



UTILITY MICROGRID INTEGRATION PLAYBOOK

ASSETS FOR RISK REDUCTION, RESILIENCE AND RELIABILITY

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Introduction: Accelerate Risk Reduction and Resiliency

The Microgrid Integration Program Playbook provides utilities and critical infrastructure providers with a framework to incorporate small- and large-scale microgrids as a cost-effective solution within their risk mitigation toolkits. Addressing the pressing needs of aging infrastructure, rising demand, and increasing risks from severe weather and wildfires, this playbook outlines essential phases, stakeholders, and best practices for integrating microgrids as resilient assets. By embedding microgrids within their risk mitigation plans, organizations can reduce reliance on vulnerable infrastructure, enhance system reliability, and support clean energy goals through scalable, localized power solutions.

Goals of a Utility Microgrid Integration Program

For utilities and critical infrastructure providers, microgrids offer a transformative, cost-effective alternative to traditional grid hardening solutions like undergrounding and line replacements. Positioned behind the meter, microgrids reduce operational and outage risks by replacing vulnerable distribution lines in remote and high-risk areas, delivering localized, resilient power that decreases reliance on aging infrastructure and diesel fuel. This approach not only enhances service reliability but also reduces wildfire and weather-related risks, avoiding the high costs associated with extensive infrastructure upgrades.

Grid-tied microgrids complement these grid modernization and risk reduction efforts by offering grid services that stabilize load demands, reduce high-cost energy purchases, and enhance overall operational efficiency. Integrated at a portfolio level, microgrids bring resilience and economic value across diverse sites—from utility customers to critical infrastructure such as water pump stations and telecom facilities—ensuring stable power under challenging conditions.

BoxPower's Microgrid Integration Playbook provides utilities with a scalable strategy to deploy these solutions, reducing operational risks and supporting grid modernization, distributed energy resource (DER) deployment, and the transition to a cleaner, more resilient energy future.



The primary goals of a Utility Microgrid Integration Program include:

- **Renewable Reliability:** By targeting worst-performing circuits and remote areas, microgrids enable utilities to improve service reliability, reduce outages, and increase customer satisfaction without the need for extensive infrastructure overhauls.
- **Enhancing Grid Resilience:** Microgrids provide localized, autonomous power generation that mitigates risks from extreme weather and aging infrastructure. This is crucial given that 80% of major outages in the last decade were caused by weather events, a frequency that has doubled from the previous decade (Climate Central).
- **Reducing Capital Expenditure:** Microgrids offer a cost-effective alternative to traditional substation or distribution line upgrades. They provide similar reliability benefits with lower upfront costs, offering a scalable solution to utilities seeking to optimize their CapEx spending.

Grid modernization and risk mitigation plans should focus on cost-effective solutions like microgrids that facilitate, rather than hinder, the deployment of distributed energy resources (DERs) and enhance grid reliability and resilience. This is increasingly critical as the frequency and intensity of natural disasters continue to rise. Avoiding costly investments in outdated infrastructure is essential to ensuring the grid transitions smoothly to a more resilient and clean energy future without impeding the adoption of proven, cost-effective technologies.

Principles of a Microgrid Integration Program

The following principles support and reflect the above goals and should be present in some form in any Microgrid Integration program. They can be used as a framework to guide the Program's plans, investments, and initiatives.

A Utility Microgrid Integration Program should...

1. Enable innovation in technology and business models
2. Prioritize the integration, adoption, and optimization of microgrids as distribution system distributed energy resources (DERs)
3. Support and enable policy, hardening, risk reduction, modernization, expansion, and decarbonization goals of the distribution system



4. Empower equitable access to reliable, clean, and affordable energy resources -- people, communities, and businesses
5. Be considered a requirement and consideration of a credible Integrated Distribution Planning (IDP), Integrated Resources Plan (IRP), Natural Disaster Preparedness Plan (NDPP), and Wildfire Mitigation Program (WMP) processes
6. Track progress and impact routinely via metrics tied to the smart, measurable goals and objectives linked to the Utility's strategic initiatives

Examples of Microgrids as Utility-Owned Distribution Asset

1. Remote Grids for Wildfire Risk Mitigation

Example: Pacific Gas and Electric Company's (PG&E) Remote Grid Program

- **Problem:** High-risk wildfire areas with aging overhead power lines create safety concerns and frequent outages. Rebuilding distribution lines in these regions presents high costs and operational challenges.
- **Solution:** PG&E's remote grid program replaces overhead distribution lines with standalone power systems, providing clean, reliable energy to remote customers. These microgrids can operate independently, reducing the risk of ignitions and improving safety for high-risk communities.
- **Result:** PG&E has successfully minimized wildfire risks while providing energy to eligible customers in remote and wildfire-prone areas, avoiding the high costs of undergrounding.





2. Critical Infrastructure End-of-Line Rebuild

Example: Southern California Edison (SCE)

- **Problem:** A malfunctioning, end-of-life underground line serving a mountaintop site with critical telecommunications and emergency services (EMS) infrastructure experienced frequent outages, poor power quality, and capacity limitations due to temporary diesel generators. The area, also located near sensitive wildlife habitats, further complicated the potential for infrastructure rebuilding.
- **Solution:** A 75% renewable Remote Grid was deployed with a combination of 160kW PV, 780kWh Li-ion battery storage (BESS), and backup propane generation. This decarbonized energy supply met GHG reduction goals while eliminating the environmental impacts of undergrounding.
- **Result:** Consistent, high-quality power for critical infrastructure, with significantly reduced environmental impact and no need for costly underground rebuilds.



3. Seasonal Facility Microgrid for Resilience

Example: Liberty Utilities

- **Problem:** A seasonally de-energized research station on an end-of-line radial distribution system suffered frequent outages due to high winds, wildfires, and Public Safety Power Shutoff (PSPS) events. Upgrading 90 poles over four miles would have cost between \$3 to \$4 million per line mile.
- **Solution:** A 97% renewable grid-tied microgrid was implemented, featuring 20kW of PV, 69kWh of BESS, and backup propane generation. The system provides peak demand





reduction, time-of-use optimization, and can operate as a virtual power plant when the line is energized.

- **Result:** The microgrid not only improved reliability but also added the capability to generate and manage data for potential energy resale, maximizing the return on investment.

4. Rural Distribution Service Rebuild After Wildfire

Example: PG&E – Briceburg Fire Recovery

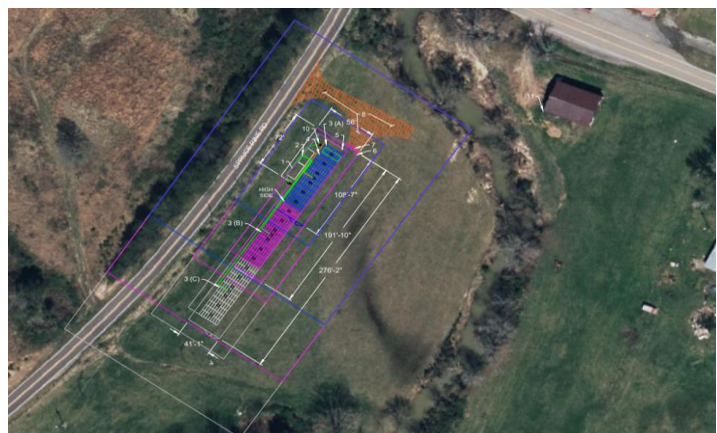
- **Problem:** The Briceburg Fire burned 5,200 acres, destroying several miles of distribution lines in the Sierra foothills. Rebuilding the lines would have cost between \$2 to \$5 million per mile, and long-term generator use was not allowed due to environmental regulations.
- **Solution:** A 90% renewable Remote Grid was installed with 32.5kW PV, 69kWh BESS, and backup propane generation, offering improved reliability and resilience.
- **Result:** Power quality improved, outages were virtually eliminated, and the microgrid became a permanent, low-cost solution for five residents, replacing the need for an expensive grid rebuild.



5. End-of-Line Reliability and Resiliency Improvement

Example: Confidential Electric Cooperative

- **Problem:** A distribution circuit ranked in the top 1% worst-performing for System Average Interruption Duration Index (SAIDI), with frequent outages affecting around 80 households at the end of a 17-mile feeder from the nearest substation.





- **Solution:** A distribution-connected microgrid was installed with 150kW PV, 450kWh BESS, and backup generation, providing a 4-hour islanded runtime and offering services such as peak load shaving and grid support.
- **Result:** The microgrid significantly reduced outage duration and improved grid reliability for this community. Additionally, the project was supported by the DOE ERA program and was eligible for Investment Tax Credits (ITC), further enhancing its economic feasibility.

Roadmap: Five Phases of Launching and Integrating a Microgrid Integration Program

The path to a successful program involves several interconnected stages, each with its critical activities.

1. **Feasibility and Planning: The foundation of a successful project lies in thorough planning and feasibility studies.**
 - **Critical Area Identification and Customer Engagement:** Identify critical customers and public/community sites for potential microgrid implementation. Factors to consider include risk index, community size, energy needs, existing infrastructure, and willingness to adopt new technologies. Early and transparent engagement with communities is crucial to building trust and ensuring their needs and priorities are incorporated into the project.
 - **Resource Assessment:** Conduct detailed assessments to evaluate the renewable energy potential in the target area. This includes analyzing solar irradiation, wind speeds, and other relevant factors to determine the optimal mix of renewable energy sources.
 - **Technical and Economic Feasibility:** Assess the project's technical and economic viability. This involves evaluating load profiles, developing microgrid system sizing and scenarios, running detailed financial models, applying technical performance standards, conducting risk assessments, and assessing regulatory and permitting requirements.
 - **Business Case Development:** Create a comprehensive business case that outlines the project's objectives, costs, benefits, and risks. This document will be the basis for securing internal approvals and attracting potential investors or partners.
 - **Procurement Strategy:** Establish a strategic procurement framework early in the planning phase to secure the necessary resources and vendor partnerships. Define specifications, sourcing requirements, and budget allocations to streamline the acquisition of



components and services, ensuring alignment with project timelines and scalability goals.

2. **Integration with distribution planning teams**

- **Integrated Site Selection and Design:** Embed microgrid site selection, feasibility analysis, and design processes within the broader distribution planning and operations framework, ensuring microgrid projects align with existing infrastructure strategies.
- **Coordinated Workflows and Priorities:** Establish coordinated workflows that streamline processes between microgrid and distribution teams, allowing for efficient resource use and shared insights.
- **Alignment with Distribution Hardening Goals:** Align microgrid program goals and priorities with current distribution hardening initiatives to enhance overall grid resilience and leverage synergies across projects.

3. **Contracting strategy for programmatic approach**

- **Vendor Selection and Qualification:** Identify and qualify eligible EPCs and service providers with expertise in utility-owned microgrids, recognizing the limited pool of vendors capable of supporting this emerging technology.
- **Requirements and Pricing Frameworks:** Develop clear, standardized requirements and flexible pricing models for microgrid projects to encourage vendor participation and streamline contract management.
- **Capacity-Building Through Clear Program Goals:** Set precise program goals and performance expectations to help vendors plan resources effectively and scale their capacity, supporting consistent and reliable execution as demand for microgrids grows.

4. **Design and Engineering: Once feasibility is established, the project moves into the EPC phase.**

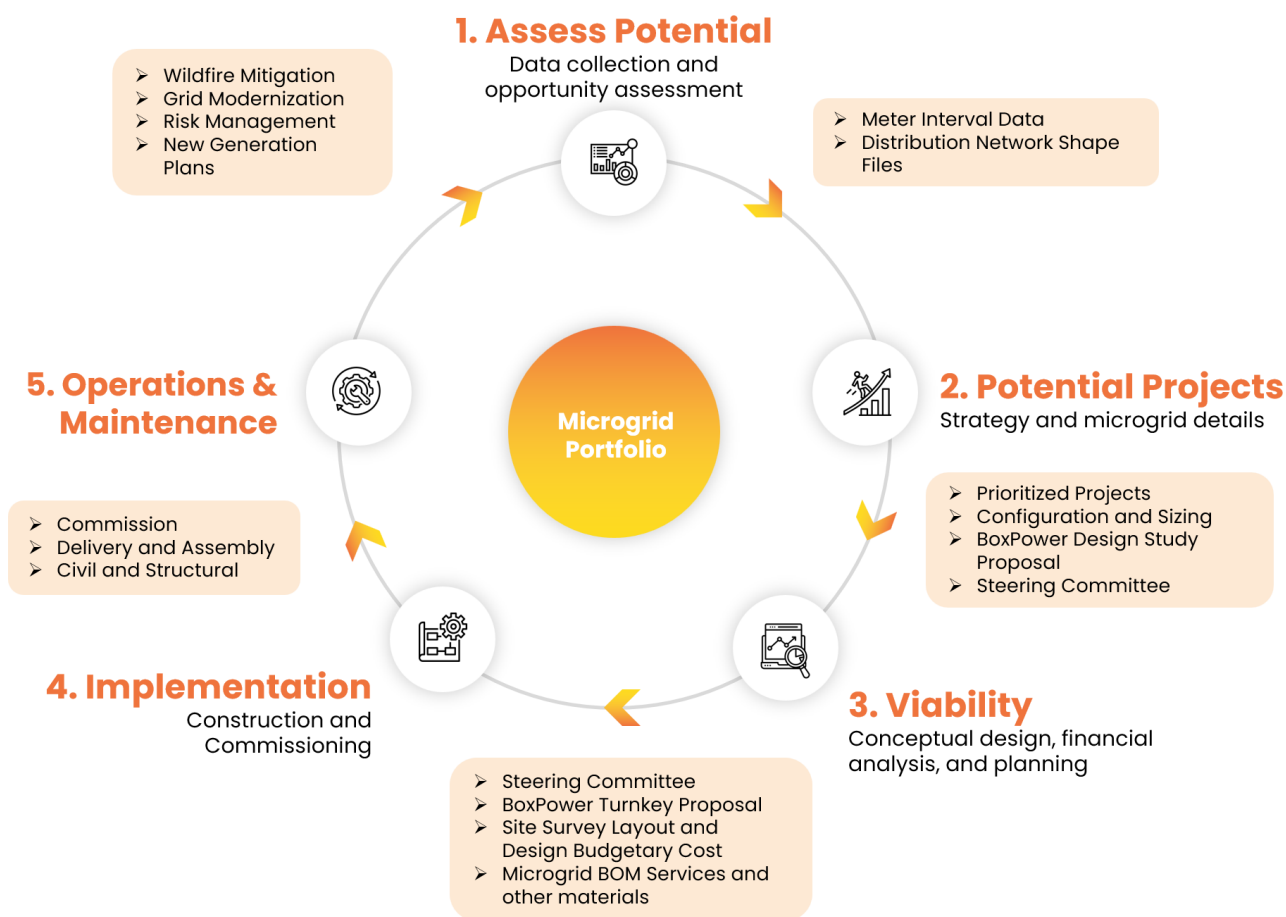
- **System Design:** Design a hybrid microgrid system that integrates renewable energy sources, energy storage, and backup diesel generators. The system should be optimized for reliability, efficiency, and cost-effectiveness, taking into account the community's specific needs and constraints.



- **Environmental Impact Assessment:** Conduct a thorough environmental impact assessment to identify and mitigate any potential environmental effects. This includes evaluating the impact on land, water, air quality, and wildlife habitats.
 - **Permitting and Approvals:** Secure all necessary permits and approvals from relevant regulatory bodies. This may involve engaging with local, state, and federal agencies to ensure environmental and safety standards compliance.
5. **Procurement and Construction: This phase involves procuring equipment and materials and constructing the microgrid infrastructure.**
- **Procurement:** Procure all necessary equipment and materials, including renewable energy generation assets (solar panels, wind turbines), energy storage systems (batteries), and microgrid control systems. Whenever possible, prioritize local suppliers and businesses to support the local economy.
 - **Construction:** Construct the microgrid infrastructure, including installing generation assets and energy storage systems and integrating control and communication networks. Implement robust project management practices to ensure timely and cost-effective completion.
 - **Community Involvement:** Maintain active engagement with the community throughout the construction process. Provide regular updates on progress, address any concerns, and ensure that the project benefits the community regarding job creation and local economic development.
6. **Commissioning and Operation: The final stage involves testing, commissioning, and ongoing operation and maintenance of the microgrid.**
- **Commissioning and Testing:** Conduct comprehensive testing and commissioning of the microgrid system to ensure all components function correctly and the system operates as designed.
 - **Operation and Maintenance:** Establish procedures for the microgrid's ongoing operation and maintenance. This includes remote monitoring and troubleshooting capabilities, as well as regular inspections and preventive maintenance activities.



- **Community Empowerment:** Provide training and support to local communities to enable them to manage and maintain the microgrid system effectively. This will empower the community to take ownership of the project and ensure its long-term sustainability.



Utility Investment and Commitment

Establishing a successful Microgrid Integration program requires significant investment and commitment from the utility.

- **Financial Investment:** Utilities must be prepared to invest substantially in microgrid program development. This includes capital expenditures for infrastructure development, technology acquisition, and ongoing maintenance and operation.



- **Technical Expertise:** Building and operating microgrids require specialized technical expertise. Utilities must have or develop engineering and project management capabilities to design, construct, and manage complex microgrid systems.
- **Regulatory Engagement:** Navigating the regulatory landscape is crucial for the success of microgrid projects. Utilities must proactively engage with regulators to understand and comply with policy frameworks and secure necessary approvals.
- **Community Partnership:** Building strong and trusting relationships with local communities is essential. Utilities need to demonstrate a commitment to transparent communication, capacity building, and shared benefits to ensure the project's long-term success and acceptance.

Stakeholders and Partners

The success of a microgrid integration program depends on effective collaboration with various stakeholders and partners.

- **Local Communities:** The primary beneficiaries of the microgrid integration program. They seek affordable, reliable, clean energy solutions supporting economic development and self-determination. Engaging with communities early and often is crucial to meeting their needs and priorities.
- **Indigenous Groups:** In many remote areas, Indigenous groups play a vital role in project development. They prioritize energy sovereignty, environmental stewardship, and cultural preservation. Building meaningful partnerships with Indigenous communities based on mutual respect and understanding is essential.
- **Government Agencies:** Government agencies at various levels provide funding, policy support, and regulatory oversight for microgrid projects. Collaborating with government agencies is crucial to securing funding, navigating permitting processes, and ensuring compliance with regulations.
- **Technology Providers:** Technology providers offer innovative solutions for renewable energy generation, energy storage, and microgrid control systems. Partnering with technology providers can help utilities access cutting-edge technologies and expertise.



- **Financial Institutions:** Financial institutions are crucial in providing project financing and investment capital. Building relationships with financial institutions and demonstrating the economic viability of microgrid projects is essential to secure funding.

Best Practices

Several strategies can help to accelerate the integration and adoption of Microgrid Integration programs.

- **Leverage, Validation, and Proof Points:** Connect with your peers in the industry and learn about their microgrid integration programs. Highlight case studies of successful microgrid implementations that demonstrate tangible benefits for communities, the environment, and the grid.
- **Partner with industry leaders and innovators:** Collaborate with technology providers, research institutions, and other industry leaders to stay at the forefront of microgrid advancements. This can help utilities access the latest technologies and expertise to optimize their programs.
- **Partnerships and Collaboration:** Forge strong partnerships with Indigenous groups, government agencies, technology providers, and financial institutions. Leverage their expertise and resources to overcome challenges and achieve project objectives.
- **Emphasize grid resilience and wildfire mitigation:** Highlight the role of microgrids in enhancing grid resilience and reducing the risk of wildfires. This is particularly relevant in areas prone to wildfires, where microgrids can provide a more secure and reliable energy supply.
- **Leverage government funding and incentives:** Use available government funding programs and incentives to offset project costs and accelerate deployment. This can help reduce utilities' financial burden and make microgrid projects more attractive.

Utilities can establish successful programs that deliver lasting benefits to communities, the environment, and the grid by embracing these best practices and leveraging available resources. The transition to a decentralized and sustainable energy system is underway, and microgrids offer a promising path forward for utilities to meet the challenges and opportunities of the future.