PHENOGY

The Race for Readiness

Resilient Energy – Secure And Thriving Economy

PHENOGY

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Executive Summary

The accelerating expansion of data centers – driven by artificial intelligence, cloud computing, and digital transformation – is reshaping global energy demand. In the U.S. utilities and commercial operators are under mounting pressure to deliver energy solutions that are not only scalable and sustainable but also resilient. In July 2025 the US Department of Energy released its Report on Evaluating U.S. Grid Reliability and Security which also highlight the following:

The status quo is unsustainable. DOE's analysis shows that, if current retirement schedules and incremental additions remain unchanged, most regions will face unacceptable reliability risks within five years, and the Nation's electrical power grid will be unable to meet expected demand for AI, data centers, manufacturing and industrialization while keeping the cost of living low for all Americans. Staying on the present course would undermine U.S. economic growth, national security, and leadership in emerging technologies.

Grid growth must match the pace of AI innovation. Electricity demand from AI-driven data centers and advanced manufacturing is rising at a record pace. The magnitude and speed of projected load growth cannot be met with existing approaches to load addition and grid management. Radical change is needed to unleash the transformative potential of innovation.[1]

1 https://www.energy.gov/topics/reliability

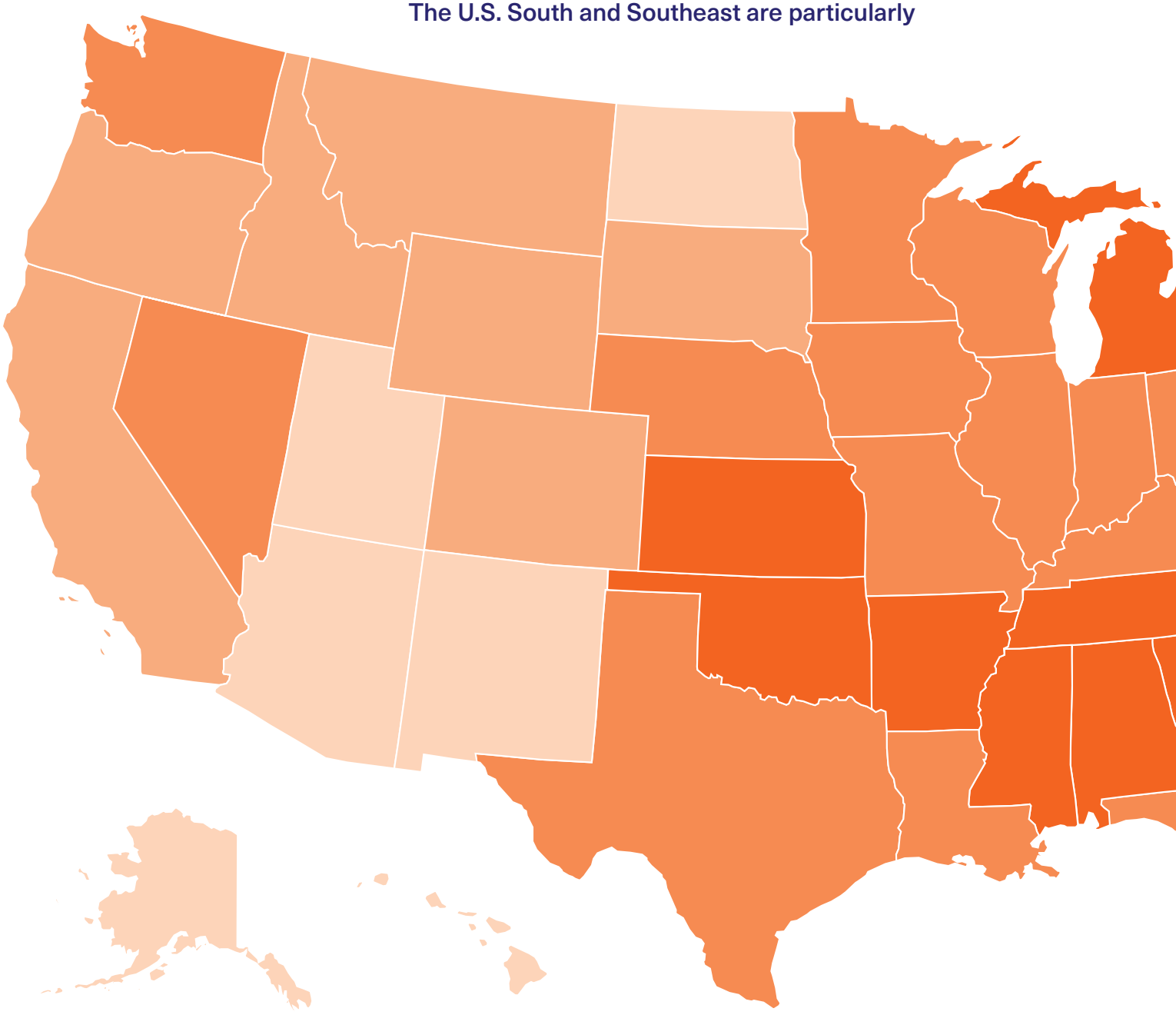
While lithium-ion batteries currently are the dominant technology, their limitations in safety, temperature tolerance, and supply chain reliability are increasingly evident. PHENOGY's Sodium-Ion Battery Energy Storage Systems (BESS) offer a compelling alternative. With superior systemic fire safety, broader operational temperature ranges, and more resilient sourcing, sodium-ion technology is poised to redefine energy resilience for mission-critical infrastructure. This whitepaper explores the urgency of readiness in the energy sector, the risks of continued reliance on lithium-ion, and how PHENOGY's innovation and pilot programs position it as a strategic partner for utilities and commercial customers seeking future-proof solutions.

The Energy Imperative in a Digital World

Digital infrastructure is expanding at an remarkable pace. Data centers, once hidden behind the scenes, now power everything from financial transactions to AI-driven analytics to asset generation.

Their energy footprint is vast and growing: U.S. data centers used 226 TWh this year (5%) and are projected to more than double their usage up to 12% of national electricity use reaching up to 606 TWh in 2030.

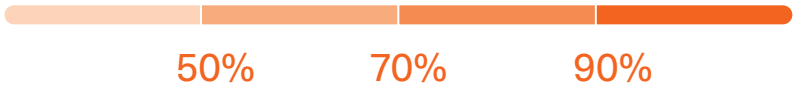
The U.S. South and Southeast are particularly



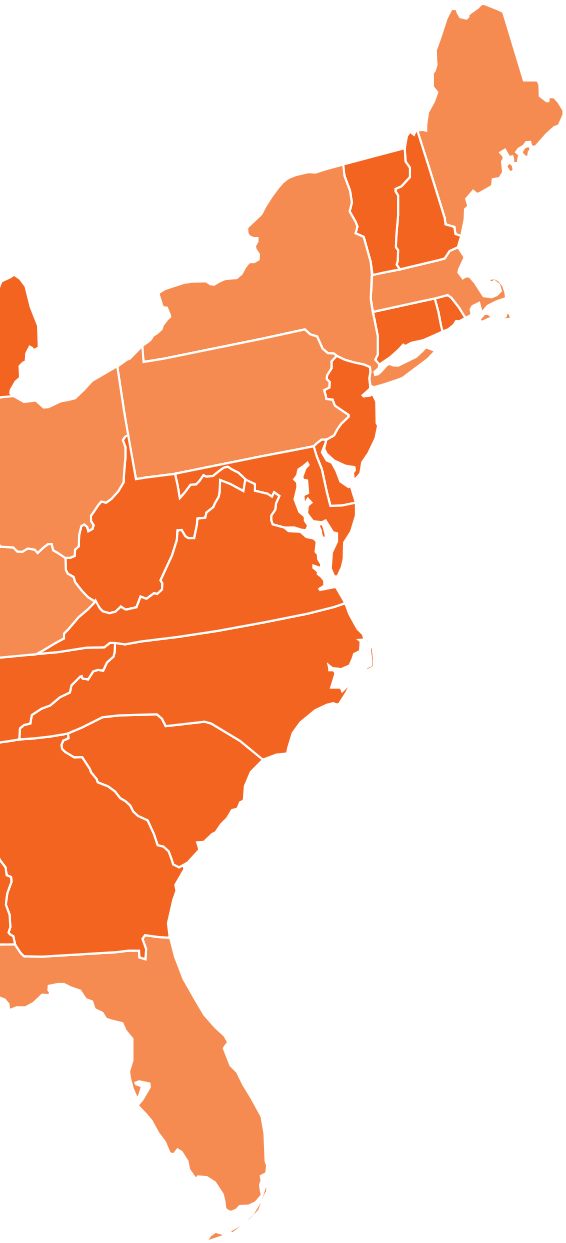
Share of major power outages attributed to extreme weather

Reported by utilities companies

2000 – 2023



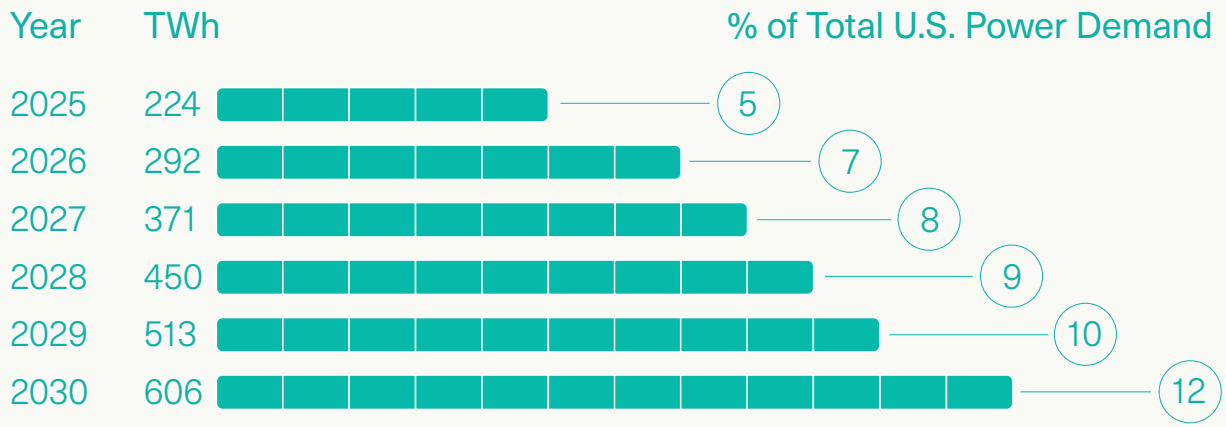
U.S. overall	80,2%
California	60,9%



impacted due to the fastest growing population regions of the country as well as housing the strong industrial base driving the need for energy supply. Utilities in these regions face a complex balancing act: maintaining reliability and affordability, while navigating infrastructure resilience extreme weather occurrences which utilities have reported as accounting for more than 80% of power outages between 2020-2023.

PHENOGY's BESS solutions offer utilities a resilient, distributed asset to relieve peak stress, manage load locally, and extend the life of grid infrastructure—all with a safer technology and lower cost of ownership.
Lithium-ion batteries, though widely adopted, are increasingly viewed as a liability. Their susceptibility to thermal runaway, narrow temperature operating windows, and dependence on geopolitically sensitive supply chains raise serious concerns. PHENOGY is leading this transition. Its sodium-ion BESS solutions are engineered for high performance, safety, and adaptability, particularly in warm climates and mission-critical environments. Supported by a pilot project in Germany and deep market insights from the U.S., PHENOGY is prepared to help utilities and commercial partners embrace the next generation of energy resilience.

The Energy Demand of U.S. Data Centers



Source: Global Energy Perspective 2023

The Hidden Costs of Lithium-Ion

Within the last decade, Lithium-ion batteries have become the default energy storage solution, favored for their cost efficiency and mature supply chains. However, their widespread adoption masks a growing set of challenges.

Safety is a primary concern. Lithium-ion cells, especially those using nickel cobalt manganese (NCM) chemistries, can reach failure temperatures as low as 302°F, posing significant fire hazards in high-density environments like data centers. This risk is amplified in warmer climates, where ambient temperatures already strain cooling systems.

Temperature sensitivity further complicates deployment. Lithium-ion batteries operate within narrow temperature bands, and performance degradation or safety risks increase significantly outside these limits. For utilities managing distributed assets across diverse geographies, this constraint adds complexity and cost, particularly

in regions facing heatwaves and grid instability.

Supply chain fragility is another growing issue. Lithium sourcing is concentrated in a few countries, exposing buyers to geopolitical risks, price volatility, and ethical concerns. Recent disruptions have highlighted the vulnerability of this system, prompting utilities to seek alternatives with greater earth abundant material and regional sourcing flexibility.

Environmental and social impacts are also under scrutiny. Lithium extraction is water-intensive and environmentally disruptive, contributing to land degradation and social unrest in mining regions. As ESG scrutiny intensifies, utilities and commercial customers are under pressure to align their energy strategies with sustainability goals.

Sodium-Ion's Strategic Advantages

Sodium-ion batteries are gaining traction as a credible alternative, backed by commercial deployments and rigorous safety evaluations. Their thermal stability and reduced fire risk stem from lower energy density and more stable electrolytes. Innovations such as nonflammable solvents and solid diluents have significantly improved safety profiles.

Unlike lithium-ion, sodium-ion batteries maintain stable performance across a wide temperature range – from sub-zero to high-heat conditions – without requiring intensive thermal management. This makes them ideal for grid-edge applications and data centers where ambient conditions vary widely.

Supply chain resilience is a key differentiator. Sodium is more than 1000 times more abundant than lithium and can be sourced from seawater or common minerals. This abundance translates into lower raw material costs, reduced geopolitical risk, and simplified sourcing.

From a sustainability perspective, sodium-ion batteries offer a lower environmental footprint. They use recyclable materials such as hard carbon and iron-based cathodes, and life cycle assessments show they have lower environmental impacts than lithium-ion systems.

Importantly, sodium-ion batteries are compatible with existing lithium-ion manufacturing infrastructure, enabling rapid scale-up without major capital investment. This is reflected in market forecasts that suggest sodium-ion battery energy systems could capture up to 10 percent of the global battery market by 2030.

PHENOGY's Pilot Program: Strategic Readiness in Action

Our pilot program, **SodiumShift,** is designed to address the evolving energy landscape with precision. Utility leaders and advisors have highlighted challenges such as surging data center demand, grid stress, and growing skepticism toward lithium-ion.

Through **SodiumShift,** participants can test PHENOGY's technology in real world conditions while ensuring seamless integration with existing utility operations. The program provides data-driven insights from performance metrics and operational feedback, guiding scalable planning for future deployments across commercial, industrial and utility sectors.

PHENOGY's sodium-ion systems are ideally suited for substation resilience, behind-the-meter deployments, and innovation-driven utilities. The pilot program serves as a strategic entry point for stakeholders seeking safer, more sustainable energy solutions.

Sustainability and Energy Independence are not mutually exclusive

Sodium-ion batteries offer a significantly lower environmental footprint. PHENOGY's systems use recyclable materials such as hard carbon and iron-based cathodes, supporting circular economy principles.

Decentralized supply chains reduce the risk of social unrest and labor exploitation. Sodium-ion technology also aligns with emerging EU and U.S. directives on carbon footprint declarations and recycling targets. Sodium is widely available, eliminating the need for intensive mining and can be produced locally therefore fostering energy independence and reducing reliance on international supply chains for critical materials. In this way, sodium-ion systems contribute to a more secure` energy landscape and align with energy security objectives.

Conclusion: A Call to Action

The energy landscape is undergoing a profound transformation. Data centers are becoming the largest electricity consumers in the commercial sector. Utilities must respond with solutions that are scalable, safe, and sustainable.

Lithium-ion batteries present real challenges. Sodium-ion technology offers a credible, future-ready alternative. PHENOGY's **SodiumShift** pilot program and strategic readiness demonstrate that sodium-ion is not only viable – but readily available for adoption.

The race for readiness has begun. PHENOGY invites utilities and commercial partners to lead the charge toward energy resilience.

PHENOGY

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