How to make the energy grid resilient and sustainable

Guest comment by **Abhishek Vinod**

With extreme weather events expected to grow both in frequency and intensity, taking steps to safeguard the grid and other critical infrastructure is paramount. The tools to do so already exist, AiDash's CEO and co-founder says

It is safe to say that 2024 has been another year of devastating extreme weather events exacerbated by the effects of climate change.

Aside from the damage to our natural environment and the associated costs, extreme weather events wreak havoc on critical infrastructure that the public relies on: electric and gas utilities, transportation systems and structures, water treatment and management, communications networks. According to NASA and the Intergovernmental Panel on Climate Change, these events are only set to get more frequent and more intense.

Owners and investors have started to recognise the challenge. According to a report by EDHEC Infrastructure & Private Assets Research Institute published in May, which surveyed 70 investment industry professionals including managers responsible for more than $2 trillion in AUM, 97 percent of those polled believed that "physical climate risk is significant" and 76 percent said they expect climate risk to have a "a medium or high impact" on their infrastructure investments.

But when it comes to grid infrastructure, the challenge of building resilience is enormous. The US alone has around seven million miles of power lines, 250 million poles, over a billion devices and assets, and billions of trees surrounding these structures. And much of this infrastructure is ageing, with approximately 70 percent of the electricity grid more than 25 years old.

This at a time when grid infrastructure needs to be strong and reliable to support the green transition, while big tech innovations such as artificial intelligence are driving up demand.

Non-traditional methods

An important part of boosting the resilience of grid infrastructure is vegetation management. If not managed properly, overgrown or poorly maintained vegetation can cause disruptions and potentially lead to wildfires.

Vegetation management is not new for utilities. In fact, it is often the single largest line item in operations and maintenance budgets and by 2029, utilities are expected to spend $39.2 billion on vegetation management alone.

But traditional methods for vegetation management are limited. They often depend on manual techniques, which is simply not feasible across

seven million miles, and they lack efficiency and level of accuracy required, making it hard for utilities to address hazards in a timely and effective way.

And despite these limitations, costs for traditional methods are high because of the cost of labour. Many of these methods are also restricted to time-based cycles, with limited flexibility and less opportunity to respond to unforeseen events. Such approaches are not fit for purpose in a world facing more extreme weather events.

Satellite tech

To deal with the enormity of the issue, wide-scale adoption of technology is critical. The EDHEC survey also revealed "an urgent need for better data, information and new tools" to measure and mitigate climate change risks.

The good news is better data, information and new tools exist today.

To improve climate resilience and reliability, utilities must adopt a data-driven approach to grid inspection and monitoring that is workable at scale and prioritises the most urgent tasks. To start this, utilities need a satellite scan across their entire network.

Satellites are the most critical technology for utilities to leverage to increase climate resilience and reliability. Recent advancements mean satellites can deliver increasingly high-resolution imagery, which gives owners and investors unprecedented visibility across networks. These scans can quickly and accurately identify most potential vegetation issues, pinpoint asset locations (poles and conductors) and assess road accessibility and terrain.

Based on specific needs, budget and criticality, partial network scans can then be performed with LiDAR, vehicle-mounted cameras, other remote inspection methods or targeted manual inspections.

Fusing satellite data with these supplemental scans – along with weather predictions and other utility data – provides a comprehensive view of vegetation and assets at a lower average per-mile cost of a scan. This proposition supports large-scale, frequent monitoring to keep critical infrastructure operating more reliably.

Digital twins

Digital twins are virtual representations of physical infrastructure that allow for accurate visualisation of current asset status. Digital twins of the grid are one way utilities can remotely monitor and manage assets across their lifecycle with fewer costly and time-consuming manual inspections, drones or planes.

By layering analytics and insight, digital twins can help utilities identify defective assets – such as leaning or damaged poles, or safety concerns – before they become critical issues, enhancing grid reliability and preventing disruptions.

This technology can also facilitate improved field operations, ensuring that repair crews are directed to precise asset locations for maintenance. This level of precision helps utilities maintain accurate network connectivity, essential for grid reliability, especially when responding to storm-related outages or other climate-induced disruptions.

When it comes to long-term strategies, these tools enable utilities to model system and climate risks, as well as sustainability impacts. They also enable more efficient operations and strategic use of budget, while prioritising the needs of citizens and the environment.

Better, stronger infrastructure

A comprehensive, end-to-end asset inspection and monitoring system using satellite-first and AI technology will make the utility grid smarter, better and equipped to enable the energy transition in the context of increasing extreme weather events.

Additionally, each dollar invested in proactive and preventative grid maintenance ultimately translates to more dollars saved. This value proposition holds not just for utilities, but for all critical infrastructure industries.

And when it comes to dealing with extreme weather events on the ground, the technology supports better cross-team collaboration as data from vegetation management, for example, can be easily shared with other functions like asset management and storm response or firefighting services, enhancing resource impact and allocation at critical times.

The reality is, it will be very difficult for utilities to manage and protect infrastructure from the impact of extreme weather events and the effects of climate change without the use of this technology. A satellite-first approach, combined with partial network scans using other remote-sensing technologies, is the only way for utilities to get the information they need at the scale, speed and accuracy needed to take effective action. ■