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WHITEPAPER

Increasing weather forecasting capacity & severe weather resilience with historic data

01.
Weather is the growing challenge for energy providers

ZOGG FIRE EVENT SUMMARY

Location: North of Igo, CA

Date started: 9/27/20

Date contained: 10/13/20

Days active: 16

Fatalities: 4

Injuries: 1

Structures destroyed: 204

Structures damaged: 27

Cause: Tree branch

Source: CalFire

Weather is such a powerful force that, if you track any given utility challenge back to its roots cause, you'll find the weather.

Service delivery continuity? Threatened by any number of weather events. Field service management? Often necessitated, informed, or even made unsafe by the weather. Renewable energy transition? Predicated on a deep understanding of weather and environmental conditions. Infrastructure-wildfire interplay? Frequently related to lightning and wind, which come from stormy weather.

Over the last decade, the weather has seemingly put black eye after black eye on the utility industry. The 2021 Texas power crisis illustrated how vulnerable energy providers can be when the actual weather is vastly different from the historic norms. A major cold wave and series of winter storms sent consumers across Texas inside and relying more than ever on heating appliances for that time of the year. The area's generation facilities were already struggling to meet the increased demand, but then the intense cold began affecting operations at natural gas plants, significantly disrupting supply. Over 10 million people in the U.S. and Mexico lost power, and at least 246 people died as a direct result of the energy crisis.

That's not to mention the major damage weather-related wildfires have done to utility infrastructure and the industry's reputation in recent years. For example, the 2020 Zogg Fire in Shasta County was traced to a single wind-blown tree falling onto power lines, sparking a fire that burned over 56,000 acres and killed four people. The weather was the root culprit, but the area's utility provider took the blame and even faced manslaughter charges in court for not proactively trimming that tree.

Weather doesn't just pose big-picture or specific event-based challenges for energy utilities; it's increasingly where profit and customer satisfaction are made or lost each day. In fact, Deloitte's 2023 Power and Utilities Industry Outlook identified extreme weather alongside inflation, fuel costs, supply chain, cybersecurity, and expansion into renewables as one of the top challenges to the security and affordability of energy.

> Providing secure, reliable, affordable, and clean electricity could become even more challenging. Inflation, high fuel costs, and supply chain snarls may keep electricity prices elevated, while **extreme weather**, cybersecurity threats, and the growth of variable renewables and DER may continue to require innovative management to ensure grid reliability.
>
> The 47 largest US electric and gas utilities plan to spend a record-breaking $169.4 billion in 2023 to enhance reliability, security, and renewable integration. But as customers struggle with bill increases, affordability could become elusive.

Deloitte 2023
Power and Utilities
Industry Outlook

02.

Why better weather intelligence is the solution

Since the end user feels the pains of weather-related service interruptions the worst, the best strategy for facing the weather lies in thinking like a consumer.

WHERE DOES CUSTOMER SATISFACTION COME FROM?

According to a McKinsey survey of more than 20,000 utility customers across North America, about 50% of customer satisfaction is derived directly from factors within the provider's direct control while the other 50% is related to things beyond their control.

Severe weather events will happen, and they will happen with increased frequency moving forward – that's beyond providers' control. However, a utility's ability to anticipate, prepare for, and respond to extreme weather proactively is well within their control.

Through that lens, the Zogg Fire probably could've been prevented through better ownership of those core responsibilities. If the provider was tracking wind gusts in that area and had visual intelligence on how the wind was affecting trees, they likely would've identified and eliminated the problem tree before the next major wind event entered the area.

What about the Texas power crisis, though? Just observing what was going on wouldn't have been enough to stop the problem. The best solution could've been reached days or weeks ahead of the event using an accurate model of how the incoming weather system was likely to impact the grid. That's why weather intelligence, more than ever, is the battlefield where utilities will win or lose in the next decade.

Source: McKinsey

Why the old way stopped working

Energy companies' in-house meteorologists are facing a higher level of responsibility and pressure than ever before, as their ability to forecast for generation and model potential outage impacts is very closely tied to operational continuity, customer satisfaction, and community safety. While the challenge has grown in scope and seriousness the last few years, the toolkit has stayed the same for most weather scientists, and that means they're set up to fail.

For most utilities, a balanced grid is achieved by building a forecast based on information from a weather service about developing conditions and combining that data with proprietary generation formulae based on similar days and weather patterns in the past to predict how much power is required and where risks exist for that given day (or the upcoming stretch of days). Until recently, those calculations worked pretty well on the whole. But in a world where we're constantly experiencing "once-in-a-lifetime" events and setting all the wrong kinds of records, the math is broken, and the data set at hand often can't tell forecasters what to expect as reliably.

On the other hand, in Texas in February of 2021, they had a reasonably accurate forecast, but because area providers had never witnessed such an extended cold snap or seen so many winter storms in a short period, they couldn't accurately predict how seriously the conditions would impact operations. Their outage and continuity models simply weren't built to understand the system that was headed their way, so time that could've been spent ahead of the crisis storing energy was lost.

Again, those freak weather systems live well within the 50% of customer-impacting events that providers have no control over, but the ability to have modeled and prepared better falls on the side of the balance sheet where the utility could be seen as responsible.

As we see, there are two potential pinch points where the traditional methods of weather risk management are now set up for failure:

Forecasting

Impact modeling based on forecast data

03.

How meteorologists at utilities can fix forecasting & modeling

To make better forecasts, meteorologists need more data.

In the past, the "best" data was always assumed to be the data from that exact location over time, but as average temperatures and wind speeds have increased in recent years, there are many areas around the U.S. and world where data from more than a half-decade ago might as well be for a different place.

Since the way the weather has behaved historically in a given service area is no longer the best indicator of how it might behave in the coming days and weeks, weather scientists need a glimpse into historic weather information from places where weather conditions closely align with what they're experiencing right now to increase the accuracy of their models.

The same goes for outage and impact modeling. For decades, utilities have relied primarily on hard-earned self-knowledge to understand their areas of risk or exposure, but now there are likely gaps in that self-assessment, where the in-house understanding lags behind rapidly changing weather patterns.

For example, it's possible that, in a given region, a certain hyperlocal area might be experiencing significantly more wind than just a few years ago. That increased wind makes the area far more susceptible to wildfires and invites interplay between vegetation and utility infrastructure. If an approach relies on internally proven historic information, major risks like that could go unnoticed.

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Rachel Rose
Texas A&M University

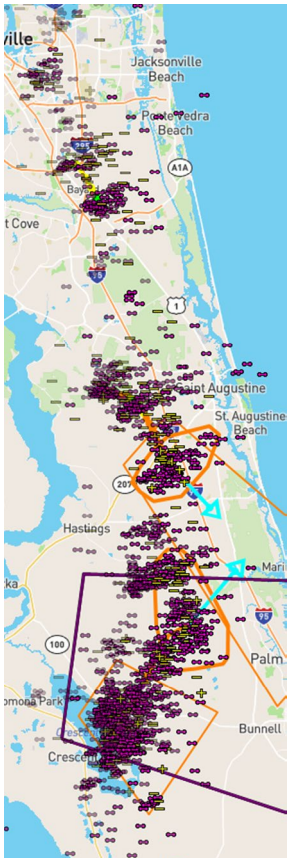
Weather information has been used in electric grid planning and operations since the 1880s. However, no one has yet introduced the idea of incorporating this information into the power flow, or load flow, of the grid, which is a system used to determine how the power flows from the generators through the transmission system to the distribution system (which is then used by consumers).

The power of historic data

Historical weather data is the key to understanding power utilities' main enemy in the battle for operational continuity. By gaining access to a broader historical data set, meteorologists can create more accurate models for short- and medium-range forecasting, which translates to better supply optimization, better customer experience, and increased resilience in the face of growing severe weather challenges.

Think of it this way: If you're going into battle against an enemy that's unpredictable, do you prepare by studying your own past victories or looking closely at theirs? You look at theirs to demystify the air of unpredictability and identify strategies aligned with the ways they fight. On the other hand, you don't learn a lot from reviewing times you won easy battles when you know the next will likely be the toughest you've faced yet.

With an expanded historical dataset that considers weather patterns and events from all over the world and throughout history instead of a very narrow geographical and chronological profile, meteorologists can forecast and plan for weather that could actually happen, not just variations of patterns that have already happened there. This approach is far more future-proof and reduces the impact of local shifts in weather and climate on the final forecast and instead builds a model that can better recognize, adjust to, and predict trends – whether they're in line with what the old hyperlocal data says or not.



The potential of lightning data

Future-focused utility providers are starting to embrace the power of expanded weather data sets to improve modeling, but, too often, historic lightning data goes untapped. Lightning is a major factor when it comes to service interruptions, damage to infrastructure, and physical risks for field technicians.

The old adage says, "lightning never strikes the same place twice," but that's actually false. Geography, topography, human development, and weather patterns all come together to create lightning in largely predictable ways. In fact, most field service or operations leads at a power utility could identify the lightning hotspots in their territory.

Historic lightning data takes a team's understanding of potential risks to another level, far beyond what's possible with the traditional anecdotal and reactive approach to lightning. For example, with historic lightning data, teams can create a data-based risk map that illustrates the areas of greatest potential interplay between lightning and power infrastructure. That information can be used as part of an operational plan to stage and pre-deploy service professionals proactively as a potentially damaging thunderstorm approaches.

Like historic weather data, even lightning data from other areas can help a utility company's meteorologist understand and prepare for growing challenges in their territory. By leveraging a dataset that includes places where thunderstorms have always been slightly more frequent or volatile, local weather scientists can increase their forecasting capacity to more accurately model a thunderstorm system that, while a new precedent for their service territory, is more predictable from a global viewpoint.

Lightning data as an investment in wildfire readiness

Understanding lightning also provides a leg up on wildfires, since lightning strikes provide the ignition source for many fires in the wildlands and wildland-urban interface (WUI), where a high percentage of utility infrastructure is located. By looking at historic lightning information, utilities can identify the optimal positions for remote fire monitoring stations and cameras, significantly increasing the chances of a rapid detection and swift mitigation response.

04.

How utilities can get the weather data they need to forecast more accurately

If the answer to so many weather-related challenges is "more data," the logical next question is, "How do we get that data?"

Local universities and state meteorologists typically operate networks of weather stations and sensors that gather data over long deployments, but those networks are unlikely to be dense or specific enough to provide the data an energy provider needs to assess risks, calculate demand, and deliver reliably. Increasingly, dedicated weather services providers are stepping up to fill in those gaps, drawing upon larger networks of privately owned sensors.

Those larger sensor networks provide two distinct advantages that align perfectly with the driving challenges of the utilities space.

First, a larger sensor network enables true hyperlocal forecasting. When a weather network is thin, like most of the publicly available ones, it provides a generalized forecast for large areas but there's no actual local insight. A more robust network enables the creation of forecasts that are specific to key areas of interest, enabling more targeted, tactical situational awareness. That means utilities can understand severe weather threats at key high-risk areas in the service area better than ever while also getting a more reliable forecast for demand across the board.

The other advantage of a large privately held sensor network is the breadth and availability of the historic data. As we touched on before, more data means better modeling. Most public mesonets are concerned with enabling agriculture or monitoring government infrastructure – they weren't designed to package data for enterprise business decision-making. Dedicated weather service providers, on the other hand, specialize in extending data to businesses in a highly digestible manner that's meant to be turned into operational action, not just studied.

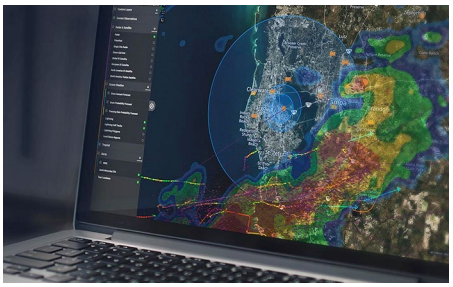
As severe weather events continue to get bigger, more dangerous, and more expensive, utility providers need every data point and piece of intelligence they can get to increase preparedness, accelerate response, and build a more resilient grid that's ready for the challenges of today and tomorrow, not yesterday.

05.

Talk with a weather services provider that understands utilities at a deep level

If you're working at a utility and need to increase your forecasting capacity or rapidly modernize your approach to severe weather risk management, AEM is here to help. We're proud to empower utilities at every scale across the U.S., from the rural cooperatives to the big city investor-owned utilities, to survive – and thrive – in the face of escalating environmental risks.

AEM offers a full range of severe weather, flood, and wildfire risk management solutions, so we can serve as an end-to-end weather services partner for any utility or help you fill a key gap to address a specific challenge. Our team has been building weather monitoring networks for more than 25 years and specializes in creating clear data narratives and alerting frameworks that turn those numbers into better day-to-day intelligence and decisive action when it matters most.



MEET THE AUTHORS

Craig Waters
Sr. Utilities Account Executive
AEM

Talk to Craig

Craig Waters has 37 years and counting in the utility industry. He has either worked for or partnered with utilities of all sizes throughout that period. In his current role at AEM, he provides complete solutions and helps utilities solve their business problems.

Mike Alberghini
Director of Commercial Sales
AEM

Talk to Mike

Mike Alberghini is Director of Commercial Sales at AEM, overseeing solutions for a variety of industries including utilities, aviation, and beyond. Mike joined AEM as a member of the legacy Earth Networks and WeatherBug team, meaning he's served AEM brands for more than 20 years.

06. Sources

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07.

Related resources

WEATHER MANAGEMENT SOLUTIONS FOR POWER UTILITIES

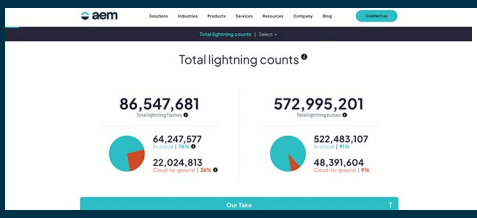
- Learn more about the solutions & technology explored in this guide
- Dive deeper into today's weather challenges & solution opportunities
- Get weather risk management planning tools that help you self-assess

WEATHER-READY PROFILE: CORE ELECTRIC COOPERATIVE

- Hear directly from an AEM utility customer
- Learn how CORE has strengthened weather & wildfire risk management
- See the advantage of working with AEM

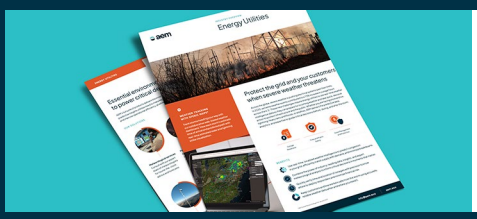
HOW UTILITIES CAN CONQUER TODAY'S GROWING WEATHER CHALLENGES

- Get a distillation of our end-to-end POV on utilities
- See how you can protect infrastructure, employees, and customers
- Learn more about enhanced decision making and improved risk mitigation



2022 U.S. LIGHTNING REPORT

- See the power & potential of AEM's Earth Networks Total Lightning Network
- Get state- and county-level insights into lightning counts and density
- Connect with insights from our lightning research & development team



INDUSTRY OVERVIEW: ENERGY UTILITIES

- Get a one-page encapsulation of our POV on power utilities
- See a vision for end-to-end weather resilience
- Learn more about our key solution areas for energy providers

ADDRESS

AEM
12410 Milestone Center Dr., Suite 300
Germantown, MD 20876

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See our approach to energy utilities