Grid modernisation

Building a resilient energy future for the UK

As the UK accelerates its transition to net zero, the resilience and adaptability of the nation's grid infrastructure is increasingly being tested – not just through a surge in electricity demand, which is expected to increase by 40% in the next decade, but also by the growing frequency and intensity of extreme weather events driven largely by climate change.[1]

These extreme weather events place additional stress on the UK national grid infrastructure, threatening supply stability, risks of physical damage to critical energy infrastructure, and create unpredictability in demand and supply.

In recent years, the UK has witnessed an increase in climate-related incidents that have put critical energy infrastructure under pressure. Storm Eunice in February 2022 brought wind speeds of up to 122mph, leaving over 1.4 million homes without power and causing widespread disruption to overhead powerlines and infrastructure.[2]

Similarly, the heatwaves of 2022 and 2023 – with temperatures exceeding 40°C for the first time in UK history – reduced the efficiency of power plants and transmission lines. This also placed a significant strain on the grid as increased use of air conditioning systems caused an upsurge in electricity demand.[3]

Other UK extreme weather events were seen in the winters of 2019 and 2020, whereby intense rainfall and flooding damaged critical energy infrastructure, including substations and underground cables, leading to localized power cuts. Such events reinforce the urgent need to modernise the grid – not simply to facilitate the decarbonisation of energy, but to enhance its operational resilience in the face of mounting challenges.

Learning from disruption: UK & Continental Europe

Operational resilience was again thrust into the spotlight in early 2025 when London Heathrow Airport experienced an unexpected power outage that disrupted hundreds of flights and caused logistical chaos. Though the root cause was ultimately a technical fault, this event highlighted the critical dependencies on stable energy supply for essential services and the need for robust operational resilience plans including disaster recovery and failover testing.

There are also lessons to be learned from the widespread blackouts that hit Spain, Portugal and parts of France and Belgium in the spring of 2025 due to a cascading failure across parts of the Continental European electricity network. In addition to underscoring the interconnected nature of modern energy systems, the blackouts highlighted a major challenge as nations increasingly embrace renewable energy. With the attendant shift away from traditional (inertia heavy) turbine generators to incorporating electronic invertors, grids are less resilient when it comes to 'bridging across' transient supply fluctuations.

The incident underscores the pressing need for investment in grid modernisation, resilience and innovation. Without sufficient investment such cascading failures can have severe, wide-reaching consequences for energy security and economic stability throughout Europe.

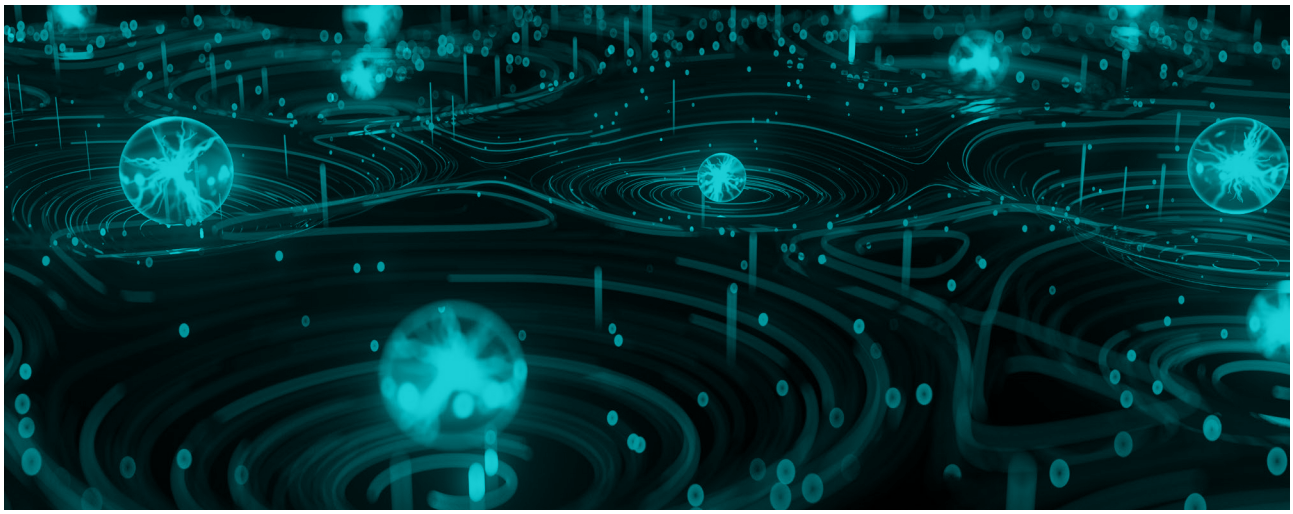
For the UK energy industry, these incidents present both a cautionary tale and an opportunity: to invest proactively in modernising our own grid architecture – not just for capacity, but for **predictive maintenance, decentralised control systems**, and **real-time recovery capabilities** that can contain disruption and minimise societal impact.

A UK vision for a smart, resilient grid

Modernising the UK grid means moving away from the traditional, centralised design towards a **smarter, more distributed system**. Key components of this transformation include:

- **Digital twin technology** to simulate, stress-test, and optimise grid performance in real time[3]
- **AI-driven demand forecasting and management**, particularly as heat pumps, EVs and rooftop solar become more widespread[3]
- **Flexible grid services**, including battery storage, peer-to-peer energy trading, and dynamic tariffs
- **Resilience-by-design**, ensuring that critical nodes can operate independently and recover autonomously in the event of failure[4]
- **Integration of renewable energy sources at scale** to decarbonise electricity generation while maintaining grid stability
- **Enhanced cybersecurity measures** that protect the grid's digital infrastructure from increasingly sophisticated cyber threats, ensuring operational continuity and data integrity
- **Grid modernisation through smart sensors** to provide real-time monitoring of grid conditions, enabling faster detection of faults and more responsive maintenance.

Crucially, resilience must not be treated as an afterthought. It should be a central pillar of grid investment strategy, alongside sustainability and scalability.



The Path Forward

Within the past few weeks, we have seen the Great British Energy Bill passed by Parliament, clearing the way for the establishment of Great British Energy (GB Energy), a publicly owned energy company that will invest in clean power projects across the UK as part of the government's Plan for Change to become a clean energy superpower.[5]

In parallel with the capital investment programme for upgrading the country's critical energy infrastructure previously announced by the Department for Energy Security and Net Zero, the government has committed to substantial investments in the electricity transmission network. National Grid has unveiled a £60 billion, five-year investment plan to decarbonise the energy system.[6] This plan focuses on expanding electricity networks and enhancing grid resilience to accommodate the growing share of renewable energy sources.

A significant driver of this transformation is the UK Strategic Innovation Fund, designed to accelerate the development and deployment of innovative technologies, including smart grids, energy storage solutions, and digital monitoring tools. These innovations will enable the grid to operate more efficiently and reliably.[7] However the success will depend on cross-sector collaboration between government, regulators, utilities, technology providers and consumers.

By embedding resilience at every level of grid modernisation, the UK can ensure it not only meets its climate goals but also builds a power system capable of withstanding a wide array of challenges. These include extreme weather events, unexpected surges in demand, network outages, and evolving cyber threats. This holistic approach ensures that the transition to net zero is sustainable, secure, and robust against future uncertainties.

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