: Gridscape Solutions’ cloud-based predictive distributed energy resource management software (DERMS) and energy management system – EnergyScope

Other Infrastructure: None

Technology Integration: Gridscape Solutions

UNIQUE PROJECT ASPECTS

➢ The solar + storage microgrid displaces diesel generation and extends fuel reserves in the event of a catastrophic emergency, keeping the fire station online longer as a viable first responder.

➢ The first fire station deployment was characterized by extensive prototype development and testing, refined over the next two deployments. Grant recipient Gridscape Solutions developed the EnergyScope product through this project.

➢ The systems have successfully executed 3-hour and 6-hour islanding tests, with plans for a 12-hour test.

Source: Navigant

Source: Ecology Way
Lessons Leaned from Microgrid Research

LESSONS LEARNED FOR POLICYMAKERS

• Costs have continued to decrease, but must come down further for an attractive ROI in the absence of grants

• Analyzing data from operating microgrids will be increasingly important as the market grows and matures

• The EPIC-funded projects significantly improved the understanding of microgrid best practices in CA

• Modular or simple building block microgrid designs need to be defined if a rapid deployment of microgrids is desired

• Microgrid controllers and communication protocols need standardization

• Utility interconnection requirements need further standardization

• Longer duration islanding capabilities (days vs hours) may be required in the future
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