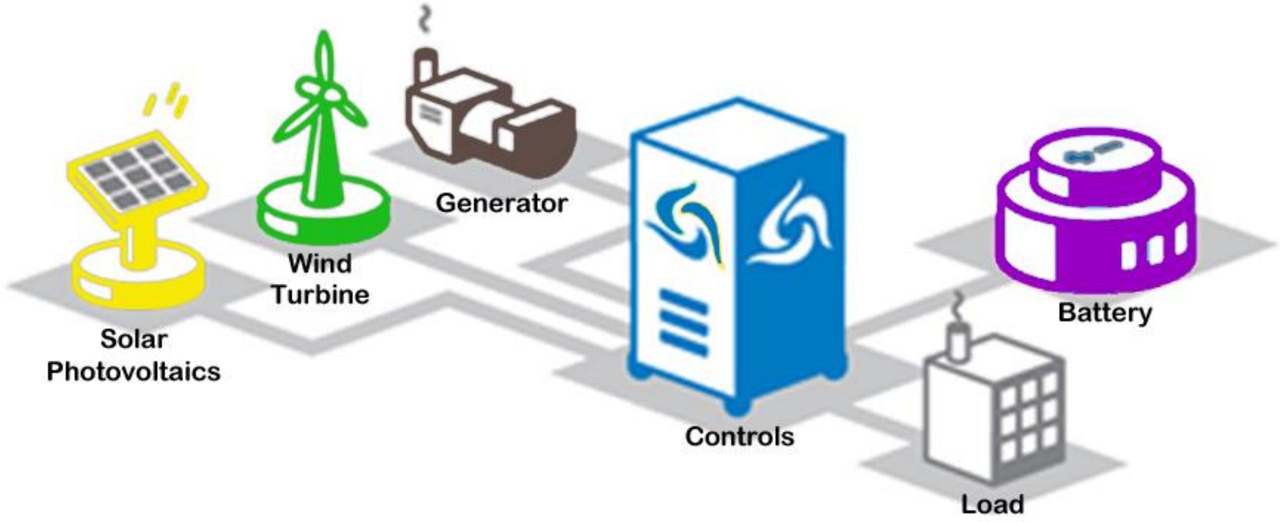
GREEN TRENDS FOR SUSTAINABLE LIVING IN AFFORDABLE HOUSING

MICROGRIDS

EMERGING TOPICS PAPER SERIES
WORKING PAPER #23



2015

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Enterprise green communities

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MICROGRIDS

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This document provides an overview on microgrids. It is part of a series of profiles to introduce affordable housing practitioners to emerging trends in green, sustainable living. Contained below are a brief introduction to microgrid technology, trends in the microgrid market, potential financing sources for microgrid projects, and case studies of innovative microgrid implementations.

I. Introduction

Microgrids are small-scale, community-level power networks. Although most microgrids connect to the existing electricity distribution networks that currently power cities, they have “islanding” capabilities that allow them to operate independent of the larger grid.

Microgrids consist of components that generate, control, distribute, and store, power. A control system coordinates multiple generation sources (e.g. PV panels, wind turbines, diesel generators), distributes and manages power based on load response (i.e., consumption from a geographic area), and stores excess energy for later use.

Microgrids typically have generation capacities in 10–50 MW range, enough to 1,000-50,000 homes.

Technologies leveraged in microgrids can include:

- Photovoltaic (PV)
- Wind
- Gas-fired electricity generation
- Electric vehicles
- Electrical and thermal storage
- Fuel cells
- Combined heat and power (CHP)
- Demand response (DR) controls

II. Sector Trends

The microgrid sector is very young and emerging, with high projected growth. Microgrid energy generation is projected to grow 330% over 2011 to 2017, with worldwide revenues increasing 467%, from $3 billion to $17 billion. North America, with 66% of world market share, will continue to drive global market growth with 2,505 MW in development, enough to power 250K-2.5M homes.

Several factors will likely undergird this projected growth:

- **Local Risk Profiles:** Microgrids can provide grid independence to mitigate exposure to system failures and associated costs from natural disasters (e.g., Hurricane Sandy).
- **Efficiency:** Transmission and distribution of power over long distances is inefficient.
- **Security:** Microgrids and smaller scale energy supplies are less vulnerable to system-wide energy supply concerns related conventional and cyber-terrorism
- **Federal, state, and local incentives:** These are often critical to making the financial case for microgrids, and even with these incentives, microgrid projects tend to require investors who can tolerate long payback periods.
- **Decreasing technology costs:** As technology components (e.g. PV panels, control systems, storage technology) become more affordable and conventional energy costs rise, the financial case for microgrids improves.

II.A. National Incentives

There are a number of potential funding sources to facilitate the launch of microgrids. The following federal incentives and financing opportunities might be available for microgrid projects.

- Investment Tax Credit (ITC)
- MACRS 5 year + 50% first year bonus depreciation
- New Markets Tax Credit (NMTC)
- Associated green incentives
- Alternative USG Funding (i.e. DOE)

Renewable energy projects are often eligible for federal tax incentives, notably the Investment Tax Credit (ITC) and depreciation incentives. Some elements that might not be considered renewable on their own may become eligible when included in green energy systems. For example, in a residential energy storage project by the

Sacramento Municipal Utility District, battery backups are included as part of PV systems being installed, and are therefore eligible for a 30% ITC. Note that the ITC and depreciation incentives are not transferable, and are therefore only applicable to entities that will have a tax liability large enough to make them worthwhile.

Microgrids in disadvantaged or low-income locations might be eligible to reduce out-of-pocket project costs with the New Markets Tax Credit (NMTC). One recent example is a 1MW solar installation in Denver.

II.B. State Opportunities

On state level, potential financing sources may include:

- **Renewable Portfolio Standards (RPS)**
- **Renewable Energy Credits (RECs)**
- **State legislature**

Factors at the state and municipal level that can affect the financial case for microgrids:

- **Renewable Portfolio Standards (RPS):** RPS mandate a certain percentage of utility power from renewables. RPS laws in 16 states (plus Washington, D.C.) include specific solar and/or distributed generation requirements, which would be satisfied by microgrid technology.
- **Renewable Energy Credits (RECs):** Incentivize renewable power production by allowing sale of renewable energy credits to utilities who need to meet their RPS requirements. Revenue based on power generated and statewide REC demand can speed up microgrid payback periods.
- **Cost per kWh:** States with high retail cost per kWh provide financial incentive to develop renewables. Recent state-by-state cost per kWh data is available here.
- **Regional or municipal environmental risk profiles:** Regions or municipalities that face increased risk of such environmental hazards that cause power outages (e.g. hurricanes, coastal flooding, earthquakes, wildfires) are more likely to embrace the heightened energy security that microgrids can offer.
- **State legislature:** The state of California, in particular, views microgrids as a way of achieving several state energy policies and goals, including reducing emissions and increasing renewable energy production. Earlier this year, the California Energy Commission awarded UC San Diego $1.8 million for its microgrid projects.

II.C. Other Factors

The following region- and project-specific factors might make the case for including microgrid technology in your development stronger.

Hazards

- Coastal flooding
- Hurricanes/tropical storms
- Tornados
- Earthquakes
- Wildfire

Vulnerabilities

- Frequent/extended power outages due to natural events or antiquated grid infrastructure
- Remote communities far from the grid

Opportunities

- Good solar exposure
- Steady wind
- Access to organic feedstock for biogas production (e.g. food waste, manure)

Other

- Resident demand for energy security and/or sustainable lifestyle
- Upcoming financing milestone and/or capital repair campaign

III. Case Studies

(Image source.)

III.A. Housing Developments

Co-op City
Location: Bronx, NY, mixed-use facility covering 320 acres.
Scale: 60,000 people in 15,372 units; 35 high-rise buildings, 7 townhouse clusters, 3 major shopping centers, and more
Owner: RiverBay Corporation
Manager & Operator: Marion Scott Real Estate, Inc.

Financial Case
Cost: $65 million
Utility savings: $15 million per year
Payback Period: 3-5 years
Variable: Excess power sold back to the grid.
Energy: 38 Megawatts
Funding Sources: $23 million DOE Grant

Co-op City, the largest residential development in the US, operates a microgrid powered by a 38 MW Combined Heat and Power (CHP) plant. 60,000 residents of Co-op City maintained electricity during and after Hurricane Sandy when neighbors were without power.

Co-op City sits on reclaimed marshlands; settling earth caused infrastructure in the development to age more quickly than expected. By 2003, immediate capital repairs were necessary, and planning for them was underway. In August of that year, New York City suffered a daylong blackout, and Co-op City's in-house generator was not able to operate. This ensured that utility self-sufficiency would be part of the capital improvement plan. The microgrid was built as part of a $480 million capital repairs and new construction campaign in 2003.

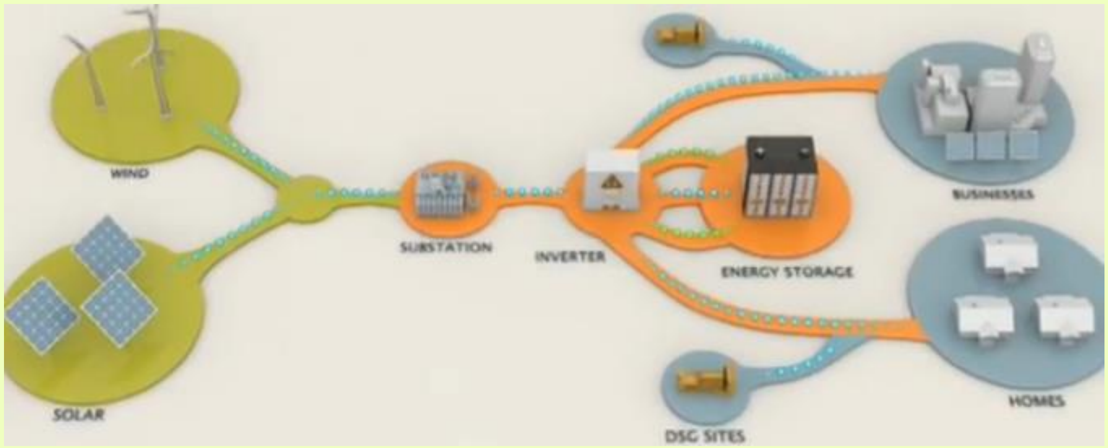
Key factors:

- Inclusion of microgrid in larger capital repairs and new construction budget made it easier to finance
- Resident demand for energy independence due to fresh memory of blackout
- Housing cooperative organizational structure aligns construction plans to resident demands

III.B. Municipalities

Salem Smart Power Center
Location: Salem, OR
Scale: 500 residential and commercial utility customers.
Partners: Portland GE, EnerDel, Eaton, DOE, Battelle, Oregon State Data Center, Oregon Military Department and the Anderson Readiness Center
Website: Portland General Electric

Financial Case
Cost: $178 million
Utility savings: Unknown
Payback Period: Unknown
Variable: Utility revenue/savings/tech
Energy: 5 Megawatts
Funding Sources: DOE



(Image source.)

This facility will initially serve 500 PG&E (local utility) residential and commercial customers. It is part of the Pacific Northwest Smart Grid initiative, a $178 million initiative that will eventually involve more than 60,000 metered customers and 11 utilities in over 5 Pacific Northwest states.

Salem Power Center is innovating community-wide solutions to store energy from inconsistent sources like solar and wind, integrate renewable energy sources and microgrids into existing networks so that homes can connect with the cheapest power sources at any given time and rely on existing networks as a back-up.

Key innovations:

- **Breakthrough energy storage:** lithium-ion batteries storing renewable energy that is not immediately consumed
- **Locally generated power:** Salem-based Kettle Brand potato chip company connects its 616 solar panels to the grid and monitors usage
- **Resource sharing:** A two-way loop between homes and power plant helps manage load during peak hours instead of funneling renewable energy one way.

IV. Additional Resources

- HOMER Energy Blog's Microgrid learning series: blog.homerenergy.com/the-microgrid-learning-series-introduction-and-overview
- Siemens: The business case for microgrids: w3.usa.siemens.com/smartgrid/us/en/microgrid/Documents/The%20business%20case%20for%20microgrids_Siemens%20white%20paper.pdf
- DSIRE database of federal, state, and local renewable energy incentives: www.dsireusa.org

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