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# Energy Journal

# The feedback loop of energy and geopolitics

*Inspired with innovation* CESI

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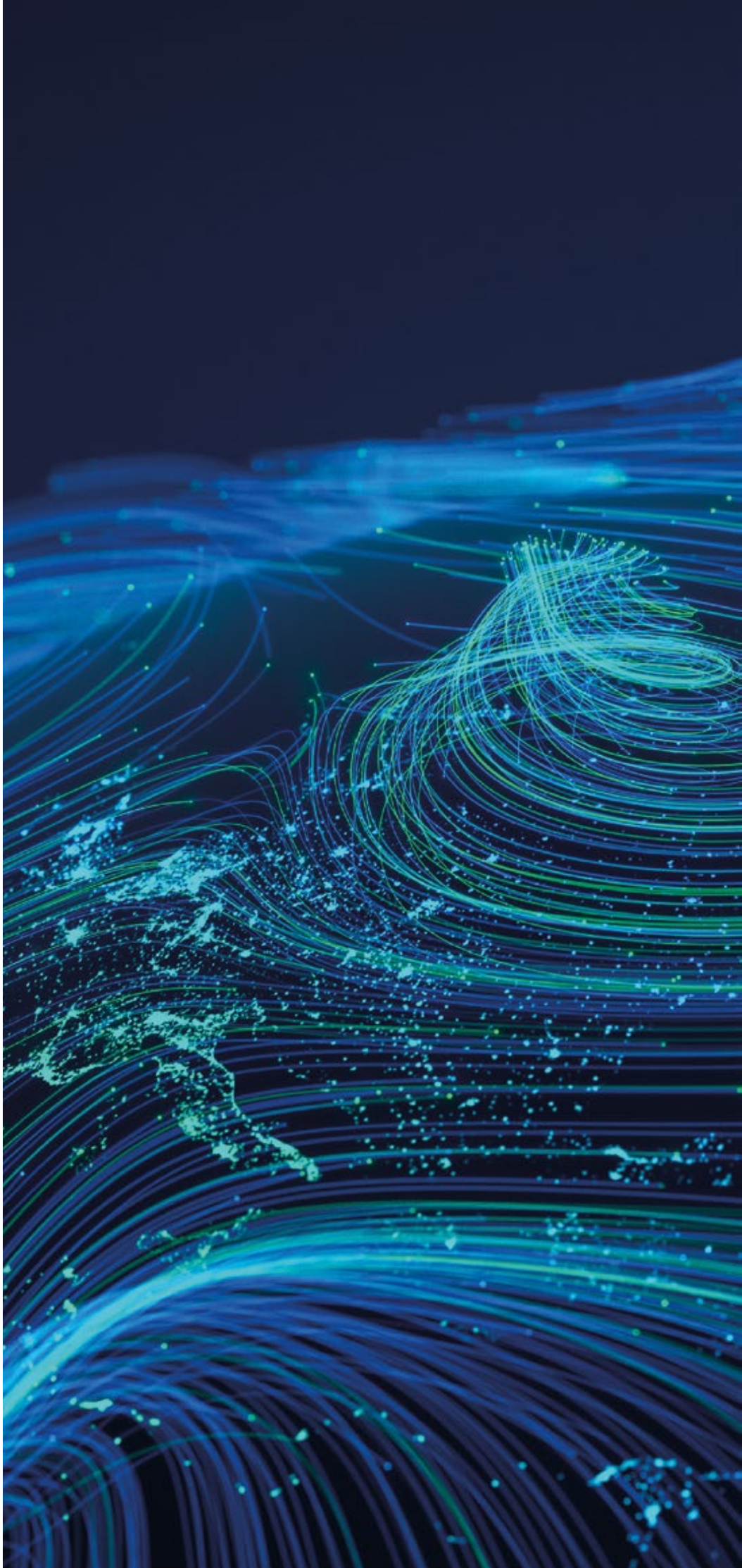

## Editorial

# When Innovation Becomes Geopolitical

**Paolo Chighine**

Geopolitics and technology are no longer moving on separate tracks. They now influence each other and are jointly reshaping the future of energy. As government strategies determine investments in artificial intelligence, big data, automation, and the space economy, these innovations are shifting global power dynamics and impacting competitiveness, supply chains, and security.

This is an unprecedented convergence. The growing demand for electricity required by AI and digitalization is driving more resilient infrastructure and smarter grids. Meanwhile, the race for green and digital technology is fueling new value chains and redefining the balance of power among nations. Whereas power was once delivered via pipelines and oil tankers, it now runs through HVDC cables, network nodes, strategic metals, and data centers.

In this context, artificial intelligence is not just an industrial tool. It's a lever of political and economic influence. Its rising energy demand brings supply security back to the forefront, creating a circular effect: technology accelerates the energy transition, but also raises challenges related to governance, equity, and global stability. Critical issues such as the development of small modular reactors, Big Tech's Net Zero strategies, and the growing role of international institutions in

setting rules and standards show that technological innovation cannot be separated from geopolitical and climate dynamics.

In this context, CESI continues to play a leading role, anticipating technological shifts and guiding its clients through innovation. As our CEO Nicola Melchiotti puts it: *"Our job is to see the future before others do. We test today the technology that will be on the market ten years from now."* Decarbonization, electrification, and digitalization, he adds, are the three trends driving the group's strategic choices. And they all converge on the electrical interconnections that are redrawing the global energy map.

In Issue 32 of *Energy Journal*, we aim to provide our readers not only with an analysis of the technology driving the energy transition, but also with a compass to navigate the geopolitical, economic, and social implications of the future that is being built today. We begin with the **Scenario** section that explores the new global balance in which energy technology and geopolitics are increasingly intertwined. HVDC grids, innovative storage systems, and demand-side flexibility are emerging as the three pillars of tomorrow's power system, while AI is driving both efficiency and international competition.

In the **Top Story**, we tackle the paradox of AI as a major consumer of electricity, but also a powerful ally in making grids and plants more resilient and secure. The energy sector is already a testing ground for advanced applications: from predictive models to Terna's pilot projects and to the solutions developed by global players. From the World Energy Congress to the United Nations, international forums are highlighting the urgency of managing this transformation to avoid new extractive dependencies and ensure that innovation deliver tangible benefits.

The **Industries & Countries** section examines how Europe, the United States, and Asia are responding to AI's "energy vertigo." As data centers become increasingly power-hungry, governments are crafting strategies that range from semiconductor incentives and R&D tax credits to new gas-fired plants to support digital growth. Europe, as CESI Chairman Guido Bortoni notes, must view this infrastructure as an opportunity to strengthen competitiveness and grid stability, thereby turning a challenge into a driver of development.

In **Future & Technology**, we showcase CESI's global commitment: from KEMA Labs in which tomorrow's core technologies are currently being tested to EnerNex's expertise in smart grids. Moreover, CESI Space, a new business unit launched as part of Space Factory 4.0, brings Italian excellence to the heart of the space economy. This mosaic of experiences demonstrates how resilience, digitalization, and decarbonization are now tightly interwoven threads in a single narrative.

We close with **Opinions**, in which influential voices from politics, institutions, and the tech world - from António Guterres to Satya Nadella, from Ursula von der Leyen to Dan Jørgensen - converge on a crucial point: without robust infrastructure and shared rules, innovation risks becoming a source of vulnerability. It's a powerful reminder that the technological transition is not just an industrial challenge, but a test for democracy, competitiveness, and global stability.

Enjoy the reading!

**Paolo Chighine**
***CESI Group Communication and External Relations Executive Vice President***

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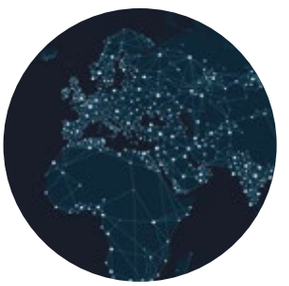
«The geopolitical landscape in today's world … is having an impact on the energy transition. … The energy transition is also having a big impact on the geopolitical landscape».

***Meghan O'Sullivan**, Director of the Belfer Center for Science and International Affairs*







News

# Latest from CESI

## Botswana



### CESI Supporting the Strengthening of the National Energy Regulatory Framework

CESI has been selected to assist the Botswana Energy Regulatory Authority (BERA) in consolidating the country's energy regulatory and legislative framework. The initiative is part of a broader modernization effort aimed at enhancing the security, efficiency, and sustainability of Botswana's power system.

The project includes a comprehensive analysis of current legislative measures and the development of targeted recommendations to align regulatory practices with international standards and attract investments to the energy sector. CESI will contribute its global expertise in technical and institutional consulting, working alongside local authorities to build regulatory capacity.

> **"Supporting BERA means helping lay the foundation for a stronger and more resilient power sector."**

## Saudi Arabia



### CESI and ACWA Power Sign MoU to Export Green Energy

CESI and ACWA Power have signed a memorandum of understanding (MoU) to jointly develop projects focused on exporting renewable energy from the Middle East to Europe. The agreement aims to leverage Saudi Arabia's renewable resources and strengthen energy connections between the two regions, supporting decarbonization and energy security goals.

The MoU outlines the study and design of innovative solutions for the generation, transmission, and integration of green energy, with a focus on HVDC technologies and green hydrogen. Through this collaboration, CESI will share its international expertise in technical and regulatory consulting, while ACWA Power will reinforce its position as a regional leader in renewables.

> **"A concrete step toward establishing new energy routes between the Middle East and Europe."**

## Baltic States



### CESI Contributing to the Development of the Baltic Energy Hub

CESI has been commissioned to support the development of the Baltic Energy Hub, a strategic infrastructural project designed to enhance energy security and market integration across Northern Europe. The initiative aims to strengthen interconnection capacity between the Baltic States and the rest of the continent, promoting decarbonization and grid stability.

CESI's role includes technical consulting for the feasibility analysis, identifying advanced HVDC transmission solutions, and assessing the regional energy system impact. The project is part of the broader effort to synchronize Baltic power systems with the continental European grid.

> **A key milestone for regional energy resilience and European integration.**

## Space

### CESI Space Joins National Space Factory 4.0 Initiative

CESI Space has officially joined **Space Factory 4.0**, an initiative led by the Italian Space Agency and supported by the Ministry of Enterprises and Made in Italy to strengthen the national space industry. The goal is to create an integrated ecosystem for the production of satellites and high-tech components to support civil and commercial missions.

With its new production line for high-efficiency solar cells, CESI Space will contribute to the development of innovative platforms for the sector, reinforcing Italy's position as a strategic hub in the space economy. The project brings together universities, research centers, and leading companies, fostering synergies and technology transfer.

> **Joining Space Factory 4.0 means putting our expertise to work in building the future of satellite missions.**

**For further information on this topic, please contact:**

*Alessio Cipullo (Head of Italy and EU Public Affairs)*

Scenario

# Energy Technology and Geopolitics: The New Global Balance

**Between algorithms and HVDC cables, global power now flows in two directions: technology is rewriting geopolitics, and geopolitics is accelerating its evolution.**

In recent years, the global energy landscape has found itself at the crossroads of three converging forces: the urgency of decarbonization, growing geopolitical instability, and rapid technological acceleration. The climate crisis has necessitated a structural shift in energy production and consumption models, while events such as Russia's invasion of Ukraine, the realignment of supply chains, and the race for critical minerals have placed energy back at the heart of national security dynamics. In this fluid context, the energy transition has become not only an environmental priority but also a strategic and economic imperative, closely intertwined with government stability, industrial competitiveness, and geopolitical balance.

To address these challenges, governments and businesses have channelled **unprecedented investments into technology capable of combining sustainability, security, and resilience**. Not all available technology has received equal attention: the focus has been on those with a high scalability potential, low environmental impact, the ability

to integrate with existing systems, and — crucially — alignment with medium-term climate goals. Alongside solar and wind, energy storage (batteries, thermal storage), green hydrogen, carbon capture and storage (CCS), heat pumps for building efficiency, digital technology for smart grid management, and, more recently, artificial intelligence as an optimization tool, have all gained prominence. Moreover, nuclear energy is also making a comeback, now reimagined in modular and innovative forms (SMRs) as a concrete response to the need for stable and programmable decarbonization.

## A Bidirectional Flow

However, the relationship between geopolitical context and technological innovation is not one-way. **Technology developed to address environmental and energy challenges are themselves reshaping the geopolitical landscape.** The growing electrification of consumption, the integration of renewables, and the digitalization of energy systems are redrawing the geographies of dependency. While power once flowed through gas pipelines or oil tankers, it now increasingly centers on HVDC cables, network nodes, strategic metals, and access to data centers. Technological dominance, particularly in AI, is becoming a lever for political and economic influence. At the same time, the energy demands of new systems — not least the training of AI models — are bringing the issue of supply security and the adaptability of existing infrastructure back to the forefront.

This circular effect is already evident: **the adoption of green and digital technology is fueling new value chains, attracting investment, and stimulating industrial innovation**. However, in doing so, it raises new governance challenges, questions of equitable resource access, and the need to balance efficiency with sovereignty. In parallel, Big Tech — now increasingly active in the energy sphere — are revising their sustainability strategies. Some are reaffirming their Net Zero commitments and investing in renewable plants or green certificates to power their servers, while others are beginning to acknowledge the limits of the unlimited growth model, particularly in relation to the surging energy consumption of generative AI systems.

**In this scenario, nuclear power is re-emerging as a strategic technology.** France, United States, China, and other countries are investing in small modular reactors, aiming

to provide a stable, decarbonized backbone within an increasingly intermittent and complex system. Buoyed by renewed research momentum and a more open public debate, interest in nuclear energy is being rekindled in Italy, too, albeit this time from a technological and industrial, rather than ideological, perspective.

Institutions, from the G7 to the European Union and specialized agencies such as the IEA, are striving to keep pace with this transformation, adopting **governance strategies and tools to accompany the advent of new energy technology**. Support for research, market standardization, protection of critical infrastructure, and the definition of ethical principles for AI use are just some of the levers being deployed. However, the most complex challenge remains that of balance: enabling innovation without sacrificing climate goals and the social justice of the transition

## The Energy–Artificial Intelligence Nexus

It is within this highly interconnected and rapidly evolving framework that **the new axis between energy and artificial intelligence** is taking shape — not merely as a technological trend, but as a key to understanding, and perhaps steering, the future of the global energy system. While artificial intelligence is now seen as an indispensable lever for competitiveness and innovation, its energy impact must not be underestimated.

According to the **International Monetary Fund (IMF)**, data centers consumed around 500 TWh of electricity in 2023 — the equivalent of countries such as Germany or France — and could reach 1500 TWh by 2030, a level comparable to India's total consumption. The consequences are twofold: on the one hand, rising demand will stimulate new investment and the expansion of renewable sources; on the other, in the absence of

adequate policies, AI could produce up to 1.7 gigatons of $CO_2$ over the next five years, equivalent to Italy's energy emissions over an entire five-year period.

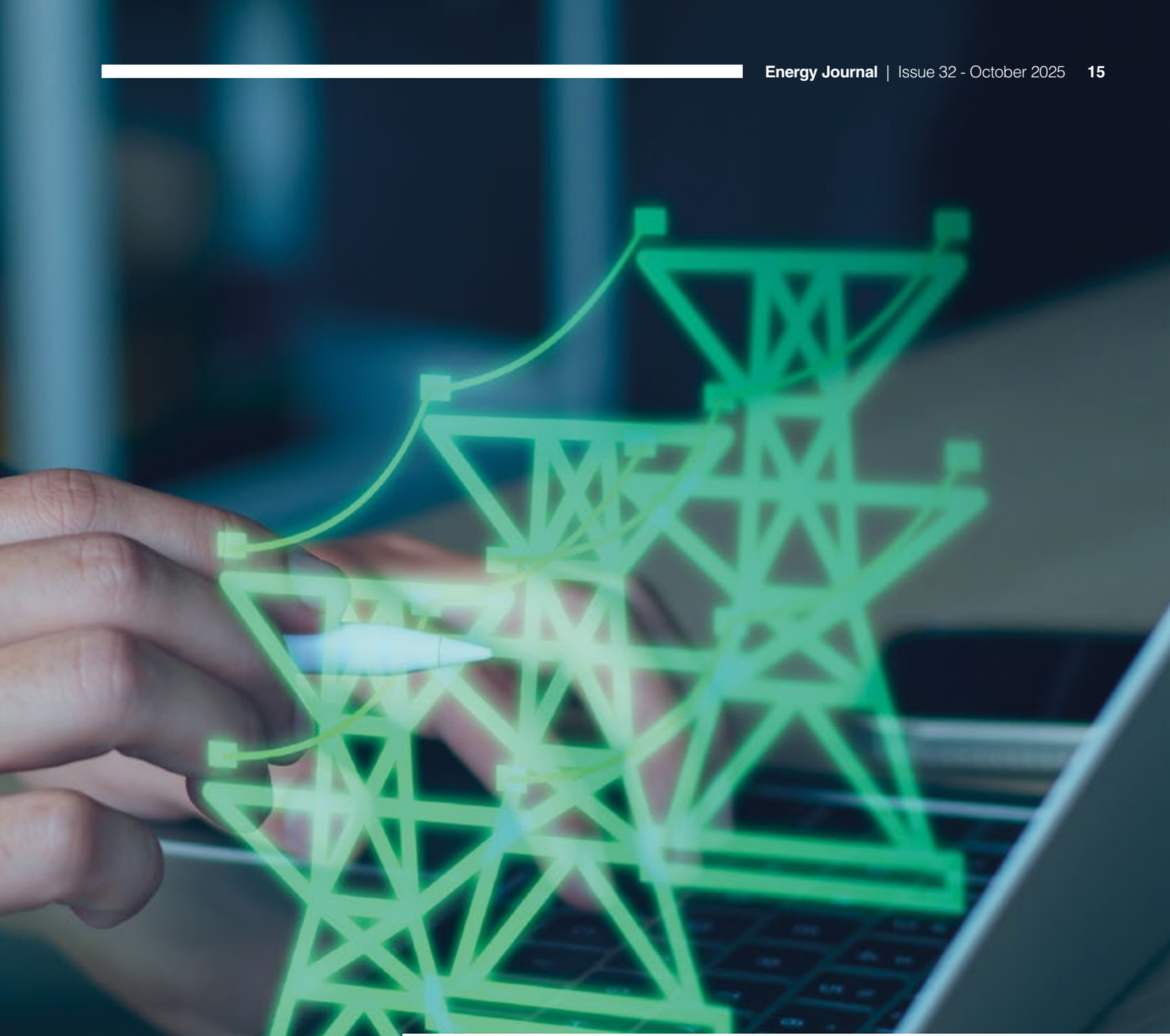
**The IMF has warned that a sluggish electricity supply could trigger price hikes severe enough to jeopardize the very growth of AI**, with effects on businesses and consumers. It is therefore clear that the technological challenge cannot be separated from the infrastructural and energy challenge. The digital revolution demands a marked change in grids, storage, and flexible demand management.

## Investments in Grids, Storage, and Flexibility

The energy transition is introducing a new era for electricity infrastructure. To ensure a decarbonization and deep electrification of the economy, the share of electricity in final consumption will need to more than triple by 2050, rising from the current 20% to over 55–70%. **This scenario entails an unprecedented increase in investment in grids, storage, and flexibility.** Power grids, the backbone of the system, will require over $22.5 trillion in cumulative investment by 2050, with an annual need estimated at $800 billion—more than double current levels.

This challenge was recognized internationally with the launch of the **Global Energy Storage and Grids Pledge** at COP29, which aims to build or upgrade 25 million kilometers of lines and install 1,500 GW of storage capacity by 2030, six times the current level. In parallel, the Green Energy Pledge seeks to connect green zones and corridors to the most needy communities, through interregional and intraregional interconnections.

In this context, **high-voltage direct current (HVDC) transmission technology** is assuming an increasingly strategic role. Once considered a niche solution for long-distance links or integrating systems with different frequencies, HVDC is now key to transporting large volumes of renewable energy from production hubs — offshore or in deserts — to consumption centers. By 2030, cross-border interconnection capacity in Europe will grow by 88 GW, over the already planned 161 GW, reaching +108 GW by 2040. This challenge also extends to next-generation submarine cables, capable of reaching record depths of 3000 meters, as in the **Great Sea Interconnector** project, and more advanced cable-laying vessels designed for greater precision and sustainability. These innovations are accompanied



by “no-new grid” solutions, such as converting AC lines to DC, using HTLS conductors, and digitalizing substations, all of which increase capacity without resorting to invasive new infrastructure.

The second pillar of the transition is **energy storage**, which is essential to manage the growing volatility of renewables. Today, global capacity stands at around 56 GW but could exceed 227 GW by 2040. The best solutions remain pumped hydro storage and lithium batteries, which have seen sharp reductions in cost and widespread adoption. However, attention is shifting to emerging technology such as flow batteries, sodium-sulphur batteries, adiabatic compressed air storage, and thermal storage systems using molten salts or sand. Lithium-sulphur and lithium-air batteries, as well as systems based on nano-materials and liquid $CO_2$ are more experimental, but have a great potential. The challenge is twofold: to attract investments in innovative solutions and, at the same time, **to build business models capable of integrating storage into electricity markets**, moving beyond today’s support mechanisms.

The third, equally crucial, element is flexibility. As electrification advances in transport, heating, and civil uses, consumers can become active participants in system balancing. Electric vehicles, heat pumps, and smart buildings provide the possibility to modulate loads and shift consumption based on renewable energy availability. According to targets, **by 2030, at least 20% of any load should be “flexible,”** with direct benefits in terms of system cost reduction and new infrastructure investment deferral. Ongoing

experiences, such as those in California and Chile, demonstrate that it is possible to integrate these distributed resources into daily grid management. Digitalization will enable this process: sensors, predictive algorithms, and dynamic management platforms will transform demand from a passive factor into a strategic resource for system security and stability.

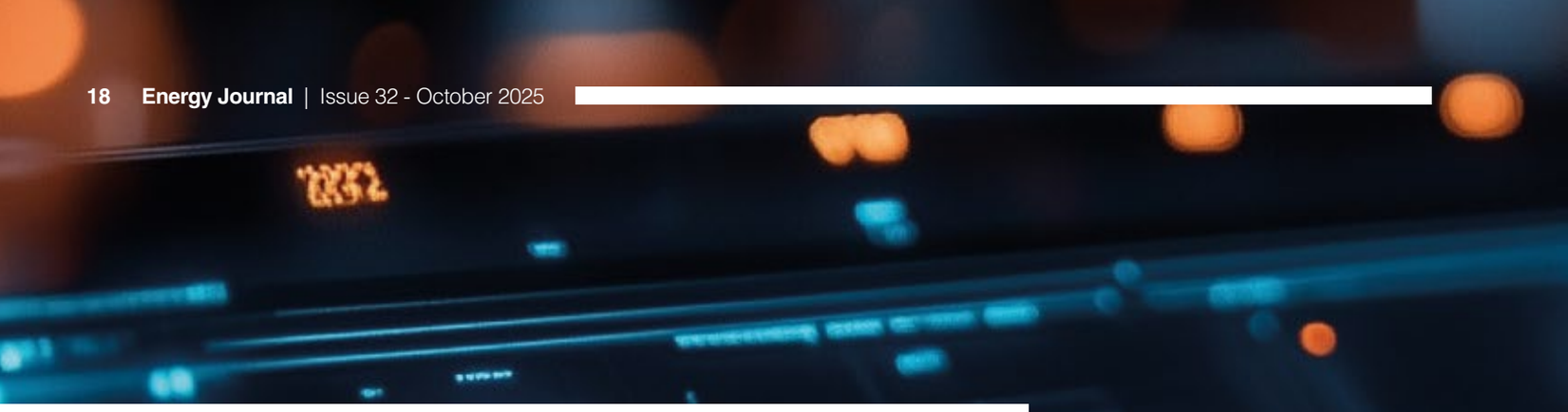
## Technology Enabling the Transition

While HVDC grids, innovative storage, and demand-side flexibility are the three pillars underpinning the new global electricity system, accelerating their deployment means laying the groundwork for a future in which **energy security and sustainability can finally go hand in hand**. This is not merely technical infrastructure, but a true transition enabler, tools capable of making economies more resilient, businesses more competitive, and energy supplies more reliable for citizens and communities.

The great HVDC backbones will be the invisible motorways of renewable energy, storage

will act as reservoirs, transforming intermittency into continuity, while demand flexibility will make consumers protagonists of the system, in a dynamic and participatory balance. **The opportunity to combine technological innovation with climate "justice" rests on this triad**, also in order to avoid the risk of turning the digital revolution into a new source of imbalance.

Looking ahead to 2050, the success of the transition will not be measured solely in terms of installed gigawatts or tonnes of $CO_2$ avoided, but in the **collective ability to build a smarter, more inclusive, and safer global infrastructure**. A system where energy, like information, will flow swiftly and reliably through interconnected networks, powering not only the economy but also society's confidence in a truly sustainable future.



Top Story

# Energy and Intelligence: Two Sides of the Same Transition

**Governance, technology and markets: the challenges of making artificial intelligence an ally of the energy transition, reshaping consumption and infrastructure.**

Artificial intelligence runs on electricity. It's an image that captures the paradox of our time: without abundant, reliable, and clean energy, there is no AI. Yet, AI itself is emerging as a key tool to make grids and plants more efficient, flexible, and secure. On the one hand, rising consumption is putting pressure on already fragile systems; on the other, AI holds enormous potential to accelerate the energy transition.

"AI must be carbon-aware to be credible. The goal is ambitious: to become carbon negative by 2030," explained Brad Smith, President of Microsoft, summarizing the challenge. It's within this delicate balance that the credibility of the technological promise is being tested. AI must be transformed from a pressure factor into a solution driver.

## AI Market & Geopolitics

From an economic standpoint, the scale of the ongoing revolution is staggering. According to Forbes, the global AI market could reach US$407 billion by 2027, growing at nearly 40% annually. A McKinsey analysis

estimates that AI could contribute between US$17 and US$25 trillion to the global economy by 2030, with up to US$7.9 trillion linked to generative AI. These figures reflect not only a technological transformation but also a new arena of geopolitical competition.

The race is led by American tech giants. As of early 2024, Microsoft, Apple, Google, Amazon, Nvidia, and Meta topped global market capitalization rankings, each exceeding the trillion-dollar mark. While the U.S. and China remain the dominant poles, Europe is also moving: France and Germany have launched multi-billion-dollar programs to develop their own language models, aiming to reduce dependence on both East and West.

Italy stands out for its uneven but growing adoption of artificial intelligence. About one in two large companies has already experimented with AI-based solutions,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*Bruno Cova (Power System Excellence Manager - CESI Consulting)*

and among these, 70% report tangible productivity gains. Leading sectors include energy and utilities, followed by finance and manufacturing. AI is not a passing trend, it's a cross-sector phenomenon that is already reshaping entire industries.

## AI in the Energy Sector

The energy sector was among the first to recognize AI's potential. Oil & gas companies have been using it for many years to better assess reserves, reduce drilling uncertainties, detect methane leaks, and plan maintenance.

"We've integrated predictive models on offshore wind turbines that reduce physical inspections by 40% and anticipate component wear months in advance," said Andreas Nauen, CEO of Siemens Gamesa, at the World Energy Congress.

However, today, the scale of change is far broader. With rising electrification, the spread of renewables, and the growth of distributed generation, the energy system is more complex than ever. Consumption is fragmented, production is intermittent, and grids must manage bidirectional flows. AI serves as a vital compass: forecasting supply and demand, integrating variable sources, and optimizing storage and consumption.

Indeed, AI is key to enabling communication among millions of decentralized plants. It's a multiplier of the energy transition, if used with environmental intelligence. Not surprisingly, Terna has launched pilot projects using machine learning algorithms to forecast variable renewable generation. These experiments enable more flexible and resilient grid management, reducing risks and waste.

## Data Centers & Environmental Footprint

The physical backbone of AI is the data center, vast digital campuses housing thousands of servers, constantly cooled to ensure stable performance. Today, an AI-specialized data center consumes as much electricity as 100,000 homes, and the largest facilities under construction could use twenty times that.

According to the International Energy Agency, data centers consumed ca. 415 TWh of electricity in 2024 —about 1.5% of the global

demand. If growth continues at the current pace, they could exceed 945 TWh by 2030, which exceeds Japan's current consumption.

The impact isn't just electrical. Millions of liters of water are used daily for cooling. A UNESCO-UCL study estimates that by 2027, global annual AI-related water consumption could surpass six billion cubic meters, more than the needs of a country like Denmark.

"For every kilowatt-hour consumed, liters of water are needed. This pushes us to rethink the design and location of our data centers," explained Kate Brandt, Chief Sustainability Officer at Google.

The issue also involves critical minerals as GPUs and advanced chips require lithium, cobalt, and rare earths. In the case of gallium, 99% of it is currently refined in China and this dependency clearly risks becoming a new vulnerability.

Technological solutions are emerging: dedicated chips like Google's TPUs or Groq accelerators, immersion cooling, direct liquid systems, and improved Power Usage Effectiveness (PUE). Energy sourcing is evolving, too. Google and Microsoft are exploring small modular reactors, Amazon has signed PPA contracts for over 10 GW of renewable capacity, and Meta is building multi-gigawatt data centers with evocative names like Prometheus and Hyperion.

## Governance & the UN's Warning

This pace of change raises questions that reach beyond technology. At the AI for Good Summit in Geneva, more than forty UN agencies delivered a clear message: AI is a tremendous opportunity, but it risks becoming unsustainable without shared governance.

"We cannot afford for the digital transition to create new extractive dependencies," warned Fatih Birol, Executive Director of the IEA, stressing the need to diversify sources, strengthen recycling, and ensure supply chain traceability.

The UNESCO-UCL study proposes three concrete strategies to reduce AI's energy consumption by up to 90%: develop lighter models, shorten response lengths, and improve compression techniques. Google and OpenAI are already testing "mini" versions of their tools that are more efficient and targeted.

However, the challenge remains global. According to the International Telecommunication Union, 85% of countries still lack a national AI policy and 2.6 billion people still have no access to the Internet.

## Emerging Markets

In developing countries, AI presents both risks and historic opportunities. These economies account for about half of the world's Internet users but have less than 10% of data center capacity. Networks are often outdated, causing high data loss and frequent blackouts. Here, AI applications like predictive maintenance or advanced load forecasting could reduce waste and costs, facilitating the integration of renewables that are already the most cost-effective generation option in many cases.

However, a key issue remains. AI models are often trained on data from advanced economies, and are poorly suited to local contexts. Investing in localized data will be crucial. AI can also help fill gaps using satellite imagery and sensors, which are useful for planning new grids or off-grid solutions. In some cases, emerging markets may even gain an advantage: new factories and infrastructure can immediately integrate smart systems, avoiding the burden of outdated legacy technologies.

Artificial intelligence is not a magic wand that will solve the climate crisis, but it can become a decisive lever to make energy systems more resilient, efficient, and sustainable.

The direction will depend on three conditions: **efficiency by design** in models and infrastructure, **access to low-emission electricity**, and **inclusive governance** capable of reducing global inequalities. This is the balance on which the credibility of the technological revolution rests: from pressure factor to shared tool for progress.

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Industries & Countries

# The Digital Energy Equation

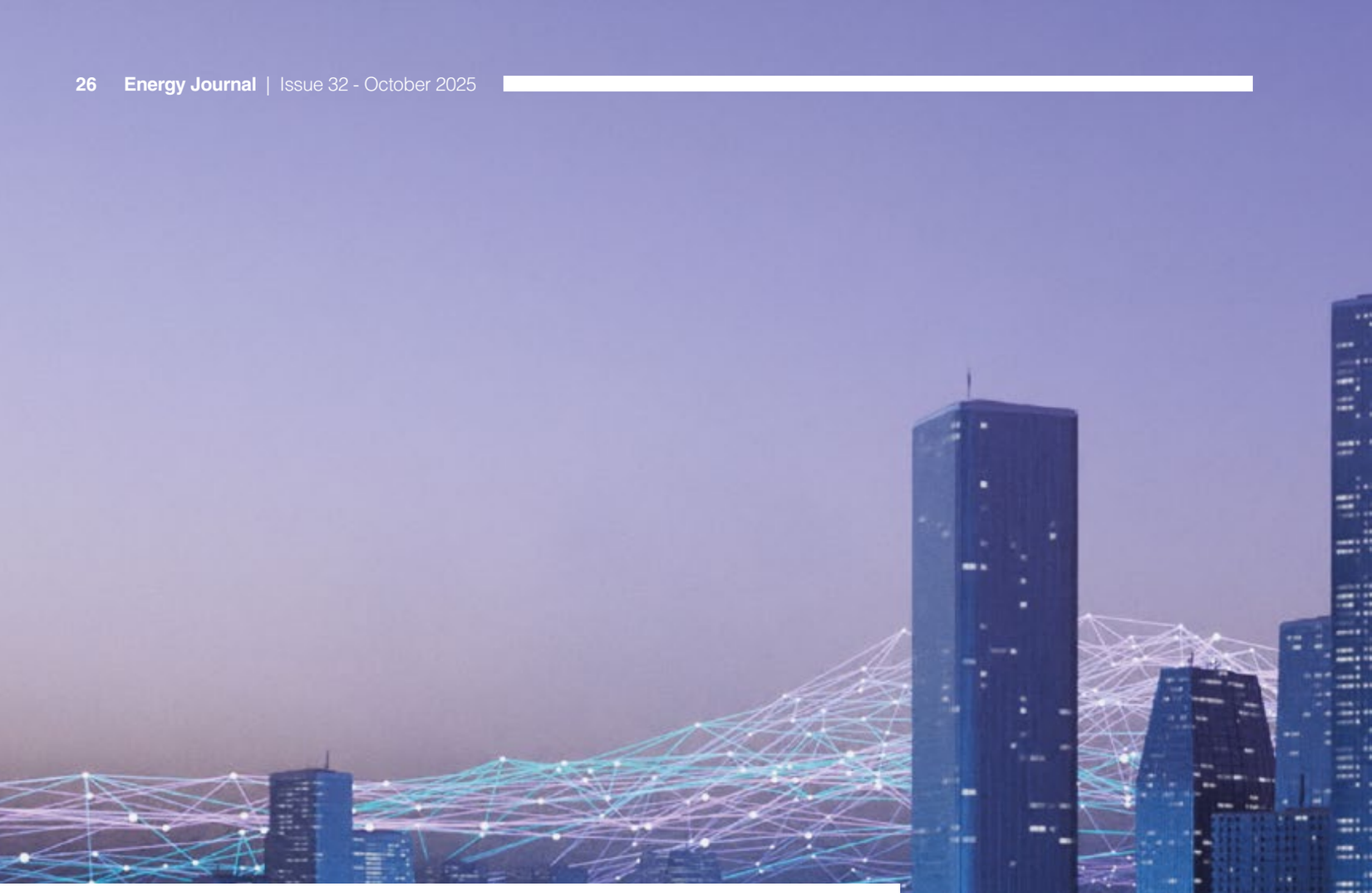
**As data centers expand and networks grow smarter, the balance between innovation, electricity, and geopolitics becomes the defining challenge of our time.**

Among the sectors most transformed by the rise of generative artificial intelligence, energy stands out as a key frontier. The ability to process massive datasets, forecast complex scenarios, optimize operations, and reduce inefficiencies makes AI a potentially revolutionary tool for utilities, grid operators, and companies across the entire energy value chain. This is no longer a distant horizon. It's a shift already underway, rewriting rules, investments, and strategic priorities.

Distinct regional specializations are emerging across key segments. Asia is now the epicenter of industrial robotics, accounting for over 70% of global installations in 2023. North America leads in industrial software revenues, while Europe is home to automation champions like Siemens, ABB, and Schneider Electric. This map reveals how industrial hubs are dividing up the innovation frontier — and how each region is working to turn AI into a competitive advantage.

## The Role of Governments

Private initiative and increasingly visible public leadership underpin these dynamics. National AI strategies tend to converge around three key levers: funding



research and development, directly supporting data center construction, and incentivizing chip and semiconductor production.

Public R&D spending on AI has surged in recent years. In the U.S., for example, the FY23 federal budget for IT & AI R&D was estimated at US$9.6 billion, with AI-related procurement rising significantly between 2022 and 2023 — a trend mirrored, to varying degrees, across many countries.

Japan has committed particularly large sums. In November 2023, it allocated an additional ¥2 trillion (about US$13 billion) to semiconductors, and in 2024 pledged at least ¥10 trillion (around US$65 billion) by 2030 to support chips and AI. Brazil approved its 2024–2028 plan "AI for the Good of All" with funding totaling RS$23 billion (about US$4 billion). Egypt launched its Second National AI Strategy (2025–2030) in January 2025, including a national AI fund estimated between US$430 million and US$860 million.

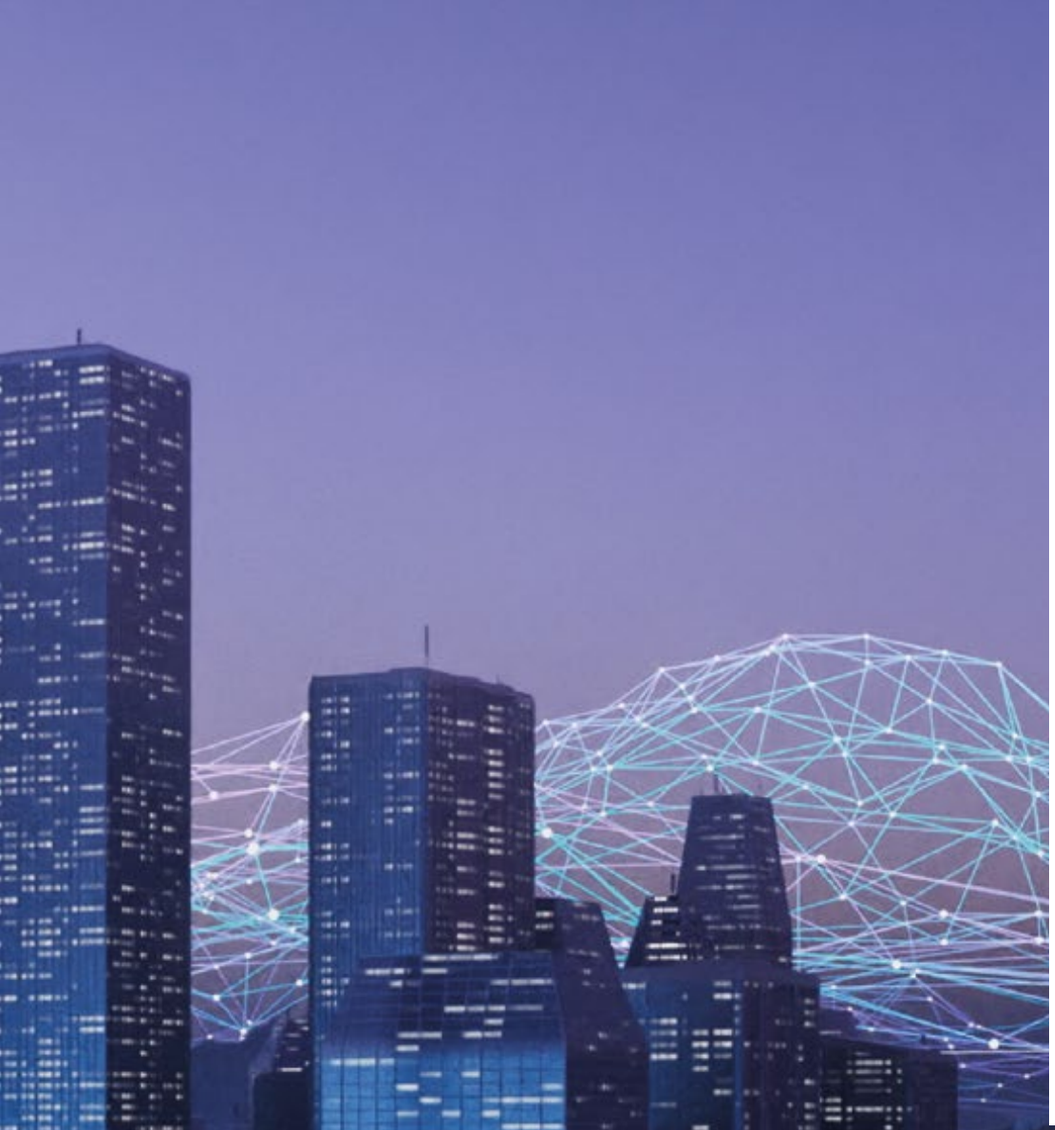
India has accelerated its AI strategy with several initiatives: three Centers of Excellence approved in October 2024 (worth around US$120 million), the IndiaAI Mission with a budget exceeding US$1.2 billion, and the Semicon India program backed by over US$10 billion in public funding. In South Korea, the 2025 tax reform designated AI as a strategic national technology, providing investment tax credits of 15–25% for AI data centers and up to 50% for R&D projects. China continues to support its high-innovation tech firms with a reduced corporate income tax rate of 15% (compared to the standard 25%).

It's a diverse mosaic of tools and strategies with a common goal: the recognition that those who govern AI will also shape tomorrow's energy and production chains.

## European Union: Scientific Excellence Meets Digital Sovereignty

Energy is a cornerstone of Europe's ecological transition but it also reflects its complexities: volatile markets, geopolitical pressures, and infrastructure vulnerabilities. In this context, the impact of generative AI has become a central issue for European institutions, from Brussels to national governments.

According to the European Commission's Joint Research Centre (JRC), the EU accounts for about 21% of global scientific publications



on generative AI, but only 2% of patent applications. This gap suggests vibrant academic activity but a weaker ability to translate knowledge into applied innovation, startups, and venture capital.

Meanwhile, concern over energy impact is growing. Based on IEA estimates, the European Central Bank projects that by 2026, AI-powered data centers could account for around 4% of the EU's current electricity consumption. Looking further ahead, a study by Ember estimates that European data center electricity demand could rise by 150% between 2024 and 2035 — from 96 TWh to 236 TWh — with significant effects in urban areas where infrastructure is concentrated.

This analysis resonates in Italy, where data centers have entered the energy and industrial debate. "A medium-large 500 MW data center could consume up to 1% of national electricity demand," noted CESI Chairman Guido Bortoni in a recent Sole 24 Ore article. It's a massive load, placing data centers among the major consumers of the future, but also a valuable additional demand that can strengthen the system's sustainability. Indeed, properly planned data

centers can help reinforce the very structure of the power grid. According to Bortoni, the predictable consumption and preference for long-term renewable energy contracts (PPAs) makes data centers "virtuous" customers, capable of bringing stability to the market. That's why Italy should view this infrastructure not as a problem, but as an opportunity for competitiveness. Attracting data centers means fueling investments in grids, storage, and renewables, transforming an infrastructural challenge into a lever for accelerating the transition and enhancing energy security.

## Policy and Institutional Responses

To address these challenges, Brussels has included generative AI in its Economic Security Strategy, developed along three pillars: boosting competitiveness, protecting critical infrastructure (including energy), and building partnerships with trusted actors. This is complemented by the AI Act and initiatives like GenAI4EU, designed to harness Europe's cognitive capital and reduce technological dependence on external players.

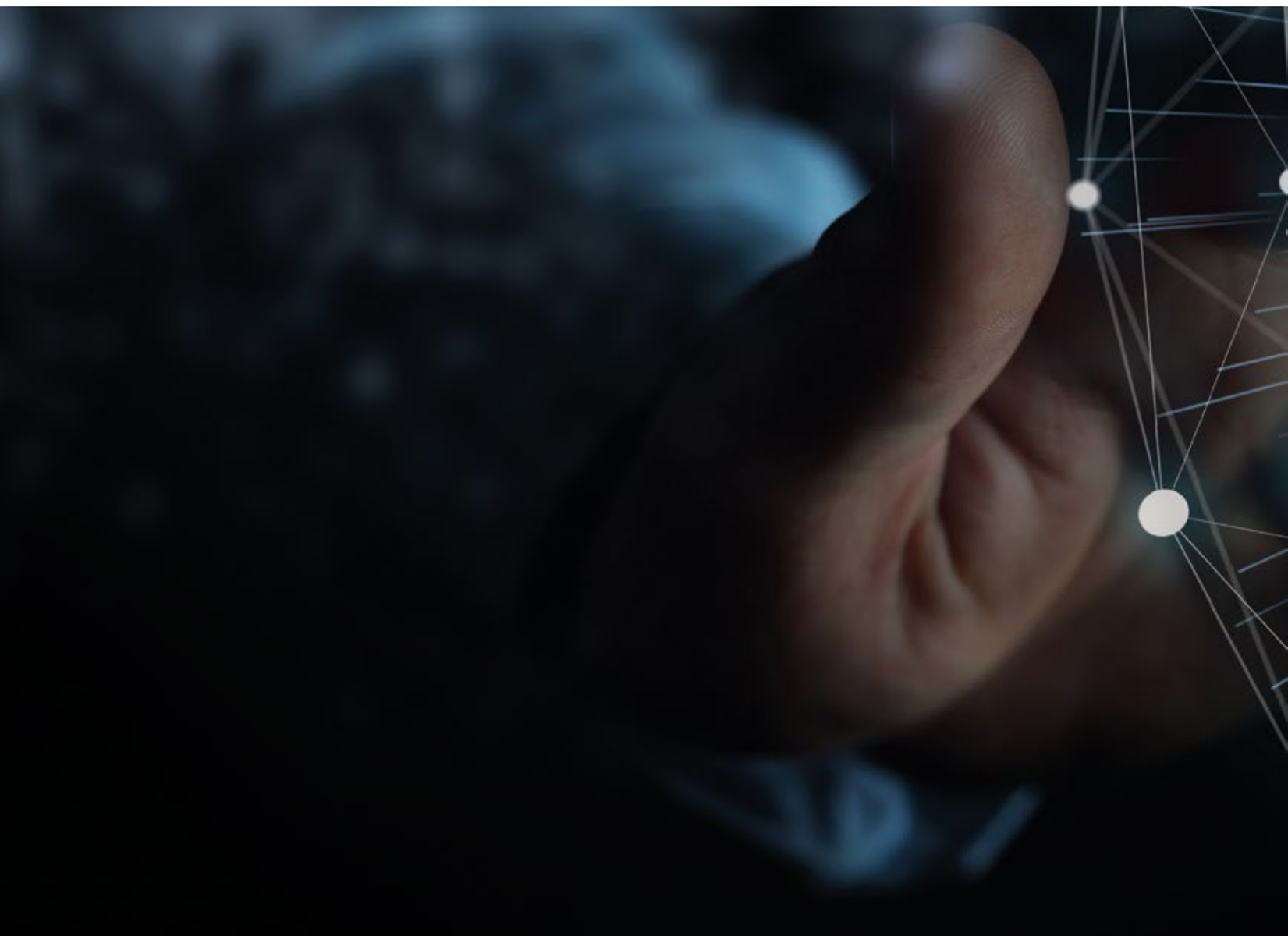
The JRC's *Generative AI Outlook Report*, published in June 2025, emphasized that AI's benefits must be balanced against real risks: from disinformation and model bias to privacy and labor implications. Europe, the report concludes, needs clear and coherent policies that will reflect its founding values and build trust in digital tools.

In parallel, the Commission is preparing a package focused on data center energy consumption. These facilities already account for about 3% of EU electricity use, and their share is set to grow rapidly. The updated Energy Efficiency Directive (EED) introduces strict requirements for data centers over 1 MW: certified energy management, PUE monitoring, heat recovery systems, and greater transparency in performance. Member States must implement the new rules by October 2025.

Europe is at a pivotal moment. It excels in research but must scale-up applied innovation and prepare to manage AI's growing energy demand. The challenge is clear: turn scientific leadership into an industrial and infrastructure ecosystem capable of supporting digital autonomy and the continent's ecological transition.

## United States: AI and Grid Pressure

In the U.S., generative AI is not just a driver of technological innovation. In fact, it's already reshaping the energy system. The explosive growth of data centers needed to power increasingly sophisticated models is pushing electricity demand to unprecedented levels.



According to a Department of Energy (DOE) report, data centers consumed about 4.4% of national electricity in 2023, but could reach between 6.7% and 12% by 2028.

The pressure is especially acute in Virginia, the beating heart of America's digital infrastructure, where much of the nation's computing capacity is concentrated. Electricity demand nearly doubled in the second half of 2024 alone, forcing Dominion Energy to revise its investment plans and coordinate with PJM to strengthen transmission backbones.

Plans for dozens of new gas plants are under consideration to meet this surge. According to the *Financial Times*, up to 80 new facilities — totaling around 46 GW of added capacity — could come online by 2030 to balance the constant loads of data centers. This outlook challenges past climate commitments, signaling a major return to fossil fuels.

The shift is also tied to Donald Trump's return to the White House in January

2025. After years of the Inflation Reduction Act promoting renewables, the new administration has taken a very different path. Several offshore wind and solar projects have been blocked or delayed, and many federal incentives from the Biden era have been dismantled.

Meanwhile, trade policy has targeted strategic imports: solar wafers and polysilicon face 25% tariffs, while Chinese lithium-ion batteries incur in tariffs up to 82%. The stated goal is to protect domestic manufacturing and ensure internal energy security, but the side effects are clear: the costs of green projects are rising and the clean tech race is slowing.

In this context, the U.S. strategy is consolidating along an "America First" axis: deregulate, build infrastructure fast, prioritize coal and gas to support AI growth, and defend American intellectual property.

## Asia: The Heart of the Digital Energy Race

If there's one continent where AI and energy are visibly intertwined, it's Asia. Not only does it host the world's largest and most dynamic digital markets, but it's also where much of the expected growth in global electricity demand will occur.

According to the IEA, data center electricity needs could nearly double by 2030, increasing from 415 TWh in 2024 to over 940 TWh. A significant portion of this growth will happen in Asia, where urbanization, digitalization, and the AI boom are advancing in parallel.

Japan is working to redesign the geography of its digital hubs. Authorities have launched plans to develop large data centers near renewable sources and transmission lines, making it easier to integrate new electricity demand. In Hokkaidō, SoftBank is building an "AI Data Center" in Tomakomai powered entirely by local renewables — a symbolic project showing how AI can shift from a load challenge to a green transition accelerator.

China, home to one of the world's largest digital ecosystems, faces a different dilemma: managing growth without compromising energy security. The "Eastern Data, Western Computing" initiative shifts computing capacity to its western regions with more space and renewables, potentially cutting data center emissions by 16–20% by 2030 and generating economic benefits estimated at US$53 billion. However, according to CarbonBrief, without stricter efficiency standards, China's data center network could consume 400–600 TWh annually by 2030, with associated emissions of around 200 million tons of $CO_2$.

India is positioning itself as a new regional hub, driven by its young population and data localization policies. Installed data center capacity, currently standing at ca. 1.4 GW, could rise to 9 GW by 2030, growing from less than 1% to about 3% of national electricity consumption. Estimates vary: IBEF projects at least 3 GW, while Colliers forecasts over 4.5 GW supported by US$20–25 billion in investments.

Whatever the scenario, sustaining this growth will require acceleration in battery storage, transmission, and stable green power contracts.

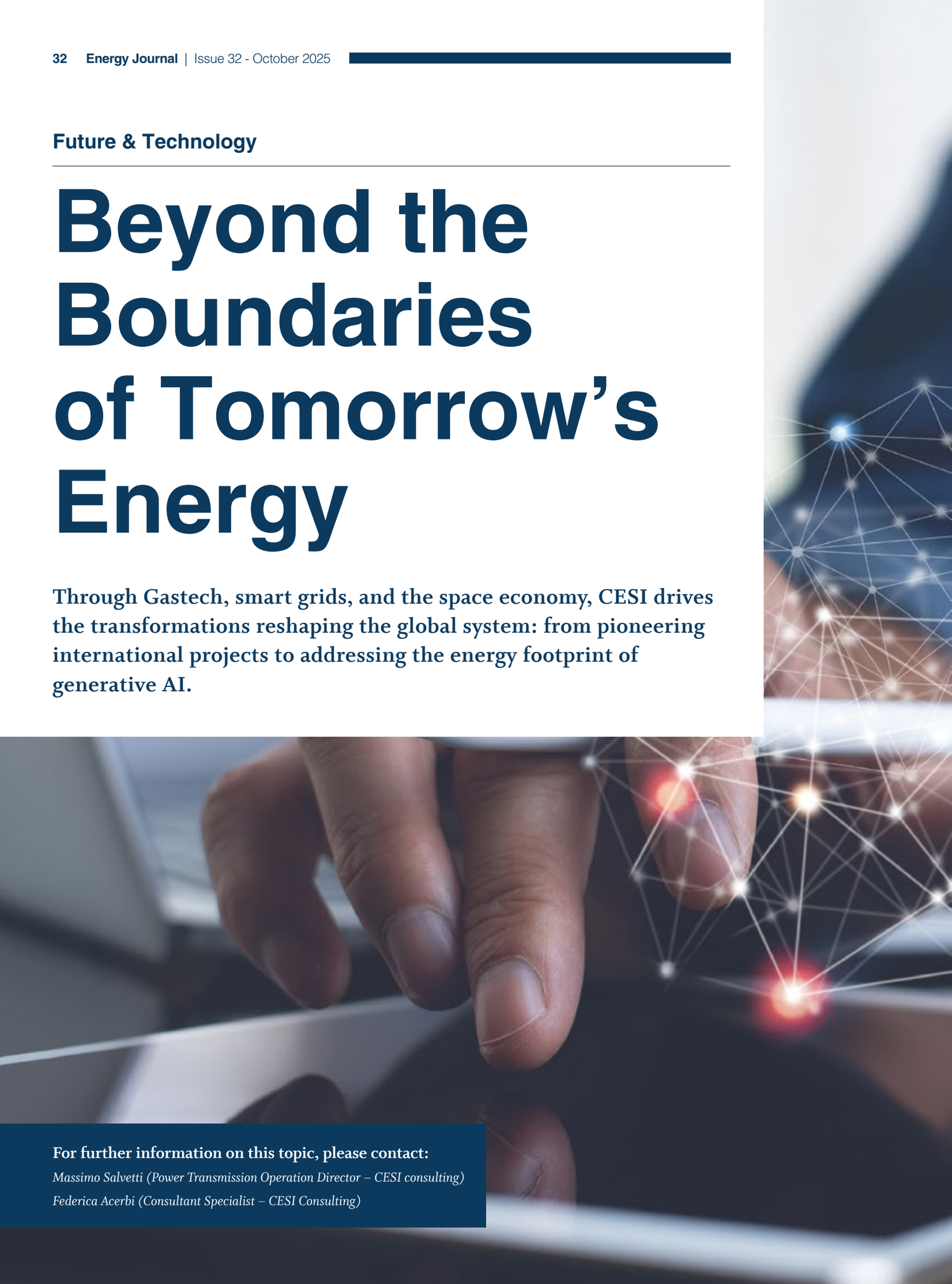
The common thread is clear: Japan, China, and India start with different conditions but share three priorities. First, rethinking data center siting to reduce congestion and losses. Second, investing in grids and flexibility, as AI loads are constant and hard to shift. Third, enforcing strict standards on efficiency and renewable sourcing.

If they succeed in aligning computing, electrons, and regulation, Asia won't just be the region consuming the most AI energy, it will become a laboratory for building a more resilient, cleaner, and accessible energy system.

**Future & Technology**

# Beyond the Boundaries of Tomorrow's Energy

**Through Gastech, smart grids, and the space economy, CESI drives the transformations reshaping the global system: from pioneering international projects to addressing the energy footprint of generative AI.**



**For further information on this topic, please contact:**
*Massimo Salvetti (Power Transmission Operation Director – CESI consulting)*
*Federica Acerbi (Consultant Specialist – CESI Consulting)*

The future of energy is now inextricably linked to the future of artificial intelligence. It's no longer just about algorithms or computing power. What's emerging with force is the energy demand of new generative platforms. According to a recent report by Google, even a simple Gemini query carries a resource cost equivalent to nine seconds of a television broadcast or five drops of water. While this may appear as a seemingly minor figure, multiplied by billions of daily requests, it reveals the scale of a colossal challenge.

The report highlights a crucial point: AI is not only a driver of innovation, but also a multiplier of energy and infrastructural needs. Data centers are becoming true consumption hubs with an environmental impact that cannot be ignored. The question is no longer whether the digital revolution will require energy, but how fast we can supply it in a secure, sustainable, and resilient way. This scenario raises urgent questions for governments, businesses, and tech operators. How do we balance digital growth with the green transition? What solutions can make AI infrastructure more efficient while ensuring grid stability and climate goals?

These are the issues dominating today's global debate. A recent example?

On September 9–12, Milan became the global energy capital with **Gastech 2025**. The city hosted over 50,000 participants from 150 countries, more than 1000 exhibitors, and a strategic conference bringing together leaders from industry, finance, and institutions. The event confirmed that the energy transition is now intertwined with geopolitical, technological, and labor challenges on a global scale.

The crisis triggered by the war in Ukraine has exposed the vulnerability of energy systems, and will have an estimated impact of 2% on the EU's GDP in 2024. At the same time, the digital revolution and AI boom have driven new consumption patterns. By 2026, data centers are expected to double their electricity demand, reaching 1000 TWh. This marks a profound transformation, making the integration of energy security, resilience, and decarbonization more urgent than ever.

At Gastech 2025, natural gas and LNG were confirmed as pillars of the transition, thanks to their flexibility and complementarity with intermittent renewables. However, innovation has pushed further: hydrogen, low-carbon fuels, digital technologies, and AI were central to the agenda, alongside finance, with BloombergNEF estimating over $32 trillion in investments needed in Europe alone by mid-century.

## KEMA Labs: Innovation and Global Expertise

CESI is rising to meet this challenge. With nearly 70 years of experience, the company supports utilities, governments, and investors in over 70 countries.

"Decarbonization, electrification, and digitalization are the three trends guiding our strategic

choices," says CEO Nicola Melchiotti. "Our job is to see the future before others do. We test today the technologies that will be on the market ten years from now."

This approach means anticipating technological shifts, testing their reliability under extreme conditions, and helping clients integrate them. It's the philosophy behind **KEMA Labs**, where solutions — from transformers to high-voltage direct current (HVDC) cables — essential for connecting new renewable generation areas with consumption centers are tested.

Fall 2025 marks a high-profile season for KEMA Labs across major international energy transmission and distribution events. From Germany to Panama to Spain, CESI's business unit will be participating in forums like the **Power Transmission & Distribution Technology EXPO** in Cologne, the **INMR World Congress** in Panama City, and **Enlit Europe** in Bilbao. These events provide opportunities to share insight, showcase innovation, and help shape the next generation of global electric systems, with a focus on digitalization, resilience, and decarbonization.

Earlier in the summer, KEMA brought its expertise to **PAC World 2025** in Glasgow, the leading forum on protection, automation, and control of electric systems. CESI engineers presented a paper entitled *Advanced Testing of Merging Units: Ensuring Reliability and Interoperability in Digital Substations*, developed with Grid To Great. The contribution emphasized the importance of advanced testing for safety and interoperability in digital substations, reinforcing KEMA's role as a trusted partner for utilities, manufacturers, and system integrators.

Another strategic event was **CIRED 2025**, held in Geneva in June, gathering over 1600 delegates and 3000 visitors from 60 countries. KEMA Labs showcased its expertise in high-voltage testing, smart grid resilience, and component reliability. Its presence at CIRED confirmed the group's ability to contribute to the development of future distribution networks, placing safety, sustainability, and technological innovation at the core.

## EnerNex: From Smart Grids to Wi-SUN

A leader in engineering, consulting, and research services for the electric power sector — and part of the CESI Group since 2018 — **EnerNex** reaffirmed its role, in 2025,

as a key player in modernizing power infrastructure. The company shared technical expertise and innovation with international forums and strategic markets.

In June, EnerNex participated in the **IEEE Power & Energy Society Technical Talk** in Atlanta, where Dr. David A. Bishop presented *Innovation for the Future: Enhancing System Protection with IEC-61850*. Through a real-world case study, he demonstrated how transitioning from wired I/O to IEC-61850 GOOSE messaging reduces both installation costs and time while improving system reliability via real-time fault data exchange between relays. A lab demo at Burns & McDonnell highlighted programmable logic based on IEC-61850 as a decisive lever for modernizing existing substations.

EnerNex also gained international recognition as a key contributor to the growth of the **Wi-SUN ecosystem** (Wireless Smart Ubiquitous Networks)—a wireless technology designed for large-scale, secure, low-power networks capable of connecting millions of devices in mesh architectures. This recognition strengthens EnerNex's position in the global smart grid landscape, where communication protocol standardization and cybersecurity are essential to accelerating the digital transition.

EnerNex's leadership is especially evident on the North American market, one of the most dynamic for Wi-SUN adoption. Here, the company actively supports the rollout of **Advanced Metering Infrastructure (AMI)** and **Automatic Meter Reading (AMR)**, helping utilities build smarter, scalable, and secure networks. With decades of experience and synergy with CESI's global capabilities, EnerNex is helping transform a sector driven by the need for efficiency and resilience. Its blend of local know-how and international innovation bridges the gap between advan-

ced research and practical application, positioning it as a key driver of the connected grid revolution.

## CESI Space: From Italy to Space Factory 4.0

Looking ahead also means venturing into seemingly distant but strategic fields such as the **space economy**. CESI has already taken a leading role with the launch of **CESI Space**, a new division established in 2025 that produces advanced solar cells for satellite applications.

"In space, there's no room for error; if a panel fails, the satellite is lost. That's why we focus on quality, robustness, and technological independence," said CEO Melchiotti.

In this spirit, 2025 marked a turning point for Italy's space economy with

the launch of **Space Factory 4.0**, an industrial initiative led by the Italian Space Agency to create a cutting-edge hub for production and innovation. Among its key players, CESI Space brings decades of expertise in testing, qualification, and electromagnetic compatibility — a vital contribution to ensuring the reliability of space-bound technologies.

Officially presented in Rome, Space Factory 4.0 brings together top national industry players — from Thales Alenia Space to Leonardo, Argotec, and Sitael — with the goal of building an integrated supply chain capable of competing globally. For CESI, joining this strategic alliance affirms its role as a technological enabler in a sector where quality, robustness, and independence are non-negotiable.

The growth of the space economy is creating new industrial and scientific opportunities, along with a rapidly expanding market on which Europe must compete with giants like the U.S. and China. In this context, CESI

Space offers unique expertise, connecting research, testing, and real-world applications.

"Space Factory 4.0 is not just an infrastructure project. It's a vision of the future," CESI emphasizes. It's a vision that looks beyond Earth's orbit, strengthening Italy's competitiveness and paving the way for new international collaborations.

## Shaping the Energy Future

Ultimately, CESI's experience across diverse domains — from high-voltage testing to North American smart grids, and now to satellites in the space economy — forms a unique mosaic. The challenge is the same everywhere: building reliable, resilient, and sustainable infrastructure capable of withstanding the impact of digitalization and the surge in global energy demand.

This is not just about technology, it's about industrial vision and the ability to anticipate what comes next. Making grids more flexible, integrating old and new components, ensuring security and decarbonization: these goals require investment, expertise, and a constant drive for innovation.

This is the approach that guides CESI in pursuit of an energy future that knows no boundaries between sectors — and finds unexpected connections between Earth and space.

From Europe to the Middle East, from the Americas to the space economy, the horizon ahead is that of an interconnected system, in which resilience is no longer just a technical requirement, but a guiding principle for security and development.

This is where CESI chooses to play its part: helping write the new rules of global energy — with its eyes set ten years ahead.

Opinions

# Technology, Energy and Geopolitics: The Challenges of Our Time

**From the UN to Brussels, from tech leaders to academic experts, the debate is converging on a single point: without resilient infrastructure and shared rules, innovation risks turning into a vulnerability.**

The demand for electricity is soaring, driven by artificial intelligence, digitalization, and the cloud, while the ability to manage this technological and energy revolution is impacting industrial competitiveness, democratic balance, and geopolitical security.

In this scenario, various perspectives intersect. Global institutions strongly emphasize the urgency of a sustainable transition, while those highlighting ethical and democratic implications warn of the risks linked to the concentration of technological power. Companies, on the other hand, must demonstrate that AI creates real value for society, while Europe is called upon to translate these challenges into a political vision capable of strengthening autonomy and stability.

It is a mosaic of voices that, when read together, outline a common trajectory: innovation will drive true progress only if accompanied by sustainability, equity, and resilience.

The first to strongly highlight the global dimension of this challenge is António Guterres, Secretary-General of the United Nations.

# António Guterres

## Secretary-General of the United Nations

In July 2025, António Guterres made it clear that the challenge of the transition is not only about decarbonization, but also about the ability to manage the energy demands of emerging technology. "This is our moment of opportunity to meet the world's surging energy demand sustainably," he said, noting how people, cities, and innovations - from artificial intelligence to digital finance - are fueling a growing demand for electricity.

According to the Secretary-General, governments must aim to satisfy new electricity demand with renewable sources. AI, he observed, can enhance the efficiency, resilience, and innovation of energy systems, but at the same time, it is energy-hungry: "A typical AI data center eats up as much electricity as 100,000 homes. The largest ones will soon use twenty times that."

The scenario he outlines is concerning. In fact, by 2030, data centers could consume as much electricity as Japan. "This is not sustainable, unless we make it so. And the technology sector must be at the forefront," he warned, urging major digital players to power their data centers with 100% renewable energy by the end of the decade, as well as to use water sustainably in cooling systems.

"The future is being built in the cloud," Guterres concluded, "it must be powered by the sun, the wind, and the promise of a better world."

But the issue is not only how much energy will be needed, but also who will control this new power. This is where Father Paolo Benanti's analysis introduces a decisive perspective: that of democratic balance.

# Father Paolo Benanti

## Advisor to Pope Francis on Artificial Intelligence and Technology Ethics and the only Italian member of the United Nations AI Advisory Body



For Father Paolo Benanti, artificial intelligence is not just another form of technology. It is a matter of power that impacts geopolitical and democratic balances. “With artificial intelligence, we are changing the power chains of the world,” he observed, noting that the issue is no longer just for engineers but “has reached institutional tables. The essential question is how to domesticate this technology in a social system that so strongly believes in democratic power mediation.”

Father Benanti also warns of the risks of concentrating computational power, which blurs the boundaries between local capabilities and centralized cloud infrastructure. “Now, centralized computational power is absorbing everything we have digitized, and whoever holds that power holds all the power,” he emphasized, inviting us to reflect on what it truly means to democratize access to digital technology.

Education, finally, remains the initial line of defense. “The first true revolution and the first real great cyber defense of this digital space is educational commitment,” he reiterated.

Faced with these risks, European policy is called to respond with a vision that combines innovation and democratic values. And this is at the heart of Ursula von der Leyen’s address.


## Ursula Von Der Leyen

### President of the European Commission



At the AI Action Summit held in Paris in February 2025, Ursula von der Leyen delivered a clear message: Europe must develop an autonomous vision for artificial intelligence, one capable of combining technological progress with democratic values. "The time has come for us to formulate a vision of where we want AI to take us as a society and as humanity, and then we need to act and accelerate Europe in getting there," she stated.

For the Commission President, the goal is to make Europe "one of the leading AI continents," embracing a way of life in which artificial intelligence is omnipresent, but anchored to principles of transparency, fairness, and responsibility.

However, political vision must be supported by credible industrial commitment. This is where Satya Nadella's remarks focus on the responsibility of businesses.

## Satya Nadella

### CEO of Microsoft



For Satya Nadella, the true measure of AI progress is not the speed of models or the most impressive benchmarks, but the tangible impact on people's lives. Speaking at the AI Startup School organized by Y Combinator, the Microsoft CEO emphasized that "the real benchmark for AI progress is whether it truly makes a difference in people's lives, in terms of healthcare, education and productivity."

Nadella also addressed one of the most sensitive issues: the enormous energy requirements of emerging digital technology. "If you're going to use energy, you better have social permission to use it," he said, making it clear that "we just can't consume energy unless we are creating social and economic value."

His message comes at a crucial moment, as companies in the sector are being pushed to justify the environmental and financial impact of their investments.

Industrial responsibility, therefore, but also infrastructure and energy policies capable of supporting it. This is the point addressed by Dan Jørgensen.

# Dan Jørgensen

## European Commissioner for Energy

For Dan Jørgensen, the European energy transition cannot proceed without accelerating investments in renewables and infrastructure. "The EU needs to deploy more renewable energy, which will require extending grids, boosting digitalization and new storage technology, and faster permitting," he stated.

The challenge is not only environmental, but also economic. "If our energy systems are not better connected, then we will not decrease (energy) prices as much as we should," Jørgensen explained, highlighting how grid bottlenecks remain one of the main obstacles to European industrial competitiveness.

At the same time, supply security remains a priority. "The European Union needs stable energy supplies at affordable prices to prosper. Gas storage is a key contributor to our supply security and market stability."

From Guterres' global call to Benanti's ethical reflections, from von der Leyen's European vision to Nadella's sense of responsibility and Jørgensen's pragmatism, a common message emerges: the digital and energy revolution is not a predetermined destiny, but a collective choice.

Only by combining sustainability, democracy, industrial innovation, and forward-looking energy policies will it be possible to transform technological growth into true progress for societies, economies, and institutions.

## News & Events

# Upcoming Energy Events

### Africa Energy Efficiency Policy Training Week 2025

**October 20 – 23, 2025**

Accra, Ghana

*www.ecreee.org*

Since 2015, the IEA's Energy Efficiency Policy Training Weeks have provided over 3000 government officials from more than 125 countries with the tools and knowledge to implement effective energy efficiency policies. The Accra edition offers a unique opportunity for policymakers to learn from global best practices through five parallel courses combining lectures, discussions, and hands-on exercises. The program also includes joint sessions on progress monitoring, communication campaigns, and the social and economic benefits of energy efficiency measures.

### RE-Source 2025

**November 4, 2025**

Amsterdam, Netherlands

*www.resource-platform.eu*

RE-Source returns as Europe's leading event for renewable energy buyers and suppliers, bringing together over 1400 participants, more than 100 speakers, and around 400 scheduled B2B meetings. The 2025 edition aims to support corporate energy buyers in staying on track toward net zero by 2050, despite economic headwinds. The conference provides a high-level networking platform to discuss strategies for sustainable and competitive renewable energy sourcing.

### The Nuclear Modeling 2025 Conference

**November 6 – 7, 2025**

London, United Kingdom

*www.oecd-nea.org*

The eighth edition of the Nuclear Modeling Conference will bring together experts to share best practices in modeling techniques aimed at improving the design and operation of nuclear energy generation, treatment, and storage facilities. The goal is to make project performance more understandable and measurable through rigorous scientific methods, contributing to enhanced plant safety and societal protection.

## Nuclear Data Week

**November 17 – 21, 2025**

Boulogne-Billancourt, France

*www.oecd-nea.org*

Nuclear Data Week brings together NEA Data Bank working groups involved in the Joint Evaluated Fission and Fusion File (JEFF) Project, which aims to produce a unified set of evaluated nuclear data for fission and fusion applications. The JEFF library is a well-established international collaboration project that is updated twice a year — in the spring and fall — to ensure the development and alignment of critical data for the nuclear sector.

## BEHAVE 2025

**December 11 – 12, 2025**

Paris, France

*www.innoverpourlatransitionecologique.fr*

BEHAVE (8th European Conference on Behavior Change and Energy Efficiency) is the flagship event of the European Energy Network, providing a unique forum where policymakers, academics, industry leaders, and professionals share experiences to promote emission reduction solutions. The 2025 edition will focus on the theme "From Energy Efficiency to Sufficiency," highlighting the need for lifestyle changes to ensure a fair transition toward carbon neutrality. The conference will expand its scope to include energy, buildings, transport, food, and digital sectors.

## World Economic Forum Annual Meeting 2026

**January 19 – 23, 2026**

Davos-Klosters, Switzerland

*www.weforum.org*

The World Economic Forum Annual Meeting is the premier global gathering of political, economic, academic, and civil society leaders to address shared challenges through international cooperation. The 2026 edition will focus on geopolitical stability, technological innovation, and sustainable development, with particular attention to the transformation of the energy system.

Key energy topics on the agenda include: the transition to clean energy, strengthening climate neutrality policies, strategies to accelerate decarbonization across industrial sectors, and the role of emerging technologies — from artificial intelligence to hydrogen —to ensure energy security and sustainability.

# Shaping a Better Energy Future

CESI is a multinational Italian group headquartered in Milan. Founded in 1956, it is now one of the world's leading technical consulting and engineering firms specializing in innovation, digitalization, and testing for the electrical sector, as well as in civil and environmental engineering. Through its KEMA Labs business unit, CESI is the world's leading independent provider of Testing, Inspection, and Certification services for the electrical industry. Additionally, through its CESI Space business unit, the Group also develops and manufactures solar cells for space applications.

With nearly 70 years of expertise, CESI operates in more than 70 countries worldwide. CESI collaborates with key global players in the energy sector, including utilities, transmission system operators, distribution system operators, power generation companies, system integrators, financial investors, and manufacturers of electromechanical and electronic components. The company also works with governments and regulatory authorities, maintaining close cooperation with major international financial institutions.

CESI is a fully independent joint-stock company headquartered in Milan, Italy, with operational facilities in Arnhem (Netherlands), Berlin and Mannheim (Germany), Prague (Czech Republic), Dubai (UAE), Knoxville and Chalfont (USA), Rio de Janeiro (Brazil), and Santiago de Chile (Chile).
For more information, visit www.cesi.it

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