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ASK THE EXPERT

Microgrid Solutions are the Future of Island Resiliency

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As extreme weather events increase in frequency and intensity, island communities face unique energy challenges that require innovative solutions. Microgrids, small-scale power networks capable of operating independently or in conjunction with the main grid, offer a lifeline for resiliency. **Roberto Muñiz, PE, VP of engineering at ELM Microgrid,** shares a wealth of experience from living in Puerto Rico as well as his expertise in designing microgrid solutions tailored to island communities.

With the unique challenges island communities face, how can microgrid solutions specifically address resiliency needs?

Island communities face unique energy challenges due to their isolation, logistical difficulties, and diverse energy demands. Natural disasters, such as hurricanes, regularly disrupt traditional centralized power grids, which are not designed for the geographic and logistical constraints that Puerto Rico or islands in the Caribbean encounter. Delivering fossil fuels to remote areas or transporting materials such as transmission poles in winding or mountainous terrain is often difficult and becomes even more challenging during and after a storm.

Microgrids decentralize power generation, allowing power to be generated closer to the load, reducing transmission losses, and improving resiliency. This approach is critical for island communities, especially when rebuilding after a disaster. Microgrids must integrate with existing infrastructure and handle bidirectional power flows from renewable energy sources like solar panels and battery storage. This adds complexity but is essential for ensuring faster recovery times and overall grid resilience.

Another consideration is the diverse load profiles across island communities. Tourist-heavy areas have different energy needs than industrial or residential zones. For example, regions that rely on tourism may

see peak energy use during certain seasons, whereas industrial areas may require constant, steady power. Designing microgrids to accommodate these varied energy demands is crucial for long-term sustainability, ensuring energy is distributed efficiently and reliably across different sectors of the island.

How can we use the latest automation and smart technologies to help islands improve microgrid performance?

Automation and smart technologies are revolutionizing microgrid performance, particularly in island communities where resiliency is critical. With advancements in smart controllers, microgrids can now automatically select the best available energy source in real time, eliminating the need for manual interventions during outages. This is crucial for industries like pharmaceuticals or data centers, where even brief downtime can result in significant financial losses.

Smart controllers also allow microgrids to predict future energy needs and optimize energy usage, managing variable sources like solar panels and batteries to ensure that critical loads, such as medical equipment, remain powered. The integration of advanced meters, smart breakers, and intelligent generators further enhances automation and improves overall system resilience.

A major challenge for island microgrids is maintaining reliable communications infrastructure, as dense vegetation and mountainous terrain can disrupt Wi-Fi and cellular signals. To overcome this, solutions like satellite communications are being explored to ensure that microgrids can operate efficiently in remote areas.

Additionally, rapid advancements in energy storage technologies, particularly in battery systems, play a pivotal role. Optimizing battery use for long-term reliability is essential for island communities, where outages can last for extended periods. By integrating better energy storage solutions with enhanced automation and smart technologies, microgrids are becoming indispensable for disaster recovery and maintaining economic stability in these regions.

How can microgrids accelerate the transition to cleaner energy for island communities, even when a full switch to renewables isn't immediately feasible?

Microgrids are crucial for creating a practical path to sustainability, especially when a 100% renewable energy shift isn't immediately possible. Their ability to seamlessly blend renewable sources like solar and wind with existing fossil fuels allows islands to cut emissions while keeping the lights on. This hybrid approach stabilizes energy supplies during the transition.

We recently won the Caribbean Microgrid of the Year Award for a project to construct a solar microgrid on the private Exuma Cay in the Bahamas. By supplementing and integrating with the island's existing diesel power plant, the new microgrid installation resulted in a 93% reduction in diesel fuel usage. This demonstrates that even in areas with tough infrastructure challenges, microgrids can significantly cut carbon emissions while maintaining reliable power.

This flexibility, paired with real-time energy management, empowers island communities to transition to cleaner energy without risking reliability, making microgrids a vital piece of the puzzle for a sustainable future. By optimizing both renewable and traditional sources, microgrids make the shift to cleaner energy more efficient and attainable.

What is the biggest need in transitioning island communities toward energy resilience and cleaner energy sources?

The biggest need in the transition to sustainable and resilient energy isn't just about technology; it's about education and training. When facing crises, having the best equipment is only part of the equation. We must also have a plan for how to respond effectively under pressure.

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Regular maintenance and clear role definitions are essential in daily operations, but when a situation becomes chaotic, trained teams can react instinctively. Education and training create muscle memory, so when a disaster hits, everyone knows who to call and what to do, getting things back on track faster. A well-prepared team knows how to handle disruptions, share responsibilities, and manage materials.

In short, education, training, and teamwork are key to achieving long-term energy resiliency. ELM is positioned to help our clients from inception to execution and throughout the lifecycle of their microgrid, especially with our ELM FieldSight system, which provides insights into energy usage and system performance.