Issue 27 / December 2023

Energy Journal

Adapting Energy to Climate Change

A magazine about energy and more by CESI

Energy Journal
CESI's house organ
Editorial coordination
Paolo Chighine / CESI
Marco Vassallo / CESI

Project, design and translations
Cultur-e
www.cultur-e.it

CESI
Shaping a Better Energy Future

via Rubattino, 54
I-20134 Milano – Italia
info@cesi.It
www.cesi.It

Editorial

A New Approach to Improving Network Resilience

Guido Bortoni
Chairman, CESI

Domenico Villani
CEO, CESI

The energy sector continues to be at the center of an unprecedented revolution in our rapidly evolving world. The leading companies in this field are called upon to adapt and modernize their business models, facing extraordinary challenges and ensuring the reliability of increasingly complex systems.

Over the past months, together with the progress of renewables, the focus is on the digital innovation of energy infrastructure and the need to keep electric grids resilient in the face of meteorological phenomena that are increasingly more extreme. So, innovation, investments, and the pivotal role of networks as the most efficient responses to the impact of climate change are the key issues addressed in this new issue of Energy Journal.

In the past recent years, we have witnessed a significant increase in the frequency and intensity of extreme weather events. Those events that were classified as rare events - and as such excluded from project design contingencies by the networks - must now be reintroduced at the design level or retro-fitted into the networks to ensure resilience to these phenomena. This is the number one challenge for electrical networks and shifts the focus towards new technological investments, testing and trials, as well as innovation in regulatory mechanisms for their remuneration. As example, phenomena such as heat waves, which were once circumscribed to specific areas, are now taking place on a much larger scale, and severely impacting the operation of distribution networks. Over the next decade, it is predicted that extreme heat waves will affect Italy every 1-2 years, rather than once every 10, with a marked impact on southern Italy.

Globally, the urgency of these challenges was addressed at the recent COP28, the conference on the climate that took place in Dubai at the beginning of December and brought together over 70,000 delegates from over 190 countries to address global warming and the responsibilities of damage related to climate change. The "Scenario" session in this issue addresses COP28, the comeback of nuclear energy, and a new era of international climate finance.

The European electric grid, which is recognized – until now – as a model of international excellence, will have to face increasingly complex challenges but must adapt. These include requirements related to the energy transition – an increased capacity to integrate renewables and the electrification of consumption – as well as the need to fostering infrastructural resilience to climate change.

The need to adopt a new approach to improve the resilience of critical infrastructure, including electricity distribution networks, emerged at an event organized by AEIT – Milano, a longer than one century lasting electrical association born in 1897 in Milan - and hosted by CESI, in Milan, on safeguarding energy transition systems. Whereas, in the past, resilience concentrated on specific events and geographical areas, and was assessed in terms of costs and benefits, it now requires a more incisive reinforcement of networks, a more extensive and aimed approach to forecast climate scenarios, and greater investments that should be adequately supported by the regulation. Moreover, besides investing significantly to reinforce networks and make them resistant to increasingly frequent extreme weather phenomena, new regulatory guidelines need to be defined as part of a simpler normative framework to allow DSOs (Distribution System Operators) to intensify their drive for resilience.

Investing in smart electric connections, thereby promoting energy efficiency, and reducing dependence on non-energy sources, is fundamental to work towards a sustainable future. Recent studies, such as the Eurelectric "Power System of the Future," highlight that in order to ensure the future reliability of energy grids, it will be essential to adopt proactive strategies. These include upfront investments, long-term network planning, the adoption of innovative energy storage technology, an incessant drive towards digitalization, and more efficient data-sharing. In particular, a study conducted by Eurelectric, in collaboration with EDSO and Monitor Deloitte, emphasized that, by 2030, DSOs will have to face an investment gap estimated at 375 to 425 billion euro to improve their distribution networks.

In this scenario, CESI continues to work on its commitment to promote innovative technology for CO2 emission reduction. As described in the "Top Story," this effort concentrates especially on HVDC (High Voltage Direct Current) infrastructure to deliver clean energy over greater distances. The expansion of HVDC interconnections is fundamental to stabilize the price of energy, mitigate geopolitical risk, and reduce our dependence on fossil fuels. Indeed, at the recent COP28, CESI presented a project on HVDC, a technology widely used to transport power over long distances, as in the case of diversified offshore wind farms.

This is the result of the exquisite work conducted by our Group's KEMA Labs Division which with the renovated labs in Milan, amongst the largest worldwide, is a global leader of HVDC cable testing. CESI's taskforce is capable of guaranteeing the resilience and security of electric infrastructure, in line with the digital evolution of the sector.

Readiness, robustness, resourcefulness, and recovery are the key words for a climate-resilient energy system; one that is better organized to face climate change (readiness), adapt and resist to the slow change of climate models (robustness), continue to operate through shocks caused by extreme weather phenomena (resilience), and restore system capacity following climate phenomena (recovery). This type of solid energy system would avoid climate risks which spread throughout the energy value chain.

Enjoy the reading!

Guido Bortoni
Chairman, CESI

Domenico Villani
CEO, CESI

Issue 27 / December 2023

Contents

Energy Journal can be browsed and downloaded at www.cesi.it

"We need as much as possible renewables, but beyond that, we need other clean-energy technologies ranging from hydrogen to carbon capture to nuclear power."

***Fatih Birol**, executive director of the International Energy Agency*

News

Latest from CESI

COP 28

Event on the energy future of the GCC

On December 9th, CESI led an event focused on the sustainable future of the Gulf Cooperation Council (GCC) in conjunction with COP 28, the 2023 United Nations Conference on Climate Change. This session emphasized the transition from regional to global electricity interconnections and highlighted ongoing initiatives, such as Saudi Arabia's exploration of interconnections with Egypt and Jordan, and in general the investments essential for the transition towards a green energy system. The event provided insights into how the GCC is at the forefront of this evolution of energy sectors, represented a strategic guide for the successful execution of these projects, and underlined their role as catalysts in the global decarbonization movement.

> **Electrical interconnections within the GCC.**

Engineering

ISMES among the top 100 Italian companies

In the esteemed 2023 Report focusing on the Italian engineering, architecture, and construction landscape, compiled by Guamari Srl, ISMES - a company within the CESI Group specializing in civil and infrastructure engineering, secured the 94th position. A recognition that underscores the firm' scommitment to be among the top 100 engineering companies at a national level. With the fundamental support of the Business Development function, ISMES is divided into two Business Units: Engineering and Testing. While the Engineering unit is dedicated to the design, verification and monitoring of civil engineering works (structural civil engineering, dam safety and hydrogeological and structural monitoring), the Testing Unit, has three laboratories located in Guidonia, Latina and Perugia , and handles laboratory and on-site tests for structural elements and building materials.

> **An award for civil and infrastructure engineering.**

Interconnections

CESI on the committee of the Green Energy Corridors Initiative

The Black Sea submarine cable is a strategic project that will contribute to the development of the renewable energy sector, increase transit opportunities and bilateral trade potential between the EU and the South Caucasus region. This project was discussed at the 4th Steering Committee of the Green Energy Corridors Initiative held at the end of November in Budapest with the attendance of the Hungarian, Azerbaijani, Georgian and Romanian ministers. Also present at the meeting were CESI Group representatives and Gianluca Marini, Executive Vice President of the CESI Consulting Division, who presented their point of view on the project to the committee. Marini explained CESI's involvement and the importance of the high-voltage submarine electric cable under the Black Sea (1,195 km long, of which 1,100 kilometers underwater and 95 kilometers on land) that will connect the South Caucasus region with the South Eastern Europe.

“The connection between the Caucasus and south-eastern Europe.”

HVDC connections

The Green Vein: the electricity corridor connecting Egypt and Italy

CESI, K&K, Prysmian Group and Siemens Energy have presented an important electricity corridor project to transport green electricity from Egypt to Italy. After a successful initial study, this project moves to a detailed feasibility phase. With a capacity of 3 GW, the corridor is aims to meet around 5% of Italy's peak electricity demand, supporting Europe's carbon neutrality goals by 2050. The Green Vein will create key energy links between the EU, MENA and Africa, improving regional cooperation and integration between energy systems. The project involves an innovative high voltage direct current (HVDC) submarine cable, approximately 2,800 km long and reaching a depth of up to 3,000 m, connecting Western Sohag in Egypt to the Italian substation of Dolo.

“A submarine cable approximately 2,800 kilometers long.”

For further information on this topic, please contact:

Bruno Cova (Advisory Services & Studies Director)
bruno.cova@cesi.it

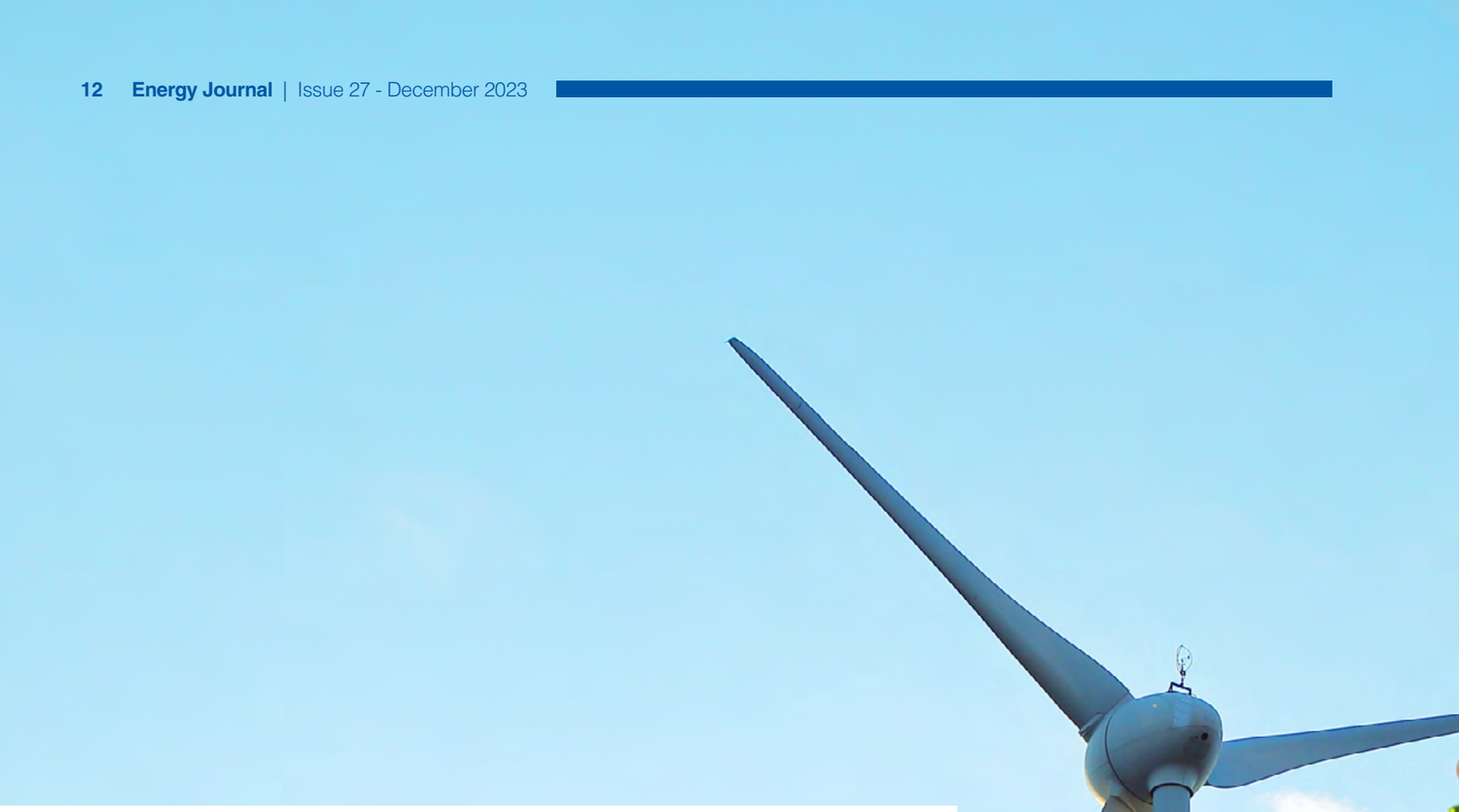
Scenario

COP 28 Calls for «Urgent Financing of Climate Action»

With 70,000 participants from over 190 countries, the event has brought new attention to global warming and the responsibility for damage caused by climate change.

The key points addressed by the two-week COP28 Conference were the commitment to update emission reductions, issues related to the replacement of fossil fuels, and support to developing countries. The most important annual event dedicated to energy witnessed leaders, sector representatives, and climate experts debate key issues at Expo City in Dubai from November 30 to December 12, 2023. However, participants – or better, states – did not arrive in their best attire following the hottest summer ever recorded, a season that confirmed that climate change is no longer a phenomenon to be addressed as a future issue, but one that has become an urgent daily problem. A study published on Nature in September underlines how the consequences of extreme climate phenomena currently cause damage of US$135 billion a year, notwithstanding the fact that environmentalists and scientists are often accused of catastrophism. However, the data presented at the 28th Conference of Parties seems to corroborate the emergency. And this situation is further compounded by the ongoing and, in some cases, rising geopolitical tension. While the world has been addressing energy security problems related to the Russian invasion of Ukraine, the new conflict in the Middle East – the war between Hamas and Israel – is taking us back fifty years to the oil crisis that led to the creation of the International Energy Agency.

"The transition to clean energy is taking place around the world and cannot be stopped. It's not an issue of *if*, but rather a question of *how soon* – and the sooner it is, the better it will be for everyone," remarked IEA Executive Director Fatih Birol at the presentation of the World Energy Outlook 2023. While the crisis of 1973-74 was triggered solely



by oil, current issues depend on various sectors. In addition to fragile oil markets, the world has experienced an acute crisis on natural gas markets caused by cuts to Russian gas supplies, which, in turn, have affected the electricity supply chain. A multifaceted crisis requires similarly omni-comprehensive solutions. In short, it will not only be necessary to diversify individual energy products, but the entire system will have to be transformed, whilst simultaneously ensuring secure energy supplies and accessible prices. Moreover, the growing impact of global warming makes this all the more important as a large part of energy infrastructure is no longer proving reliable or sufficiently resilient as temperatures rise and meteorological events become more extreme. The good news is that the world is facing this emergency with new technology and knowledge. Indeed, the oil crisis of 1973 acted as an important catalyst to change, driving improvements in energy efficiency and the production of energy from alternative sources. And this is why the World Energy Outlook 2023 portrays a context from here to 2030 that calls for optimism.

Driving Renewables

Renewable energy, energetic efficiency, and electrification are completely transforming the energy scenario. Peak fossil fuel emissions should be reached by 2025, after which their dominance for global energy supplies will drop to 73% by 2030, after stably remaining well above 80% for various decades. By the same year, global solar photovoltaic will generate more energy than all that currently produced in the United States. In addition, there will be a tenfold increase in electric vehicles and renewable energy will satisfy 50% of the global energy mix (compared to the present 30%). Heat pumps and other electric heating systems will trump the sale of fossil fuel heaters around the world, while investments in new offshore wind farm projects will be three times greater than in gas and coal thermoelectric plants.

The dominance of fossil fuels may be coming to an end, but this does not mean that investments in them will stop. However, it will undermine the logic behind any further spending in the sector. The IEA has pointed out that, to date, satisfying energy demands implied an increase in oil and gas investments during this decade; however, the increasing demand for clean energy and the falling request for fossil fuels have changed the paradigm. Nonetheless, current investments in oil and gas are nearly double those envisaged by the NZE Scenario to 2030 and this clearly points to the risk of a prolonged use of fossil fuels, a possibility that would completely undermine the objective of limiting global warming to 1.5° C.

A simple cut to oil and gas spending will not put the world on the right path. The key for an orderly transition is to increase investments in all aspects related to a clean energy system. The development of a green energy system and its effect on emissions can be further reinforced by policies that promote a stop to inefficient and polluting assets such

as obsolete coal plants or that limit the adoption of new systems. However, the urgent challenge is to increase the rate at which new clean energy projects are adopted, especially in many emerging and developing economies (with the exception of China) where investments in the energy transition will have to increase fivefold by 2030 to achieve the levels described in the NZE scenario. A renewed commitment, including greater international support, will be fundamental to face obstacles such as the high cost of capital, limited fiscal opportunity for public support, and complicated entrepreneurial contexts.

This approach is exactly the path indicated by the IEA that has identified five priorities to address the crisis and keep the world en route to the climate objectives set for 2030. These include tripling renewable capacity; doubling the rate of energetic efficiency improvement; committing oil and gas companies to work towards the energy transition and reduce the emission produced by their activity, including a 75% reduction in methane emissions; develop large-scale financial mechanisms to support investments in clean energy in emerging and developing economies; and adopt measures to guarantee an orderly reduction in the use of fossil fuels. And, at COP28, the Presidency of the Summit announced the commitment of 116 countries to triple global renewable energy capacity by 2030.

Net Zero: Global Progress and Emerging Alliances

However, this will not be sufficient. As indicated in the new edition of the "Net Zero Roadmap," rich countries must increase decarbonization, bringing the deadline for net zero emissions forward to 2045 from 2050. And China must antedate its deadline from 2060 to 2050. The first edition of the plan, published in 2021, aimed to provide policy makers and enterprises with recommendations on possible strategies addressing climate change to help them achieve the objectives set by the Paris Agreement. The 2023 plan has factored in the changes that have taken place over the past two years: the post-pandemic economic recovery and the development of clean energy technology, but also the increase in investments in fossil fuels and persistently high greenhouse gas emissions. Since 2021, the record growth in the production of solar energy and the sales of electric vehicles have been in line with the goal of eliminating emissions by mid-century. And so have industrial plans for the development of a new productive

capacity based on this technology. Solar and electric vehicles alone guarantee a third of the necessary reduction in emissions. Technological innovation for decarbonization has also made giant bounds ahead in these two years, reports the IEA. In the Roadmap to 2021, nearly one half of the reduction in emissions to achieve net zero by 2050 were based on technology that was still not available on the market. Now, this percentage has dropped to ca. 35%, a clear sign that the technology available to pursue decarbonization continues to develop.

A positive signal comes from Dubai, where enterprises announced the "Utilities for Net Zero Alliance" (UNEZA) with 31 partners, including 25 utilities and electric companies with 250 million clients, that have united their effort to promote electrification, renewable-compliant networks, the diffusion of clean energy, as per the climate objectives set for 2030, and a future of net zero emissions by 2050. Utilities will work to overcome the challenges on the route to net zero described in IRENA's "World Energy Transitions Outlook." The announcement heralds a new framework for global cooperation amongst enterprises involved in the energy system value chain. The main objective is to promote an accelerated adoption of renewables and develop the necessary infrastructure, whilst also providing a platform for joint efforts addressing

bottlenecks in the supply chain, promoting the flow of capital for the transformation of the energy sector in southern regions, and increasing dialogue with policy makers and regulators. UNEZA will develop a plan of action to mitigate the macro challenges of the energy transition, including: the mobilization of capital, the reduction of risk in the supply chain, development of talent, and facilitate political and normative support.

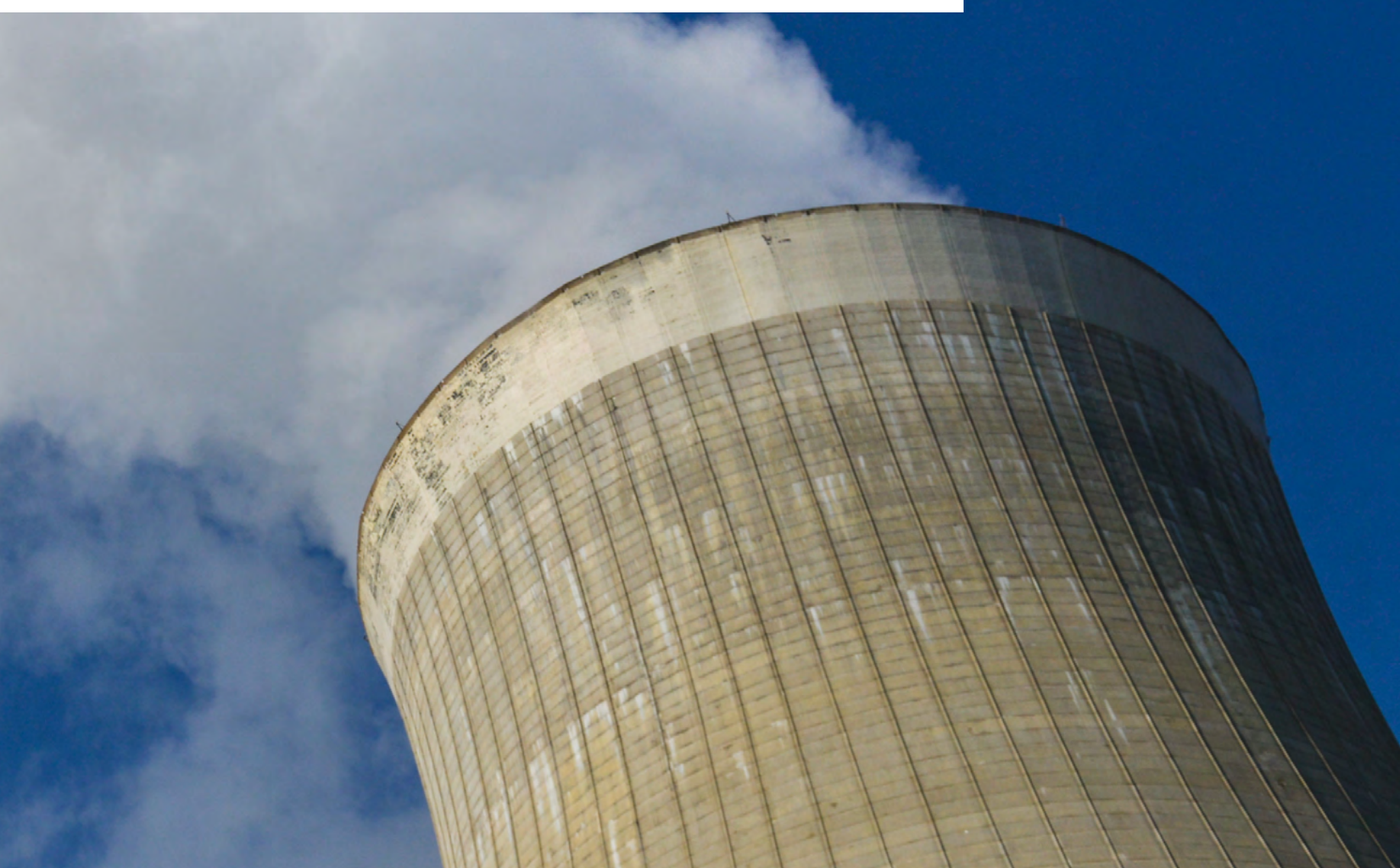
Nuclear Comeback

COP28 also officially marked the return of nuclear energy at the center of the international debate. Nearly twenty countries, including the United States, France, and the United Kingdom, signed an agreement for a threefold increase in the production of atomic energy by 2050. Indeed, "clean" last-generation nuclear energy is considered the most powerful alternative to guarantee truly sustainable development. The announcement was made by United States Special Envoy for Climate, John Kerry, and French President Emmanuel Macron. Belgian Premier Alexander De Croo announced that in March 2024, in collaboration with the International Agency for Atomic Energy (IAEA), Belgium would host the first global summit on nuclear energy. The objective is to reach net zero emissions by mid-century.

Climatic Financial Challenges

The issue of fossil fuels and their reduction or gradual elimination remains the most difficult subject which countries were called to address. The European Union is in favor of their elimination and that COP28 in Dubai must "signal the beginning of the end for fossil fuels," remarked EU Commissioner for Climate Action **Wopke Hoekstra**. However, it's an uphill road, as underlined in a provocatory manner by the Executive Secretary of UNFCCC, the United Nations Agency on Climate Change, who believes that climate action "is travelling on an old carriage on wobbly tracks rather than on a bullet train."

However, this train could speed up decidedly, if correctly fueled; if political action were to run parallel to economic means. "The breadth of the crisis requires urgent and revolutionary solutions in every sector," declared COP28 President, **Sultan al Jaber**. "Finance plays a fundamental role in transforming our ambitions into concrete action." The 2015 Paris Agreement, at Article 2.1, indicates the need to "make financial flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development." Observing the coherence described



in Article 2.1 in terms of actions and commitments would certainly be good news, underlines Action AID which, on this issue, presented a **detailed report** denouncing how European banks continue to finance fossil fuels and industrial agriculture in the global south for over €40 billion a year against the €9.7 billion in climate-related investments, a ratio of one to four.

One of the key issues for less developed countries, that will have to spend more than anyone else to adapt (2.4% of the GDP for Sub-Saharan African countries), is the obstacle represented by public debt in terms of the energy transition and adaptation.

The request to reduce and cancel the climate debt is led by a group called the Vulnerable20 (Ghana, Barbados, Kenya, Colombia, and Senegal) and AILAC, the Independent Association of Latin America and the Caribbean, plus Brazil. At the Dubai Summit, German Development Minister Svenja Schulze and the Special Climate Envoy for Ghana, Nana Addo Dankwa Akufo-Addo, presented a request for a Marshall Plan for debt reduction. Oxfam also requested a new approach. According to the international organization, aid to help poor countries contrast the climate crisis – also areas of armed conflict in some cases – are too often loans that contribute to making indebtment worse. Only subsidies can truly help these countries, according to Oxfam. Based the organization's report, between 2019 and 2020, aid from rich to poor countries totaled, on average, US$13.64 per person. And paradoxically this sum drops to US$6.68 per person if we only consider subsidies to war zones. There are marked inequalities in climate finance levels for states that are considered fragile or involved in a conflict: i.e., Tuvalu receives US$1083 per resident, while Syria only receives US$0.67. And, in any case, this aid is completely insufficient, even considered as a total. More than half of financing for these countries are allocated via loans or other forms of debt. In 2022, 29 countries in these conditions were classified as having a medium-high risk indebtment. Notwithstanding this, Oxfam points out, nearly 10% of climate finance is provided through unsubsidized loans and just over 41% of the total has been allocated as subsidized loans.

Something, however, is beginning to change. During the first week of COP28, commitments were pledged for a total of ca. US$57 billion. The President of the World Bank, Ajay Banga, stated that by 2025 the bank will allocate 45% (rather than 35%) of its annual financing to climate-related projects. This represents over US$40 billion per year, nearly 9 more than the original objective. Moreover, over US$3

billion in new resources have been allocated to the Green Climate Fund; US$2.7 billion to health safety projects; US$2.6 billion to nature-based-solutions for the climate; US$1.2 billion for development, economic recovery, and peace projects; US$2.5 billion for renewable energy; and US$1.2 billion for the reduction of fugitive methane emissions.

An important result was the activation of the Loss and Damage Fund with which rich countries have committed to allocating US$700 million climate-related loss and damage funding to developing countries. The United Arab Emirates launched a US$30 billion fund in partnership with the private sector, aiming to stimulate funds for US$250 billion by 2030. According to some estimates, by 2030, at least US$2400 billion in climate finance will be necessary from the public and private sector for developing countries (excluding China). In addition, there is a vast call for the reform of finance architecture to free up thousands of billions in funds by 2030. Larry Fink, CEO of BlackRock, called on his colleagues to rethink the foundations of finance and channel capital for climate finance where it is most necessary, in the global south. In the name of full disclosure, we must add that Altérra (the name of the UAE fund) is managed in collaboration with BlackRock, as well as Brookfield and TPG as inaugural launch partner, who have allocated US$6.5 billion for global investments in climate-dedicated funds. One of the first investments will address the development of over 6 GW new capacity in India (operative by 2025); 5 GW in onshore wind and photovoltaic energy in Africa, and a rural electrification platform in Latin America that will provide electricity to over one million people in remote rural areas with a potential for growth. The concern is that part of this money will be used to invest in the reduction of Oil & Gas emissions, besides heavily supporting investments in Carbon Capture and Storage (CCS) projects.

Multiplying Climate Investments

COP28 President Al Jaber has called for a new era of international finance, claiming that "Altérra provides a transformational solution for attracting private capital. Its scale and structure will create a multiplier effect in climate-focused investment, making it a vehicle like no other. Its launch reflects the COP Presidency's Action Agenda and the UAE's efforts to make climate finance available, accessible, and affordable."

In short, the importance of climate finance is emerging more clearly as the key to progress in the reduction of climate-altering emissions. The objective is to make no less than US$2.4 billion per year in investments and resources available through 2030 via investments, new debt reduction mechanisms, and taxes to contribute to driving mitigation and adaptation. The new global financial architecture is taking shape more rapidly than the political decarbonization objectives and commitments made by individual countries. And this is evident in the fact that COP28 has made important progress and proposals on the reform of multilateral banks, green finance, debt reform, global taxes, and carbon market.

Top Story

HVDC Cables: KEMA Labs Extend Testing Capacity

The expansion of the CESI Group Division, which operates through ten global independent facilities, allows testing for over 78,000 cumulative hours and certification of nine different connected projects. This is a significant step ahead to guarantee the quality and reliability of HVDC infrastructure.

At the recent COP 28 Conference in Dubai, Europe emerged as a leader in decarbonization, thanks to its aim to achieve a 47% renewables quota in its energy mix by 2050. This objective, which is in line with the Net Zero Carbon Strategy, aims to limit global warming to 1.5° C. Current efforts call for a 20% reduction of CO_2 emissions by 2030, a fundamental step to drive energetic independence and the fight climate change.

In this context, HVDC (High Voltage Direct Current), which transmits clean energy across long distances, is a fundamental technology for the reduction of CO_2 emissions. Indeed, as the expansion of HVDC interconnections is key to stabilizing energy prices, mitigating geopolitical risk, and reducing dependence on fossil fuels, it is essential for transmission operators and their clients to ensure operable and resilient HVDC interconnections.

Extensive system testing is crucial to guarantee high performance, reliability, and efficiency, as well as to significantly reduce the dispersion of electric current in the system, thereby contributing to a marked reduction in emissions. As we will see further ahead, the CESI Group KEMA Labs are at the forefront in this issue. And thanks to its advanced labs in Milan and Mannheim, they are global leaders in HVDC cable testing, a technology that is also perfectly suited to submarine connections.

The Benefits of HVDC Transmission

HVDC transmission provides significant economic, technical, and environmental advantages over HVAC (High Voltage Alternating Current). In the case of large offshore wind farms, which require the transferal of energy across long distances, the energy collected from the AC network is transformed into DC via an AC/DC converter. The direct current is then transmitted to its destination, via cables or overhead power lines, where a DC/AC converter transforms it back into AC for the grid. Comparing lines transmitting the same power, DC provides the cheaper alternative per unit of length and only requires two conductors (phase and neutral) rather than three which are necessary with AC lines. In some cases, the ground can even be used in place of the neutral line, further reducing operational costs.

Moreover, economic advantages are further enhanced by the reduction of dispersion. Again, comparing lines with the same power, long distance energy transmission over HVDC lines leads to a minor dispersion of energy. And this means making renewable energy from distant areas accessible to a larger portion of the population. In fact, this technology has been described as a “true highway for

For further information on this topic, please contact:

Antonio Boccuni (Marketing & Strategic Tools Manager)
antonio.boccuni@kema.com

Stefano Malgarotti (Engineering Consulting Director)
stefano.malgarotti@cesi.it

the transmission of clean energy across frontiers, helping Europe to achieve its ambitious decarbonization objectives."

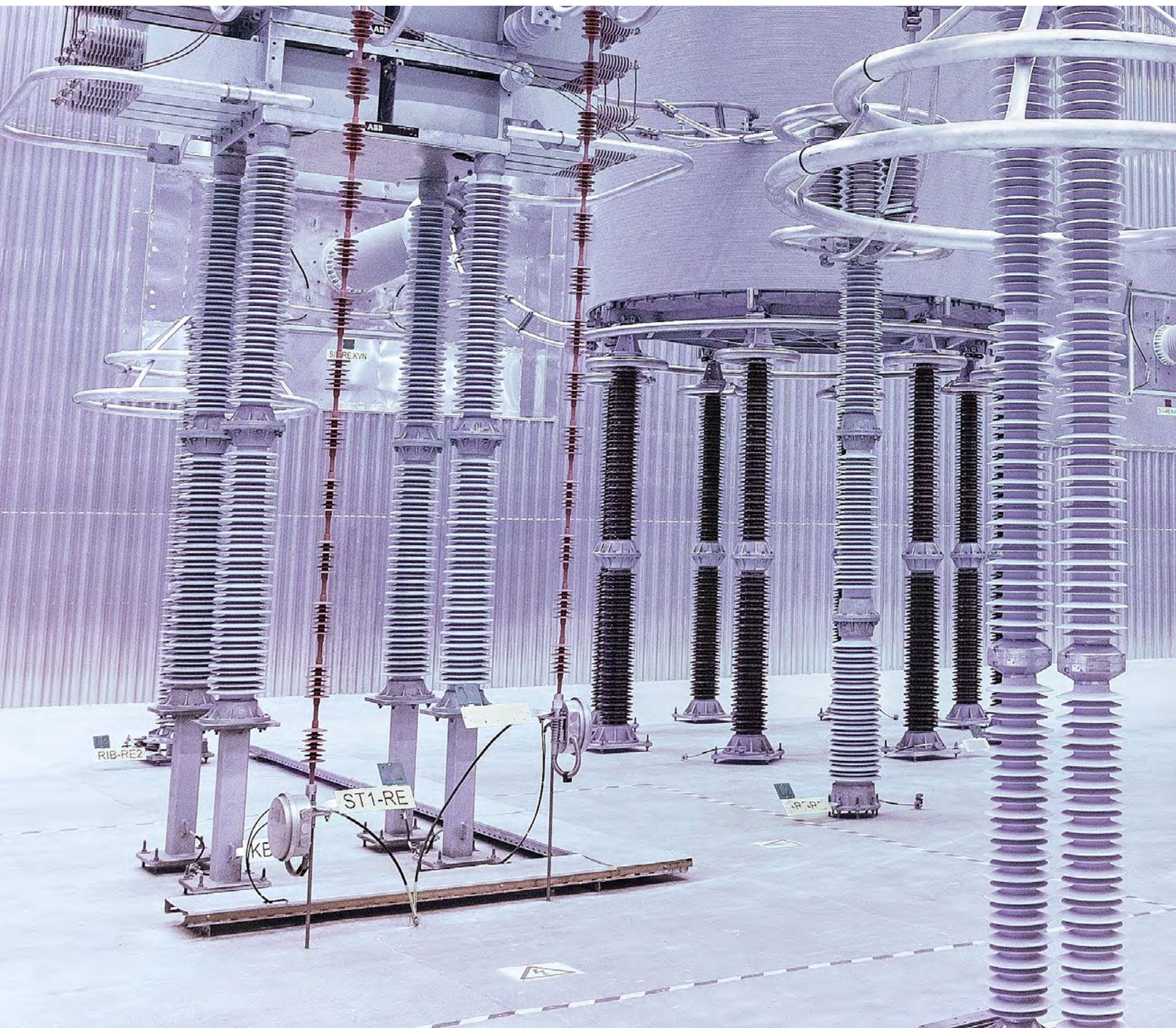
In particular, as emerges from the data presented in the IEA "Electricity Transmission and Distribution" Report, based on cable length and voltage level, HVDC preserves more energy than HVAC (High-Voltage Alternating Current), especially on greater distances. For example, on ±800 kV lines, dispersion is ca. 3% per 1000 kms on HVDC vs. 7% on HVAC. And this efficiency is driving significant market growth. A study conducted in 2023 by Allied Market Research forecasts that the HVDC sector will reach a total value of US$23.7 billion by 2032, increasing by 8.4% between 2023 and 2032.

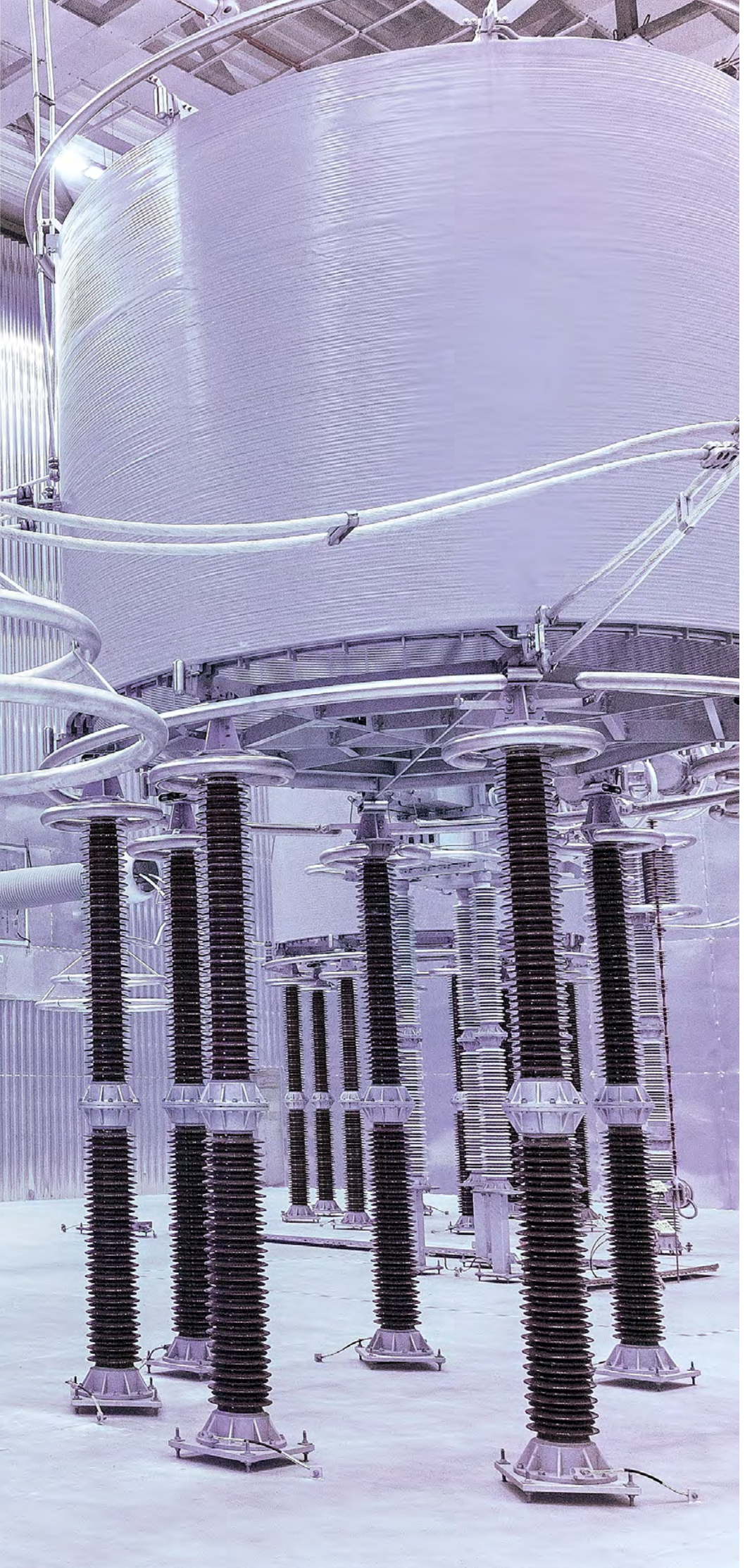
CESI: A Global Leader in HVDC Cable Testing

In a continuously evolving energy panorama, KEMA Labs – the CESI Group Testing, Inspection, and Certification Division – has recently improved its operative capacity to support the progress of HVDC technology, further reinforcing its position as a global leader. With over ten independent testing facilities, KEMA Labs is now the largest global HVDC cable testing lab. Indeed, in recent years, CESI has been involved in over 40 important global HVDC consulting projects for a total of 30,000 kilometers of overhead power lines, 7000 kilometers of submarine cables, and 50 GW installed capacity.

In Milan, the new expansion of KEMA Labs involves the complete renovation of one of its laboratories. The renovation has allowed the creation of three specialized HVDC testing areas with advanced technology including state-of-the-art HVDC current and voltage generators, automized control systems, and last-generation impulse generators to identify malfunctions and verify cable integrity. CESI expects that this lab upgrade will allow testing for a total of over 78,000 hours and the evaluation of up to 9 different cable projects in an area of 3,100 square meters.

Each cable is tested through a rigorous program that meets international standards and has been designed to simulate a forty-year life cycle under extreme conditions.





International Projects with a Global Impact

In the international context of the energy transition and decarbonization, CESI has played a key role in various HVDC projects. The Group's support was fundamental for the "German Corridor" project, an important initiative in the field of HVDC systems. In 2017, KEMA Labs conducted four key pre-qualification (PQ) tests on HVDC cables for the German Corridor, one of the longest and most powerful global networks for DC power transmission. In particular, HVDC cables are used to transfer energy generated from wind farms on the North Sea to consumption centers in southern Germany, thereby highlighting the capacity and efficiency of this technology for the transferal of power over long distances.

More recently, CESI played a fundamental role in supporting ISA Interchile in the development of the HVDC Kimal-Lo Aguirre transmission line in Chile, a fundamental step for the decarbonization strategy of the Latin American country. The project connects Kimal – the site of photovoltaic plants and wind farms in Northern Chile – with Lo Aguirre, near the capital, Santiago. With an extension of 1500 kms and a capacity of 3000 MW at ± 600 kV, the Kimal-Lo Aguirre line is the largest transmission project developed in Chile, and a crucial step towards carbon neutrality. CESI's contribution to the project includes the initial design for the conversion stations, budget estimate and reviews, and the evaluation and selection of the station developers. This project is also particularly significant for President Sebastián Piñera's ambitious climatic objectives, which aim to provide 70% of the national electricity requirements from renewables by 2030 and reach net zero carbon emissions by 2050.

Previously, CESI obtained a major contract with the Saudi Electricity Company (SEC), the main Middle Eastern and North African utility, to develop an advanced HVDC electric interconnection system between Riyadh and Mecca. This network, which extends over 800 kilometers, will provide power to the central and western regions of Saudi Arabia, connecting the stations in Dharma and Bahrah. This new HVDC interconnection will not only reinforce the existing grid, increasing the local distribution capacity by over 3000 MW, but will also provide a reliable energy reserve, reducing the risk of blackouts and improving energy security in emergency situations.

Industries & Countries

Innovation and Investment: The Central Role of Networks in the Energy Transition

Global investments in energy transition technology reached US$1.3 billion in 2022, a new historical record. However, resources are concentrated on a just a few forms of technology and a limited number of countries. Global investments for the modernization of electric networks and their operativity should increase from the current US$274 to US$605 billion by 2030.

As the key nodes driving a new era of renewable energy, electric grids – the backbone of the electric systems that for over a century have provided energy to homes, factories, offices, and hospitals – represent the mainstay of progress for modern society. The transition towards clean energy is guiding the transformation of our energy systems and extending the role played by electricity in all economies. Consequently, the transition of countries towards net zero emissions must be bolstered by larger, better organized, and more intelligent networks. New generation electric grids will have to not only respect the parameters of energetic security, but also be capable of meeting the increasing demand for energy that is being further compounded by climate change.

This expansion presents both challenges and opportunities as growth must be balanced with the need to protect grids against blackouts and security threats. Progress towards larger and more intelligent networks is based on digital innovation, which is necessary to optimize network management and simplify its integration with distributed energy resources.

The **International Energy Agency**, which for the first time has dedicated a report to this issue, emphasizes that without greater political attention and investments, infrastructural limitations could hamper the objective of limiting global warming to 1.5° C, as well as compromise energy security. "Efforts to contain climate change and ensure reliable electricity supplies could be

For further information on this topic, please contact:
Massimo Salvetti (Grid Modernization & Innovation Director)
massimo.salvetti@cesi.it

compromised unless policy makers and companies act timely to improve and expand global electric networks," the IEA admonishes in its **Electricity Grids and Secure Energy Transition Report**. According to the IEA, we are facing asymmetrical growth. Our grids are not developing at the same pace as the main forms of clean energy technology. And issues are already emerging. The report identifies a long and growing queue of renewable energy projects that await connection to the grid. These are projects in an advanced state of progress for the production of 1500 GW of energy (five times the solar photovoltaic and wind energy capacity that was added globally last year). The IEA has estimated that grids will require €400 billion in investments from here to 2030 – 8% of which (€32 billion) need to be allocated to improve resilience. These investments, the agency emphasizes, require steadfast political action.

In this context, at the end of November, the Italian Council of Ministers approved a legislative decree introducing urgent measures for national energy security, the promotion of renewables, and support to energy-intensive companies. The bill also includes a specific section on normative simplification for the development of intelligent networks and their resilience. This process will see Terna – the main independent electricity transmission system operator in Europe – develop a digital portal with data and information on electric grid development operations, connection requests, and the state of advancement of all procedures. In order to simplify the digitalization of networks established by the PNRR through the "Smart Grid" and "Electric Networks Resilience" measures, various regulatory simplifications and shorter application times will be necessary.

As explained by Luca Marchisio, Terna Head of System Strategy, "the three enabling factors for Italy's energy transition, promoted by Terna, are the development of efficient and innovative electric infrastructure, an increased installed capacity of renewable energy, and an increase in storage systems." Consequently, Terna's new ten-year development plan calls for investments totaling more than €21 billion to increase the reliability and efficiency of the Italian high- and extra-high voltage grid. "A grid," Marchisio adds, "which in the coming years will have to intake the growing quota of energy produced by renewables. And storage systems are no less important. They will allow the transferal of a part of the energy produced by non-programmable renewables from high availability slots to times at which there is little or no energy available, thereby allowing the management of excess energy generation."

For a total of €35.8 billion earmarked for the 2024-26 strategy, Enel is allocating €18.6 billion (more than half) to reinforcing and modernizing the Italian grid. The decision was

made to support the growth of renewables and better counter the impact of extreme weather events via a well-balanced and stable regulatory framework. As explained at the end of November at the Capital Markets Day by CEO Flavio Cattaneo, "Enel is ready to face challenges and grasp any opportunities that will arrive in the future." Over the next two years, group activities will concentrate on core business countries: Italy, Spain, USA, Brazil, Chile, and Colombia.

Progressive Electrification

In order to achieve energy and climate objectives, global electricity consumption must increase 20% more rapidly over the next decade than in the previous. And the demand for electricity will have to grow even more sharply at a global level to achieve net zero emissions by 2050 and limit global warming to 1.5° C.

In this scenario, the extension of networks is fundamental to accompany this growth. According to IEA estimates reviewing all the countries involved in this process, 80 million kilometers of power lines will have to be improved or replaced by 2040 – a quantity equivalent to the entire current global network. In addition to this mastodontic infrastructural operation, significant changes to the way in which networks operate and are regulated will be essential, too. Similarly, annual network investments, which have remained substantially stagnant, will have to double to over US$600 billion per year by 2030.

Networks that have not been enhanced – extended and reinforced, digitalized, modernized, and made more efficient

– pose electric security risks, as well as limiting and increasing the cost of a clean transition. And this is not just a problem for the future, it's an issue that has already emerged in situations where network development schedules have delayed the necessary updates. In these cases, network connection acts as a bottleneck to the diffusion of renewable energy in many places.

A new scenario developed for the report – the **Grid Delay Case** – analyzes what would happen if network investments were not rapidly increased and regulatory reforms were too slow. In this scenario, the cumulative global emissions of carbon dioxide between 2030 and 2050 would total nearly an extra 60 billion tones, the equivalent of the total CO_2 emissions of the global energy sector over the past four years. This would drive the global increase in temperature above the 1,5° C objective of the Paris Agreement, with a 40% probability of reaching 2° C. Thus, considering the time required to modernize and extend networks, decisive action is necessary.

In parallel, the report also identifies various strategic actions that can make a difference. These include the expansion and reinforcement of network interconnections within countries (but also amongst countries and regions) to make electric systems more resilient and allow them to integrate the growing quotas of solar and wind energy more easily. The report recommends that governments support large-scale transmission projects to guarantee that grids will be ready for a further marked increase in renewable energy. It urges developers and network operators to embrace digitalization to allow future networks to be more resilient and flexible.

A Resilient System

Energy systems that are resilient to climate change may well have more benefits than costs. According to the Climate Resilience for Energy Security Report, the net benefits deriving from investments in resilience to flooding in the African and Asian energy sector – used as an example after the devastating damage provoked by extreme weather events in recent months – could total nearly US$1000 billion by 2050, even in a low-emissions scenario.

It's highly probable that the impact of climate change on energy will increase in the coming decades. Higher temperatures will lead to more frequent heat waves and a faster melting of ice masses, a more marked variation in precipitation (with a greater probability of floods and droughts), and more intense tropical cyclones.

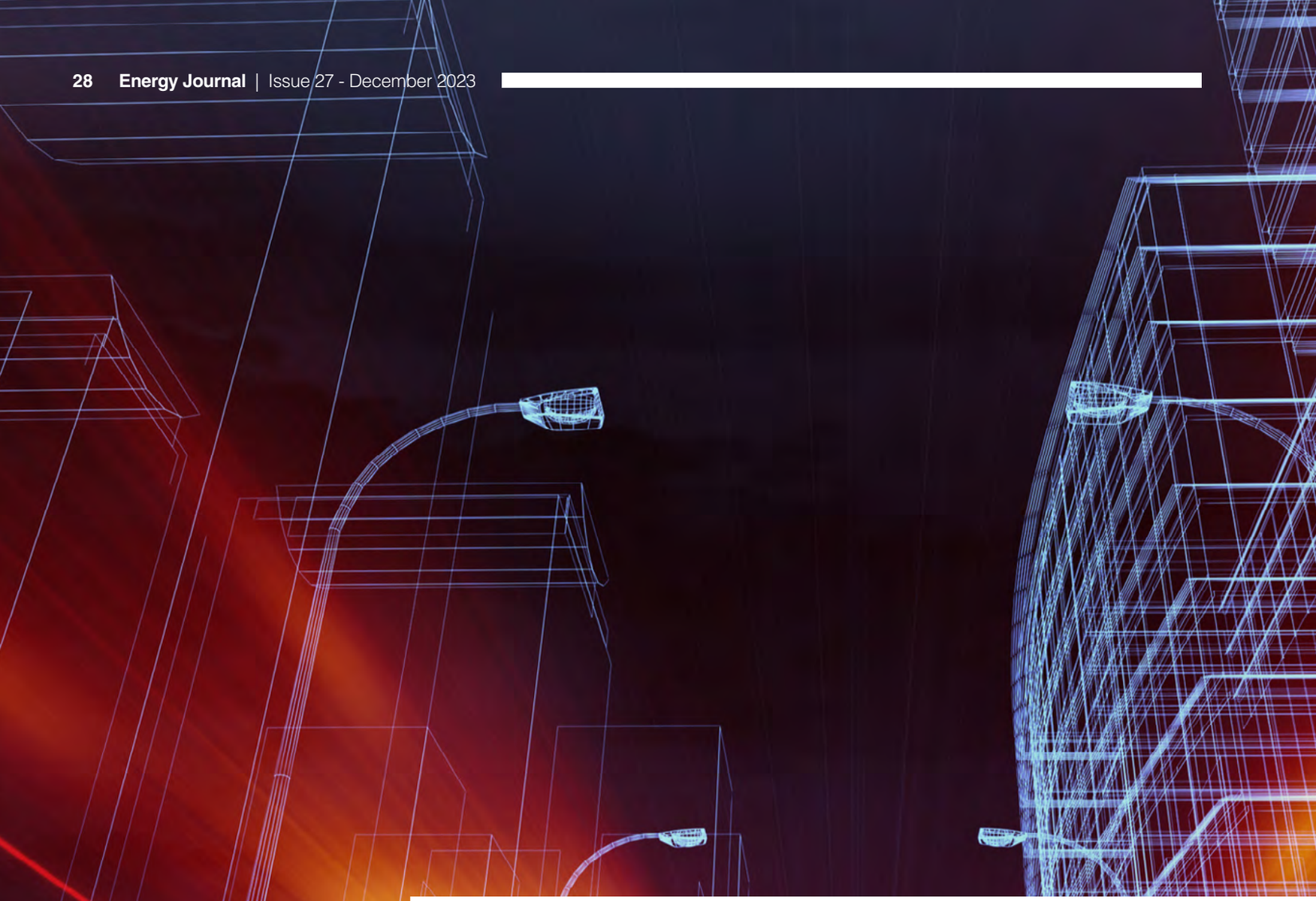
Electric networks are highly vulnerable to climatic impact. Globally, ca. half of all electric grids are exposed to fires for more than 50 days a year. A further 18% is considered at high risk as it is exposed over 200 days a year. Moreover, electric networks also have to withstand the impact of tropical cyclones and increasingly violent storms, as strong winds damage transmission and distribution lines, pylons, and transformers. Over 10% of networks is currently exposed to tropical cyclones, especially in North America, Australia, and Eastern Asia.

Rising temperatures increase the global electricity demand for air-conditioning and can stress the grid during peak hours; however, milder temperatures in the winter reduce the energy demand for heating. Globally, these changes could lead to a 7-17% increase in energy consumption by 2050, depending on the general rise in temperature. In conjunction with economic growth, this could drive the demand for electricity, especially in emerging and developing economies. Higher temperatures also impair transmission capacity and lead to greater dispersion. Even a 2° C increase in temperature could cause 28% of electric grids to operate at temperatures exceeding 35 degrees for 60 extra days (as compared to 1850-1900).

Readiness, robustness, resourcefulness, and recovery are the key words for a climate-resilient energy system, one that is better organized to face climate change (readiness), adapt and resist to the slow change of climate models (robustness), continue to operate through shocks caused by extreme weather phenomena (resourcefulness), and restore system capacity following climate phenomena (recovery). This type of solid energy system would prevent climate risks spreading throughout the energy value chain.

And this is why, in order to achieve these benefits, all interested parties have to cooperate.

Energy suppliers, including producers and distribution and transmission system operators, play a key role in improving resilience in all four of these areas. Energy authorities, which include governments and regulators, have to provide information and data



to consumers, conducting risk assessments and establishing market policies and contexts to catalyze climate-resilience activity.

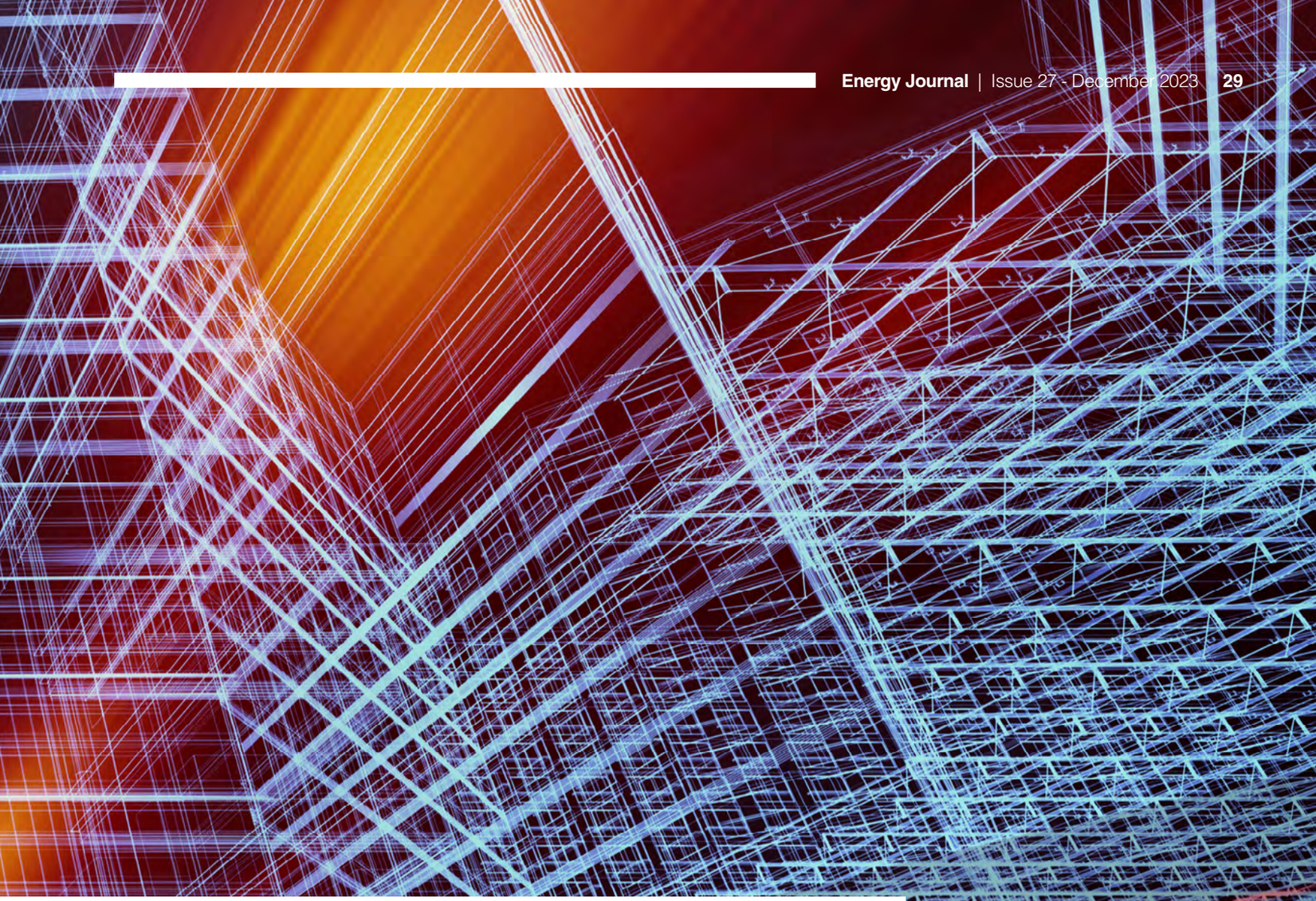
All parties involved in the energy market have a primary responsibility and interest in protecting their goods and providing reliable energy services to their clients. They can improve resilience to climate change by conducting climate risk and impact assessments, reinforcing the physical system, shifting to an efficient production process in terms of water and heat resilience, diversifying the energy supply chain, and introducing better climate monitoring systems for timely alerts and emergency response.

Energy consumers can contribute to climatic resilience by adopting measures affecting demand in the main end use sectors (buildings, industry, and transport) to improve flexibility and lead to a better management of grid load peaks. Demand-side measures that have already proved efficient include climate-proof projects, energy reduction options, increased energy efficiency, new technology, nature-based solutions, and climate-resilient materials.

Energy authorities (governments and national and subnational regulatory agencies) will also play a fundamental role in developing climate resilience for the energy sector by establishing enabling policies and market contexts. Moreover, energy authorities can simplify the actions of energy suppliers and consumers by addressing the obstacles that restrain climate resilience actions. Impediments include high initial costs as opposed to long-term benefits, a non-uniform distribution of costs and benefits, and limited knowledge and understanding of climate impact and risk.

Energy authorities can catalyze the actions of energy suppliers and consumers by improving their understanding of climate risks and impact; devising adequate policy frameworks; integrating climate resilience into legislation, standards, and pertinent guidelines; mobilizing financing and investments; supporting adequate mechanisms for risk-sharing to counter the potential costs deriving from climatic impact; and guaranteeing an efficient and well-coordinated response system to catastrophes.

As already emphasized in the World Energy Outlook 2023, diversification and innovation are the best strategies to manage supply chain needs. If, on the one hand, a series of strategies to reinforce resilience has already been fielded, on the other, there is an understanding



that it will take time to reap the benefits of these processes.

New Investments

As certified by **Global Landscape of Renewable Energy Finance 2023**, the document prepared by IRENA and the Climate Policy Initiative, global investment in energy transition technology reached US$1.3 trillion in 2022, a new historical record. Investments, however, are concentrated on a just a few forms of technology and a limited number of countries. For example, 85% of global investments in renewable energy have benefitted less than 50% of the world's population, with sub-Saharan Africa receiving less than 1% over the last two years. And while we have recently witnessed a remarkable increase in investments in clean energy, it is also true that in order to achieve the announced climate-related commitments, overall spending for energy generation, networks, and storage will need to increase by a further 30% by 2030.

In particular, investments to modernize electric networks and improve operativity would have to increase from the current US$274 to US$605 billion by 2030. As the IEA underlined in the **Electricity Grids and Secure Energy Transitions** Report, the acceleration of the diffusion of renewable energy requires the modernization of distribution networks and the creation of new transmission corridors to connect renewable resources – such as solar photovoltaic plants in deserts and offshore wind farms – that are distant from high consumption centers such as cities and industrial areas. The addition of more widely distributed energy production sources will also add resilience, especially against the increasing extreme weather phenomena driven by climate change.

According to **World Energy Investment 2023**, advanced economies, as well as China, continue to lead investments in networks and account for 80% of global spending. Investments in electric networks are increasing at a stable rate in advanced economies with capital expenditure increasing by 6% in 2022. China leads investments with an added 16%. There clearly is a growing attention to the distribution segment that now accounts for over 75% of total digital expenditure. Moreover, there has been a substantial resumption of investments in EV charging infrastructure, which doubled in 2022 compared to the previous year. The energy system is undergoing a

significant transformation towards a more flexible system capable of meeting demand and price volatility. In 2022, spending on battery storage exceeded US$20 billion with the United States, China, and Europe accounting for 90% of the total.

The United States

The United States is investing record amounts on the electric grid. In 2022, they invested ca. US$90 billion, a 7% increase over 2021. The efforts of the Biden administration have concentrated on improving reliability and updating the obsolete infrastructure. In November, the U.S. Department for Energy allocated US$3.5 billion to subsidize the expansion of its wind and solar energy capacity, reinforce its power lines against extreme weather phenomena, integrate batteries and EVs, and develop micro-grids capable of supplying power during blackouts. The announcement will allow the implementation of 58 projects in 44 states that are eligible for funding. In conjunction with state and local funds, as well as funding by public service and industry partners, this represents investments for over US$8 billion.

According to United States Secretary of Energy **Jennifer Granholm**, this is "the largest amount ever invested in the United States for grid infrastructure." The first important round of financing for the Resilient Nation Partnership Network totals US$3.5 on a total budget of US$10.5 billion to expand transmission lines, improve network resilience, and implement smart-grid technology. This is a marked step ahead of the last great investment in network infrastructure operated by the Obama administration: US$3.4 billion in 2009.

Naturally, the need for investments has grown significantly since then. Climate change is intensifying the heat waves, winter storms, droughts, and floods that have led to increasingly serious blackouts, including the lethal interruptions that affected the Texas

grid in 2021 and a Louisiana-wide blackout following Hurricane Ida in September 2021. Transmission networks are not expanding rapidly enough to satisfy the growing demand for electric energy. Therefore, investments in grid expansion will allow an extra 35 GW of renewable energy to be integrated by the end of this decade, allowing a 10% increase in the capacity of the national grid.

Moreover, funding will help develop over 400 micro-grids, on-site combinations of energy generation, batteries, and control systems to supply critical structures such as hospitals, emergency centers, and shelters in New York, Michigan, Louisiana, Tennessee, and other states.

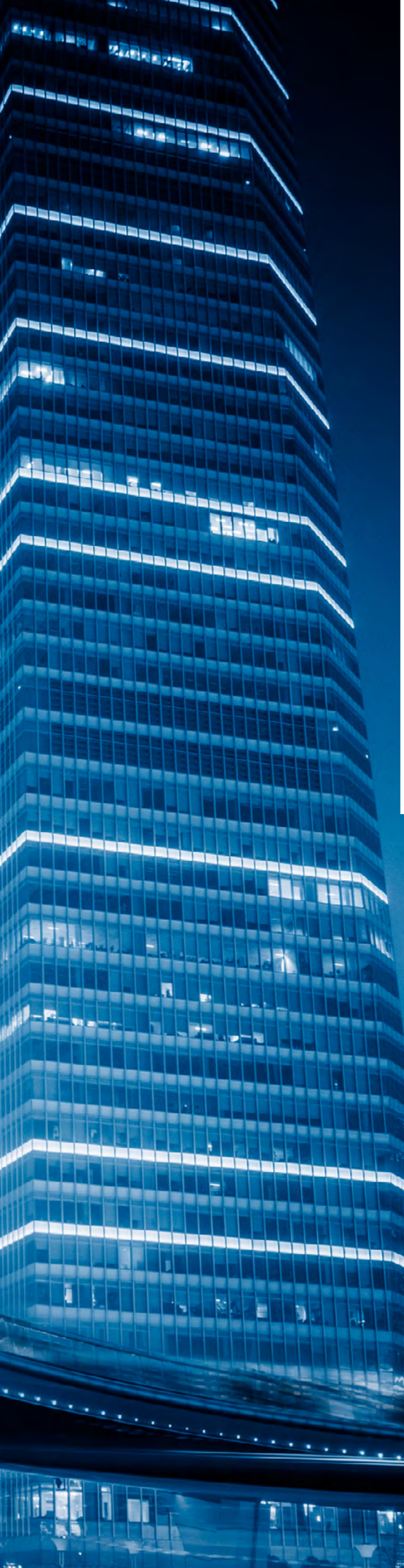
The **Grid Resilience and Innovation Partnerships** will finance projects to improve the quality of life in often overlooked contexts such as rural, native, and low-income communities thanks to the Biden's administration Justice40 Initiative which calls for 40% of all federal climate-related funding to be allocated to underprivileged communities.

The European Union

In 2021, the Connecting the Dots di Eurelectric study had already estimated that over 2020-30 €33 billion would be required to support electric distribution network resilience to extreme weather events

caused by climate change. More recently, in September 2023, the Eurelectric **Power System of the Future** has certified that, by 2030, Europe will boast 50-60 million heat pumps, 65-70 million EVs, and over 600 GW of added renewable capacity, as called for by the REPowerEU Plan. Ca. 70% of this capacity will be directly connected to distribution networks, the power lines that cross cities and towns and connect to wind farms and solar plants. Although they are key to continental decarbonization, European distribution networks are riddled by scarce capacity, complex authorization procedures, and insufficient investments. "Adapting our grids to the net zero emissions objective must be an absolute priority in the coming years, both at the EU and national level," stated Eurelectric Secretary General **Kristian Ruby**. "This calls for a new mentality by regulators and legislators, a plan that can pre-empt Europe's ability to integrate more renewables projects and drive an unprecedented electrification of transport, buildings, and industry to achieve the pace and capacity required for the European energy transition."

Low capacity means longer waiting times for grid connection, more congested areas, and higher costs for users. In order to avoid this, Eurelectric recommends that Europe reinforce and expand its network infrastructure to add capacity by exploiting the existing grid to its maximum extent. Planning grid extension is fundamental to satisfy the EU's electrification requirements through 2030 and guarantee reliable electricity along thousands of kilometers of powerlines throughout Europe.



The best way to manage such an urgent need is to plan and invest ahead of time.

Upfront investments must be structurally incorporated into the electric market assets reform to bridge the €7-billion annual EU gap in electric infrastructure. As revealed by Eurelectric's **Decarbonization Speedways** study, the EU is currently investing €23 billion per year in network infrastructure, far too little. Investments in distribution networks should reach no less than €38 billion per year through 2030 and then up to €65 billion through 2050, considering the forecast added demand necessary to achieve the EU decarbonization agenda.

The NextGenerationEU Program has allocated 30% of its €2018-billion budget to fighting climate change. Indeed, the European Union and its member states apportion the highest amount of public funds to address the climate issue, globally. In 2022, they set aside €28.5 billion from public funds and mobilized a further €11.9 billion from private resources to help developing countries mitigate and adapt to the consequences of climate change. Over half of these public funds is employed for climate adaptation and related operations. At COP28, the President of the European Commission promised to invest €2.3 billion of the EU budget, over the next two years, to promote the energy transition in neighboring countries and around the world.

China

Total investments in the energy sector in China and other advanced economies should respectively increase by 5% and 10% a year between 2024 and 2030. Maintaining such high growth rates for an entire decade will not be easy. It will require supply chains to be extended, authorizations guaranteed, flexibility requisites managed, and funding mobilized. If China were to maintain the overall growth rate it has achieved since 2019, this would allow them to meet the investment levels required by 2030 for the Net Zero Emissions Scenario.

Investments in China continue to grow, especially in terms of extra-high voltage transmission, with projects totaling over US$22 billion between the second half of 2022 and the beginning of 2023. China has also proved its commitment to battery storage with significant investments, including the construction of the largest global battery

storage power station. Moreover, Beijing has recently developed its first market for peak-shaving capacity, which sets price limits to transactions and compensation for demand. In total, spending for battery storage in China tripled in 2022 reaching nearly US$8 billion. Forecasts are that, in 2023, this sum will increase to US$14 billion thanks to the favorable economy for industrial-scale battery storage and strong political support.

Global Scenario

Investment trends in the energy sector for most developing countries and emerging economies are markedly distant from any scenario that might prove satisfactory to sustainable development goals. Indeed, investments in developing countries have decreased over the last five years, dropping to an annual average of 7% and concentrating on access to electricity and greater demand. Consequently, even network investments have decreased. The average annual expenditure for 2019-22

was a third less than over 2015-18.

Even private investments in transmission and distribution have remained low, except for specific areas such as Latin America, where private financing is becoming more important. Investments in Africa remain low overall notwithstanding its enormous need for power. However, 2022 was an interesting year for the African continent and network investments increased significantly. In South Africa, investments rose by a third reaching US$290 million; however, this still falls short of the investments recommended by the national investment plan. The national regulatory authority has recently approved an 18% increase in tariffs that should improve Eskom's budget and provide financial support to the energy system.

In India, investments increased in 2022, especially in terms of network expansion, improved efficiency, and the integration of renewables. Moreover, Phase II of the Green Energy Corridor was approved, which will allocate more than US$1.4 billion over the next four years to increase capacity (lines and substations), interregional transmission, and nearby commercial connections. Spending in 2022 was ca. one third less than the average over 2015-18. Pacific Asia invested 27% more than last year, reaching a total of over US$1 billion in 2022, and is aiming to triple investments this year.

Obstacles

The main obstacles to grid development differ. Countries such as India and the Southeast Asian regions have made giant improvements in connecting people to the grid. In these areas, a significant percentage of investments in energy infrastructure depend on public funding that is often managed by state companies. There are some exceptions, such as Brazil, where the private sector is far more involved in public-private partnership programs and concession policies. In Africa, notwithstanding efforts to improve access to electricity, factors such as insufficient financial resources, normative barriers, and, in some countries, political instability, have proved to be the greatest obstacles to investments in electric networks.

Currently, notwithstanding their vast potential, many developing countries are behind in terms of the implementation of renewable energy systems and relative investments. For example, Africa has only received US$60 billion or 2% of the global cumulative investment totaling US$2841 in renewable energy over 2000-2020. Access to funding and the high cost of capital are the main barriers in many emerging markets and developing economies, especially in sub-Saharan Africa. In Europe, the United States, Chile, and Japan, the foremost obstacle is public acceptance of new projects and the need for normative reform. In this case, policy makers need to accelerate network progress by improving planning, guaranteeing that the assessment of normative risks allow upfront investments, and simplifying administrative processes.

Future & Technology

New Horizons: The Challenge of Advanced Technology to Climate Change

"Governments and enterprises must work together to guarantee that electric networks are ready for the new emerging global economy," declared IEA Director Fatih Birol. And while the EU is reviewing its plans to improve geopolitical resilience, a new electric corridor will transport green energy from Egypt to Italy.

In the 21st century, it has become clear that electric grids must not only be reliable but also resilient to natural disasters, mainly caused by climate change, and cybercrime. These increasingly frequent extreme events often damage electric networks and lead to blackouts. So, grids must be not only reliable but also resilient.

When we speak about grid reliability, we are referring to their ability to uninterruptedly satisfy consumer energy demand, both in terms of quantity and quality. This aspect is measured by IEEE 1366 standards, which assess a network's capability of providing energy with minimal interruptions. A grid is considered reliable if it provides power constantly and without interruptions. In other words, grid resilience is the capability to quickly recover service following an interruption. Resilience is different from reliability, especially in contexts in which climate change and cyberattacks increase the frequency and gravity of interruptions.

For further information on this topic, please contact:

Giampiero Montagna (Head of Digital Lab at CESI)
giampiero.montagna@kema.com

Eighty Million Kilometers of Networks

In October 2023, in a global study entitled "Electricity Grids and Secure Energy Transitions," the IEA indicated that we would have to add or substitute 80 million kilometers of networks by 2040 – a quantity equivalent to the entirety of existing global networks. This would need to happen in order to achieve national climate objectives and promote energy security. Moreover, significant changes should be made to the way the networks operate and are regulated. Additionally, though annual investments are virtually stagnant now, the study indicates that they will double to over US$60 billion by 2030.

Indeed, several issues are already emerging. The report identifies a long and growing queue of renewable energy projects that await authorization to connect to the grid. This includes projects for 1500 GW that are in an advanced state of progress and will provide five times the solar photovoltaic and wind energy capacity that was added globally last year. "The recent progress that we have witnessed in various countries in the field of clean energy is unprecedented," explains IEA Executive Director Fatih Birol. "It's a reason to be optimistic. However, progress could be jeopardized if governments and enterprises do not work together to guarantee that grids will be ready for the new global economy. This report reveals what's at stake and what needs to be done. We must invest in networks, today, or face a stall tomorrow."

In the meantime, many countries are rapidly adding new renewable energy projects to meet the increased demand for powerlines to be connected to electric systems and distribution networks and guarantee reliable supplies to end users. This includes the digitalization of distribution networks and a greater flexi-

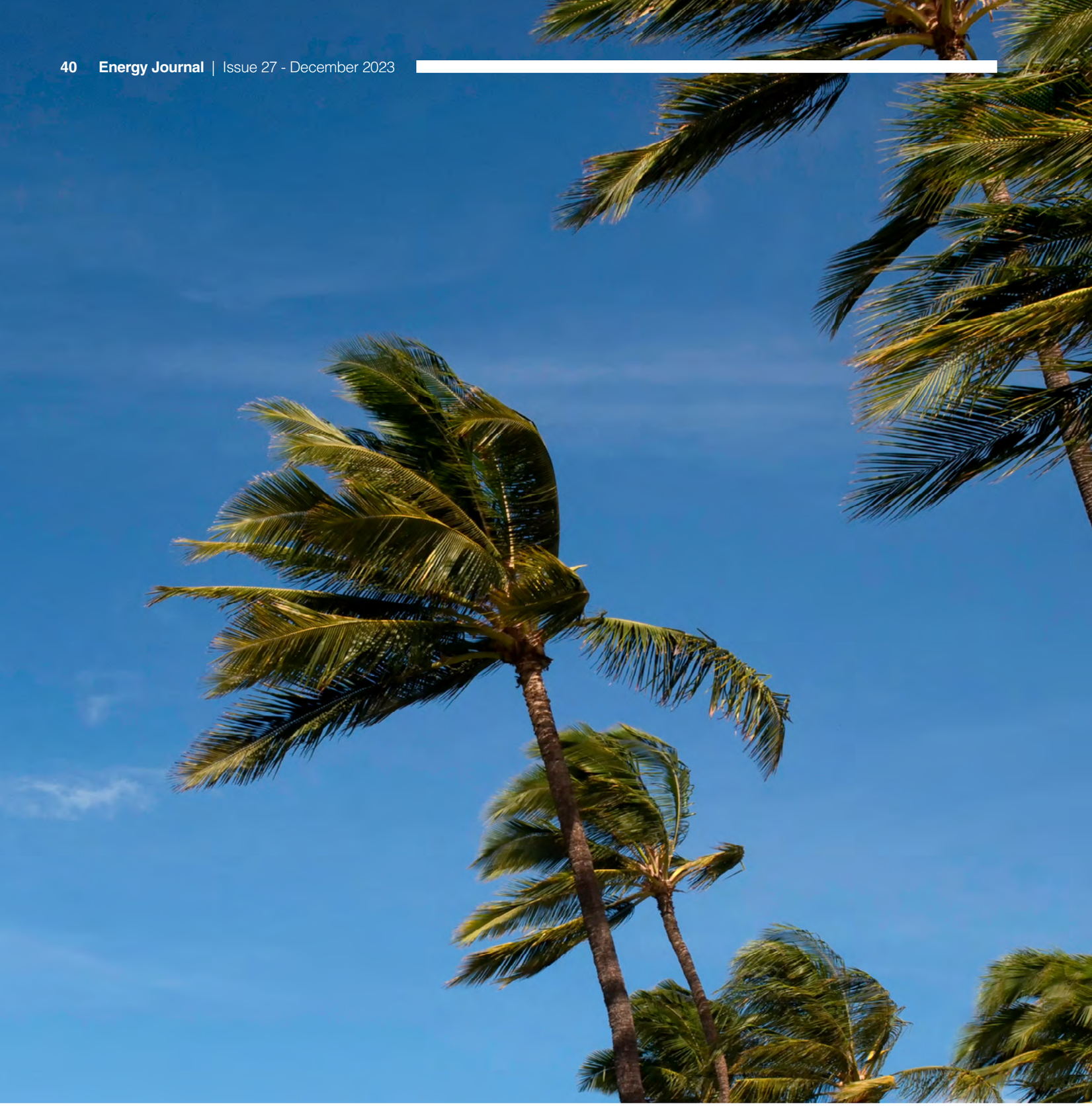
bility thanks to Demand Response (readiness to reduce or increase consumption based on peak demand and supply of the electric market) and energy storage. The report identifies various strategic actions that can make a difference. This includes expanding and reinforcing network interconnections within countries and amongst countries and regions to make electric systems more resilient and allow them to better integrate the growing quantities of solar and wind energy. Moreover, the report recommends that governments support large-scale transmission projects to prepare networks for the upcoming increase in renewable energy. It calls on developers and operators to embrace digitalization to allow future networks to be more resilient and flexible.

Recent studies indicate that investments in electric systems that are resilient to climate change are also economically advantageous. Savings are estimated at six dollars for every dollar invested. And the World Bank has warned that delaying this action by ten years could nearly double its cost. In terms of technology, the studies refer to submarine transmission and distribution cables that, although they require greater initial investments than overhead lines, are far less subject to climate risk caused by strong wind, fires, floods, and landslides. Consider, for example, the case of the Gudrun Storm in Sweden that caused prolonged blackouts. Damage persisted for up to 20 days in rural areas where the overhead lines were damaged, while underground infrastructure in urban areas was restored within hours. The prolonged blackouts caused substantial economic damage to the Swedish network operators (€250 million), while socio-economic loss totaled ca. €3 billion.

Eurelectric Study on Resilience to Extreme Events

Kristian Ruby, the Secretary General of Eurelectric, also explained how adaptation to climate change and extreme weather phenomena have become a major challenge for electric companies. “Resilience is increasingly a key component of investment strategy in public utilities and requires that everyone act together: utilities, policy makers, and other sectors threatened by extreme weather events, such as telecommunications.”

While storms, thunderstorms, and cyclones, which can cause trees to collapse on overhead powerlines, pose a serious



threat, floods are more likely to compromise secondary substations, transformers, and underground cabling, besides weakening the foundations of pylons and posts and increasing the risk of landslides. Another important challenge is represented by snow and ice. During winter storms, snow, low clouds, wind, and rain can cause the accretion of snow or ice, especially on overhead powerlines.

In other seasons and at other latitudes, the heatwaves caused by climate change damage underground cables, especially due to cycles of drought, high temperatures, and marked daytime/nighttime temperature variations. And while dry land reduces the ability to transmit heat, underground cable junctures and insulation – which maybe under a high load due to the use of air-conditioning – can overheat, increasing the likelihood of failures. Moreover, heat waves can also cause overhead lines to collapse and overheat substation transformers.

A study published by Eurelectric – **The Coming Storm: Building Electricity Resilience to Extreme Weather** – explains how advanced energy systems have already been equipped with the means to manage climate-related risk. These include the timely recognition of extreme weather conditions via advanced alert systems that allow enterprises and citizens to prepare for the oncoming weather fronts. In the transmission and distribution sectors, the report highlights the efforts made to reinforce overhead distribution lines by adding structural support, as well as increasing the insulation and mechanical resistance of conductors, bars, and electrical insulators.

While underground infrastructure is protected from vehicles and lightning, new-design pylons and overhead lines reduce the risk of damage from falling trees and branches. Naturally, digitalization plays a key role in risk prevention. Network automation allows systems to automatically reconfigure and supply energy, reducing the number of clients affected and the on-site operations necessary in extreme weather conditions. In addition, there also are connection systems between electric grids and distributed energy resources, such as photovoltaic plants and wind farms, which employ flexibility to limit the effects of climate change.

A Plan to Improve EU Geopolitical Resilience

In October 2023, the European commission announced a review of the **Strategic Energy Technology Plan** (SET), which was launched in 2007 to define a European policy in this matter. Since then, the SET (joined by all EU member states, as well as Iceland, Norway, and Turkey) has become a key political tool for research and innovation in the energy sector by member states

and associated countries. The general objective of the plan is to provide a vision, set objectives, and coordinate the activity necessary to accelerate the development and implementation of clean, efficient, and cost-effective technology. More specifically, SET was designed to improve the EU's geopolitical resilience in terms of energy supply security. Thanks to the recent revision, the plan will incorporate new priorities ranging from integrated sustainability from the outset of the design phase to the development of skills, research, and innovation, as well as digitalization and market accessibility.

The SET Plan, which was already updated in 2015 with six priorities (in line with the Research, Innovation, and Competitiveness triad of the EU Energy Union), plays a key role in orienting national energy research strategies and the national energy and climate plans. Over the years, it has contributed to efficiently associating national efforts with industrial alliances and important projects of common EU interest, such as the Battery Alliance and the IPCEI on batteries. SET Plan members have collected over €500 million from the partnership for the transition to clean energy co-financed by Horizon Europe. "The review of SET," explains **Iliana Ivanova**, European Commissioner for Innovation and Research, "contributes significantly to the development of a sustainable and low-carbon emission future, as well as supporting Net Zero energy technology in Europe." EU Energy Commissio-

ner **Kadri Simson** added that the review was timely: "Now member states will have to intensify their collaboration and work together to accelerate the transition to clean energy for our planet and our economy."

CESI's Commitment to Strategic Connections

We address technological developments at CESI more fully in the "Top Story" section of this issue, explaining how **KEMA Labs** – the CESI Group Testing, Inspection, and Certification Division – has recently improved its operative capacity to support the further development of **HVDC technology**, thereby reinforcing its position as a global leader. With over ten independent testing sites, KEMA Labs is now the biggest global laboratory for HVDC cable testing.

At the beginning of December, **CESI**, **K&K**, **Prysmian Group**, and **Siemens Energy** announced an ambitious project: an electric corridor that will connect Egypt to Italy for the transport of green energy. The corridor, which will have a 3 GW capacity, will be able to satisfy ca. 5% of the peak electricity demand in Italy, as well as support European objectives to achieve carbon neutrality by 2050. Moreover, the project aims to establish strategic connections between the European Union, the MENA Region (Middle East and North Africa), and Africa, promoting regional cooperation and the integration of the energy system. The core of the project is the development of a 2800-kilometer submarine HVDC cable (at a maximum depth of 3000 meters) to connect Sohag in Egypt with the Dolo substation in Italy.

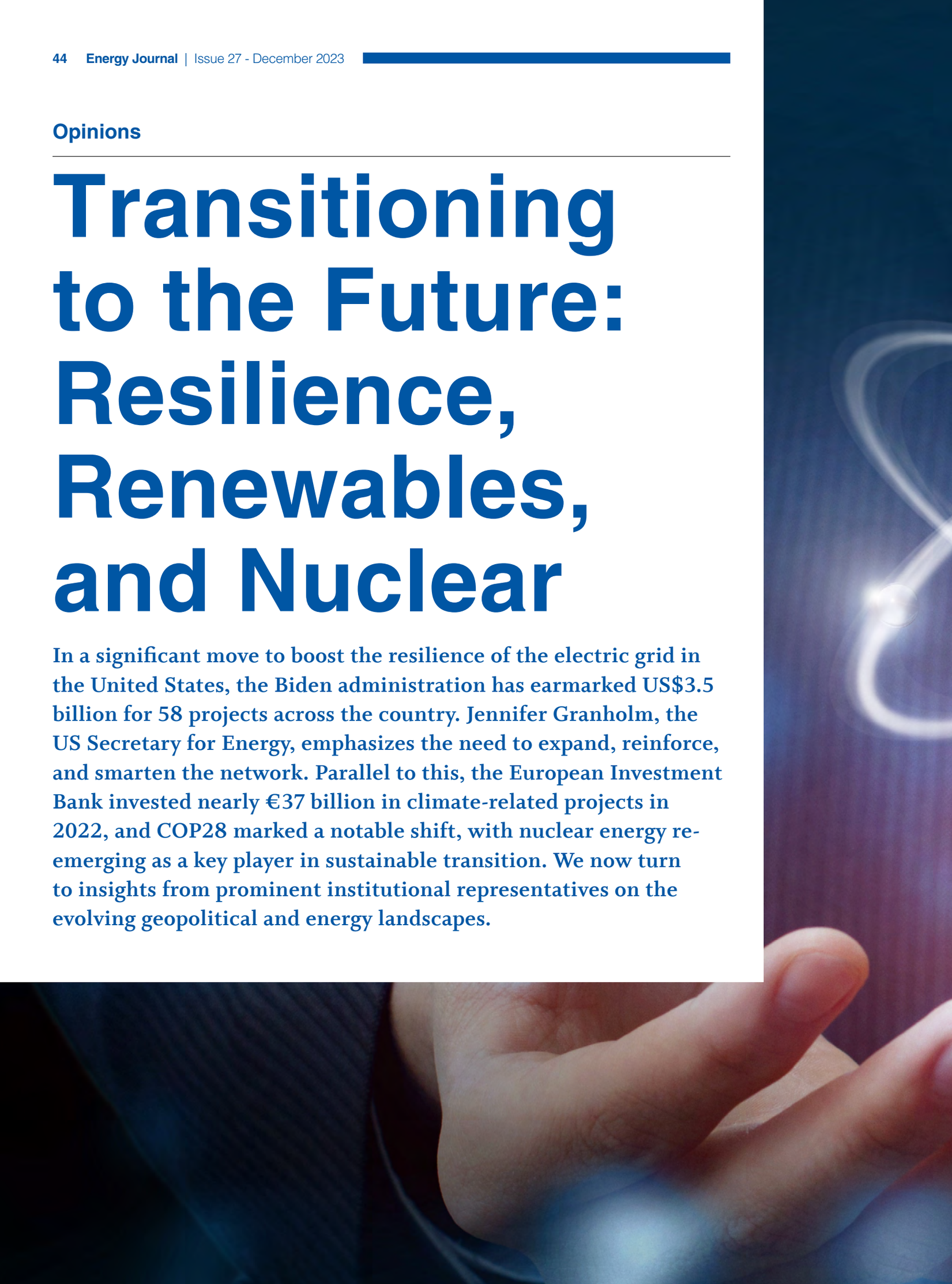
Artificial intelligence and intelligent networks – the opportunities and risks of this industrial revolution – were addressed at the end of November at **Technology Watch**, the observatory created by Elettricità Futura, in partnership with CESI, to monitor technological innovation in the electric sector. "Using the analytic and predictive capacity of artificial intelligence allows us to analyze data more rapidly and accurately, increasing network infrastructure flexibility, optimizing system efficiency, and providing more accurate forecasts of energy demand and supply," explained **Agostino Re Rebaudengo**, President of Elettricità Futura.

In the energy sector, Generative AI provides energy consumption estimates, optimizes the distribution of demand, predicts system failures and anomalies, and develops predictive models that can forecast peak demand. **Giampiero Montagna**, Head of Digital Lab at CESI, concluded by saying that artificial intelligence is obviously not the only digital technology that is involved in modernizing grids. "Enabling factors for the energy transition include the integration of digital technology into networks such as intelligent IoT devices and sensors, 5G and 6G connectivity, and digital twins. In particular, digital twins allow on-line simulation and monitoring of components, systems, and processes for critical applications such as security evaluation, maintenance, and life cycle forecasts."

Opinions

Transitioning to the Future: Resilience, Renewables, and Nuclear

In a significant move to boost the resilience of the electric grid in the United States, the Biden administration has earmarked US$3.5 billion for 58 projects across the country. Jennifer Granholm, the US Secretary for Energy, emphasizes the need to expand, reinforce, and smarten the network. Parallel to this, the European Investment Bank invested nearly €37 billion in climate-related projects in 2022, and COP28 marked a notable shift, with nuclear energy re-emerging as a key player in sustainable transition. We now turn to insights from prominent institutional representatives on the evolving geopolitical and energy landscapes.



Describing the initiative, United States Secretary for Energy Jennifer Granholm termed it as "the largest amount ever invested in the United States on electric network infrastructure." This US$3.5 billion financing by the Biden administration is aimed not just at fortifying the United States' electric grid, but also at enhancing energy reliability and accessibility.

Jim Skea, President of the Intergovernmental Panel on Climate Change, shared his thoughts in an interview with the Financial Times. Despite the extreme weather experienced last summer, he sees a silver lining in the progress made in climate action: "We have made enormous progress in some areas. If ten or twenty years ago someone had told me what would happen with renewable energy, I would have fallen off my chair …"

At COP28, Werner Hoyer, President of the European Investment Bank, highlighted the EIB's nearly €37 billion investment in climate-related projects in 2022. He stressed that tools like EU green bonds are crucial for financing clean technology innovations such as floating wind farms, green hydrogen, and new battery technology.

The conversation at COP28 also delved into new-generation nuclear energy. John Kerry, U.S. Special Presidential Envoy for Climate, remarked, "We cannot achieve net zero emissions by 2050 without resorting to some nuclear energy, just as we cannot reach the objective without using capture technology to use and store carbon." The Dubai conference not only focused on nuclear energy but also announced an agreement involving 22 countries to triple global production capacity by 2050. IEA Director Fatih Birol also emphasized the pivotal role of nuclear energy in the future energy transition.

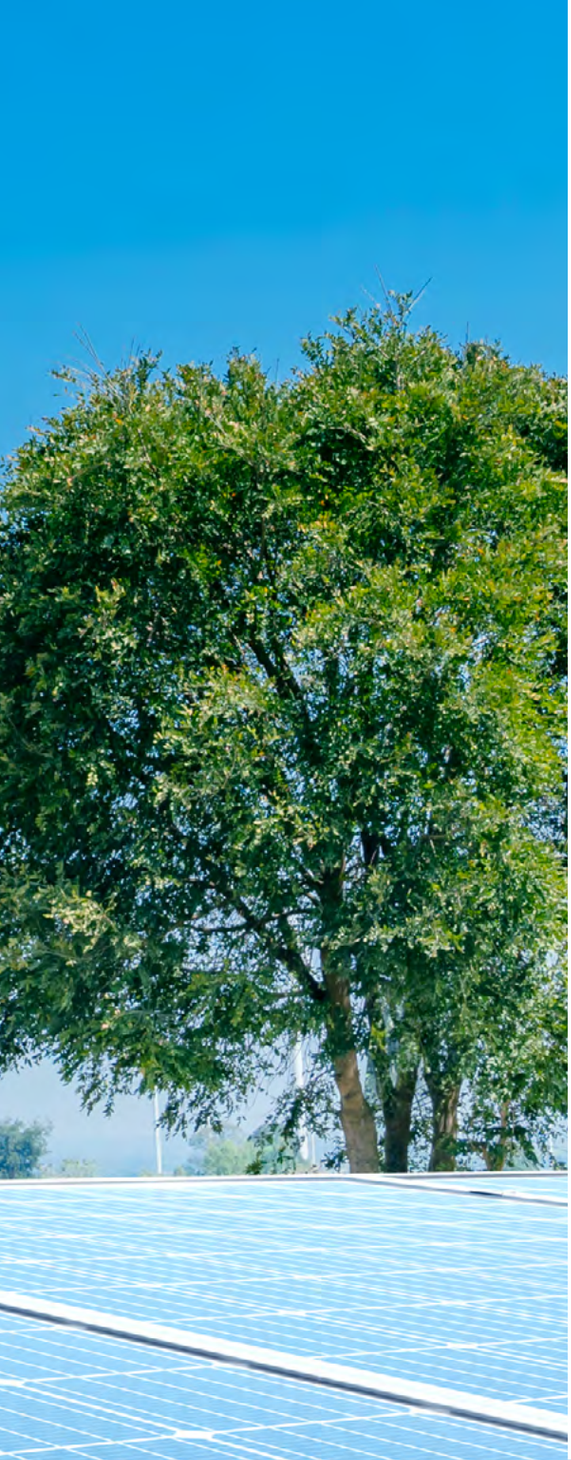
Jim Skea

IPCC President and Professor of Sustainable Energy at the Imperial College of London

"This is the decade of climate action, and I want to use this opportunity to set out some clear messages from the IPCC and the scientific community. I can sum it up in three words: urgency, agency, and equity. Climate policies have begun to bend the upward trend in emissions, but we have yet to put global emissions on a steep downward path. Without immediate action to reduce emissions and adapt to continued warming, threats to planetary health and human systems are inevitable."

"Fortunately, we have the tools available to take the necessary action. There is a critical message of hope in the last IPCC report: we, humans, do have the agency to avoid the worst impacts of climate change and shape our future on this planet. We have started to make progress. The costs of renewable energy have fallen dramatically; wind and solar energy are growing exponentially. Electricity is increasingly used in markets dominated by oil and gas, for transport and heating. But this growth has been concentrated in just a few parts of the world. Infrastructure investment in developing countries will be key to continued expansion. Our message on agency is blunt: we have the technology, the know-how, and the money to tackle climate change. We need to put them to use. Now."

"In view of the extreme weather phenomena that took place this summer, I think we should be increasingly worried about the consequences of climate change. However, if we compare the situation on effective climate action to ten or twenty years ago, I'd say there is reason to be optimistic. If ten or twenty years ago, someone had told me what was to happen with renewable energy, I would have fallen off my chair. We have made enormous progress in some sectors. However, the hardest part still lies ahead. In a certain sense, these major renewable projects – for example, a gigawatt of energy from offshore wind energy – seem incredibly difficult, and they are technically. So, my greatest respect goes to those who are developing all of this. The board of administrators of a large company can make a single decision that will have a major impact. Nonetheless, many of the measures that we will need to adopt in the future are on a smaller scale and will touch the lives of individuals more directly. It's going to be a great challenge."



Jennifer Granholm

United States Secretary for Energy

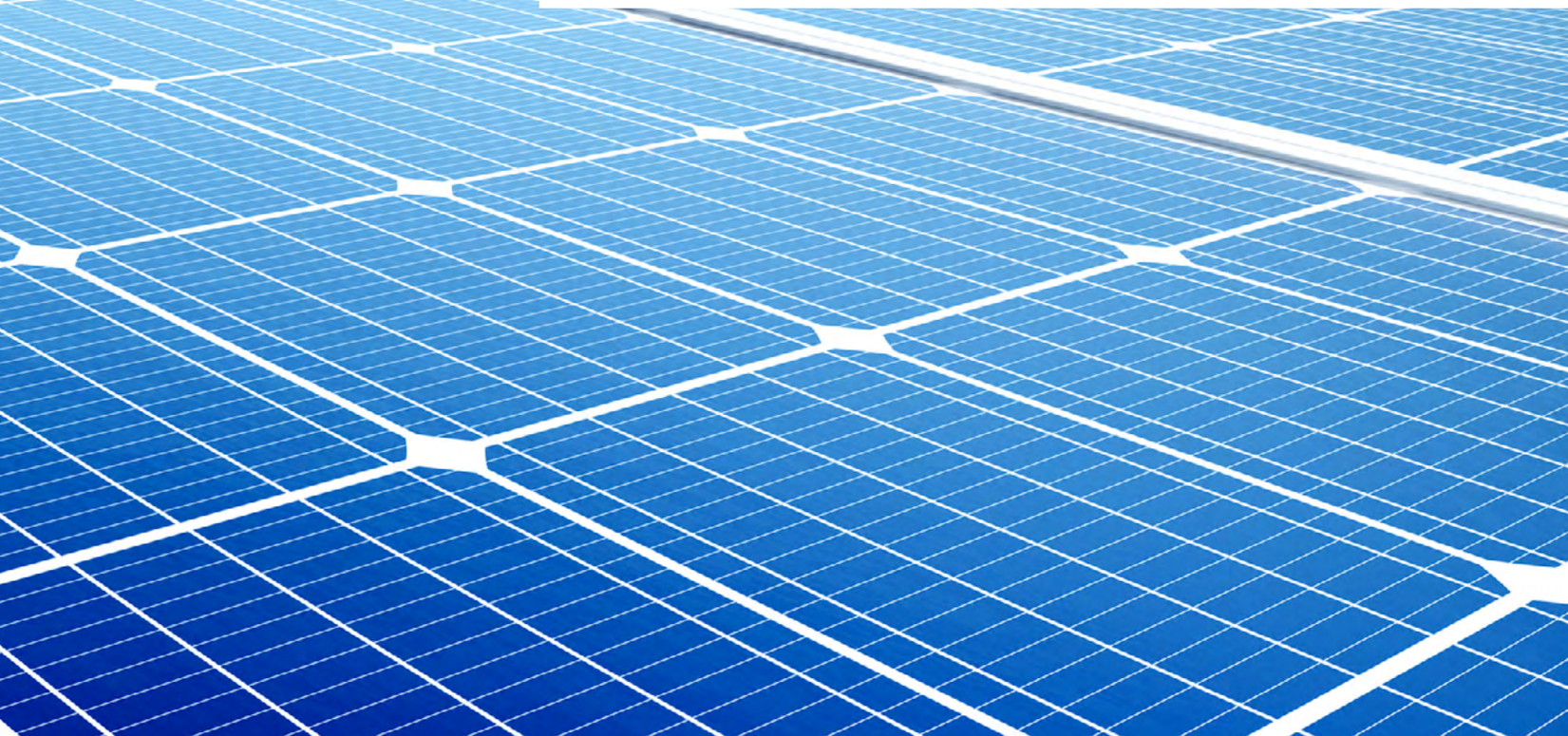
In mid-October, the Biden administration has announced funding for US$3.5 billion for 58 projects throughout the country. This massive investment aims to reinforce the resilience of the electric network in the United States, a need made all the more urgent by recent extreme weather phenomena, such as the devastating fires in Hawaii and California, that severely tested the country's ageing electric transmission infrastructure.

Jennifer Granholm, Secretary for Energy, emphasized that this was "the largest federal investment ever made on the electric grid." The objective is to promote projects that will not only improve the electric system, but also drive energy reliability and accessibility. With the addition of funds pledged by private partners, the overall investment for the modernization of the national grid should total US$8 billion.

At a press conference, Secretary Granholm pointed out that "the current grid is not capable of managing increased demand and resisting natural disasters or extreme weather conditions, further compounded by climate change." According to the Secretary, the grid needs to be made bigger, stronger, and more intelligent "to support a range of renewable energy projects and achieve the Biden administration objective of 100% clean energy by 2035."

Projects funded by the federal Grid Resilience and Innovation Partnerships program will increase the flexibility, efficiency, and reliability of electric power systems, with a particular focus on driving solar, wind, and other renewable energy. Granholm also pointed out that "these projects aim to resolve problems that may contribute to wildfires and other disasters, as well as to improve reliability by deploying innovative approaches to electricity transmission, storage, and distribution."

Financed projects include US$249 million for each rural area in Georgia and Louisiana and US$250 million for a tribe of Native Americans in Oregon. The most consistent subsidy will be allocated to improve transmission projects in seven midwestern states, from Iowa to North Dakota. The funds also include an already announced US$95 million allocated to Hawaii following this summer's devastating fires and US$150 million to PacifiCorp to modernize the grid and mitigate fires in California, Oregon, Utah, and other states.



Werner Hoyer

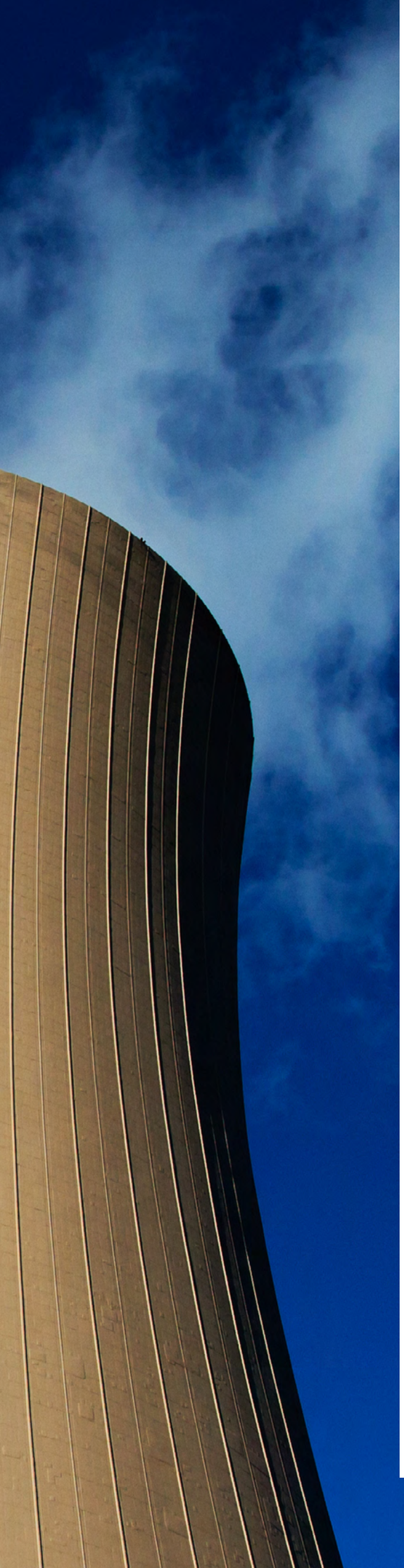
President of the European Investment Bank

"The EIB has gradually phased out investments in fossil fuels and is investing record amounts in renewable energy. To promote solidarity, we give our partners breathing space, deferring loan repayments when disaster strikes. Why are we doing it? It's not because we are noble or generous. We are a bank, and a successful bank is one that earns the trust of its partners and clients. We also don't want climate change to propagate food and water insecurity, conflict, and mass migration. A livable planet is in the interest of our shareholders: the EU member states."

"We made ambitious commitments, and we are on track to deliver on them. In 2022 alone, we supported climate action projects worth almost €37 billion. However, alone, we cannot turn the tide. Most of our projects in developing countries are co-financed with other MDBs. And we need more of this. As a collective we are stronger, and this is particularly true among multilateral development banks. Partnerships are key. We also need partnerships with the private sector. These allow us to leverage our scarce capital, mobilize additional investments, and increase our impact."
"The economic case for many climate action projects has been strong – just look at the surge in renewables. Last year alone, we invested €19 billion in clean energy. And this very clearly shows that there is no trade-off between climate action and development. Climate change affects every region on this planet. We must make sure those most affected by climate change are at the center of our efforts. There will be a fair transition or no transition at all."

"2023 seems destined to be the hottest year on record. Fires, drought, and extreme flooding around the world have had a heavy economic and human toll. The evidence is clear: a study produced by the European Central Bank indicates that the longer we wait to reduce emissions and transition to a green economy, the higher the cost will be. And a survey by the European Investment Bank on investments in 2023 reveals two thirds of European enterprises are already suffering damage and loss due to climate change.

Finance tools such as the EU green bonds will help drive innovation in clean technology and would be even more effective in a fully completed capitals market union. Custom-tailored financing solutions or guarantees to mitigate the risk associated with highly innovative private investments – such as floating offshore, green hydrogen, and new battery technology – will help develop the infrastructure that Europe requires to achieve Net Zero."



The Nuclear Comeback

Here are the opinions of global experts on the "Declaration to Triple Nuclear Energy," an agreement announced at COP 28, in Dubai, that commits 22 countries to triple the global production of nuclear energy by 2050.

At COP28, in Dubai, 22 countries signed the "Declaration to Triple Nuclear Energy," an agreement that commits them to increase the production of global nuclear energy threefold by 2050. The signatories believe that a comeback of nuclear energy will be fundamental to reduce the greenhouse gas emissions that will drive climate change over the coming decades. The signatories are: United States, Bulgaria, Canada, Czech Republic, Finland, France, Ghana, Hungary, Japan, South Korea, Moldova, Mongolia, Morocco, Netherlands, Poland, Romania, Slovakia, Slovenia, Sweden, Ukraine, United Arab Emirates, and United Kingdom United.

The declaration states that these countries will develop or increase global nuclear energy production by investing in the construction of new nuclear plants, besides improving existing ones. Nuclear energy – the declaration reads – is the most rapid and efficient way to stop using fossil fuels and promote the energy transition, as also recently indicated by the International Energy Agency (IEA).

The 22 countries include the United States, which produces 18% of its energy with nuclear plants, and France, Europe's largest producer of nuclear energy which produces 70% of its power with nuclear plants. French President Emmanuel Macron has defined nuclear energy as an "essential solution" to fight climate change.

"We cannot achieve net zero emissions by 2050 without a bit of nuclear energy, just as we need carbon capture, use and storage," commented John Kerry, United States Special Envoy for Climate. Similarly, Belgian Premier Alexander De Croo announced that his country would organize a global summit on nuclear energy, in March 2024, with the International Atomic Energy Agency (IAEA).

Macron and other leaders, including Swedish Prime Minister Ulf Kristersson, invited the World Bank and other international financial institutions to contribute to the financing of nuclear projects. Global nuclear capacity currently stands at 370 GW with active plants in 31 countries. Tripling this capacity by 2050 will require a significant increase in funding. A report published last year by the International Energy Agency states that nuclear energy will be fundamental to reduce carbon emissions as established by the objectives of the Paris Agreement in 2015. In Dubai, IAEA Director General Rafael Grossi indicated that the inclusion of nuclear energy revealed the current depth of a debate that had become "taboo" after the nuclear disasters in Chernobyl and Three Mile Island in Pennsylvania. Grossi confirmed that the greatest issue concerns funding: "There are statutory norms, even in international banking institutions, that explicitly exclude nuclear energy. I believe that this is obsolete and no longer corresponds to any scientific or technological criteria. Rather, I think, these are things of the past." The World Bank, for example, has not funded nuclear energy projects since 1959. "I think and truly hope the situation will evolve" in terms of financing.

The main obstacles to the declaration's goals are cost and time. Due to a wide range of factors, including inflation, building new reactors has become even more expensive than in the past and the construction phase even longer. IEA Director Fatih Birol remarked that besides renewables, which will provide the greatest amount of energy, nuclear will also play an important role: "After Fukushima, there was less interest in nuclear energy, but it is slowly returning. The lifecycle of existing plants is being extended. If instead we seek to build new plants, we must be aware that it will take a long time. This means that nuclear energy cannot provide an immediate contribution to cutting emissions."

News & Events

Upcoming Energy Events

Powergen International 2024

January 23-25, 2024

New Orleans, USA

www.powergen.com

As one of the main appointments in the energy generation sector, the event brings together nearly 10,000 professionals to address the challenges posed by a market in constant evolution.

E-world Energy & Water 2024

February 20-22, 2024

Essen, Germany

www.e-world-essen.com/en/

In its 20 years of existence, E-world Energy & Water has become the traditional annual inaugural appointment for the energy sector. The event brings together the European energy industry and serves as a platform for the sector.

World Sustainable Energy Days (WSED) 2024

March 5-8, 2024

Wels, Austria

www.wsed.at

The three-day event dedicated to sustainability will host a series of events including the European Pellet Conference, the European Energy Efficiency Conference, the Energy Efficiency Policy Conference, the Industrial Energy Efficiency Conference and the Young Energy Researchers Conference.

WindEurope 2024

March 19-22, 2024

Bilbao, Spain

windeurope.org/annual2024/

The annual conference on wind energy will attractc over 10,000 participants and host dozens of conference sessions with hundreds of speakers, and over 400 exhibitors to showcase innovations and sign agreements. The conference also organizes social events to drive networking and informative sessions on wind energy.

European Green Ammonia Summit 2024

March 6-7, 2024

Düsseldorf, Germany

www.wplgroup.com/aci/event/european-green-ammonia-summit/

The two-day event will bring together key industry stakeholders, including green ammonia producers, hydrogen suppliers, fertilizer producers, suppliers of renewable energy, consultants, and solution and technology providers.

Future of Utilities - Energy Transition Summit

March 20-21, 2024

Amsterdam, Holland

www.futureofutilities.com

The summit on the energy transition brings together long-standing sector businesses, innovators, politicians, and investors to promote the transition towards a renewable energy ecosystem.

Shaping a Better Energy Future

CESI is a world-leading technical consulting and engineering company in the field of technology and innovation for the electric power sector. In particular, through its Division KEMA Labs, CESI is the world leader for the independent Testing, Inspections and Certification activities in the electricity industry. With a legacy of more than 60 years of experience, CESI operates in 40 countries around the world and supports its global clients in meeting the energy transition challenges. CESI also provides civil and environmental engineering services.

The company's key global clients include major utilities, Transmission System Operators (TSOs), Distribution System Operators (DSOs), power generation companies (GenCos), system integrators, financial investors and global electromechanical and electronic manufacturers, as well as governments and regulatory authorities. In addition, CESI works in close cooperation with international financial institutions such as, among others, the World Bank Group, the European Bank for Reconstruction and Development, the European Investment Bank, the Inter-American Development Bank, the Asian Development Bank.

CESI is a fully independent joint-stock company headquartered in Milan and with facilities in Arnhem, Berlin, Prague, Mannheim, Dubai, Rio de Janeiro, Santiago de Chile, Knoxville (USA) and Chalfont (USA).

www.cesi.it

CESI
Shaping a Better Energy Future

Get it on Apple Books