WHITE PAPER

Remote Microgrids as a Stepping Stone Towards Decarbonization

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One of the major trends in the energy industry today has been the growing shift in the basic architecture of the electrical grid from the traditional hub-and-spoke model to a distributed generation model. The traditional model with large centralized generation facilities that have distribution and transmission networks to serve its customers has been the default way to provide power since 1882[1]. At the time, this architecture was ideal to generate large amounts of baseload power and transmit it over long distances to serve many customers from a common source. However, as the demand for energy grows globally, this architecture has to evolve to meet the needs and goals of today's customers in terms of system reliability, efficiency, cost and sustainability.

The shift to distributed energy resources (DERs) can generate power where the energy is needed. This allows for more efficient systems that do not suffer from large transmission losses that are seen with centralized power plants, which may lose up to 15%[2] of the energy generated as it travels from the point of usage. This is especially true for very rural and remote customers. Also by using DERs, the overall system is going to be more flexible and resilient as it limits mass outages that may occur with centralized systems resulting from severe storms, natural disasters, fires or other unplanned outages. These events are occurring more frequently and can cause damage to overhead lines, transformers, substations or other components in the centralized system. Any of which will then cause mass outages to customers downstream. For example, there were 30 named storms in 2020 versus 19 named storms in 2019[3], which left millions in the aftermath without power.

In California, the high risk of wildfires force the electric utilities to shut off power to many of its customers in the high risk fire areas to avoid sparking a fire due to the energized system. According to According to the California Public Utilities Commission (CPUC), from 2014-2016, a total of 1,384 individual fire incidents[4] were caused by CA electric utilities' equipment.

Picture of Sagehen Microgrid in California

Hardening the lines is one of the solutions being done to mitigate this risk, but this option can be very expensive and resource intensive. The cost of hardening the system to minimize this risk can cost utilities in the range of $750,000 to over $1.5M per mile depending on terrain. This is a significant investment required by the utility to serve remote customers that are usually the most vulnerable to frequent outages due to long transmission runs. This is where distributed generation and remote microgrids are a logical technical and economic solution.

Per the US Department of Energy[5], 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. Those distributed energy resources within a microgrid can, and should, be a combination of renewable energy resources like solar, wind, hydro or geothermal energy generating assets along with a means to store the energy generated with batteries, pumped hydro, flywheels and thermal energy storage. This combination allows the utility to capture as much of the renewable energy as possible to meet sustainability goals. The addition of a fossil-

[1] https://www.powermag.com/history-of-power-the-evolution-of-the-electric-generation-industry/
[2] https://blog.se.com/energy-management-energy-efficiency/2013/03/25/how-big-are-power-line-losses/
[3] https://www.noaa.gov/media-release/record-breaking-atlantic-hurricane-season-draws-to-end
[4] https://www.cpuc.ca.gov/fireincidentsdata/
[5] https://www.energy.gov/sites/prod/files/2016/06/f32/The%20US%20Department%20of%20Energy%27s%20Microgrid%20Initiative.pdf

fueled reciprocating engine driven generator improve overall system resiliency when the renewable resources are not able to fully meet the load requirements. The generator can provide a stable power source to charge the batteries or cover loads for long durations such that the microgrid will provide reliable power when sunshine nor wind are available, or if there is a fault in the renewable system. This configuration make microgrids the best solution to meet all of the needs and goals for both in front of the meter and behind the meter stakeholders

From a utility in-front-of-the-meter standpoint, a microgrid can serve the grid edge customers who are at the end of distribution lines and require a large investment to connect them into their larger network. The utility can own the microgrid and use it as a DER providing those remote customers with the same reliability that non-remote customer's experience. This is likely more consistent reliability than what they were seeing before the microgrid. This system will likely be less expensive than running transmission lines to remote customers, and more efficient without losses from transformers or line losses. The renewable energy resources within the microgrid will also aid the utilities' sustainability goals by reducing carbon footprint, as many of these microgrids target at least 70% renewables penetration. The utility can still manage and control all these DERs through virtual power plant and distributed energy resource management control software like that offered by Enbala with its Concerto platform. All of the utility's assets can be controlled under a common platform for simplicity and efficiency in system control.

A containerized microgrid solution allows for a more standardized design to minimize footprint of the system, reduce system design costs and allow for very quick deployment and installation. This type of solution can be installed onsite in as quickly as one day and typically less than five days depending on the extent of site preparation required. By having a compact and standardized containerized solution, the customer no longer has to pay for a one-off system design, and the solution can easily be replicated for a repeatable solution to meet project requirements in a given load range. It also allows for scalability from very small loads to larger load requirements without major design required, saving time and money.

From a customer behind-the-meter standpoint, a microgrid can potentially reduce energy costs. For grid-edge customers, the system reliability with a local microgrid will greatly improve as the potential for failures upstream is reduced. With local generation from a microgrid, there is much less exposure for storms taking out overhead lines or animals damaging the distribution or transformer components that can cause frequent outages.

For very remote customers that were relying solely on diesel or propane generation to provide all power needs, by incorporating renewables to form a microgrid, the operating costs of the system will be greatly reduced. Planned maintenance and refueling schedules can be extended, as the generator will be running less hours per year due to the system using the renewable generation when available to cover the loads.

For businesses, remote microgrids can be either grid-tied or off-grid systems, so they can be used in either configuration to meet the needs of each business individually. For a grid-tied microgrid, the system can be used to reduce energy cost through energy management like peak shaving or participating in demand response programs, as well as provide resiliency during longer utility outages to minimize impact on business operations. For islanded microgrids, resiliency is likely the main driver for the microgrid, but it also could be less expensive to self-generate power onsite instead of paying the interconnection fees with the utility. When used in either configuration, a microgrid will improve the carbon footprint of the organization and help work towards sustainability goals.

With the global push toward decarbonization, more organizations have sustainability goals to reduce their carbon footprint. Using microgrids with high renewable penetration and generators for resiliency of the system makes a logical stepping stone to achieve these goals.

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