



Energy markets and geopolitics

THE ROLE OF AI IN SECURING THE GLOBAL ENERGY FUTURE IN AN AGE OF DISRUPTION



As global energy markets face increased geopolitical uncertainty and volatility, the need for a secure, stable and resilient energy future has never been more important. ADIPEC has launched this **Energy markets and geopolitics** series to provide market insights into the impact of the ongoing conflict on global energy markets and the way forward for the industry.

The series provides decision-makers with informed analysis, helping the industry navigate disruption, assess risk, and identify pathways to resilience in an increasingly complex energy landscape.

The strategic pivot: building a secure AI framework for the global industry

By **Caspar Herzberg**, CEO, AVEVA

I believe 2026 will be the year that business leaders begin to give artificial intelligence (AI) governance the attention it deserves. I'm afraid, however, it may take some painful lessons before managing AI risk is properly prioritised.

The truth is that lots of technologies can be used to make mischief or even sow destruction. Utilised the wrong way (or by the wrong people), an aeroplane is dangerous. So is a nuclear power plant, a turbine, or a power saw. Many of the machines and systems we rely on every day can cause all sorts of damage. But by creating standards and protocols for their use, we can incorporate these technologies in how we work and live, with a high level of predictability and safety. That is the task before us as consumers of AI and especially as leaders of the industry.

Accelerating industrial AI adoption

Accelerating the adoption of polyfunctional and humanoid robots was one of my predictions for 2025. It's impossible not to feel both excitement and a chill when interacting with this technology. I have been astounded by the leaps in "physical AI" over the past year, particularly the capacity to shift robots from one task or environment to another in a matter of moments, thanks to what are known as "robotic foundation models." There are many promising applications of physical AI technology in plant-floor contexts, and observers forecast that industrial humanoid robot deployments will double by 2030.

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Caspar Herzberg, CEO, AVEVA



Thought leadership

I see major developments in industrial AI this year, and for a very pragmatic reason: industrial AI is highly mature. We have decades of experience running AI-powered predictive maintenance, for example, and these solutions are the perennial, undisputed champions in delivering business value through AI. Now, we're applying the lessons learned across domains such as engineering and design, energy management, quality assurance, supply chain orchestration and more.

Building sovereign compute capacity

Generative AI interfaces are another innovation making waves in industry, with AI assistants making it possible for engineers to "talk" directly with the industrial infrastructure they supervise and control. I anticipate greater focus on user experiences like this that support natural language queries and chat. Firms this year will also pivot from purely cost-optimised compute sourcing toward geographically secure infrastructure to exert strategic control over AI use. Deloitte projects that nearly US\$100 billion will be spent this coming year on sovereign AI compute.

Geopatiation as a strategic hedge

From Canada to the Middle East to the European Union and beyond, there is a clear trend toward what Gartner calls "geopatiation" as a strategic technology hedge against volatility. This represents a profound shift from the overriding emphasis on cost control that has been the main driver of IT spending in recent years – a decidedly pragmatic recognition that complexity and risk are here to stay.

Leaner, less energy-intensive AI models must be

on the industry's to-do list. We need to optimise "watts per token," and deploy AI aggressively to improve energy efficiency in data centres. AI can be an asset, not just a liability, on the global balance sheet of energy use.

In that same light, I also hope we don't lose sight of where energy is really going. The International Energy Agency highlights that industry – heavy and non-heavy – will consume around four times the electricity of all data centres over the next five years, even with skyrocketing growth due to AI. This points to where the biggest potential for decarbonisation really lies: industry. And it's why AI-powered industrial intelligence is so critical to the energy transition.

Helping bridge the talent gap

In the industrial sector, I see a clear direction of travel. Sectors like manufacturing, energy, mining, and cement face a well-documented talent gap. Here, AI is augmenting roles, not supplanting them. AI is helping new employees accelerate their time to productivity. It's helping industrial companies preserve institutional knowledge that is headed for retirement. It's making everyone better at making decisions.

Agentic AI will autonomously handle complex, multi-step tasks that once required constant human input and attention. It will connect data sources and adapt processes in real time, freeing experts to focus on contextualising insights and making good decisions. Leaders should therefore focus on efficiency, resilience and sustainability – the hallmarks of modern competitiveness – and harnessing AI to make their employees more productive. ■

The role of AI in securing the global energy future in an age of disruption

Executive summary

The ongoing crisis in the Middle East has reinforced a deeper structural reality: energy flows now operate under continuous physical and digital risks. Attacks on shipping routes in the Red Sea and tensions around the Strait of Hormuz are not isolated incidents but systemic stress points that transmit instantly across interconnected oil, gas, electricity, and other commodity markets.

At the same time, disruption is evolving from physical to cyber-physical. Energy infrastructure is now a contested domain where digital intrusion, misinformation, and automated attacks intersect with kinetic risks. Energy security is thus less about reserves, contracts, or infrastructure and more about detection speed, system intelligence, and real-time response capacity. AI is therefore arguably shifting from an optimisation tool to a foundational layer of energy security, emerging as a general-purpose technology comparable in systemic importance to electricity. In an environment of continuous disruption, energy security is increasingly determined by AI.

“ This implication is structural: energy systems are no longer exposed to sequential failures, but to coordinated, multi-layer attacks. ”

Market outlook

Chokepoints and global spillovers: the Strait of Hormuz

A small number of physical chokepoints continue to anchor global energy stability, and none is more consequential than the Strait of Hormuz. Roughly 25% of seaborne global oil trade transits this narrow corridor, alongside significant volumes of LNG and other strategic commodities. This geographical concentration creates a structural vulnerability that becomes acute under geopolitical stress.

Recent tensions in the Middle East show how even limited disruptions to shipping trigger immediate global repercussions. European gas markets react almost instantly through Dutch TTF pricing, while Asian importers, particularly Japan, South Korea, and China, face rising LNG spot prices and shipping premiums. These effects are not gradual but rapid system-wide responses, reflecting tightly coupled energy markets.

The scale of risk is well established. The 2019 attacks on Saudi Aramco's Abqaiq facility removed around 5.7 million barrels per day (mbd) or nearly 5% of global supply, driving a nearly 20% price spike in a single trading session, one of the largest intraday increases in modern energy markets. The lesson is not only about the costs of energy system exposure, but also about limited system adaptability. This gap between disruption and response is where AI is beginning to play a critical role.

The cyber-physical threat: hybrid warfare and infrastructure targeting

Energy infrastructure is increasingly targeted across multiple vectors simultaneously, including cyber intrusions into operational technology systems, AI-enabled phishing, and physical sabotage of pipelines, terminals, and grid assets. This shift is measurable. Cyberattacks on energy utilities have tripled over the past four years, partly driven by AI that has

25%

Of global seaborne oil trade transits the Strait of Hormuz

increased the scale and precision of attacks. This trend has exposed the vulnerability of industrial control systems, with Supervisory Control and Data Acquisition (SCADA) networks and sensor data susceptible to manipulation through false telemetry injection or compromised operator interfaces.

Recent incidents and threat assessments show growing exposure to concurrent disruptions across digital and physical layers. The expanding digitalisation of energy infrastructure has widened the attack surface, increasing risks to both IT and operational systems. Institutions such as the US Cybersecurity and Infrastructure Security Agency and the National Institute of Standards and Technology warn that adversaries can alter control processes and mislead monitoring systems through data manipulation, while the European Union Agency for Cybersecurity warns that phishing and social engineering are the primary entry point risks. This implication is structural: energy systems are no longer exposed to sequential failures, but to coordinated, multi-layer attacks.

AI as the shield for predictive resilience

Traditional models of energy security are inherently reactive, focused on restoring the system after disruption. AI shifts this paradigm toward predictive resilience, enabling early detection of anomalies in grid behaviour, market signals and cyber intrusions before they escalate into system-wide failures. Machine learning models trained on historical operational data can identify deviations in load balancing and system performance within milliseconds, reducing response times that previously took hours. Evidence from grid operators shows that AI can reduce outage durations by 30-50% while also improving utilisation of existing grid infrastructure. This marks a structural shift from failure response to failure prevention, where AI is no longer an efficiency layer but a core mechanism of risk containment.

Agentic AI and real-time threat neutralisation

The emergence of agentic AI marks the next phase in energy system resilience. Unlike conventional systems that depend on human intervention, agentic AI operates autonomously within predefined constraints, enabling real-time detection, decision-making, and response. In operational terms, this allows systems to isolate compromised grid nodes, reroute electricity or gas flows, and pre-emptively shut down vulnerable components before cascading failures occur. Evidence from simulated grid environments suggests that AI-enabled control and rerouting significantly improve fault containment by accelerating detection and response time, reducing the propagation of local disturbances. This shifts energy infrastructure toward a dynamic, self-adaptive operating system in which stabilisation and recovery are automated. In the context of hybrid warfare, such autonomy is critical as resilience is no longer just a recovery

30-50%

The reduction in outage durations that AI can facilitate

function but an embedded system capability that continuously adapts as threats unfold.

Digital twins: simulating disruption before it happens

Digital twins are emerging as a central component of energy system resilience. By replicating physical infrastructure in real time, they allow operators to simulate and analyse disruption scenarios before they occur, using continuously updated operational data from assets such as refineries, pipelines, LNG terminals, and electricity grids.

Companies such as Shell and Equinor have already deployed digital twins at the asset level, achieving measurable

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gains in efficiency and reductions in unplanned downtime. At the system scale, they enable scenario modelling for infrastructure loss, cyberattacks, and geopolitically driven supply disruptions. In the context of market instability, this allows European and Asian operators to simulate LNG rerouting, stress-test supply shocks, and adjust operational strategies in advance. The result is a shift from reactive crisis management to anticipatory system design, where disruption is modelled and mitigated before it materialises.

Decentralisation: reducing systemic vulnerability

Conventional energy systems are highly centralised, relying on large-scale generation and long transmission networks. While efficient, this structure concentrates risk in critical nodes, where disruptions can cascade across entire systems.

AI is enabling a shift toward decentralised energy systems built on distributed energy resources, smart microgrids, and local balancing systems. These reduce dependence on single points of failure and enhance overall system resilience. AI thus functions as the orchestration layer, continuously balancing supply and demand, optimising storage, and managing load flows in real time. The result is a structural transition from rigid, hierarchical systems to adaptive networks better able to absorb both physical and geopolitical shocks.

Technology as a stabiliser of energy markets

Beyond infrastructure, AI is becoming a stabilising force in energy markets. As global systems grow more complex and volatile, accurate forecasting and logistics optimisation are more critical than ever. AI-driven predictive analytics are now used to anticipate demand shifts, optimise LNG shipping routes, and improve price signalling across interconnected markets.

3%

The increase in global electricity use due to the rapid expansion of AI-driven data centres

During periods of volatility, these tools reduce forecasting errors and improve decision-making for utilities and industrial consumers. This enhances planning certainty and lowers price volatility, hedging costs, and exposure across supply chains. In a world where geopolitical shocks transmit rapidly through markets, data-driven stabilisation becomes a core pillar of energy security.

Resource AI: maximising existing supply

AI is also reshaping supply dynamics by improving the utilisation of existing energy assets. Rather than focusing solely on capacity expansion,

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it enhances efficiency via predictive maintenance, drilling optimisation, and reservoir modelling, increasing output while reducing downtime. At scale, these incremental gains translate into significant supply-side improvements, particularly in constrained markets. Platforms such as ADNOC's ENERGY_{ai} – an agentic AI solution to improve decision making and operational efficiency – exemplify this approach by integrating demand forecasting with upstream optimisation to maximise asset performance and resource utilisation.

Case study: building the energy-AI nexus

The integration of AI across energy systems is already visible at the national level. In the UAE, ADNOC's Energy_{ai} project has deployed AI across predictive maintenance, demand modelling, and digital twin applications in its refining operations, leading to efficiency improvements, reduced downtime, and enhanced responsiveness to market volatility.

Similar trends are emerging across Europe, particularly in systems with higher shares of variable renewables. Grid operators in Germany and the Nordic region are increasingly using AI-driven forecasting and optimisation tools to manage intermittency and maintain system stability.

AI, energy demand, and a new geopolitical layer

AI is not only securing energy systems but also reshaping them. The rapid expansion of AI-driven data centres is creating a major new source of electricity demand, rising from around 415 TWh in 2024 to nearly 945 TWh by 2030 – just under 3% of global electricity use. Growth is driven by AI workloads, with specialised servers expanding at around 30% annually, though efficiency gains in hardware and cooling are helping to contain overall demand. According to the International Energy Agency, electricity demand from data

17%

Electricity demand growth from global data centres in 2025

centres grew at 17% globally in 2025. In the United States, data centres accounted for around 50% of total electricity demand growth. This introduces a new geopolitical dimension to energy security. Countries able to provide reliable, scalable, low-cost electricity will gain a strategic advantage in deploying AI. Energy security is increasingly tied to digital competitiveness, blurring the line between the energy and technology sectors, making them not just complementary but interdependent.

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Risks and limitations of AI in energy systems

Another critical factor to consider for the long-term outlook on the AI-energy nexus is that integrating of AI introduces risks that extend beyond operational performance into system design and governance. As AI becomes embedded in real-time grid control and forecasting, it expands the cyber-physical vulnerabilities, exposing energy systems not only to conventional cyber intrusion but also to manipulation of data inputs, training processes, and model outputs, with cascading effects on dispatch accuracy and grid stability. These risks are amplified in renewable systems, where volatility requires rapid automated responses.

AI performance is also constrained by uneven data quality, limited interoperability, and fragmented legacy infrastructure, which can embed bias and reduce predictive accuracy. The use of opaque “black-box” models raises governance and accountability concerns in safety-critical grid operations where decisions must remain understandable and traceable.

In addition, AI infrastructure itself is resource-intensive and requires significant electricity and water for data centres, exacerbating competition for resources. With these numbers set to grow further in the coming years, one of the most critical challenges for the energy sector is balancing the power demand growth with AI’s pivotal role in securing the future of energy in an age of disruption.

Conclusion: AI as the new energy resource

The current instability in the Middle East reflects a structural shift in the global energy landscape rather than an isolated disruption. Physical chokepoints remain exposed, infrastructure is increasingly targeted, and market responses are both immediate and amplified by interconnected systems – where speed, scale and the complexity of disruption are the defining factors.

50%

Total electricity demand growth from data centres in the US in 2025

With the critical ability to enable predictive action, autonomous system management, and real-time asset optimisation, AI and digitalisation can therefore alter how energy systems manage risks and pave the way for a more robust energy future. AI is no longer a tool for efficiency, but a system-level capability in a world where energy security is no longer defined solely by access to resources but by the capacity to process information, anticipate shocks and respond dynamically. In this framework, AI becomes a core strategic asset, functionally analogous to an energy resource in its ability to sustain system stability under conditions of persistent disruption. ■

Sources and acknowledgments:

ADNOC; CISA; European Commission Joint Research Centre;
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