EET&D MAGAZINE

Quarterly Issue 1, 2026 — Volume 32

AS PRESSURE MOUNTS, UTILITIES OPTIMIZE RESPONSE & RESTORATION

Photo credit: Trico Electric Cooperative, Inc.

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POWER POINTS

Exploring Visibility

Elisabeth Monaghan, Editor in Chief

For folks working in the electric energy industry, terms like load, flexibility, switch and circuit mean something different to them than they do to everyday consumers. Even the word "power" does not mean the same thing to a utility as it does to a consumer, who is an athlete or a voter at the polls.

THE GRID TRANSFORMATION FORUM

As Pressure Mounts, Utilities Optimize Response and Restoration

Manuel Velasquez and Wyatt Darrnell

Trico Electric Cooperative, which serves more than 53,000 members surrounding the City of Tucson, uses a web-based portal for members to track their service requests, receive updates, and share photos and notes with line crews. Daupler RMS uses AI-enabled logic to group alarms and member calls that represent multiple reports of the same event, preventing a second crew from being dispatched unnecessarily.

GREEN OVATIONS

The Architects of Resilience: How Engineers Are Designing a Smarter, Stronger Grid

Nicole Pearson

The work of China Energy, Copel and Exo Inc. is more than just impressive engineering; it's the future happening right now. They prove that resilience isn't an abstract goal, but a direct outcome of empowering engineers with the tools to design with confidence. This is what it means to build a smarter, stronger grid. This is how we, as an industry, will deliver a truly resilient built world.

How CenterPoint Energy and Climavision are Building a Weather-Ready Grid

Chris Goode and Matt Lanza

When CenterPoint Energy set out to future-proof its electric infrastructure and operations after Hurricane Beryl, they decided not just to account for extreme weather but for every facet of weather that affects its ability to consistently deliver power to customers. Through its work with weather technology company Climavision, CenterPoint Energy has shifted its perspective on weather as an unpredictable risk factor as a measurable operational asset.

Grid Edge Automation Turns Utility Data into Measurable Resilience

Kumar Chandran

As power demand rises from data centers, electric vehicle charging and distributed energy resources, the need for proactive grid management has never been more urgent. Utilities must serve increasing customer bases, incorporate variable renewable energy sources and uphold high reliability standards—all while preparing for more extreme weather events.

How Power Grids Can Prepare for the AI Era

Martin Fengler

Large corporations aren't the only ones paying a hefty price. To make AI visions a reality, more than a cash injection is required — they also need energy. The immense amount of power that AI initiatives require is placing a heightened strain on an already overloaded grid. In addition to businesses, consumers are also using more energy than ever, especially during recent extreme heat events.

GUEST EDITORIAL

A Grid Under Pressure: Tackling Utilities' Challenges Today to Plan for a Better Tomorrow

Marc Lamoureux

Traditional planning processes are no longer equipped to meet the complexities of today's utilities landscape—let alone build the electrical grid required for the future. With pressure mounting to keep pace with consumer and regulatory scrutiny, the acceleration of electrification and the rise of data centers set to drive unprecedented power demand, utilities must also ensure distributed energy is delivered closer to the point of use.

GUEST EDITORIAL

Why DERMS Crossing the SCADA Threshold Means Big Changes in 2026

Nick Tumilowicz

Something is happening at the grid edge that is reshaping what "essential infrastructure" means. Distributed Energy Resource Management Systems (DERMS), which are used to manage distributed energy resources (DERs) like batteries, solar photovoltaic, electric vehicle (EV) chargers and demand response programs at scale, are approaching that same threshold SCADA crossed decades ago. Once viewed as an optional software system, DERMS platforms are approaching critical infrastructure status within utilities nationwide—and we are hitting the inflection point in 2026.

SECURITY SESSIONS

What the Poland Grid Attack Reveals About Battery Storage Risks

Rafael Narezzi

A cyberattack on Poland's energy infrastructure in 2025 targeted distributed energy resources across roughly 30 sites, including wind farms, solar installations and combined heat and power facilities. Rather than targeting a single large generating station, attackers focused on the distributed edge of the grid, disrupting communications and operational visibility across multiple facilities.

POWHERFUL FORCES

Steering Through Change

Tamara de Gruyter

For this issue's Powherful Forces, we asked Tamara de Gruyter, president of Wärtsilä Energy Storage and executive vice president at Wärtsilä, to talk about her work, the role Wärtsilä plays in the global energy transition and how she envisions the role energy storage will play in the industry over the next five years.

POWER POINTS

EXPLORING VISIBILITY

ELISABETH MONAGHAN
Editor in Chief

Whether the contributors to our publication work for utilities, manufacturers, software developers, field workers, consultants, etc., they each play a part in an interconnected system. Because they are all pushing to create and maintain a reliable, modernized grid that will meet an ever-increasing demand for more energy, none of them who want to be part of the industry's future can afford to be an island.

For folks working in the electric energy industry, terms like load, flexibility, switch and circuit mean something different to them than they do to everyday consumers. Even the word "power" does not mean the same thing to a utility as it does to a consumer, who is an athlete or a voter at the polls.

As I reviewed the articles for this issue, I noticed another term with multiple meanings, "visibility". Recognizing that visibility is yet another word that means different things to people in the electric utility space, depending on their roles, I wanted to look at how two different articles approach the term.

Seeing the storm before it strikes

In their article on building a weather-ready grid, Chris Goode with Climavision and Matt Lanza with CenterPoint Energy write about the importance of a systemwide resiliency plan and how such a plan can help utilities know in advance not just that a storm is coming, but what it will do, where it will hit and how severe it will be, leaving enough time to prepare a meaningful response.

As Goode and Lanza explain, when Hurricane Beryl struck in 2024, CenterPoint Energy, which provides electrical power to the Houston metro area, suffered 2 million customer outages. In response, CenterPoint set out to future-proof its electric infrastructure and operations. As they explored their plan, CenterPoint opted not to account only for extreme weather, but for every facet of weather that affects CenterPoint's ability to deliver power to customers consistently. CenterPoint brought in weather technology company Climavision to implement the plan.

CenterPoint had an opportunity to put its new capability into action this past October, before thunderstorms it had identified several days earlier, knocked out power to nearly 200,000 customers.

In the past, using publicly available weather model data alone, CenterPoint's meteorologists had only been able to identify "chances of strong to severe thunderstorms." Using Climavision's HI-RES model suite, however, CenterPoint could now forecast the risk of 50 to 70 mph wind gusts in the Houston area.

By working with the weather technology company Climavision, CenterPoint Energy shifted its perspective on weather from an unpredictable risk factor to a measurable operational asset. This approach makes it more resilient to extreme events and more efficient, sustainable and reliable.

CenterPoint's visibility problem was about seeing the physical world clearly enough to act on it. What's the storm doing? Where exactly will it hit? How severe will the wind gusts be at the neighborhood level? Their visibility was meteorological and geographic: knowing what is happening, where and when, with enough precision and enough lead time to deploy people and resources before the threat arrives.

Losing sight, losing control

Where Goode and Lanza address what utilities need to see regarding weather, Rafael Narezzi, CEO of Centrii, is concerned with what utilities need to see within their own systems.

In "What the Poland Grid Attack Reveals About Battery Storage Risks," Narezzi writes about the role a different type of visibility plays in his part of the electric energy world.

Early in his article, Narezzi sets the stage with an anecdote about how, in the film "Ocean's Eleven," the criminals use a device called a "pinch" to generate a powerful electromagnetic pulse that shuts down power across the Las Vegas Strip. In this scenario, security systems fail, cameras go dark and chaos ensues.

Narezzi uses this scene to show that when operators can no longer see their assets, when telemetry shuts down and the signals stop flowing, they lose visibility, which means they lose control.

He then segues to a real-life cyberattack on Poland's energy infrastructure that occurred in 2025. As Narezzi explains, rather than targeting a single large generating station, the attackers focused on the distributed edge of the grid, disrupting communications and operational visibility across multiple facilities. By disrupting communications rather than physical equipment, the attackers came within striking distance of eliminating operator visibility into a quarter of Poland's energy mix, as temperatures approached -15°C.

The attack was ultimately contained through network segmentation and rapid response. Still, the lesson it delivered is clear. In a decentralized grid, losing sight of your assets means losing control of your system, and a lack of visibility means that control becomes guesswork.

Narezzi notes that because they balance supply and demand, stabilize frequency and help integrate intermittent renewable generation, BESS are rapidly becoming central to grid stability. It makes sense then that global BESS deployment is expanding quickly. As BESS deployment accelerates, cybersecurity risks are becoming increasingly relevant to utilities and operators.

What is particularly sobering about Narezzi's visibility argument is that the infrastructure in Poland was mostly intact. No turbines were destroyed. No substations went dark. The attack was informational — and that was enough. As the grid becomes more decentralized and more dependent on software-driven systems like battery storage, the communications layer connecting assets to operators becomes as critical as the physical infrastructure itself.

Narezzi lists key cybersecurity measures utilities and storage operators should prioritize to address these risks. These measures, which include "real-time visibility across operational technology environments" at the top of the list, help ensure that distributed energy resources remain both visible and controllable, even during inevitable cyber incidents.

Storms don't wait for utilities to modernize their weather intelligence. Cyberattackers don't pause while operators upgrade their OT security. The pressure on the grid is continuous, and it's increasing. What CenterPoint and the operators responding to Poland's cyberattack have in common isn't their technology or their threat environment — it's the standard they're held to. When the lights go out, nobody asks whether the outage was caused by a hurricane or a hacker. They want the power back on. Visibility is what makes that possible. Resilience is what it adds up to.

If you would like to contribute an article on an interesting project, please email me:

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Elisabeth

THE GRID TRANSFORMATION FORUM

AS PRESSURE MOUNTS, UTILITIES OPTIMIZE RESPONSE AND RESTORATION

MANUEL VELASQUEZ AND WYATT DARRNELL

In recent years, changing customer expectations and internal operational pressures have pushed electric utilities to rethink how they manage outage response and after-hours communications. Gartner reported in 2024 that "technological advancements and changing customer attitudes" are driving utilities to reimagine their traditional ways of working. Trico Electric Cooperative agrees. Like dozens of electric utilities this year, Trico invested in safely speeding up response, reducing errors in dispatching crews and better communicating with members when outages occur.

Trico's motivation came partly from a strategic plan initiated by leadership to improve member satisfaction, particularly around outage handling and estimated time of restoration. Members increasingly expect utilities to interact in the same way they track parcels, hail rides and schedule service appointments. They want multiple options for reporting issues, real-time information on progress and confirmation when crews are on the move.

Equally important to Trico is improving reliability. While Trico processes have always worked, Chief Executive Officer and General Manager Brian Heithoff has continually looked for opportunities to improve the cooperative's way of working, including its speed of outage response. When the utility began discussing a strategic plan for safely improving restoration times, Heithoff's team looked for ways to reduce manual decision-making, boost Trico's reliability and shorten the time it takes to deploy crews.

Prior to implementing any changes, Trico staff followed a complex callout process dictated by a work agreement with a local union. Operators juggled incoming member calls and alarms while also making numerous outgoing calls to assemble a crew. Identifying the correct field staff in the proper order could involve numerous separate phone calls, each subject to union rules on overtime and entitlement. In real time during major service events, operators had no automated way to verify availability, balance overtime, or eliminate inappropriate callouts. These manual decisions increased the risk of overtime disputes. Under the Trico and union work agreement, any crew not called in the correct order could file a grievance requiring the cooperative to pay two hours of overtime. This created a strong financial incentive to ensure callouts happened efficiently and equitably.

Credit: Trico Electric Cooperative, Inc.

The system Trico and dozens of other utilities have implemented helps them communicate about outages and mobilize crews to restore service more effectively. Trico Electric Cooperative, which serves more than 53,000 members surrounding the City of Tucson, implemented the Daupler Response Management System (RMS) in June 2025. For Trico, Daupler RMS automates after-hours callouts of linemen, utility locators and substation workers and streamlines communication with members during outages. The AI-enabled system also helps Trico's operation center employees triage incoming data from AMI and SCADA systems (as well as members) to boost the speed and accuracy with which crews are deployed into the field.

Expediting response

Before implementing the new system, Trico relied on a manual process to field member calls and assess the state of its system during major outages. Both members and first responders would call the system operations center on separate lines. While these calls poured in, the operations center staff and managers focused on evaluating the scope of the outage in Trico's OMS. Judging the scale of an outage and analyzing the fault often pulled system operations center staff away from getting a callout organized and processed.

This process for event identification, paired with the complicated callout process, posed a major barrier to shortening restoration times.

To automate its callout process, Trico used Daupler RMS to add union rules as part of each call. Trico simply uploads an accurately built crew roster, and the system calls line workers in accordance with the union work agreement. This ensures operators launch a callout for the correct and available worker to accept. With algorithms built in, the platform ensures the equitable distribution of overtime. This, in turn, prevents grievances.

Once a worker accepts the callout, Daupler automatically routes crews to the correct location. As part of the solution, Trico has an analytics capability that reports on how quickly a lineman accepts a callout and provides a heat map of where crews are working once deployed.

During this year's storm season, Trico assembled a complete crew in less than one minute, compared to the 15-30 minutes previously needed using the manual phone method. The overall process also significantly reduced the likelihood of overtime disputes and supports a more equitable distribution of callout assignments.

Credit: Trico Electric Cooperative, Inc.

Meeting customers where they are

The system also provides new ways to engage members. Trico uses a web-based portal for members to track their service requests, receive updates and share photos and notes with line crews. Instead of handling issues solely by phone, now members can supplement their calls by uploading a photo of a limb on a conductor or by texting additional information about the location of an outage. Daupler RMS uses AI-enabled logic to group alarms and member calls that represent multiple reports of the same event, preventing a second crew from being dispatched unnecessarily.

The notes from the portal help foremen and linemen better understand the location and context of an outage before arriving on site. And collecting this data from members empowers crews with additional details for efficiency and safety. For example, if a photo shows a damaged pole behind several homes, Trico's crew will know the confined space may call for a backyard machine versus a bucket truck.

Once Trico dispatches its crew, members can get updates (e.g., crew en route, working to repair) or track the status of their requests through the portal, much like they would track a package with a retailer and logistics company. Trico sees the portal improving member satisfaction by expanding on the traditional, one-way communication methods of making a call or filling out a website contact form.

Credit: Trico Electric Cooperative, Inc.

Credit: Trico Electric Cooperative, Inc.

From fault to fix

Trico is also testing integration with its NISC outage management system. Today, operators still manually verify an outage location within the OMS and then create a callout in Daupler RMS. Once integration is complete, verified OMS outages will automatically trigger a callout, shortening response times even more and reducing manual steps by operators.

Here's how a real-world callout with Daupler might work at Trico. Imagine a driver skids off the road late on a Saturday night and strikes a pole, causing a major outage. Trico detects the event through its AMI metering, which sends a signal to a collector and into the cloud before publishing the outage information to Trico's OMS. At that point, Daupler RMS becomes the operational hub for managing the event. As the outage is registered in the OMS, an incident is created within the RMS in less than a minute. The system immediately begins triaging the event, grouping related alarms and member reports and launching an automated callout to the appropriate on-call crews in accordance with Trico's union rules. Operators gain immediate visibility into whom they contacted, who accepted the callout and where they dispatched the crews, all without relying on manual phone trees.

The same workflow applies when the SCADA environment detects an outage. When the car strikes the pole, a pole-top electronic recloser sends an alarm with fault current information to Trico's SCADA environment, which publishes the event to Trico's OMS via MultiSpeak Web Services. Daupler RMS then takes over, initiating incident tracking, coordinating crew callouts and supporting faster, more consistent response regardless of which system detected the outage.

Continued improvements

Trico recognizes that it must navigate the path to modernization with clear goals. For Trico, phase one focused entirely on improving callout speed and accuracy. Phase two emphasizes deeper automation between systems, so outage tickets and member information can flow seamlessly without manual data entry. In phase three, Trico will automatically send notifications to all affected residents to keep them updated during outages, improving transparency and increasing member satisfaction.

While the intensity of large storm events in southern Arizona has recently been lower, Trico leadership believes that having an automated system during past major storms would have significantly improved response and restoration times. Faster dispatching also supports clearer estimated time for restoration, which has been a core metric in member satisfaction efforts.

Implementing modern response management is not only about speed. It is about having the confidence that utility managers handle outages consistently and fairly, with clear documentation and communication. For Trico, automating callouts and integrating data from dispatch, OMS, AMI and SCADA has helped operators expedite restoration while completing their critical responsibilities during outages.

Utilities across the country are feeling increasing pressure to improve outage management, communicate with customers and streamline internal workflows. Investments in response management can shorten dispatch times, reduce errors and enhance member trust. Trico believes that implementing a response management system will improve reliability across the entire outage lifecycle, from triaging customer outage reports to expediting the dispatch of crews. To measure the impact, Trico plans to gather data over time and compare IEEE reliability numbers like SAIDI and CAIDI before and after implementation. Ultimately, Trico views the system as a way to move beyond traditional systems for calling out crews, fielding member calls and restoring service. For Trico, Daupler RMS efficiently links systems for response, restoration and reliability, all of which play a critical role in boosting member satisfaction.

Wyatt Darrnell is director of account management at Daupler. His work focuses on helping gas, electric and water utility clients use Daupler's software to improve customer service, expedite restoration time and keep crews safe. He earned his bachelor's degree in business from the University of Missouri.

Manuel Velasquez, dispatch manager at Trico Electric Cooperative, maintains the operation of the utility's 24/7 dispatch section and supports service continuity and reliability objectives for its electric distribution system. He is a native Tucsonan and Navy veteran who has over 10 years of control center experience at Trico. He is currently pursuing an electrical engineering degree from Arizona State University.

GREEN OVATIONS

THE ARCHITECTS OF RESILIENCE:
HOW ENGINEERS ARE DESIGNING A SMARTER, STRONGER GRID

NICOLE PEARSON

After 25 years in this industry, I can't remember a time when the stakes were higher or the job was more complex. We're no longer just managing the flow of electrons; we're trying to orchestrate a delicate balance between aging infrastructure and the explosive demands of a digital-first world. We're juggling an aging grid, n-1 contingencies that feel more like n-5 some days, and a load forecast that looks like a hockey stick thanks to EVs and data centers. Just "keeping the lights on" doesn't cut it anymore.

The buzzword floating around boardrooms is "resilience," but for those of us who live and breathe this industry, it's not a buzzword. It's a mandate. It means having absolute confidence in designs and operational data. It's about building a grid that doesn't just withstand a storm but anticipates it and recovers with precision. It's about creating a resilient built world, and engineers are the ones who are building it.

From 2D guesswork to award-winning certainty

What really gets me excited is seeing what happens when brilliant engineers get their hands on technology that can keep up with their vision. A perfect example is our recent Year in Infrastructure 2025 winner, the China Energy Engineering Group, and their groundbreaking 500kV power transmission project in Nanning. This wasn't a simple build; they faced complex, hilly terrain. The old way—stacks of 2D drawings and siloed teams—would have been a recipe for disaster.

Instead, they went all-in on a full-lifecycle digital approach. Using ProjectWise, a connected data environment as their single source of truth, they started with a drone-based reality mesh or site and route selection and terrain modeling of the station area. With software for intelligent 3D modeling and utility design OpenUtilities and OpenBuildings Designer, they built a data-rich, intelligent 3D model, allowing them to identify and resolve 85 major technical clashes before a single shovel hit the dirt. By linking the model to the schedule with SYNCHRO, a 4D construction modeling application, they optimized their entire construction sequence, shortening the design phase by 10% and verification by 15%. They didn't just build a substation; they delivered a benchmark for efficiency and a living digital twin ready for intelligent operations.

Application of GIS+BIM Digital Intelligence Technology to the Entire Lifecycle of the Project.
Credit: China Energy Engineering Group Guangxi Electric Power Design Institute Co., Ltd.

The project included drone-based terrain modeling, geological 3D analysis and multi-disciplinary collaborative design.

BIM And GIS Technologies Drive Full-Lifecycle Delivery Of A 500-Kilovolt Digital Substation in Nanning

Credit: China Energy Engineering Group Guangxi Electric Power Design Institute Co., Ltd.

Engineering confidence in action

This principle of using digital twins for precision and speed applies just as powerfully to substation design and emergency response, as seen in the work of Copel and Exo Inc.

In Brazil, Copel revolutionized their substation design process by embracing a full BIM environment with a specialized application for intelligent substation design, OpenUtilities Substation. By moving from 2D to an integrated 3D system, they could identify physical and electrical conflicts on screen, not in the field. The result? They cut the development time for mechanical elements by 50%, leading to an estimated annual savings of USD 630,000.

And when a crisis hit in Missouri, Exo Inc. used a digital twin to avert disaster. After a flood damaged a critical transmission tower, they launched a drone to create a high-fidelity model of the bent steel. This allowed their engineers to safely analyze the damage and design a precise stabilization fix in a matter of days—a process that would have taken 4 to 6 weeks with traditional methods, protecting the power supply to nearby hospitals.

The work of China Energy, Copel and Exo Inc. is more than just impressive engineering; it's the future happening right now. They prove that resilience isn't an abstract goal, but a direct outcome of empowering engineers with the tools to design with confidence. This is what it means to build a smarter, stronger grid. This is how we, as an industry, will deliver a truly resilient built world.

Nicole Pearson is a marketing leader and energy industry expert who has spent her career at the center of the electric grid's transformation. With more than two decades of experience spanning regulated utilities and global infrastructure software, Pearson brings a practitioner's perspective on how market forces, infrastructure investment and customer expectations are reshaping the future of energy. Today, she leads global product and industry marketing for energy solutions at Bentley Systems, where she focuses on translating complex grid modernization challenges into clear, actionable market strategies.

Before joining Bentley, Pearson spent 23 years at Georgia Power and Southern Company, where she led enterprise marketing, communications and economic development efforts supporting customer programs, infrastructure growth and long-term energy strategy.

HOW CENTERPOINT ENERGY AND CLIMAVISION ARE BUILDING A WEATHER-READY GRID

CHRIS GOODE AND MATT LANZA

When Hurricane Beryl hit Texas in the summer of 2024, it resulted in widespread devastation to regional energy infrastructure. CenterPoint Energy, which provides electrical power to the Houston metro area and suffered two million customer outages, has since committed to **investing as much as $2.7 billion** through its Systemwide Resiliency Plan. These efforts include hardening overhead lines with stronger, storm-resilient poles and wires, expanding undergrounding in targeted areas, conducting enhanced vegetation management and other initiatives–all aimed at fortifying operations and proactively guarding against weather-related crises going forward.

CenterPoint Energy is far from alone. Over the last year, Tampa Electric in Florida, Entergy in Louisiana and LUMA Energy in Puerto Rico were also hit hard by hurricanes, resulting in widespread outages and other storm-induced damage.

While no energy provider is completely immune to the effects of extreme weather, such as hurricanes or otherwise, they're able to drastically reduce impacts by getting ahead of these events. In the case of a hurricane, this requires more acute visibility into its progression, advanced knowledge of exactly when it will make landfall, where it will strike and hourly updates leading up to that point.

But it's not just extreme weather that affects utilities. Every day, weather events can also have a disproportionate impact on energy production, demand, storage, alternative energy needs and pricing. These everyday shifts include events that likely don't even hit the radar of the passive observer, such as summer heat that lasts a bit longer than anticipated, lower-than-average wind speeds, more or less precipitation than usual, unexpected cold snaps, high or low solar radiance and drought, to name a few.

When CenterPoint Energy set out to future-proof its electric infrastructure and operations after Hurricane Beryl made the decision not just to account for extreme weather but for every facet of weather that affects its ability to consistently deliver power to customers. Through its work with weather technology company Climavision, CenterPoint Energy has shifted its perspective on weather as an unpredictable risk factor to weather as a measurable operational asset. This approach makes it more resilient to extreme events and more efficient, sustainable, and reliable every day.

Climavision Radar in Edna, Texas

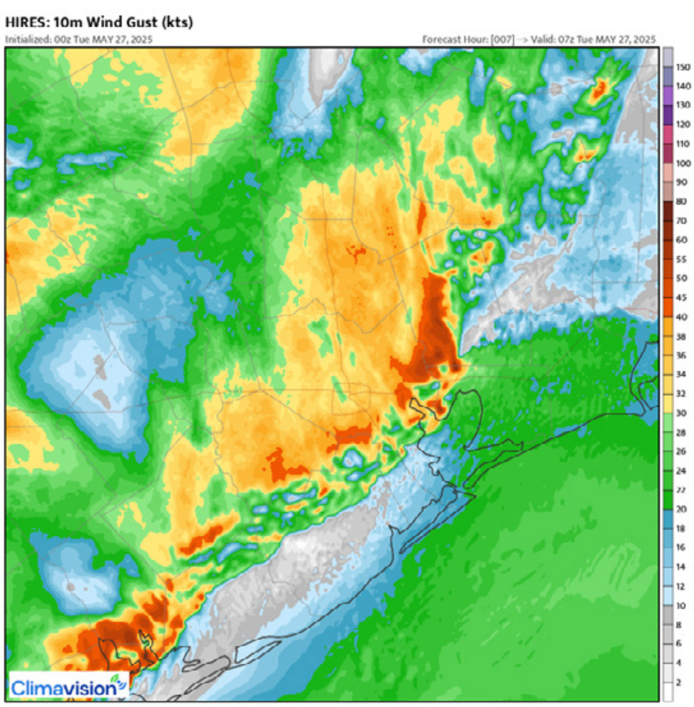
Here's a look at how CenterPoint Energy's far-reaching operational overhaul places weather at the forefront of its everyday decisions–and how other utilities can do the same.

1. Internal weather operations now reflect the importance of weather early warning impact on the organization.

It's not unusual for utilities to have a meteorologist on staff, but weather has traditionally been siloed from the rest of the utilities' operations. This means that while weather information is available, it's not integrated. CenterPoint is now changing this.

CenterPoint has built out its weather operations to include two in-house meteorologists, a suite of publicly available tools and partnerships with private weather companies like Climavision to disseminate weather information across the company.

CenterPoint's weather team is housed within its Emergency Preparedness and Response organization, although it monitors all weather events, not just extreme ones. When the team identifies a potential weather concern, it broadcasts it out via email and video to much of the organization, who escalates it further as needed.



Climavision HI-RES model of Houston-Area Forecast from May 2025

2. Risk management plans now include more proactive measures in response to increasingly advanced weather visibility.

While energy grids across the U.S. remain **vulnerable to severe weather**, utilities are no longer totally helpless against it. Gone are the days when energy companies only had a handful of days or just hours to prepare for extreme weather events. They can now plan ahead to predict how damage to infrastructure will lead to outages and when and how to safely dispatch ground crews, among other precautions.

With advanced AI-enhanced weather modeling from Climavision CenterPoint Energy has visibility into specific weather formations and their progression into its region up to weeks in advance. This has enabled it to update its risk management plan to include key steps to be taken starting the moment it determines that a storm is approaching.

CenterPoint had the occasion to put this new capability into action this past October, before thunderstorms it had identified several days earlier knocked out power to nearly 200,000 customers. Using publicly available weather model data alone, CenterPoint's meteorologists had only been able to identify "chances of strong to severe thunderstorms." Using Climavision's HI-RES model suite, however, it was able to forecast the risk of 50 to 70 mph wind gusts in the Houston area.

Equipped with this information, the team likened the risk to a similar event in May that had knocked out power to over 150,000 customers. CenterPoint got to work, convening internal calls and meetings to prepare for an Emergency Operations Center (EOC) activation and disaster response. The team was pre-positioned, staffed up and ready to respond to the storm. While there was nothing it could do to prevent outages altogether, its goal was to have almost all customers restored within 24 hours. And it was able to achieve exactly this, thanks to the advanced planning and the enhanced weather visibility afforded it.

3. From extreme weather to big-picture seasonal shifts, any weather event that influences energy production and operations is officially "on the radar."

It's not enough for utilities to look only at last year's data to roughly predict what will happen this year. Instead, they should look at subtle shifts in regional weather, month to month and quarter to quarter, to predict the seemingly small nuances that can have a disproportional influence on energy output, demand and pricing.

For instance, if the season stays warm for even a few days longer than average, energy companies must be prepared to continue powering cooling for up to millions of people until temperatures lower when they might otherwise be gearing up for heating.

It's also important to understand basic heat trends, considering that heat directly affects renewable performance: while solar output often improves, wind and hydro resources often underdeliver. And when heat sticks around, cooling is also delayed, which has an outsized impact on gas markets.

Similarly, precipitation levels directly influence hydropower. For regions that rely on it, lower levels of rainfall could leave them with less hydropower than they need.

And in states like Texas, where wind power is essential to supplementing traditional energy sources, even minuscule decreases in wind speeds are guaranteed to be felt for weeks. One metric that CenterPoint's meteorologists are paying increased attention to is potential thunderstorm wind speeds, which they can see at high resolution several days in advance of an event using Climavision's HI-RES model. As occurred during the October event, CenterPoint meteorologists now use data from HI-RES to speak to decision-makers less in terms of explicit forecasts and more in terms of potential risks.

This enables CenterPoint to view potential outcomes at a resolution and granularity it cannot achieve using publicly available model guidance. CenterPoint's region-specific knowledge and understanding of local Houston weather optimize its response, knowing that the conditions it's preparing for will occur directly in its service area, rather than surrounding ones.

4. Hyper-local weather data gives utilities the street-level visibility they need during extreme weather events.

Knowing that a storm will hit their overall region gives utilities information they need to take big-picture precautions, but CenterPoint Energy now goes far more granular than generalized regional data. Instead, it uses operational forecasts that reflect moment-by-moment conditions happening in its direct grid footprint.

To do this, CenterPoint Energy uses every data point possible, including those from its own network of ground-based weather sensors across its service area, as well as those from Climavision's hyper-local radar network, which gives it acute insight into what's happening within 60 miles of each radar. Through Climavision's proprietary radar network, CenterPoint is also able to capture weather events that were previously invisible using existing NEXRAD government-operated radars alone.

Together, these sources create a dynamic feedback loop: Data from CenterPoint's sensors continuously feed Climavision's models, while Climavision's forecasts inform where CenterPoint should deploy additional sensors, creating a closed-loop system for real-time weather intelligence.

And all the while, CenterPoint receives direct, real-time measurements of temperature, wind, pressure and humidity conditions that are integrated directly into Climavision's forecast models.

CenterPoint now has a continuous, hyper-local stream of weather intelligence that lets teams see severe convective activity forming between radar gaps (areas of land not covered by the existing government radar network), anticipate power restoration risks with greater precision and position crews based on forecasted storm severity at the neighborhood level. Climavision's additional radar coverage importantly allows CenterPoint to keep its crews safe in the event of a prolonged storm response effort.

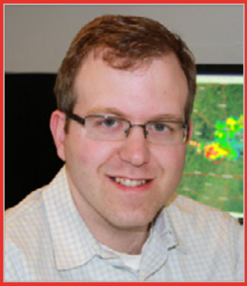
These hyper-local observations aren't just valuable in a crisis; they've become foundational to day-to-day grid optimization, helping CenterPoint refine load forecasting, renewable generation planning and maintenance scheduling around subtle but significant weather shifts.

With this level of advanced insight into which neighborhoods are most likely to be affected, utilities can prevent–or at least, offset–scenarios such as poles going down, transformers and crossarms being damaged and electricity wires being strewn across roads and public areas.

To consistently deliver power to customers, even in extreme circumstances, utilities must ensure the predictability and adaptability of their operations and infrastructure. For most utilities across the US–and the world–this requires a fundamental transformation.

Working with Climavision, CenterPoint Energy has created a path forward for itself and others who are exploring a similar transformation that reflects the realities of the weather's impact on their operations and infrastructure.

Chris Goode is the founder and CEO of Climavision, where he leads the only comprehensive supplemental radar network in the United States and a suite of high-resolution forecasting technologies. With more than 30 years of weather industry experience, he has guided the company's rapid expansion since its 2021 launch, with backing from TPG's The Rise Fund. An Air Force Weather veteran and former executive at The Weather Channel Companies, AirDat and Enterprise Electronics Corporation, Goode brings deep operational expertise to advancing real-time weather intelligence for grid resilience, energy trading and other weather-sensitive sectors.



Matt Lanza joined CenterPoint Energy in 2024 as the meteorology manager. He leads the company's internal weather intelligence efforts for daily, short-term and long-term weather planning. Lanza has been working to transform how weather data and analytics are integrated into CNP's outage planning to prepare for, respond to and mitigate against the impacts of hurricanes, tropical storms, winter weather, wildfires and other extreme weather events that may impact any parts of our service territory. Lanza brings over 20 years of experience in meteorology and leadership. His background includes meteorology broadcasting, natural gas trading and load forecasting. He earned a bachelor's degree in meteorology from Rutgers University and is a Certified Digital Meteorologist with the American Meteorological Society.

GRID EDGE AUTOMATION TURNS UTILITY DATA INTO MEASURABLE RESILIENCE

KUMAR CHANDRAN

The challenge facing today's utility operators isn't a lack of data—it's data paralysis. After years of equipping our grid infrastructure with intelligent devices, we're producing unprecedented amounts of operational data. Still, many utilities find it difficult to turn these digital insights into concrete actions that genuinely improve grid performance and customer experience.

As power demand rises from data centers, electric vehicle charging and distributed energy resources, the need for proactive grid management has never been more urgent. Utilities must serve increasing customer bases, incorporate variable renewable energy sources and uphold high reliability standards—all while preparing for more extreme weather events.

The solution isn't about collecting more data, but about strategically integrating existing data streams with targeted automation technologies to generate actionable intelligence where it counts most: at the grid edge.

Why the grid edge holds the key to resilience

Distribution systems represent both utilities' greatest vulnerability and their biggest opportunity for improvement. According to the U.S. Energy Information Administration, investments in distribution grids have surged 160% over the past two decades, yet most outages still originate from these networks.

The grid edge(neighborhood lines) presents compelling opportunities for resilience improvements:

- Outage concentration: The vast network of neighborhood lines creates multiple failure points, with the majority of customer-impacting events occurring on single-phase distribution circuits.
- Technology gaps: While utilities have modernized transmission and primary distribution systems, many lateral networks still rely on decades-old protection schemes and limited monitoring capabilities.
- Fault characteristics: Approximately 80% of overhead distribution faults are temporary, caused by wildlife contact, vegetation, or weather conditions. The right technology can prevent these momentary disturbances from becoming sustained customer outages.

The power of strategic technology integration

Traditional grid modernization often follows a reactive approach—replacing equipment after failure and implementing point solutions that operate in isolation. This fragmented strategy delivers limited value and fails to capitalize on the complementary effects between hardware upgrades and data systems.

True transformation happens when utilities strategically merge automation technologies with data analytics platforms. This combined approach delivers three unique operational benefits:

- Enhanced prevention: Predictive analytics identify equipment degradation patterns and environmental risk factors before they cause outages.
- Intelligent response: Automated switching and protection systems respond to faults in real-time, often restoring power before customers experience an interruption.
- Accelerated restoration: When outages persist, accurate fault location data helps crews restore service more quickly and safely.

Implementing intelligence where it matters most

The question is: where should utilities focus on these integrated technology investments to achieve the greatest impact? The answer is that different parts of the distribution system need different strategies based on their specific operational challenges and fault characteristics.

Overhead distribution lines face specific vulnerabilities—wildlife contact, vegetation interference and weather exposure—that lead to predictable fault patterns. Underground systems, although protected from environmental hazards, present different challenges for fault detection and location. Each environment requires tailored solutions that combine the right automation and data technologies.

Fortunately, there are proven strategies for implementing both overhead and underground distribution systems. These examples demonstrate how utilities can adopt integrated solutions that address the unique resilience challenges of each environment.

Proven Solutions for Overhead Distribution

Outage prevention strategies

- Strategic recloser deployment: Replacing traditional fuses with intelligent reclosers prevents temporary faults from causing sustained outages. Modern reclosers can distinguish between temporary and permanent faults, automatically restoring service for momentary disturbances while protecting the system from persistent problems.
- Grid segmentation optimization: Implementing smart switching devices to create distribution segments serving 100-300 customers limits outage scope and enables more targeted restoration efforts. This approach significantly reduces both the number of affected customers per incident and the complexity of restoration operations.

Service restoration enhancement

- Automated fault indication: Advanced reclosers with visual drop-out mechanisms provide immediate fault location information, enabling field crews to identify problem areas quickly and safely.
- Remote monitoring integration: Digital sensors paired with protection devices create comprehensive situational awareness. Utilities can track fault frequency patterns, identify equipment requiring maintenance attention and optimize crew deployment during restoration events

Underground Distribution Transformation

Prevention-focused approaches

- Systematic undergrounding: Converting overhead laterals to underground configuration eliminates weather-related outages while reducing long-term maintenance requirements. When combined with underground distribution restoration systems, this approach creates highly resilient neighborhood networks.
- Predictive maintenance programs: Digital transformer monitors continuously assess equipment health and transmit data to AI-powered analytics platforms. These systems can predict equipment failures up to months in advance, enabling proactive maintenance that reduces unplanned downtime by up to 50%.

Automated restoration capabilities:

- Loop automation systems: Underground restoration systems deployed across residential transformer networks can isolate faults and automatically transfer customers to alternative supply sources within seconds. This technology prevents many underground faults from becoming sustained customer outages.
- Precision fault location: Digital monitoring solutions provide exact fault location information for underground circuits, eliminating the time-consuming process of manually testing cable sections during restoration efforts.

Measuring success: From investment to impact

The true measure of successful grid modernization isn't the number of new technologies deployed — it's the visible improvement in system performance and customer experience. When utilities strategically combine automation and data technologies at the grid edge, they typically achieve:

- Reduction in outage frequency: Automated reclosing and grid segmentation can reduce customer interruptions by 40-60%
- Decreased restoration time: Precise fault location capabilities often cut restoration times in half
- Improved maintenance efficiency: Predictive analytics enable condition-based maintenance strategies that optimize resource allocation and reduce cost
- Enhanced customer satisfaction: Fewer outages and faster restoration directly translate to improved customer experience metrics

Building tomorrow's grid today

Grid modernization is fundamentally about building a foundation for the energy future. The technologies and data systems deployed today at the grid edge will support tomorrow's distributed energy resources, electric vehicle integration and dynamic load management needs.

By turning existing data into actionable insights and strategically implementing automation technologies where they are most effective, utilities can create resilient distribution networks that reliably serve customers today while preparing for future demands.

The path forward requires moving beyond data collection to data activation, turning insights into automated responses that strengthen the grid where customers feel it most. Utilities that make this transformation don't just improve operational metrics; they create competitive advantages through improved reliability, optimized asset utilization and enhanced customer trust. As customer expectations for reliable power continue to rise, the utilities that successfully integrate automation with data intelligence at the grid edge will set the standard for modern distribution operations.

Kumar Chandran is senior director – Market Strategy and Business Development at S&C Electric Company. Chandran is responsible for driving the global growth of S&C's Utility Grid Automation business, customers enhance grid resiliency and reliability. His team works with utilities to craft insight-driven business cases and compelling stories that highlight the real-world impact of adopting innovative technologies. Beyond adoption, the team plays a critical role in helping scale these solutions across utility operations—accelerating transformation and delivering long-term value.

Chandran has been with S&C for 19 years, bringing broad experience across engineering, operations, services, strategy and business development. He holds a master's degree in mechanical engineering from the Illinois Institute of Technology and an MBA in strategy and international business from Northwestern's Kellogg School of Management.

HOW POWER GRIDS CAN PREPARE FOR THE AI ERA

MARTIN FENGLER

The rise of AI is transforming industries across the U.S., with giants like Meta investing billions in new data centers to fuel their AI aspirations. But these large corporations aren't the only ones paying a hefty price. To make AI visions a reality, more than a cash injection is required — they also need energy. The immense amount of power that AI initiatives require is placing a heightened strain on an already overloaded grid. In addition to businesses, consumers are also using more energy than ever, especially during recent extreme heat events. This summer alone, temperatures of over 100° swept the nation for weeks at a time, causing communities to keep ACs pumping around the clock.

All of these factors together are causing rising concern among grid operators, with 65% second-guessing their ability to meet demand, especially during extreme weather. The question many are now scrambling to answer is how to prevent energy shortages during these events and keep the lights on for the communities they serve.

The challenge - and opportunity - of renewable energy

To ensure the grid is as resilient as possible, relying solely on oil and gas power sources is no longer enough. Renewables, such as wind, solar and hydro power, are essential to supplementing the supply. However, renewable energy is notoriously challenging to manage.

Green sources are at the whim of the weather and fluctuate drastically, making them difficult to predict and integrate into the power grid. Utilities cite solar and wind variability as a top operational challenge (68%), with wind production relying on wind speed and air density and solar energy relying on intensity and duration of sunlight. However, energy companies remain undeterred. Despite these challenges, Meteomatics' 2025 Weather Data Trends in Energy Report found that more than half (51%) of U.S. energy executives plan to increase their reliance on renewable energy sources within the next decade.

To manage shifts in production and make renewables as efficient as possible, utilities are turning to advanced battery technologies. Battery energy storage systems (BESS) enable energy companies to store any excess energy produced, thereby eliminating energy waste and serving as a backup energy source during high-demand intervals. On days when renewable energy production is low, these storage systems are crucial in maintaining the grid's operation. Over the next 10 years, 52% of utilities plan to increase their investments in BESS to improve grid stability.

Weather is the key to true energy efficiency

Utilities can proclaim reliance on renewables and invest more in BESS, but to unlock the full potential of these technologies, energy executives must have a strong understanding of the day-to-day environmental factors that affect production and demand.

The process of leveraging solar, wind and hydro power can be optimized with real-time, hyper-local weather forecasts. Knowing how long wind gusts will persist, or when a heat wave is sweeping through, is essential for understanding everything from a transmission line's capacity to whether utilities will have to fill in gaps in renewable generation. With that knowledge, they can confidently develop and implement a distribution strategy, ensuring the lights stay on for communities and businesses alike.

The majority of grid operators (62%) currently spend less than $50,000 annually on weather data; however, this is set to change, as energy executives (49%) indicate plans to increase investment in advanced weather forecasting solutions and data analysis tools over the next decade.

The future of the energy industry

It's abundantly clear that AI isn't just a fad that the business community will move away from in a few years. The benefits of the technology are numerous, and more companies will continue to integrate it into their businesses. As a result, power grids must adapt their strategy to remain resilient.

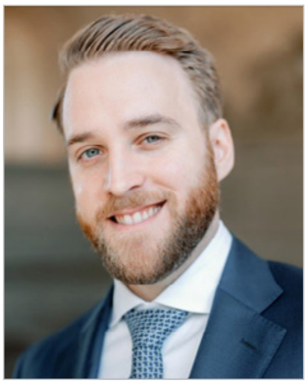
Renewables, with the support of weather intelligence and battery solutions, are a vital resource for supplementing demand. Paired with other energy sources like oil, gas and nuclear, if renewables can be harnessed effectively, utilities will be able to not only meet AI demand but also eliminate stressors for true grid resilience.

Dr. Martin Fengler is the founder and CEO of Meteomatics, a Swiss-based weather intelligence company founded in 2012. He earned his Ph.D. in applied mathematics from the TU Kaiserslautern in Germany. Dr. Fengler then went on to develop several numerical weather prediction codes for Meteomedia AG (now MeteoGroup Switzerland, integrated into DTN), where he later led the Technology and Innovation department.

GUEST EDITORIAL

A GRID UNDER PRESSURE:
TACKLING UTILITIES' CHALLENGES TODAY TO PLAN FOR A BETTER TOMORROW

MARC LAMOUREUX



Traditional planning processes are no longer equipped to meet the complexities of today's utilities landscape—let alone build the electrical grid required for the future. With pressure mounting to keep pace with consumer and regulatory scrutiny, the acceleration of electrification and the rise of data centers set to drive unprecedented power demand, utilities must also ensure distributed energy is delivered closer to the point of use.

The challenges are mounting, and unstable situations such as extreme weather and the inherent variability of renewable energy sources are creating their own planning hurdles. Utilities must rethink their traditional approaches to investment planning, argues Marc Lamoureux, Principal Product Manager at IFS Copperleaf. Modernizing the electrical grid will be a business imperative for ensuring a stable, reliable and resilient grid, and it's where a new generation of integrated grid planning (IGP) tools, which quantify and integrate risk across the entire grid, is stepping in to fill the gap.

Demand predictions estimate that **many utilities will need to double grid capacity** within the decade.

Current grid infrastructure is already under pressure. The solution isn't just to make the future grid bigger at the points of need. The grid needs to be viewed as a whole to be made stronger, more intelligent and focused on sustainability. A new approach to investment and asset planning is essential, and sooner rather than later.

Why traditional grid planning will no longer make the cut

Distributed energy resources (DERs), rapid electrification and extreme weather are transforming grid dynamics faster than conventional planning cycles can keep up. The convergence of these growing external pressures is making traditional, siloed grid planning a huge risk. Meanwhile, grid infrastructure — transmission lines, substations and distribution systems — is aging and often nearing or past its intended service life.

The grid of tomorrow needs to address today's issues. Only then will grid resilience prove its worth in improving energy security and sustainability. The **solution lies in IGP**, which links generation, transmission, distribution and emerging technologies in a single decision model that calibrates risk against capital investment.

There are three ways IGP will help utilities battle the growing threats in today's landscape:

1. Electrification is here—the grid knows only too well.

Electrification targets are no longer a distant challenge—they are straining the grid right now. The ripple effects are already becoming clear. Industry analysts project an **18-fold increase in EV load by 2030**, driving major spikes in electricity demand that could ultimately push consumer bills higher.

But electrification goes beyond EV production. The shift includes **transportation, buildings and industry**, which will each continue to push the electrification charge. In the U.S., the rapid adoption of digitalization and AI technologies has fueled the demand for data centers nationwide. To keep pace with this adoption alone, data center power consumption is expected to grow by **three times current capacity** by the end of the decade.

The urgent need for grid modernization and smarter investment strategies is stronger than ever. Traditionally, utilities have operated on reactive reinforcement, a method in which grid operators wait for a problem to occur and focus only on the short term. Effective in a stable environment, but in today's unpredictable market, utilities cannot afford to stay siloed. It often leads to capacity shortfalls and is a waste of capital and time. Proactively reinforcing the grid to prepare for future electrification demand will be crucial to ensure a reliable and safe energy supply.

2. Distributed energy reshapes grid investment—and don't forget sustainability.

The integration of DERs is rapidly increasing. It's predicted to **grow sevenfold by 2030**, holding enough potential to provide **61-67% of the 2050** global power mix. With variable renewable energy sources now likely to make up a larger portion of the power supply, utilities face growing uncertainty in hosting capacity and the risk of reverse-power flows.

Without an AI-enabled IGP, this uncertainty can lead to incorrect decisions resulting in overbuilt infrastructure or missed opportunities for low-cost flexibility. IGP helps guard against multiple factors, such as environmental, social, and technological changes, while responding to evolving energy demands. It addresses this by using probabilistic analysis to pinpoint the least-cost upgrades and identify non-wires alternatives that maintain reliability while deferring capital spend.

There are sustainability and regulatory benefits too! IGP also supports better grid integration with solar and wind energy sources and enables the transition to a clean energy future while reducing greenhouse gas emissions. In turn, it strengthens stakeholder trust by ensuring every investment directly supports resilience, reliability and ESG commitments on a clear economic scale. Beyond this, regulatory compliance cannot be ignored, and utilities need to be prepared to pivot to ensure they stay in compliance with changing rules. IGP helps build regulatory confidence through transparent, value-based plans that shorten approval cycles and help secure performance incentives.

3. Extreme weather—the new normal?

Extreme weather events are becoming more frequent and more severe, and they have the capacity to upend modern life as we know it. In North America, hurricanes and wildfires have dominated headlines—resulting in outages to key resources across large areas. Weather events we once called one-in-100 or one-in-1,000-year events are now happening every year, sometimes multiple times a year.

While energy generation facilities—especially centralized ones such as nuclear plants—are generally well-protected, the transmission and distribution (T&D) networks remain highly vulnerable. As energy generation becomes more distributed with the likes of solar and wind, the threat is only increased.

The challenge is how to make informed decisions regarding assets and infrastructure amid these growing weather events. Traditional planning methods, such as SAIDI (System Average Interruption Duration Index) and SAIFI (System Average Interruption Frequency Index), measure the duration and frequency of power outages, but these often fail to account for extreme weather events and can result in prolonged outages and higher recovery costs.

SAIDI and SAIFI measures, alongside operations and maintenance (O&M) overruns, have only been rising. Here, IGP solutions that support rapid re-forecasting, such as IFS Copperleaf, help relocate crews and capital within minutes to the highest-value fixes—reducing downtime, protecting assets and enhancing resilience. Using advanced analytics and forecasting, decision-making for grid investments and operations is all data-driven, meaning utilities can see major cost optimization and performance improvements.

Treating the entire energy system as one—the integrated way

IGP uses a holistic approach that considers the entire energy system, including generation, transmission and distribution. Instead of juggling separate priorities across disparate lines of business, planners can understand how a non-wires alternative competes with a substation rebuild for scarce capital. By integrating input from utilities, regulators, legislative bodies and community representatives throughout the planning lifecycle, IGP can help ensure decisions are aligned with comprehensive requirements and needs from different parties.

The holistic scope of IGP flips traditional reactive measures on its head. Through the IFS Copperleaf Value Framework, utilities can align crucial investments to long-term strategies, helping futureproof the grid of the future. Utilities can quantify diverse outcomes on a common economic scale and be confident in optimizing portfolios continuously to ensure decisions stay valid, even when conditions change. With scenario analysis, organizations can pressure test potential investment plans under any number of possible future scenarios to understand the potential impact of anything from budget changes to extreme weather damage on their plans.

IGP in action: Just ask PG&E

The results of effective IGP are already being realized. Capital efficiency gains are felt as funds shift from low-value projects to those mitigating the most risk per dollar. In 2024, **Pacific Gas & Electric (PG&E) piloted IFS Copperleaf to support integrated grid planning** to assess the impact of bundling work across its grid portfolio. The results were impressive—a 20% improvement in unit cost efficiency across a $100 million portfolio, freeing millions for reinvestment. By grouping projects and coordinating execution across programs, PG&E avoided redundant fieldwork, reduced outages and delivered measurable financial and operational gains.

Retiring spreadsheets for good

It's clear that traditional, siloed planning approaches simply can't keep up with accelerating demand, rising uncertainty and increasingly extreme operating conditions. They lack the flexibility, speed and system-wide insight required to deliver the reliability today's consumers and stakeholders expect—and that tomorrow's grid will demand.

However, IGP is way more than an incremental improvement. It's a fundamental shift in how utilities strategically manage, plan and prioritize critical assets and grid infrastructure. Those who make the pivot now will be the ones leading the transition to a smarter, more resilient, future-ready energy system.

As senior product manager at Copperleaf, **Marc Lamoureux** specializes in product strategy, data visualization, and GIS — helping teams turn complex challenges into value-driven outcomes. Lamoureux has successfully led cross-functional efforts across sales, client engagement and solution implementation in diverse sectors, including utilities, transportation and municipal markets.

GUEST EDITORIAL

WHY DERMS CROSSING THE SCADA THRESHOLD MEANS BIG CHANGES IN 2026

NICK TUMILOWICZ

Twenty-five years ago, you wouldn't have found many power companies that didn't rely on Supervisory Control and Data Acquisition (SCADA) as part of their critical infrastructure. Put simply, utilities could not operate their business without it. Operators sat in control centers, issuing commands to substations and switchgear, managing transmission lines and grid operations in a system designed around the predictable flow of electricity from large, centralized generation assets.

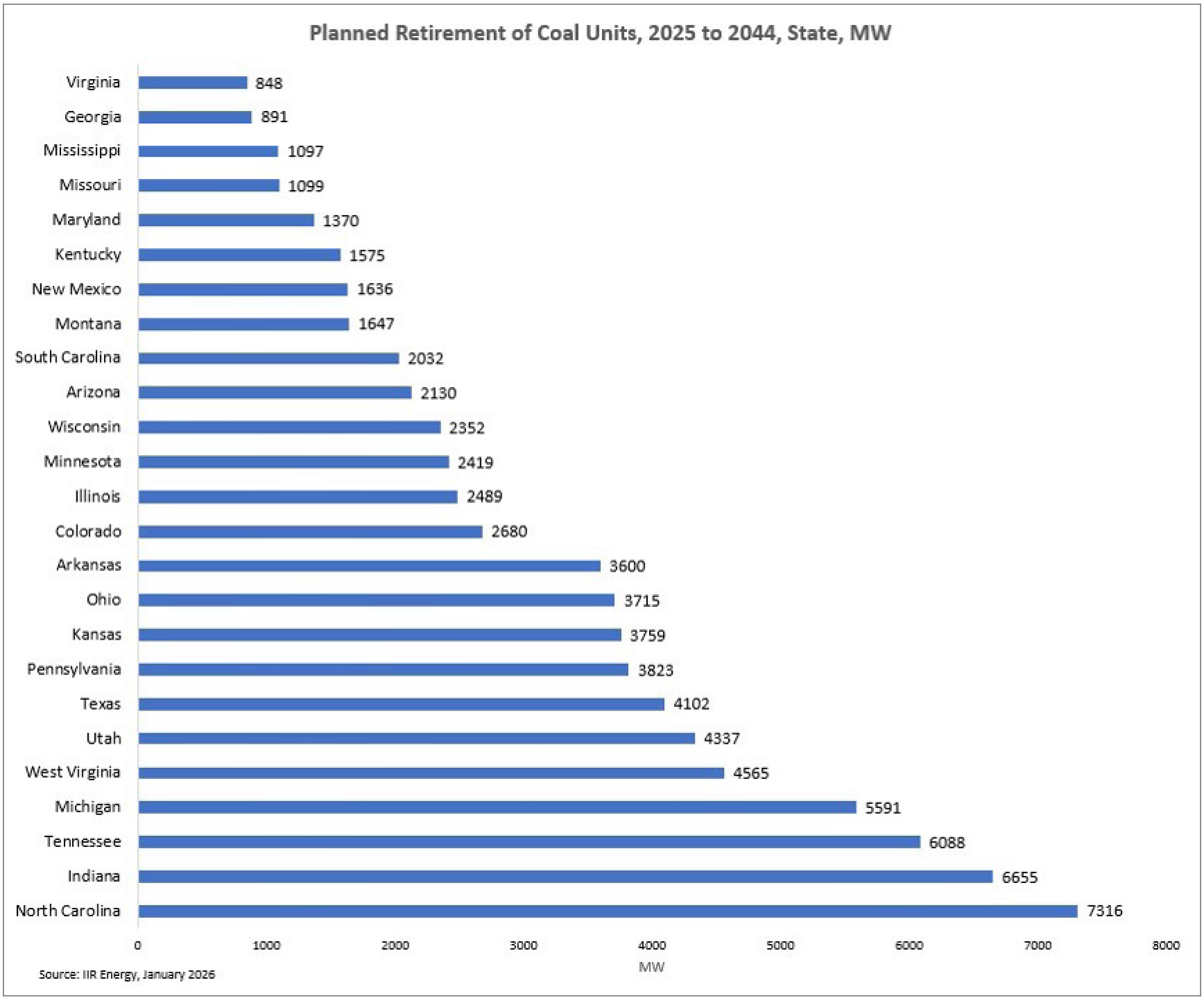
Today, something similar is happening at the grid edge that is reshaping what "essential infrastructure" means. Distributed Energy Resource Management Systems (DERMS), which are used to manage distributed energy resources (DERs) like batteries, solar photovoltaic, electric vehicle (EV) chargers and demand response programs at scale, are approaching that same threshold SCADA crossed decades ago. Once viewed as an optional software system, DERMS platforms are approaching critical infrastructure status within utilities nationwide—and we are hitting the inflection point in 2026.

Why DERMS means operational necessity today (and where we see threshold moment happening)

The simple truth is that utility executives have crossed the point of asking, " Do we need DERMS?" and are now asking, "How can we operate without DERMS?" The reasons can be summarized as shifts across three vectors:

- **Vector #1:** Supply is being redefined by accelerated decarbonization timelines
- **Vector #2:** Reliability expectations are changing faster than ever
- **Vector #3:** Customer flexibility is now part of the grid management equation

These three vectors are influencing how utilities think about DERMS technology today and where we expect the tipping point to occur across the industry.



Planned Retirement of Coal Units, 2025 to 2044, State, MW. Source: IIR Energy, January 2026

Vector #1: Supply is being redefined by accelerated decarbonization timelines

With US electricity needs estimated to grow by **200GW by 2030**, utilities face an operational reality where traditional generation can't cover evening peaks without aggregating distributed resources.

Factor in that **IIR Energy's** power plant tracking reports that around 78 gigawatts (GW) from 167 coal units at 81 plants are planned for retirement over the next two decades. As fleets of dispatchable generation powered by fossil fuels shut down, the strain will fall disproportionately on systems that aren't yet ready to manage high penetrations of DERs.

DER resources aren't just adding new capacity—they're fundamentally different than traditional generation assets. Unlike baseload coal plants that run smoothly between scheduled outages, DER facilities can frequently change how much electricity they generate or consume from one moment to the next. A utility-scale solar farm delivers power only during the day; stored battery packs can be dispatched but have limited energy capacity; demand response programs leverage customer flexibility to shift load, but aren't always easily predicted. Orchestrating this level of flexibility at scale—aligning distributed resources with grid needs in real time—is only possible with DERMS.

To be clear, utilities have added DERs to the grid for decades and have long used DERMS pilots to tap into flexibility from small sets of distributed resources as part of grid management programs. Systems without DERMS technology have found ways to continue integrating DERs, but they're now managing millions of highly dynamic, bidirectional endpoints rather than the thousands of largely one-way assets legacy systems were built to manage. And they're doing it while navigating aggressive decarbonization mandates and heightened reliability expectations that were virtually unheard of just a few years ago. The challenge today is not only one of scale, but of variability and complexity.

Vector #2: Reliability expectations are changing faster than ever

Maintaining reliability means managing the transition from legacy generation assets to new flexible resources like DERs. Extreme weather events have also exposed weaknesses in traditional reliability planning tools, indicating that it's not enough for utilities to respond to reliability issues. They need to anticipate them before they happen. The utility industry's obsession with reliability scores isn't going to let up either. From JD Power customer satisfaction scores to performance incentives designed by regulators, utilities are being held accountable for reliability like never before.

DERMS platforms help manage both challenges. Integrating advanced metering infrastructure (AMI) and DERMS technology lets utilities tap into flexibility from millions of customer endpoints across DERs, customer-owned batteries and load. Utilities are already using this capability to create real-time visibility into distribution feeder voltages and enable remote load management for the first time, providing a new tool for outage prevention and response.

DERMS platforms that integrate utility-scale solar, battery storage resources and legacy grid infrastructure likewise give operators visibility into how distributed assets and centralized plants will operate fleet-wide at any point in the future—essential information when you're planning how to keep the lights on for tens of millions of customers.

Vector #3: Customer flexibility is now part of the grid management equation

DERMS solutions also align directly with changing customer experience expectations. Utilities need access to distributed customer-side flexibility to manage reliability at scale, but they need to do it without taking away what matters most to customers: comfort, convenience and choice.

The bottom line for customers is simple: stay cool in summer, stay warm in winter and have a cold beer waiting for you when you get home. Demand response programs that disrupt customer comfort will create irritated customer lines...literally. DERMS technology that can coordinate both grid-side assets like substations, batteries and solar plants with customer-side devices solves that problem. These systems give utilities visibility into how much flexibility is available from customer-side assets at any given moment—not just how much load can be shed, but also how much demand can be added if that creates more value for grid operators.

Flashback to SCADA: Technology threshold moments matter

Ask most utility executives what SCADA is, and you'll get a quick answer: SCADA refers to the combination of hardware and software that lets utilities monitor and control substations, switchgear and grid assets remotely—a capability that has been part of how every electric utility does business for decades. Emerging in the 1970s and 80s, SCADA was a "big tech bet" in many ways—costly to install and maintain, disruptive to organizational processes and often pitched to capital committees by enthusiasts rather than engineers. Gradually, as grids got more complex and chaotic, SCADA earned its keep operationally and began moving out of the innovation budget and into the infrastructure budget.

DERMS is tracing a familiar trajectory. Certain utilities have been validating this technology for years—Germans interfacing with prosumers, Australians triaging too much distributed solar on their systems and coastal utilities in the U.S. dealing with grid hosting capacity issues. But we've learned from their experience what fundamental qualities second-generation DERMS platforms need to be considered operationally reliable: interoperability with other systems, scalability to any number of endpoints and coordination of grid-side and customer-side assets within integrated operational workflows—and now that understanding is spreading to capital committees.

DERMS coming out of 2026 will be different because utilities are no longer treating these systems as experimental. Budgets are being drafted to move DERMS solutions out of pilot programs and innovation initiatives into 3-, 5- and 10-year capital plans alongside grid modernization, AMI deployments and other core infrastructure investments.

With that shift comes a higher bar. Utilities now expect DERMS to be utility-grade and fully baked, with end-to-end testing and validation that demonstrate high confidence at scale. The questions being asked have changed from "can it work?" to "can it perform reliably in real-world operating conditions?" and, increasingly, "what does it cost us NOT to have it?" That inflection point—where a system must prove itself as bullet-proof and operationally trusted as SCADA—is the hallmark of any piece of technology that's about to go infrastructure-sized.

The AMI connection: An infrastructure asset often overlooked

A piece of the DERMS discussion frequently undersold when discussing market opportunities is AMI. Because tens of millions of distributed intelligent meters are already in the field across the U.S., utilities have grid-edge communications and control layer that is vastly more capable than the legacy metering solution it replaced. Modern smart meters are no longer merely measurement devices—they are networked computers able to run multiple applications that support grid monitoring, outage detection, load control and real-time visibility, and they're already changing how utilities manage reliability.

DERMS platforms designed to leverage AMI technology gain a powerful operational edge. Treating AMI as siloed from grid management and customer participation leaves value on the table. An "edge DERMS" architecture, which is purpose-built to manage customer-side assets via the AMI layer, allows demand flexibility programs to integrate with grid operational systems to produce two-way value: improved customer programs with visibility into grid conditions in real time and grid operations made more efficient by previously hidden flexible load.

Today's smart meters can also provide real-time feedback and alerts that highlight emerging grid-asset overload conditions. When paired with DER visibility, availability and control, utilities gain the ability to dispatch local flexibility to stabilize conditions and reduce the risk of subsequent outages. As these capabilities are unlocked at scale, endpoints are shifting from passive meters into active grid assets.

We are starting to see broader industry recognition of AMI's importance to DERMS functionality—and how utilities should be thinking about these technology investments.

Adoption barrier: Organizational readiness

Maturity of enabling technologies is necessary but not sufficient for DERMS to reach critical mass. An equally important condition is organizational readiness—and many utilities are still working through internal hurdles that slow adoption.

The challenge is often structural. The entities that run grid operations and the entities that run customer programs have historically been separated within utility organizations, with little coordination between the two groups. Grid operations are concerned with reliability of the transmission and distribution grid, while demand response and energy efficiency program managers are concerned with customer outreach and load shaping. They use separate systems that report into separate branches of the organizational hierarchy and often have limited awareness of each other's needs.

Some utilities are beginning to move toward a more integrated operating model. Sacramento Municipal Utility District (SMUD), for example, has **publicly described efforts** to align grid edge visibility, flexible customer programs and operational planning as part of its broader reliability and decarbonization strategy. Utilities undergoing similar organizational transitions are finding that closer coordination between grid operations, AMI and customer programs can reduce friction and accelerate deployment. As a result, DERMS initiatives that once required lengthy pilot phases are increasingly being stood up more quickly as utilities align people, processes and systems around shared operational goals.

Closing thought: There's no going back from a DERMS future

SCADA didn't become critical infrastructure overnight. It reached a point of no return as a series of small decisions and growing operational truths that made going back impossible. DERMS is crossing that threshold right now in 2026. In fact, utilities have added DER to the grid for decades, and early adopters have been proving DERMS concepts for years.

Global deployments illustrate how DERMS is moving from pilot technology to core infrastructure, particularly as utilities integrate customer-side flexibility directly into grid operations.

In North America, Xcel Energy (Colorado) provides a clear example of this shift. Through its **Renewable Battery Connect (RBC) program**, Xcel has used DERMS capabilities to onboard and coordinate thousands of customer-owned batteries, enabling the aggregation of more than 15 MW of flexible capacity in under six months. The program lays the foundation for Colorado's first battery-owned virtual power plant while demonstrating how DERMS can bridge customer programs and real-time grid needs. Xcel has outlined plans to expand this model to include solar, electric vehicles and thermostats, significantly increasing the scale and operational importance of DERMS across its system. **Hawaii Electric** has also been an early and aggressive DERMS adopter, given Hawaii's exceptionally high rooftop solar penetration, using the technology to manage reverse power flows and voltage issues on distribution feeders.

In Europe, distribution system operators in Germany, the UK and the Netherlands have deployed DERMS as part of broader smart grid initiatives, where high renewable penetration has made real-time DER coordination a grid stability necessity rather than an option. **National Grid in the UK**, for instance, has been actively managing behind-the-meter flexibility resources through DERMS-enabled demand response programs.

Utilities across the globe are using DERMS to enable virtual power plant participation at scale. In Western Australia, Synergy is participating in **Project Jupiter**, a multi-utility initiative that uses DERMS-based coordination to register and manage rooftop solar and customer batteries, enabling households and businesses to participate in virtual power plants under emerging interoperability standards.

The millions of distributed energy resources already connected to the grid (and millions more that will be added in the next 5 years) will not be whipped into reliability by spreadsheets and phone calls. They need real-time, operational technology that can see, coordinate and optimize across assets at the edge. These platforms operate at utility-scale today. The capital committees that must prioritize them are just starting to realize why.

Nick Tumilowicz is a thought leader, strategist and a recognized expert in DER management. In his current role as Itron's director of product, Tumilowicz leads the Distributed Energy Management business unit, accountable for global product development of Demand Response, DER and Forecasting solutions that enable access to flexible customer energy resources. Tumilowicz holds a variety of positions on advisory councils, including Department of Energy (NREL, Building Technologies Office, Solar Energy Technologies Office), Department of Defense (Naval Research Laboratory), General Services Administration, California Energy Commission, Grid Forward Leadership Committee, Incubate Energy Labs, Saudi Gulf Cooperation Council Interconnecting Authority and regularly informs Public Utility/Service Commissions across the U.S.

WHAT THE POLAND GRID ATTACK REVEALS ABOUT BATTERY STORAGE RISKS

RAFAEL NAREZZI

In the film *Ocean's Eleven*, the criminals use a device known as a "pinch" to generate a strong electromagnetic pulse that shuts down power across the Las Vegas Strip. Security systems fail, cameras go dark, and chaos ensues.

The scene works because it taps into a real vulnerability of modern infrastructure: when operators lose visibility, they lose control.

Moving from fiction to the real world, in December 2025, a cyberattack on Poland's energy infrastructure illustrated how this principle applies to the real grid. The attack targeted distributed energy resources across roughly 30 sites, including wind farms, solar installations and combined heat and power facilities. Rather than targeting a single large generating station, attackers focused on the distributed edge of the grid, disrupting communications and operational visibility across multiple facilities.

Polish officials later confirmed that operators came close to losing visibility into roughly a quarter of the nation's energy mix during the event, which occurred amid temperatures approaching –15°C. **The incident was ultimately contained**, thanks to strong network segmentation, redundancy protocols and rapid response by national cyber defense teams.

But the attack revealed an important lesson for energy operators worldwide: as the grid becomes more decentralized, the attack surface expands. And the systems most critical to balancing modern power grids, including battery energy storage systems (BESS), may represent the next major target.

Why battery storage is becoming a critical cyber target

Because they balance supply and demand, stabilize frequency and help integrate intermittent renewable generation, BESS are rapidly becoming central to grid stability. It makes sense then that global BESS deployment is expanding quickly. According to the International Energy Agency, global energy storage capacity is expected to grow more than sixfold by 2030, with grid-scale batteries accounting for the majority of that growth.

As adoption grows, it's important to remember that BESS assets operate very differently from traditional generation. A modern battery facility is essentially a software-based digital control environment. It includes battery management systems (BMS), programmable logic controllers (PLCs), energy management software, remote communications networks and automated dispatch signals tied to grid frequency and market conditions.

Since BESS respond to software commands and software is a honey pot for malicious activity, gaining access to control systems or communications channels that could intentionally destabilize grid balancing mechanisms is only a matter of a few keystrokes.

The goal would not necessarily be to destroy infrastructure but to manipulate the grid itself.

Five emerging BESS cybersecurity risks

As BESS deployment accelerates, several cybersecurity risks are becoming increasingly relevant for utilities and operators. Let's look at six very real scenarios:

1. **Loss of Visibility into Distributed Assets**
   The Poland attack demonstrated how attackers can target communication systems connecting distributed energy assets to grid operators.

   When operators lose telemetry from multiple distributed resources simultaneously, situational awareness disappears. This can make it difficult to understand system conditions, coordinate response actions, or maintain frequency stability.

   In distributed grids, a lack of visibility means that control becomes guesswork.

2. **Manipulation of Dispatch Signals**
   Battery storage systems respond automatically to grid signals. These signals may include frequency data, dispatch instructions, or market-based price signals.

   If these communications are manipulated, attackers could potentially trigger coordinated battery behavior across multiple assets. For instance, batteries could discharge simultaneously during periods of grid stress or dispatch timing could be deliberately altered. Systems could even be forced to charge when the grid requires additional supply.

   These actions could create frequency instability or strain protection systems designed to maintain grid balance.

3. **Remote Access Infrastructure**
   Battery installations are often remotely managed, meaning operators rely on remote connectivity for monitoring, maintenance and software updates. Vendors frequently access systems through secure VPN connections or cloud-based management platforms.

   However, remote access infrastructure can introduce risk if it is not properly secured. A recent BESS cybersecurity assessment found that remote access and VPN management represented one of the most significant potential vulnerabilities in storage facilities, particularly where monitoring and access controls were insufficient.

   Without strict authentication controls and network monitoring, unauthorized access could allow attackers to interact with operational systems.

4. **OT Security Gaps in Distributed Environments**
   Many battery facilities rely on operational technology systems originally designed for isolated industrial environments. But, as grid infrastructure becomes more connected, vulnerabilities can become entry points for attackers.

   Supervisory Control and Data Acquisition (SCADA) systems and battery management platforms are now increasingly connected to wider networks. In some deployments, outdated firewalls, infrequent patching, or poor vulnerability management leave systems exposed to modern cyber threats.

   OT environments must now contend with threats ranging from ransomware to unauthorized command injection and denial-of-service attacks.

5. **Compliance Lagging Behind Deployment**
   Energy storage systems are being deployed rapidly, often faster than regulatory frameworks can adapt. In some jurisdictions, smaller battery installations fall below certain regulatory thresholds for cybersecurity oversight, even though they may still influence grid stability.

   As distributed energy resources grow in scale and complexity, operators will need to ensure that cybersecurity protections evolve alongside deployment.

6. **Local Manufacturing, Supply Chain Risk and Geopolitics**
   BESS rely on embedded electronics, firmware and control components that often move through complex global supply chains. When manufacturing occurs outside trusted or local production environments, operators may have limited visibility into how firmware is developed, secured and maintained throughout the product's lifecycle.

   These opaque supply chains can introduce risks related to embedded firmware integrity, update mechanisms, potential hardware backdoors and patch lifecycle management. As geopolitical tensions and energy security concerns grow, many operators are beginning to view local manufacturing, supply chain transparency and vendor accountability as core elements of their cybersecurity posture, not simply procurement preferences.

   These risks are not theoretical. As battery deployments expand, the consequences of compromised control systems extend beyond individual assets and into grid stability itself.

The real risk: Manipulating grid balancing

Traditional cyber incidents in the energy sector often focus on data theft or IT system disruption. As the distributed edge continues to grow, the greater risk for modern grids lies elsewhere.

Because battery storage participates directly in grid balancing, manipulating these assets could affect real-time system stability. If attackers can influence charging or discharging behavior across multiple battery sites simultaneously, they could potentially disrupt frequency control mechanisms or overload protective systems.

In extreme cases, this could trigger cascading instability across interconnected power systems, resulting not only in the loss of power generation but also in the loss of grid balancing.

To address these risks, utilities and storage operators should prioritize several key cybersecurity measures:

- Real-time visibility across operational technology environments
- Segmentation between IT and operational control systems
- Strong authentication and monitoring for remote access infrastructure
- Continuous vulnerability management and patching
- Monitoring for abnormal control commands or network activity

These capabilities help ensure that distributed energy resources remain both visible and controllable, even during inevitable cyber incidents.

A new era of grid security

The modern grid is becoming increasingly decentralized, digital and automated, and BESS play a central role in the transformation. These systems help integrate renewable energy, balance supply and demand and maintain stability in increasingly complex power systems.

But as the Poland incident demonstrated, distributed infrastructure can also create new cybersecurity challenges. And while the "pinch" in *Ocean's Eleven* disabled the grid in seconds, we are in the real world where bad actors don't need Hollywood magic to disrupt critical infrastructure. They only need access to the systems that control it.

Rafael Narezzi, co-founder and CEO of Centrii, is a business and technology leader with more than 20 years of experience. At Centrii, he oversees the company's mission to create efficient, secure, and sustainable energy solutions for the renewable sector and beyond. Narezzi is also the founder of South America's leading cybersecurity event, Cyber Security Summit, a regular speaker at industry events, and a published author.

STEERING THROUGH CHANGE

TAMARA DE GRUYTER

As president of Wärtsilä Energy Storage and executive vice president at Wärtsilä, Tamara de Gruyter leads the company's global energy storage business. A member of Wärtsilä's board of management, de Gruyter helps shape the company's long-term strategy as the global energy and marine sectors evolve. She has been with Wärtsilä for over 25 years, working across Marine, Services and Portfolio, and has held international leadership roles in China, Singapore and Europe.

For this issue's Powherful Forces, we asked de Gruyter to talk about her work, the role Wärtsilä plays in the global energy transition and how she envisions the role energy storage will play in the industry over the next five years. The following are her insights and perspectives on leadership, innovation, and the future of energy storage.

Purpose-driven leadership

At the heart of my role is advancing Wärtsilä's mission to lead the way in decarbonising the energy and marine ecosystems. We work with utilities, developers and system operators to deploy energy storage solutions that make power systems more flexible, reliable and resilient as they transition to cleaner energy.

Throughout my career, helping colleagues discover their strengths, giving them room to step forward and watching them gain confidence has kept me motivated. I love working with diverse international teams with people with different perspectives. Working internationally makes the world feel smaller and more connected.

I also enjoy the feeling of knowing that the work we are doing at Wärtsilä matters. Energy storage sits right in the middle of the changes happening in our industry, and knowing that what we do helps build a cleaner, more resilient energy system is incredibly rewarding. Seeing Wärtsilä systems operating in very different environments around the world is a powerful reminder of how meaningful this work really is.

Navigating leadership

I often go back to lessons I learned from sailing, long before I ever joined Wärtsilä. On a boat, you learn quickly that everyone is equal, and the only way you reach your destination is by working together, openly and calmly, even in rough seas when conditions change quickly.

My career has taken me to China, Singapore, and back to Europe, and those experiences reinforced the same lesson: listen first, seek to understand local realities, and build trust. Energy storage is no different; every market is unique, and you make progress by respecting different perspectives, developing long-standing relationships founded on trust and using that trust to support and elevate others as your career progresses meaningfully.

This lesson also aligns directly with the holistic mindset we have at Wärtsilä Energy Storage. We don't view storage as a standalone product, but rather as part of a broader power system transformation. My background helps me maintain that whole-system view.

Misconceptions about energy storage

The biggest misconception is that storage “fills gaps.” In reality, modern power systems, especially those with high renewable penetration, rely on storage for essential stability and control. Storage provides fast response, frequency regulation and grid-forming capabilities that conventional assets once provided.

Global electricity demand is expected to surpass 60 trillion kWh by 2050, with AI data centres alone using about 8%. Meeting this load will require more than 150 TWh of energy storage, creating a storage market worth over US$14.3 trillion.

Without storage, the energy transition becomes more expensive, slower and less reliable. It’s not an add-on; it’s foundational.

Milestones that matter

Over the past year, we’ve worked with partners like Zenobē, EDF Renewables, Origin, and Flow Power on systems that are not only first-of-their-kind but also among the largest and most technically advanced storage projects worldwide. Announcing our tenth project in Australia was a proud moment too. It shows that customers trust us with assets that are critical assets to their grids.

At the same time, I’m very encouraged by the progress we’ve made on the technology side. We’ve invested heavily in areas such as fire safety, grid stability and advanced controls. Innovations like our GEMS Pulse software are helping customers operate their systems with more intelligence, precision and confidence.

But what excites me most is the people behind all of this. Seeing our teams evolve, challenge assumptions, and push the boundaries for what storage can do are what make me proud and keep me energized every day.

The next wave of energy storage

Looking ahead five years, I see three developments that will be especially important for grid stability as renewable generation grows and new demands, especially from data centres, reshape how power systems operate.

The first is the rise of grid-forming and synthetic inertia capabilities. As more conventional generators retire, grids lose the natural inertia that keeps frequency stable. Advanced storage systems can now provide synthetic inertia and other system-strength services in milliseconds, helping stabilise grids with high levels of renewables. We’re already deploying these capabilities, and I expect them to become standard requirements in many markets as they mature.

Second, smarter controls and software will play a major role. Storage is becoming an intelligent asset, not only charging and discharging, but actively supporting the grid. Advanced forecasting, real-time optimisation and fast response systems like our GEMS platform make storage far more flexible and capable than it was even a few years ago. And solutions like GEMS Pulse help owners optimise performance, uptime and revenue throughout the entire lifecycle. Today, many storage owners leave a safety buffer of up to 20% of their capacity unused because they lack full visibility into energy and cell health. GEMS Pulse helps operators reclaim much of that margin by providing accurate information, enabling them to use their assets with greater confidence and flexibility.

Third, I expect a much stronger focus on fire safety and operational resilience. As systems grow larger and more critical to the grid and become closer to essential infrastructure, safety standards must evolve with them. Recent full-scale fire tests and innovations across the industry - including our own work - are raising the bar for how safely and reliably storage can operate. Customers are asking not only for performance, but for demonstrable, independently verified safety. Over the next few years, built-in proactive fire safety features, such as our very own Active Ignition Mitigation system, will become one of the defining differentiators in project design, permitting and long-term operation.

Why flexibility is the new power

One of the most promising trends is the growing recognition that flexibility is just as important as energy. As renewables scale and data centres add large, fast-changing loads, grids need assets that can respond quickly and keep the system stable. Storage is uniquely positioned to do that, and markets are finally beginning to value services such as fast frequency response, synthetic inertia, and system strength. That shift will accelerate deployment significantly.

I'm also encouraged by the momentum behind smarter, more integrated systems. Customers are moving away from standalone assets toward hybrid solutions in which storage, renewables and advanced controls operate as a coordinated portfolio. This momentum leads to higher efficiency, lower curtailment and more predictable performance. Software plays a big role here – platforms like our GEMS system help operators optimise their assets across the entire lifecycle.

Navigating global energy

What we've learned is that every region moves at a different rhythm. In the US, the scale and demand are enormous, especially with the growth of renewables and data centres, but the regulatory landscape is highly fragmented. Navigating interconnection queues, permitting and different state and ISO rules can slow projects down, even when the need is urgent.

Internationally, markets often move faster once a clear national direction is set. In places like Australia, when flexibility and system capability are properly valued, storage deployment accelerates quickly. That's why we've now reached our tenth project there. The UK is similar. Our work with Zenobē shows how quickly storage can scale when the market recognises its role in stabilising the grid. Europe, on the other hand, has strong policy signals but more evolving safety and performance standards, which require careful adaptation. It's a different type of complexity: more about aligning with national grid codes and system-strength requirements than navigating fragmented processes. But those markets face their own challenges, from evolving safety standards to supply chain constraints.

For us, the key is adapting to each system's realities and understanding the local environment. The complexities differ, but the need is the same everywhere: confidence in safe, reliable, long-term performance. When that foundation is there, projects move much faster in any market.

Critical next steps

We need to keep improving how the system operates at high renewable penetration. That means greater grid-forming capability, better controls and more storage deployed in the right places to strengthen the system, provide fast frequency response and maintain stability. We also need faster grid build-out – things like transmission and distribution, upgrades, and smarter interconnection processes. The technology is moving quickly, but the system around it has to keep up.

Another big need is policy clarity and consistency over time. The transition is a multi-decade effort. Developers, utilities and investors can move very fast when the rules are clear, but uncertainty slows everything down. We also need permitting and planning processes that align with the urgency of the transition while maintaining safety, quality and community trust.

The human side of the energy transition

The energy transition is ultimately carried out by the people designing, operating and maintaining these systems. As grids become more digital and complex, we need to ensure we're developing the right skills. Supporting people through that shift is just as important as the technology itself.

Another challenge is the system's complexity. With more renewables, more storage, and fast-growing demand from data centres, coordinating all these assets has become more complex. That requires better alignment among grid operators, policymakers and technology providers and clearer processes so projects can move from concept to operation more quickly.

And finally, trust. Communities, regulators and customers want confidence that storage systems are safe, reliable, and operated transparently. Higher safety standards, better visibility into asset health, and proven long-term performance will all play a role. When trust is there, everything else moves forward much more smoothly.

A meaningful journey

What motivates me is the feeling that the work truly matters. I already mentioned that I grew up sailing. When you're sailing, you learn early on that you're responsible for the conditions you leave behind for the next crew. I carry that mindset with me – the decisions we make today shape the energy systems that future generations will rely on. Being able to contribute to something that has long-term value is incredibly meaningful to me.

I'm also motivated by people. Throughout my career, I've taken a lot of joy in helping others grow and watching teams gain confidence as they take on new challenges. The energy transition is complex, and no single person or company can do it alone. Leading with trust, openness and collaboration makes the journey possible.

Be genuinely curious about how the energy ecosystem works. And remember that people matter just as much as technology. Strong teams built on trust, openness and support are what make real progress possible. When people feel encouraged to challenge ideas and to grow, the quality of the solutions improves dramatically. And finally, don't wait for perfect conditions. The energy transition will always involve uncertainty, shifting policies and moments of discomfort. What matters is having a clear direction, taking steady steps forward, and continuously improving along the way.

Embarking on the energy transition

I would say that the energy transition is not a single project; it's a long journey. What matters most is that we move forward together, with openness, trust and a willingness to keep learning and improving along the way.

We already have many of the technologies we need. The real work now is in how we bring them together, how we operate them reliably over time and how we support the people who make the system work every day. If we stay focused on collaboration and continuous improvement, I'm confident we can build energy systems that are cleaner, more resilient and truly sustainable for the long term, and this is what we are doing at Wärtsilä Energy Storage.

Tamara de Gruyter is the president of Wärtsilä Energy Storage, where she leads the company's global efforts to accelerate the transition to a decarbonised energy future.

de Gruyter brings more than 25 years of international leadership experience within Wärtsilä, having held senior roles across the company's Services and Marine businesses. Her career has spanned continents — from serving as managing director of two joint ventures in China to leading operations in Singapore. Upon returning to Europe, she continued to shape Wärtsilä's strategy through multiple vice president positions.

Known for her cross-cultural leadership and deep operational expertise, de Gruyter plays a pivotal role in positioning Wärtsilä Energy Storage at the forefront of the clean energy transformation.