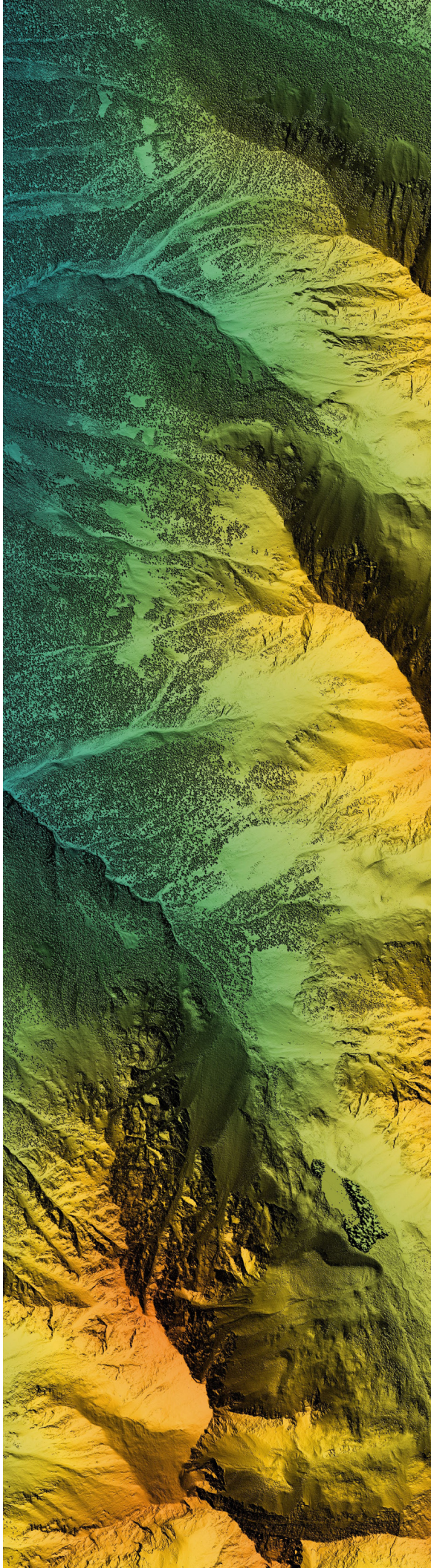
Google Public Sector | GovExec

White paper
August 2025

Powering a resilient future: How geospatial innovation is reinventing energy security

Experts explore how AI-powered geospatial tools are helping public sector agencies strengthen energy resilience, modernize infrastructure and respond more effectively to growing demands on the nation's power grid.



As global energy systems grow increasingly connected, they become more critical to daily life, powering everything from transportation and industry to data centers and electric grids.

To maintain reliable, affordable power for the nation, the public sector is turning to geospatial technology. However, a recent market research study conducted by GovExec, surveying over 400 federal, state and local leaders, found that while agencies overwhelmingly view geospatial data as critical to improving government efficiency and decision-making, progress is uneven. Barriers ranging from limited funding to training gaps to data standardization continue to stall successful implementation, particularly for civilian agencies. Results from the research survey will be published later this year.

Indeed, 20% of defense agencies report relatively high levels of geospatial integration and leadership understanding, and only 9% of civilian respondents said their organizations are very or fully ready to scale geospatial capabilities.

These gaps are concerning, as new vulnerabilities like cyberattacks, supply chain disruption and natural disasters threaten infrastructure stability, making energy security and resilience a national imperative.

“An affordable, reliable and resilient electric grid is really key to all sectors of the economy,” said Beth Hartman, industry executive for federal science and research at Google Public Sector during the *Balancing Innovation, Sovereignty, and Energy Resilience: Scalable Cloud Solutions for Government* panel at Google’s Geo for Gov event.

A grid under pressure

Nowhere is the intersection between geospatial data and resilience more evident than the nation's energy sector. However, Alejandro Moreno, principal deputy assistant secretary at the Department of Energy (DOE), explained that the U.S. electric grid is facing historic challenges.

"Demand is growing in a way we haven't seen in the energy space, particularly in the electricity space, in at least a generation — 30 or 40 years," Moreno said, pointing to the rise of electric vehicles, appliances and data centers as drivers of energy demand. At the same time, 80% of the nation's distribution lines are nearing the end of their life span, supply chains for essential equipment are fragile and extreme weather events are becoming more frequent and severe.

"There's 80,000 substations in the United States ... 180 million power poles ... 600,000 miles of transmission line and [at least] 6 million miles of distribution line," said Carter Christopher, director of geospatial science and human security at Oak Ridge National Laboratory. "There's a lot of pinch points in the grid. To manage and mitigate all that is critical to ensuring that ... we as United States citizens have continuous power that meets our needs."

Geospatial data: The blueprint for energy resilience

From modeling population clusters to identifying infrastructure vulnerabilities, geospatial data gives agencies the precision needed to anticipate, plan for and respond to energy challenges. When paired with AI, these tools become faster, more scalable and predictive. Machine learning models can automatically classify satellite imagery, detect changes to the built environment and forecast energy usage based on climatic or demographic shifts.

At Oak Ridge National Laboratory, researchers are using AI-powered geospatial tools to map every building in the United States. This level of granularity helps governments better predict energy demand, identify at-risk populations and respond more effectively to outages or emergencies.

"For any time during the day, we can model the occupancy of that building, and that's critical for understanding the projected energy utilization," Christopher said. "But it's also critical for understanding when there's outages and when there's risk to populations, how emergency responders need to respond to that."

The research study, commissioned by Google, reinforces this point. Across all agency types, emergency response was identified as the top area where geospatial tools could make a measurable impact by improving agencies' ability to respond faster and more effectively during crises.

Moreno added that DOE is increasingly focused on integrating geospatial insights with AI and simulation tools to better understand energy system vulnerabilities and modernize water management, an often-overlooked but essential component of resilience.

"There are huge policy questions around [water], but it, to me, is an incredibly ... open area for utilization of geospatial data," he said. "If there are ways that we can obviate the need for really expensive on-the-ground sensors in every sort of stream, reach and use satellite data, that could change the world."

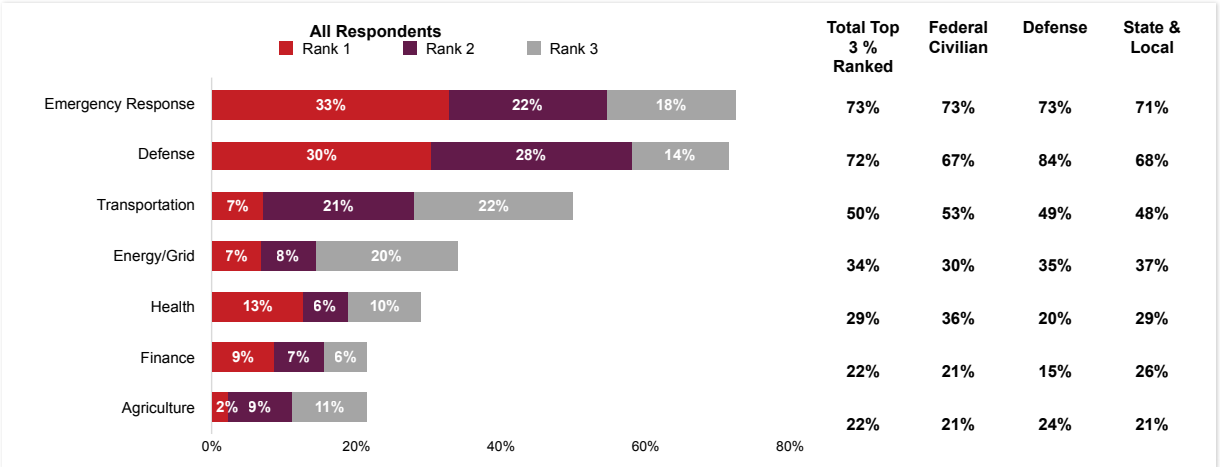
The AI advantage: From the cloud to the grid edge

While geospatial tools provide the foundation, AI offers the intelligence to optimize energy systems in real time. Google's recent work with PJM, one of the nation's largest grid operators, demonstrates how AI can streamline grid interconnection processes — a bottleneck in expanding renewable energy and data center operations.

But AI's potential extends far beyond the cloud. "The world operates at the edge," said Chistopher, referring to the need for AI to function not just in large data centers but in remote sensors, field devices and grid-edge assets. One promising solution is TinyML, or the ability to run miniaturized AI models on low-power devices.

Sectoral Benefits

Emergency response is the most common benefit among all respondents combined, while defense capabilities is the top benefit for defense respondents.



Q. Rank the sectors that, in your view, benefit most from geospatial technology. (Rank the sectors in terms of benefit, where 1 benefits the most, 2 benefits the 2nd most, etc.)

"There's a critical need to be able to take these huge models ... and miniaturize them so that they run in a low power, low comms environment," Christopher explained. This enables AI-powered decision-making on the front lines of grid management, without reliance on constant connectivity.

Data centers themselves, commonly viewed as energy-intensive liabilities, can become assets as well, Moreno added. With smart workload management and deeper integration between software and grid operations, data centers could help balance energy supply and demand, functioning as a flexible resource for the grid.

"How do we look at data centers, not just as a new load, but actually as a type of resource to the grid?" he said. "Effectively a giant battery that's going to require geospatial data to understand the impact of that and the value of different types of shifting load."

A call to action: collaboration, investment and innovation

The path forward is clear but requires action. GovExec's research study underscores the need for increased funding, leadership prioritization and workforce training to accelerate geospatial adoption.

Perhaps equally important to addressing grid resilience is public-private partnership. Google is working with a variety of partners to deliver exactly that, from new solar energy agreements in the south to helping implement a clean transition tariff for geothermal energy in Nevada to ensure data center energy demands are met without raising rates for other customers.

Additionally, as part of its commitment to collaboration and innovation with government, Google and the National Renewable Energy Laboratory (NREL) recently co-hosted an artificial intelligence hackathon. Aimed at tackling data center energy challenges, the event brought together top researchers, engineers and technologists to explore how AI and large language models can optimize data center operations, reduce energy consumption and enhance grid flexibility.

"Things have to change. The utility and the electric power industry cannot do things the way we have in the past," said Moreno. "There are a lot of ... geospatial technologies, and some of the data that [comes from them] ... can really help us be at an inflection point where we turn the power system, the energy system, into something that is more resilient, more responsive, more reliable than it's ever been before."

White paper
August 2025

Powering a resilient future: How geospatial innovation is reinventing energy security

Learn more about how Google Public Sector can help your agency drive innovative energy solutions. To experience these geospatial technologies in action, register for the Google Public Sector Summit on October 29 in Washington, D.C.

Google Public Sector | GovExec