e2 Companies

Accelerating Grid 3.0 Modernization

7 Emerging Trends

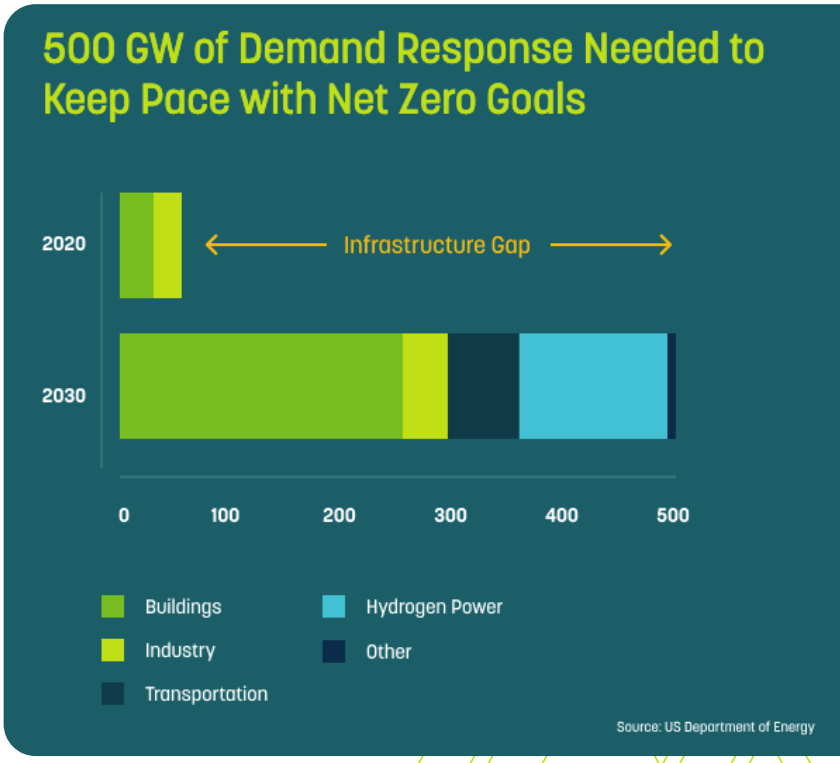
Ten seconds without power may not seem like a long time — unless you're a surgeon in the middle of a life-saving procedure. Or a manufacturer in the middle of restarting all your equipment, halting production for a full hour. Or a data center that experiences loss of data, security breaches, and damaged equipment. Or a casino who has to pay out every customer whose game was interrupted.

These occurrences are increasing as our aging electric grid becomes more strained.

The world was first introduced to the AC version of the electrical grid in 1893 at the World's Fair in Chicago. Most of the same infrastructure has been in place since the 1960s and 70s and is approaching the end of its life, making grid modernization a top priority.

At the same time, demand for electricity has increased significantly and will continue to as analysts project more than 30 million light-duty electric vehicles could be on the road by 20301, in addition to as many as half of all consumer vehicles.2

Data center expansion is projected to require approximately 40,000 megawatts ("MWs") of new capacity requirements by 2030, which would equal up to 7.5% of the nation's projected electricity demand.[3]



On top of that, the Inflation Reduction Act of 2022 provided an additional $40 billion in loans for the grid modernization initiative, including projects that "retool, repower, repurpose or replace energy infrastructure" with projects that reduce greenhouse gas emissions.

All this is projected to require an additional 500 gigawatts of capacity by the end of the decade. It also factors in significant advancements in the production of hydrogen, which may not be realistic by 2030, said James Richmond, President and CEO of e2Companies.

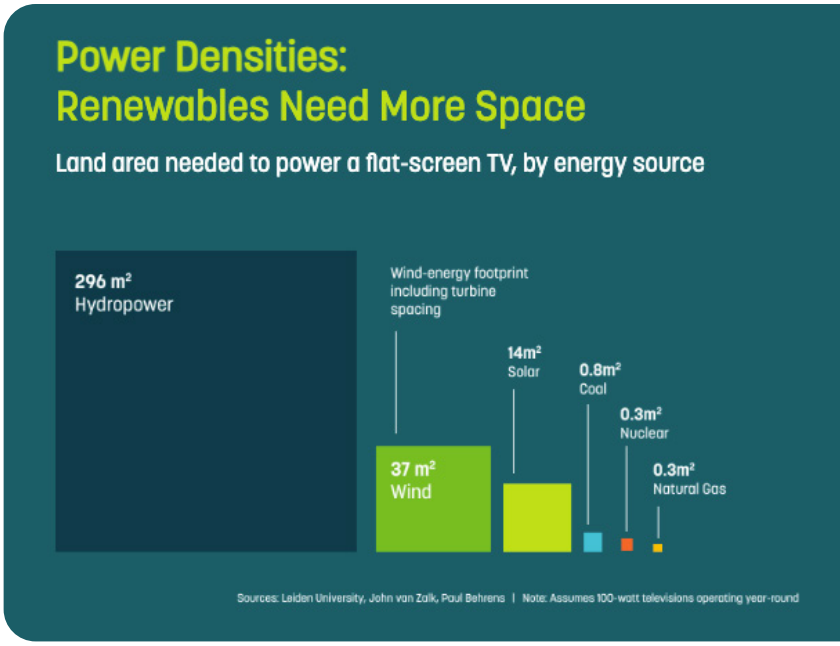
See why we can't afford to wait to make the transition to a more modern grid in this video.

Even amid the search for cleaner alternatives and a move to a more modern grid, "the reliability and affordability of fossil and nuclear fuels cannot be ignored," said Dr. Timothy G. Nash, executive director of the McNair Center for the Advancement of Free Enterprise and Entrepreneurship at Northwood University, in a recent report grading eight energy sectors based on capacity, reliability, and innovation, among other factors.

The research gave natural gas an "A" rating, followed by nuclear power with a B+ and coal with a B-. Other renewable sources, including solar and wind, had much lower scores due to their weather dependency and general unreliability. The report's authors called for utility companies and lawmakers to prioritize "clean, reliable and affordable" energy sources without rushing the transition.

A lesser discussed, yet important criteria for energy sources is the amount of space (land area) they require to be effective at powering the modern day grid. A study from the University of Leiden, Netherlands found that power densities can vary by as much as 1000 times, with biomass the lowest (at 0.8 W/m2) and natural gas the highest (at 1000 W/m2).

Solar and wind power needs around 40-50 times more space than coal and 90-100 times more space than gas. So there is an inherent tradeoff between cleaner energy sources and the land required to make these energy sources reliable at scale.



Another issue is the urgency of solutions needed compared to the average time of installation for new projects.

These are simply moving in two different directions. Currently, many grid projects are withdrawn from the interconnection queue after confronting costs and timing implications. In fact, only 10-20% of queued projects have materialized since 2010, often taking over 5 years post-application to finally connect, and those timelines are only lengthening.[4]

How do we achieve grid modernization, or Grid 3.0, without long wait times that compromise reliability and resiliency?

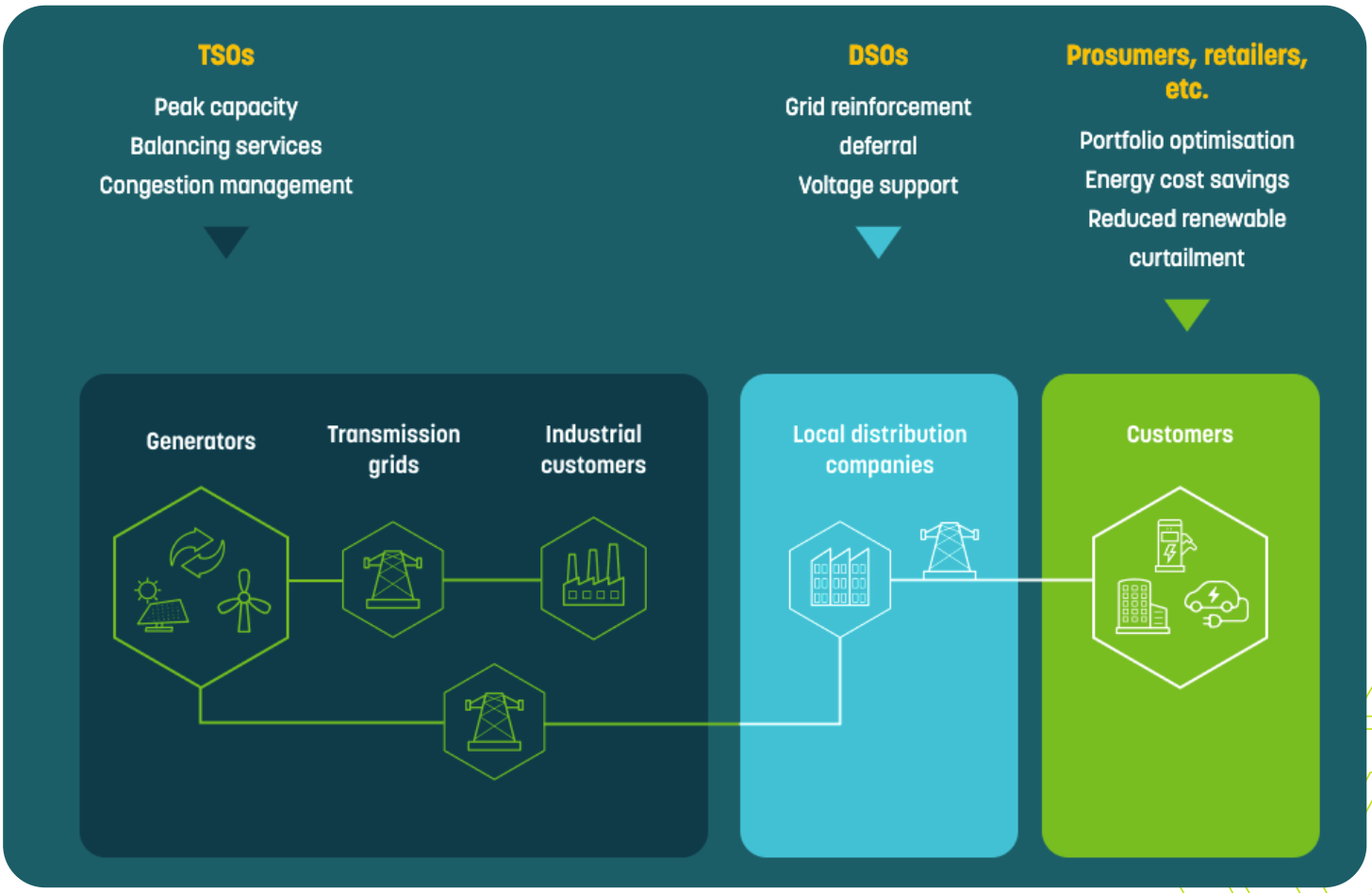
Here are seven trends energy leaders and business owners explored at the 2024 DISTRIBUTECH conference, and what they mean for utility companies and commercial energy users alike.

1. Distributed energy resources are crucial to the energy transition

Distributed energy resources (DERs) are smaller energy resources located at or near sites that use electricity. These include microgrids, rooftop solar panels, wind turbines, battery systems, and even smart thermostats.

According to the IEA50 report 'Unlocking the potential of DERs' the integration of Distributed Energy Resources (DERs) into the energy grid is becoming increasingly vital for enhancing grid reliability and resilience. This is especially true when the electrification of end-use devices (ex. electric vehicles) is placing an increased burden on the grid. Many DERs, such as battery energy storage systems (BESS), can typically ramp up and down quickly, so they are better at providing real-time flexibility. TSOs require flexibility resources to maintain supply consistency to meet demand, and since DERs are situated close to consumers along the distribution grid, they can manage load variability more effectively than traditional networks.

Multiple grid benefits of digitally enabled DERs



Virtual power plants are groups of distributed energy resources that the U.S. Department of Energy sees as key components of grid modernization.
The agency's report estimates that deploying 80-160 GW of virtual power plant capacity could cover 10-20% of the peak demand needed, saving billions in annual grid costs.6

While this form of distributed energy resources reduces the need for new transmission and distribution infrastructure and diversifies power production, they pose several major challenges.

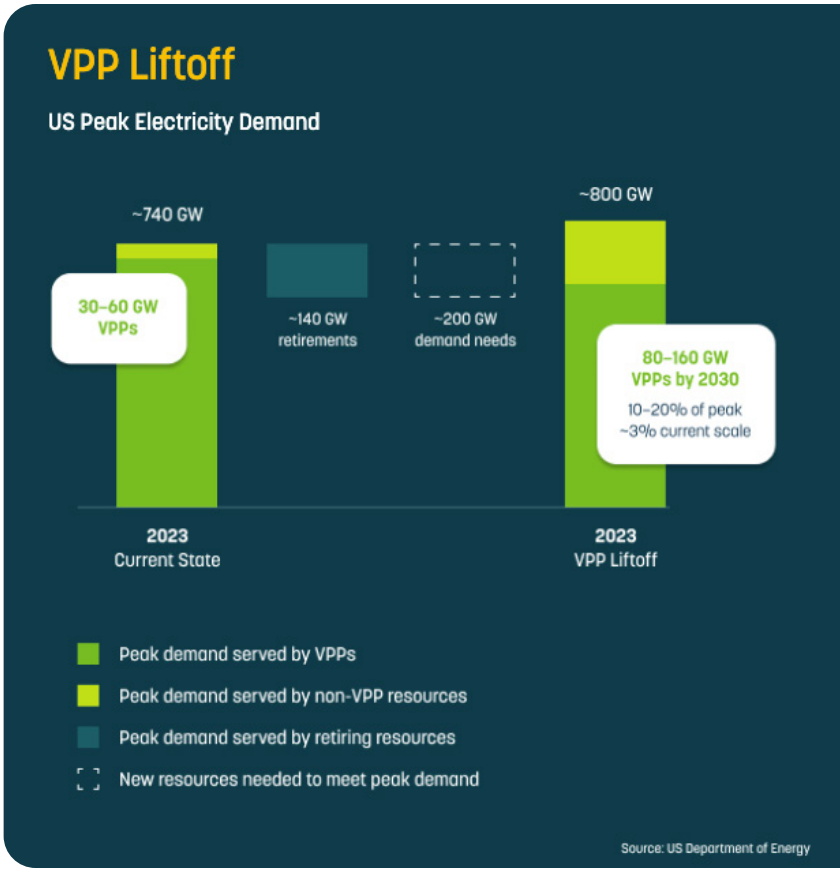
First, they require a coordinated system with advanced controls to manage distributed resources. Owners also need a way to participate in energy markets and provide grid services while allowing operators to generate revenue to provide enough incentive for widespread adoption.

There are also regulatory challenges to overcome.

While Federal Energy Regulatory Commission Order 2222 opened up the wholesale market for distributed energy resources, many states enacted bans blocking third-party aggregators from enrolling customers.7

Another concern with this model is the potential to create greater disparities between people able to afford their own distributed energy resources and those who aren't. Energy costs are a bigger burden for low-income households, which typically spend a far larger percentage of their gross income on utility bills than higher-earning households, according to the U.S. Energy Department of Energy.

"You're seeing this move toward independent products, people building their own microgrids and their own infrastructure, and not always depending on the utility to be their revenue source," Richmond said. "As the costs continue to climb from the utilities, people will put in their own power more cheaply than the utility can provide it. That creates an energy economy which has a whole plethora of social issues that goes along with it."



The takeaway: Larger energy consumers, including retailers, healthcare organizations, manufacturers, and commercial and industrial users, should consider investing in distributed resources like Virtual Utility®, which provides them the flexibility of generating on-site power with or without the electric grid and without requiring an interconnection agreement.

2. Combining AI with human expertise will make distributed resources more reliable

AI's ability to learn from large amounts of data and respond to complex scenarios makes it particularly well suited for supporting grid stability. Many software companies are already beginning to introduce AI into power distribution, although they face challenges when it comes to integrating their solutions with utility companies' aging technology.

The Department of Energy recently awarded $3 billion in grants to "smart grid" projects that include AI initiatives. A few of the most promising include[8]:

- Developing AI models to predict how much electricity will be needed each day and how to distribute it
- Helping customers optimize energy usage by gathering data to create personalized models of their homes' energy needs
- Collaborating with consumers and utility companies to identify the best times to charge electric vehicles

"A key part of our AI strategy is to be able to intelligently figure out, "when's the best time to use solar? When's the best time to charge the batteries?" said Jay Douglas, CEO of Keyfive.

"Using AI, we're able to resource costs of the overall energy profile, put less stress on the grid, and bring a more reliable, consistent experience to consumers."

Zack Kass, the former head of go-to-market for OpenAI and a self-described "AI optimist" said he foresees a future where AI becomes embedded into its own grid similar to a public utility, instead of being built into many different devices.

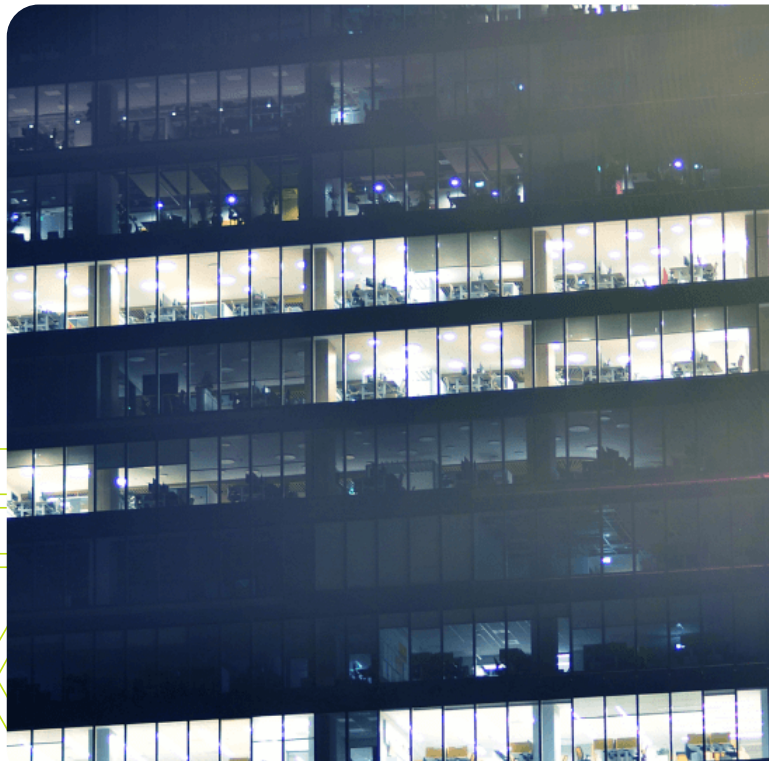
AI is already leading to advancements in the grid, but as it becomes more advanced, it requires more computing power, making grid modernization critical.

The ultimate goal of Grid 3.0, Richmond said, is a fully autonomous grid that provides exactly the right amount of power to consumers precisely when they need it.

"We'll have demand side and power side that will work autonomously together to really keep the grid balanced, to keep the costs down," he said. "It's really efficiency and effectiveness together that will give the customer the best bang for their buck from a cost standpoint."

The takeaway

For companies with high energy demands, integrating AI into energy management systems can lead to substantial benefits. AI can help organizations identify patterns in their energy consumption, allowing them to adjust their operations to improve efficiency while reducing costs and lowering their carbon footprint.



3. The customer must be at the center of the energy transition

While AI offers the potential to help energy "prosumers" reduce costs and demand on the grid by using less energy at peak times, they won't be widely adopted by the public unless they are convenient.

Consider how the introduction of the Telephone Act and the cell phone changed the telecommunications industry. Instead of being tied to landline phones, consumers can charge their phones virtually anywhere and use any compatible tower while staying connected.

"The utility space has been considered the best return on assets for many years because of 40 and 50-year assets that have been available to make a significant return," Richmond said. "That significant return is now down to 3-5%," he added, compared to Apple's nearly 30% return on assets.

"Putting assets at the customer side (results in) a 9-15% return on assets. That means the investment world is going to change where they put their dollars. The dollars are going to flow from the utility to the end user."
The electric vehicle industry is at a similar crossroads as it tries to devise ways to change consumers' habits by recommending they charge their vehicles at certain times instead of simply making it easier for them to charge their vehicles anywhere.

Watch James Richmond talk about the role of consumers in grid modernization.

The grid has already evolved from a model of bulk power generation, efficiency and passive response to a model focused on greater reliability, interconnection, demand response, and an increase in renewable sources — a change brought about by consumer demand.

To get to the next evolution of grid modernization, known as Grid 3.0, we'll need a few key elements:

INTERACTIVE FLEXIBILITY

This refers to the ability of the power grid to dynamically manage the flow of electricity between consumers, utilities, and distributed energy resources. Unlike traditional power grids, it is bidirectional, allowing energy to flow to consumers and allowing consumers to contribute back to the grid from their own power sources. This requires advanced communication to share real-time data between grid operators, consumers, and energy resources.

STANDARDIZED INTELLIGENCE

Standardized intelligence refers to the need for smart meters, sensors, software, and control systems operating together in a uniform way to analyze data and manage the grid. These systems must integrate with utilities and be scalable.

REAL-TIME AUTOMATION AND AI

Grid 3.0 will be largely automated and self-directed, reducing the need for manual intervention.

A SELF-HEALING, SYNTHETIC BUS

The system will automatically detects faults or failures, such as power line failures, and reroutes the power, adjusts load distribution, or activates backup systems to maintain stable, continuous operations.

All these elements will result not only in a zero-carbon future, but a return on assets that is three times higher than the current utility model.

This transition will be essential to paving the way for consumers to be able to use the grid more efficiently and contribute back to it.

Landis + Gyr is just one example of a company focused on providing better communication between utilities and end users to pave the way for more efficient electric vehicle charging and lower energy costs.

"When you buy an electric vehicle, it's like adding a house onto that transformer," John Romero, Landis + Gyr VP of Electric Vehicle Solutions, said at DISTRIBUTECH.

"When there's 10% in one particular neighborhood or area, that's when you start seeing concerns on infrastructure. We've taken our platform of electric metering and evolved with the industry, so we've moved into AMR (advanced meter reading), AMI (advanced metering infrastructure), and that provides a whole host of solutions from network solutions to analytics solutions."

The takeaway

Implementing customer-centric solutions that enable Grid 3.0 requires an intentional shift in the way many companies operate. John Gounaris, VP of Marketing for G&W Electric, said fostering a culture of listening to the customer, collaborating with partners, and focusing on scalability and cost effectiveness will be key elements to the transition.

"If you think about the scale of this transformation, utilities are not going to have enough money or enough people to do this," he said.

"So we need to help them by making solutions as cost effective as possible, as versatile as possible, so that more of that solution can be applied globally to solve problems across the world. You need that to build a lasting relationship to be able to work together with your utility partner."

4. Tax incentives will impact investments in and sourcing for energy solutions

The Inflation Reduction Act of 2022 introduced a number of incentives for companies and consumers to invest in energy solutions that reduce carbon emissions.

The Act modifies and extends tax credits for producing electricity from renewable resources such as wind, solar, and geothermal for projects that meet specific criteria, including being manufactured in the United States.

Under the IRA, qualifying microgrid systems that begin construction before January 1, 2025 are eligible for tax credits up to 30% the cost of installation.

In addition, the IRA provides bonus tax credits of up to 10% for projects located in Energy Communities.

For businesses, these tax credits reduce the capital costs of deploying renewable energy solutions like solar panels, wind turbines, and energy storage systems.

The Inflation Reduction Act is also incentivizing the adoption of electric vehicles (EVs) by offering consumers up to $7,500 in tax credits qualifying purchases. This promotes cleaner transportation and encourages automotive manufacturers to ramp up production of EVs.

Michael Worry, CEO of Nuvation Energy, said this has shifted consumer expectations to favor solutions made in North America rather than overseas. One example is the company's G5 Battery Management System, which meets manufacturing requirements to address concerns about projects that will contribute to the domestic utility grid and will be eligible for tax credits.

As energy storage becomes more critical to improving the reliability of renewable energy sources, engineers and manufacturers are focusing on designing solutions that are highly flexible and configurable, making them easier to integrate with other equipment.

In addition to supplying the battery management system for e2Companies' R3Di® System, "[W]e also get designed into a wide variety of energy applications, including renewables integration and PV smoothing. We also get designed into systems doing demand charge management and a lot of microgrids."

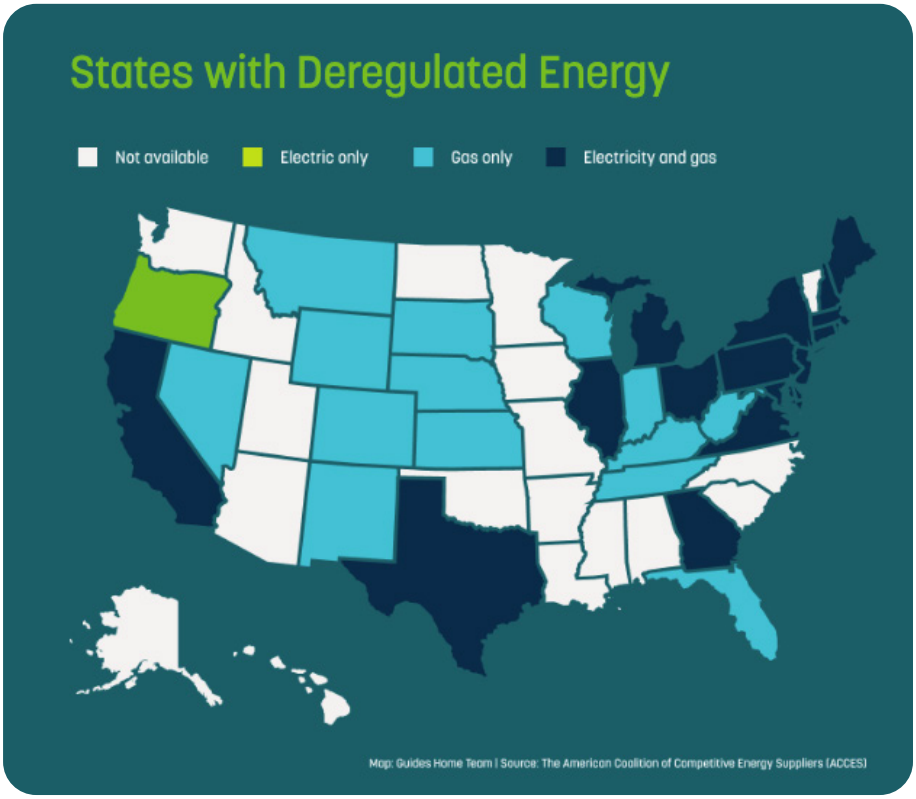
The takeaway

The Inflation Reduction Act and other state-specific legislation, including the Texas Backup Power Package, present many opportunities for qualifying organizations, making it more financially feasible to implement new energy solutions. However, energy storage can leave a significant footprint. Company leaders should consider solutions with greater power density so they can maximize their ability to take advantage of tax credits while minimizing the amount of real estate they need to allocate to energy storage.

5. The regulatory environment will impact the speed to implementation

While many companies are introducing new technologies contributing to grid modernization, power consumers will almost certainly face regulatory challenges on the path to deploying them.

Although customer choice is becoming more prevalent in the energy sector, eighteen states still have regulated markets that don't give consumers the option to switch to a different energy provider. Some states have deregulated markets for gas only, while 17 states (and Washington, D.C.) have deregulated markets for both, according to MarketWatch.9



Additionally, state and federal regulations continue to impact power transmission systems and distribution, including the Federal Energy Regulatory Commission's (FERC) Order No. 2023, aimed at reforming procedures and agreements for integrating new generating facilities into the transmission system. This rule is expected to improve the notoriously difficult interconnection process and give new technologies access to the transmission system.

More than $13 billion in new financing has been allocated for grid modernization, with the goal of reaching Net Zero by 2035.

Despite these new developments, complying with existing regulations for permitting, indemnification, emissions standards, maintenance, and other areas is still a complex maze for many organizations, said Todd Snarr, Senior VP, Professional Services for e2Companies.

"There are a lot of federal rules in place to restrict the use of diesel engines and natural gas engines. The EPA is recognizing the amount of folks using their generation equipment for non-emergency purposes, so they're starting to inspect more and pay attention to what the rules are saying. A lot of companies don't realize the level of effort it takes to stay in compliance with those pieces of equipment."

Dan Meyer, the team lead for transmission protection at San Diego Gas and Electric, can attest to these challenges. The company serves 3.9 million customers with a load consisting of 55% renewable energy, which has made it a winner of the reliability award for the past 18 years.

The takeaway

Navigating the regulatory environment required to implement new distributed energy resources and other technologies to supplement power from public utilities can be time-consuming and frustrating even for engineers and facilities managers with previous experience in this area. First, they need to design a system that combines on-site power generation with energy storage while complying with all applicable regulations. This often means implementing emissions tracking and monitoring systems, such as a continuous parametric monitoring system, and filing annual paperwork with the EPA. They also need to develop an environmental and safety management system in compliance with ISO 14001/8001.

Additionally, a typical interconnection agreement with a utility can take several years to be approved.

"We have 16 different federal requirements where we have to manage compliance," he said, including compliance with PRC 23, which helps power systems handle higher loads without compromising reliability.

"(Our engineers') workload is ever increasing with interconnection agreements, with distributed energy resources, renewables, all sorts of things coming onto our system, plus the traditional infrastructure replacement and upgrades. We're not getting more people, so we are looking at technology to help us adapt to these changes."

— Dan Meyer,
Team Lead for Transmission Protection at
San Diego Gas and Electric

A turnkey system like Virtual Utility® offers several advantages when it comes to complying with these regulations. The system has already been designed and engineered by an experienced team who will also cover compliance and indemnification.

6. Data privacy and security will become an even bigger concern

The emergence of more devices and applications providing data to the electric grid, such as smart meters, Advanced Metering Infrastructure (AMI) systems and EV charging management systems, is bringing concerns about data privacy and data security to the forefront.

Smart grid technologies collect detailed information on consumer energy usage patterns, potentially creating concerns about unauthorized surveillance of their daily habits, having personally identifiable information stolen, or having their data sold to companies for other purposes like marketing.

This makes it critical for technology companies to have written policies in place describing what data will be collected, how it will be stored, and for how long.

The interconnected nature of these systems also means a breach in one area can affect the entire grid, making them potential targets for cyberattacks. Therefore, new monitoring platforms like the Grove 365 are leveraging a combination of advanced security protocols, including encryption, network segmentation, and robust authentication. These measures safeguard the power distribution systems to ensure data security and uninterrupted delivery of electricity.

Last December, Duke Energy disconnected large-scale batteries made by a Chinese company from U.S. Marine Corps base Camp Lejeune because of these concerns. Two U.S. senators expressed concerns that China's "near monopoly" on battery production posed "substantial defense and economic security vulnerabilities."[10] Duke Energy has since made the decision to decommission the CATL battery energy storage system at Camp Lejeune and replace it with a domestic or allied nation supplier.

The takeaway

As threats evolve, energy technology providers are developing more sophisticated cybersecurity measures, including encryption technologies, secure authentication methods, and regular security audits to protect against unauthorized access and data leaks.

Maintaining high standards of data privacy and security will also be essential to maintaining consumer trust.

7. On-site energy solutions improve reliability and flexibility

As large energy consumers seek to reduce costs and emissions, they are realizing the advantages of producing at least a portion of their power on-site. While they're exploring a variety of options, from solar panels and wind turbines to combined heat and power systems and fuel cells, these solutions only supply a small portion of their power.

To fill the gap, companies are also looking at ways to use their existing backup power generation systems in a greater capacity. Integrating these traditional systems with battery storage offers several benefits, including greater energy efficiency, reduced emissions, and better reliability and power quality. The combination of on-site power generation and battery storage is typically considered a microgrid.

Microgrids can be remote, connected to the grid, or networked, meaning they combine several different distributed energy resources managed by a central control system.

Microgrids offer many advantages, including:

- Improving power reliability and power quality, especially for facilities located at the grid's edge that experience frequent disruptions
- Greater flexibility and the ability to operate independently from the electric grid if needed
- The potential to reduce carbon emissions by using on-site storage to improve the reliability of renewable resources, such as solar or wind power vehicles
- The ability to receive incentives for contributing power back to the grid
- The ability to offer on-site charging for electric vehicles

Traditionally, backup power systems have relied heavily on diesel generators, which are costly, noisy, and result in higher carbon emissions that may require retrofitting and additional reporting to meet EPA regulations.

Many diesel generators also aren't designed to support long-term outages. And regardless of the type of generator they use, most microgrids still require 10-20 seconds to transfer power.

The takeaway

At a time when severe weather and increased demands for power are putting additional strain on the grid, on-site power generation and energy storage increases your company's resiliency and reliability. The best solutions are capable of picking up a full load without significant transfer time. They are also able to connect to a variety of energy sources, including natural gas, renewable resources, and the public grid.

Futureproof your energy strategy with

Virtual Utility®

e2Companies recognizes these trends and has created the building blocks for a more reliable future with Virtual Utility®, the first distributed network for autonomous grid stability.

Virtual Utility® combines on-site energy generation and storage with the advanced monitoring of grid conditions, weather, and energy prices, offering a more holistic approach. This system is designed to provide an independent energy position to consumers, empowering them with the flexibility to choose between renewable sources and the public grid based on current market prices, avoiding the more speculative whims in energy futures.

At the heart of Virtual Utility® is our patented R3Di® System, a self-contained, onsite energy generation and storage system capable of providing up to one megawatt of power. The system uses natural gas instead of diesel and can operate in sync with or independently from the power grid or any power source, picking up a full load instantaneously and providing continuous, conditioned power for extended durations.

The system also uses lithium iron phosphate batteries for greater power density, resulting in a much smaller footprint.

See how the R3Di® System compares to typical backup diesel generation solutions.

Virtual Utility® goes beyond monitoring with the Grove365, which combines technology with a team of experts working 24 hours a day, seven days a week, 365 days a year to proactively manage distributed assets. Customer data is centralized and secure in one platform, in the hands of the customer versus the utility. The Grove team works directly with customers to determine the best use of energy resources based on business goals, including achieving substantial cost savings and meeting emissions targets.

The system can integrate seamlessly with utility planning and incentives, offering near instant switchover to alternate power sources and supporting larger-scale operations.

"Usually if there's a grid issue, you ask, 'What's your switching time?'" said Michael Worry of Nuvation Energy. "We don't even have that question with the R3Di® System, because it's always there, instantly ready, available to take over, clean up that power, handle any brownout events and handle any grid droppages without any glitch or drop on the load. So if I'm a manufacturer, I don't have to worry about what's going to happen if I lose power and my equipment goes down. It's confidence that we haven't traditionally had in our energy and power."

Ready to get ahead of these trends and future proof your company's energy management strategy? Request a preliminary quote today to see how much you could save.

Request a Quote

Sources

1. Building the 2030 National Charging Network: NREL Study Identifies Nationwide Charging Needs for Accelerating EV Adoption
2. Will the U.S. Reach 50% EVs by 2030? Jury's Out (U.S. News and World Report, March 2023)
3. Boston Consulting Group: The Impact of GenAI on Electricity
4. Decentralizing the Electric Grid | Andreessen Horowitz (a16z.com)
5. https://www.iea.org/reports/unlocking-the-potential-of-distributed-energy-resources
6. The Pathway to Virtual Power Plants Commercial Liftoff (U.S. Department of Energy, September 2023)
7. 'Call to Action' on Virtual Power Plants Resonates Across US Grid (S&P Global Market Intelligence, January 2024)
8. Four Ways AI is Making the Power Grid Faster and More Resilient (MIT Technology Review, November 2023)
9. What Is Deregulated Energy? 2024 Guide (MarketWatch, March 2024)
10. Duke Energy Disconnects CATL Batteries from Marine Corps Base Over Security Concerns (Reuters, December 2023)

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