Energy Management

Why AI-Driven Network Optimization Is Necessary

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Decentralized renewable energies make the power grid complex. AI-driven grid management is therefore essential—but explicitly requires trained engineers and strong industry collaboration.

The question arises of how the rapidly growing demand for energy and new technologies can be aligned with the existing infrastructure.
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According to the energy think tank Ember, 59 percent of electricity in Germany was generated from clean sources in 2025, with wind and solar energy alone accounting for 45 percent. This fundamental shift from centralized, fossil fuel-based energy generation to decentralized and weather-dependent renewable energies increases the complexity and urgency of modern grid management. In this dynamic environment, AI-driven grid management is essential.

Increasing Complexity Requires Rethinking

It is easy to underestimate how much this shift to decentralized energy sources is changing the rules of grid operation. Older power supply systems were designed for a small number of large and controllable generators that provided predictable output. Today, the German grid must instead coordinate millions of decentralized systems, from onshore wind farms and rooftop solar installations to batteries and electric vehicles—all operating with varying degrees of intermittency.

Without effective management, this increasing complexity could lead to higher system costs and greater pressure on grid stability. Congestion management, balancing reserves, and equipment maintenance are no longer challenges that can be handled solely through manual intervention. They require real-time insights, predictive capabilities, and adaptive control—areas where AI and machine learning play a crucial role in modern grid operations.

The Problem with Traditional Grid Management

Despite decentralization, electricity demand continues to rise. The electrification of transport, heating, and industry increases consumption, while the rapid expansion of data centers and AI-driven services has created entirely new levels of load.

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This has put grid planners in a dilemma: How can we align the needs of rapidly growing demand and new technologies with the existing infrastructure, which was often never designed for today's operating conditions?

Traditional management relied on predictable outflows from a few large producers, guided by historical data and experience. Today, electricity flows in multiple directions, renewable energy generation fluctuates with weather conditions, and demand can increase unpredictably. Manual approaches alone can no longer keep up.

However, it is important to keep a key limitation in mind: The challenge is not only to add infrastructure but also to make better use of already available information and to adapt operations in real-time to the growing uncertainty of the system.

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Flexibility Through AI

Artificial intelligence is increasingly changing the way power grids are operated. By analyzing data from generation, storage, consumption, and network sensors, AI can, for example, predict the performance of renewable energies, forecast demand peaks, and identify potential bottlenecks.

Grid operators must continuously work to optimize power flows and maintain grid capacity without always resorting to costly physical infrastructure expansions. This is precisely where intelligent technologies come into play: by leveraging AI tools, grid operators can act more quickly and plan proactively, ensuring the system remains adaptable despite increasing complexity.

Ultimately, the responsibility still lies with the engineers. Algorithms are only as effective as the quality of the data they receive. Predictions rely on accurate information from across the system, including real-time demand patterns, renewable energy forecasts, grid load data, and equipment condition monitoring. If this information is incomplete or delayed, optimization decisions can quickly become unreliable.

Bridging the Skills Shortage

It is undeniable that the power grid is undergoing structural changes, and the workforce must evolve with it. As someone who recently earned a master's degree in engineering management and conducted research on EV chargers in Berlin, I see firsthand how important it is for those of

us now entering the industry to have a solid foundation in grid physics and be familiar with AI-driven tools and data analysis.

According to the Center for Higher Education Development, engineering degree programs encompass twelve disciplines, including mechanical engineering, electrical engineering, architecture, and computer science. To prepare the next generation of engineers, however, these programs must also address the role of AI and the potential of intelligent technologies to enhance grid operations. Practical experience—through simulations, sandbox exercises, internships, and mentoring—would help them prepare for complex operational scenarios before encountering them in practice.

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However, training must be a continuous process. As technologies evolve, engineers must constantly learn and adapt. Companies that integrate continuous learning and AI expertise into their culture are best equipped to manage increasingly complex, decentralized grids.

Utilize Industry Platforms for Networking

Collaboration within the industry is also becoming increasingly important, as no company can tackle these challenges alone.

In addition to education, it is important for those working in grid operations to regularly network and exchange ideas with other stakeholders along the supply chain. Industry platforms and professional events like Cwieme Berlin are crucial in this regard. This trade fair, for example, brings together industry leaders from the entire energy transmission and distribution (T&D) ecosystem. At this year's event, there was a Transmission & Distribution Club, an exclusive lounge for transmission system operators (TSOs), distribution system operators (DSOs), and grid equipment manufacturers. The club aimed to provide energy asset owners with a central meeting point to discuss grid innovations, power transmission, and energy distribution. The next Cwieme Berlin will take place from May 11 to 13, 2027.

Conclusion

The energy transition in Germany demonstrates how quickly power systems can change. The large-scale integration of renewable energies depends not only on new generation but also on smarter grid operations and a workforce capable of managing the growing complexity. AI offers powerful tools to enhance flexibility and efficiency, but its success ultimately relies on engineers who can responsibly deploy it to achieve optimal outcomes while balancing constraints, regulations, and system behavior.

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