ASK THE EXPERT

How Microgrids Are Accelerating Renewable Energy Integration

ROSS OIEN
Vice President of Engineering

Renewable energy grew at an unprecedented pace in 2024, continuing a trend of accelerating adoption in recent years. A record 600 GW of solar, 125 GW of wind and 170 GW of energy storage capacity were installed globally.

As the energy transition accelerates, integrating renewable energy resources like solar and wind into the grid presents opportunities and challenges. Microgrids offer a solution by enabling a more flexible, resilient and efficient energy system. They boost adoption of renewables by supporting grid stability and delivering benefits to business operations.

Ross Oien, vice president of engineering with microgrid developer ELM, shares his insights on how microgrids can strengthen the electric grid and deliver operational resilience, cost savings and flexibility to individual customers in a variety of industries. For Oien, the key to achieving those benefits is a smart microgrid controller, which optimizes distributed energy resources (DERs) to serve customers' unique needs.

What electric grid challenges have emerged with the adoption of more clean and distributed energy technologies?

The ability to integrate renewable energy sources to reduce reliance on centralized power plants and enhance grid resilience has never been more achievable. However, this transition also presents challenges related to intermittency and reliability, grid congestion and aging infrastructure, cybersecurity, and regulatory and market barriers.

Renewable energy sources like solar and wind are inherently intermittent, varying based on time of day, weather and seasons. This requires advanced energy storage and intelligent controls to maintain stability. Increased DERs can strain outdated grid

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infrastructure, requiring investment in modernization and intelligent grid management. More decentralized generation also introduces new cybersecurity risks and a need for robust monitoring and control systems. Finally, policies and incentives vary by region, creating uncertainty in strategies to best deploy renewable and distributed energy resources.

How can microgrids play a role in supporting the sustainable energy transition?

The electric grid's challenges highlight the critical need for innovative microgrid solutions to provide resiliency, flexibility and efficiency through energy management. Microgrids facilitate renewable energy adoption by intelligently managing distributed solar, wind and energy storage to optimize and effectively dispatch these resources. They enhance grid resilience as renewable DERs are integrated, empowering communities to adopt decentralized, low-carbon solutions.

While renewable DERs were initially seen as a threat to grid reliability, microgrids with smart controls enable these resources to enhance grid resilience and reliability. Microgrids operate independently or in coordination with the main grid, providing power during outages caused by extreme weather, cyber threats or demand surges. They help critical facilities stay operational, supporting a more resilient energy ecosystem. Microgrids can also supply ancillary services like voltage regulation or peak shaving.

Lastly, microgrids provide communities, businesses and homeowners energy independence. Microgrids use local solar and storage to reduce dependence on centralized, carbon-intensive energy from the grid. They can also improve access, delivering clean energy to underserved or remote areas where extending the main grid is impractical.

How can microgrids help their owners solve their unique energy challenges?

Microgrids can provide tailored energy solutions for different use cases.

Utilities face pressures to modernize aging infrastructure, integrate renewables and maintain

reliability amid growing energy demand and climate disruptions. Microgrids can help utilities balance loads, integrate renewables more effectively and improve system resilience.

Businesses face energy challenges tied to cost, operational resilience and sustainability goals. Microgrids deliver targeted solutions to help achieve energy independence, reduce operational downtime from outages, cut energy costs and generate revenue through demand response or energy arbitrage.

At the community level, local governments can use microgrids to improve the resilience of critical infrastructure, support emergency preparedness and lower carbon emissions.

How do advanced microgrid control systems help maximize the value of DERs?

A microgrid without intelligent control is just a disconnected set of assets. Advanced microgrid controllers leverage real-time data, automation and intelligent decision-making to ensure energy assets deliver the greatest possible benefit to owners.

Real-time decision-making helps dynamically manage resource allocation, ensuring the most efficient use of all energy resources. Automated load balancing adjusts energy distribution to match consumption patterns, balancing supply and demand and reducing inefficiencies. Smart islanding capabilities enable seamless transitions between grid-connected and off-grid operations during outages, enhancing grid reliability and the resilience of individual operations. Intelligent controls enable participation in demand response programs, time-of-use optimization and energy trading to generate financial returns. Microgrid controls also collect data on asset performance, energy flows and market conditions, which feed analytics that reveal inefficiencies and opportunities.

What industries are currently best positioned to benefit from microgrids?

Data centers, given the high energy demand and need for uninterrupted operations. Microgrids ensure uptime, optimize energy costs and reduce reliance on fossil fuels.

Manufacturing and industrial facilities benefit from energy cost stabilization, backup power capabilities and sustainability-driven operational improvements.

In health care and emergency services, hospitals and critical care centers require absolute reliability, making microgrids essential for backup power and disaster preparedness.

Energy security is a strategic priority for the military and defense sector, and microgrids provide self-sufficiency in remote or mission-critical environments.

Finally, remote and island communities often rely on expensive diesel generators or lack grid access entirely. Microgrids can greatly reduce diesel use and slash fuel costs. Localized power ensures consistent supply, improving quality of life and economic activity.

The future of energy is flexible, resilient, and intelligent. See how ELM is leading the way. Learn more about https://elmmicrogrid.com to explore a tailored solution for your business or community.

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