Issue 23 / September 2022

Energy Journal

Ready to overcome fossil fuels dependence?



Energy Journal

CESI's house organ Editorial coordination Paolo Chighine / CESI Luca Luciano Pincelli / CESI

Project, design and translations

Cultur-e www.cultur-e.it



via Rubattino, 54 I-20134 Milan – Italy info@cesi.It www.cesi.It

While all efforts have been made to contact relevant copyright holders with respect to the materials included in this publication, we invite any person whose rights have not been cleared as yet to contact the Publisher for necessary arrangements.





Editorial

A Positive Trend for Green Energy Sources



Matteo Codazzi CEO, CESI

Guido Bortoni Chairman, CESI

This extraordinarily hot summer presents complex challenges from both a climactic, market and a geopolitical point of view. The global energy transition apparently seems to mark a step backwards over the past few months on account of several causes: the economic effects of the pandemic, the recovery from the pandemic, the gas market stresses due to temporary stop of the relevant supply investment across the world, the exceptionally dry summer for hydroelectric plants as well as for the cooling of thermal power stations the relative scarcity of wind production and, last but not least, the extraordinary out-of-order periods for the electronuclear fleet and the huge commodity crisis sparked by the Russian invasion of Ukraine.

Just as many European observers, IRENA - the International Renewable Energy Agency - had recommended the fast tracking of renewables as one of the long-term, most efficient and sustainable routes to becoming independent from fossil fuel imports, in order to give a structural solution to the independence problem to Europe's energy. Yet, in the short term, this solution could not be sufficient for Europe to cope with the possible interruption of Russian gas supplies and the long-lasting increase in prices. To solve the short-term dilemma, many western governments and the European Union have been forced to resort to (non-Russian) fossil fuels such as LNG and, in some cases, coal. In the previous issue of Energy Journal, we introduced the new roadmap to the transition, describing how difficult it is to maintain a balance and keep our economies growing and being on track towards decarbonization. Now, the issue has become even more critical due to the need to immediately compensate the possible lack of Russian gas supplies. And this is not just the opinion of analysts at IRENA, who forecast that 45% of the reduction in emissions to 2050 will have to come from energy efficiency and electrification, especially for the final uses of energy.

Independence from fossil fuels is the starting point that has driven CESI to develop a new analysis in which we emphasize how in the long term – in order to replace fossil fuel imports from Russia, address the high cost of energy, and become independent – structural solutions need to be identified, integrating energy storage activities with an increased production of renewables.

The CESI analysis, focused on the Italian electricity market, reveals how a greater penetration of wind and solar energy in the power system could reduce the need to import gas. Indeed, it would allow Italy to reduce its dependence on Russian gas to satisfy the national energy demand. In 2021, Italy imported 38% of its natural gas requirements (29 bcm) from Russia. Besides diversifying gas supplies through the existing infrastructure, the CESI analysis simulates the impact in 2026 of 40 GW from renewable sources to the electric system. This additional generation capacity would guarantee accessible prices, environmental sustainability, and the security margin (ca. 8.5 bcm) necessary to face the potential risks posed by drought and the consequent decrease in hydropower, Asian competition for LNG, decreased energy from France (in case of prolonged nuclear plant maintenance activities), and possible delays to the full implementation of additional LNG regasification plants.

In this issue of Energy Journal, we address the issue of market turbulence and how this has generated a significant increase in the cost of energy, a phenomenon that the European Commission has begun to address. In mid-June, in order to stem the increase in the cost of energy, a proposal to place a price cap on gas, the first step in a process that has continued in the following months, is under consideration by the EU Member States.

The Industries & Countries section addresses the transition phase from a geopolitical perspective. Notwithstanding an increase in the production of oil to compensate for the difficulties caused to the energy sector by the Russian invasion of Ukraine, the outlook remains positive for the development of renewables in many countries, including those in the Gulf Area. Moreover, the positive trend for green energy sources is also confirmed by the IEA's last study, which highlights the important results achieved in a year as complicated as 2021: added renewable capacity has increased by 6%, reaching a record of nearly 295 GW, notwithstanding the supply chain issues caused by the pandemic, construction delays, and the record cost of raw materials. And while there was a 17% global drop in added annual wind capacity, this was compensated by an increase in solar photovoltaic and the development of new hydroelectric plants. In our section dedicated to the future and technology, we present an article on CESI activities to drive our independence from fossil fuels, as well as to develop flexible, interconnected, and sustainable energy systems. The focus from page 36 will address topics such as market impact analyses, tests to guarantee the security and resilience of networks and grid, HVDC technology, as well as energy storage. All these activities underscore CESI's commitment to developing a flexible and resilient energy market throughout the five continents, thanks to cutting-edge resources and high-quality skills.

Finally, in the Opinions section we are presenting the point of view of four different institutional representatives with regard to the current geopolitical and energy scenarios. EU Commissioner for Energy Kadri Simson proposed a six-point plan to the EU Council to prepare for winter in case Russian gas supplies were to be interrupted. Michael Regan (Administrator of the United States Environmental Protection Agency), on the other hand, focused on the USA pathway to replace fossil fuels with more sustainable energy sources. With his statements, Thierry Breton, the European Commissioner for the Internal Market, pointed out that the EU energy mix depends exclusively on the decisions of member states. Finally, Thierry Bros (Professor of Energy and Political Science at the University of Paris) voiced his concerns that the world may be forced to temporarily delay its green energy plans, after having snubbed clean energy solutions when there was an abundant supply of fossil fuels.

Enjoy the reading.

Guido Bortoni

Matteo Codazzi

Issue 23 / September 2022

Contents



8 News

Latest from CESI



10

Scenario

Reducing Dependence on Fossil Fuels and Fast-Tracking Energy Transition Goals



18 Top Story

Sustainable Solutions to Avert the Need for Russian Gas



24 Industries & Countries

Global Solutions to Face the Energy Crisis Energy Journal can be browsed and downloaded at www.cesi.it

"The starting point of energy security today is diversification of supplies and sources." **Daniel Yergin**, American author and founder of Cambridge Energy Research Associates



34 Future & Technology

Innovation and Reliability: Moving Beyond Fossil Fuels



40

Opinions

A Route to Independence that's not troublefree



46 News & Events

Upcoming Energy Events

News

Latest from CESI



KEMA Labs

KEMA Labs performed the first ever Transient Over Voltage test on a 525kV DC Cable System

The long distance between renewable energy sources generation centers and the main power networks, as well as the need to transport the energy with the highest efficiency, with low losses, is driving increasing adoption and investments on HVDC power transmission infrastructures. In this respect, KEMA Labs (CESI's Testing, Inspection and Certification Division) has carried out the first TOV (Transient Over Voltage) test on a 525kV DC Cable System, manufactured by Prysmian Group R&D. This new and important goal for the HVDC Cable Sector has been reached in the KEMA Labs Mannheim HVDC Laboratories, in Germany. As some TSOs, engaged in the transport of electricity from offshore wind farms in the North Sea and the Baltic Sea decided to verify the greater ability to withstand electrical transients of 525kV DC cable systems, which occur in HVDC Schemes, after the computational simulations, the first TOV has now been officially performed for a real Cable System Loop consisting of 2 External Terminations, 2 joints and the DC cable, produced by Prysmian Group R&D.

A new and important goal for the HVDC Cable Sector.

"



Nigeria

CESI supported the Rehabilitation of Nigerian Transmission SCADA Systems

Under a World Bank funded project, CESI is supporting the Transmission Company of Nigeria to implement a full-scale state-of-the-art SCADA, EMS and telecommunication system to monitor and manage in a safe and reliable manner the relevant Nigerian electrical network as well as monitoring energy exchanges in the interconnected zones. The project also involves the implementation of Remote Terminal Units (RTUs) and related adaptation works at relevant substations. The CESI consultancy services include procurement support for the selection of the design, supply, and installation contractor for SCADA/EMS system, as well as construction Supervision of the EPC Contract, including Detailed Engineering Design Review, Site Supervision and Commissioning works.

An innovative telecommunications system to manage the Nigerian electricity grid safely and reliably.

"



Nuclear

KEMA Labs carried out HEAF tests for the U.S. Nuclear Regulatory Commission

High energy arcing faults (HEAFs) are one of the main risks that need to be assessed by nuclear power plant (NPP) operators in the United States. In order to do so, the existing methodology for modeling switchgear and load center HEAFs in fire probabilistic risk assessments (PRAs) required several intermediate steps to be determined and finalized. One of the key steps is represented by conducting physical testing including small-, medium-, and full-scale tests. In this respect, KEMA Labs Chalfont (USA) performed twenty-six full-scale experiments, which were conducted in an OECD Nuclear Energy Agency (NEA) project, issued in 2017. The experiments performed by the KEMA Labs experts were carried out on equipment rated from 480 volts up to 10,000 volts at various fault current levels and durations. The experiments were performed under an oxygen consumption calorimeter to measure the heat release rate of any ensuing fire. As a result of our tests, significant cable damage was only seen when there was also a significant, sustained, ensuing enclosure fire.

KEMA Labs Chalfont (USA) carried out physical tests on small, medium and full scale.

"



"

Chile

Electrical studies & Basic design for Kimal-Lo Aguirre HVDC line in Chile

CESI supported ISA Interchile in participating in the auction for the development of the Kimal-Lo Aguirre HVDC transmission line in Chile. With its 1,500km length and its capacity of 3,000 MW at ffl 600 kV, the Kimal-Lo Aguirre line is the biggest ongoing transmission project in the country and it will mark a key milestone in Chile's plan to decarbonize its power matrix over the coming decades by enabling additional transport capacity from the north to the center-south. In this respect, the CESI consultancy services included a basic design of the converter stations, the project budget estimate, a review of the detailed design of the line, the selection of the manufacturer of the stations, a review of the design proposed by the selected stations manufacturer.

The Kimal-Lo Aguirre line is the largest ongoing transmission project in the country.

"

For further information on this topic, please contact: Andrea Venturini (Market Analyses & Grid Codes Product Leader – CESI) andrea.venturini@cesi.it

Scenario

Reducing Dependence on Fossil Fuels and Fast-Tracking **Energy Transition** Goals

According to Francesco La Camera, Director General of IRENA, we must drastically modify the way in which we produce and consume energy. "This is our last opportunity to act timely, with the technology that we already possess." Meanwhile, IEA Director Fatih Birol points to the enormous potential of energy efficiency for saving energy. The European Commission has calculated that we will need €210 billion in further investments, through 2027, to grow independent from the importation of Russian energy sources.



he energy crisis that has been caused by the invasion of Ukraine is a further alarm bell that must drive us to fasttrack the ecological transition. Commenting on the main data presented in the World Energy Transitions Outlook at the end of March, Francesco La Camera, Director General of IRENA - the International Renewable Energy Agency, commented on the high cost of centralized energy systems based on fossil fuels. "The evidence is clear: not only coherence with climate targets and economic efficiency, but also the issue of our dependence and the guarantee of continued supplies. We are nearing the point at which it will no longer be possible for us to limit the increase in temperature to less than 1.5 degrees," la Camera explained. "We must drastically modify the way in which we produce and consume energy. This is our last opportunity to act timely, using the technology that we already possess."

The crisis caused by Covid-19 has proven to be yet another missed opportunity. A mere 6% of the total resources fielded by G20 members for the post-pandemic recovery

has been invested in green energy. The IRENA Report calculates that US\$5700 billion a year in investments will be required, from today to 2030, to implement an energy transition program that may allow us to limit global warming to the levels established by the Paris Agreement. In the scenario envisaged by IRENA, 45% of the reduction in emissions from here to 2050 will have to be achieved through energy efficiency and electrification, especially in terms of the end use of energy. In fact, industrial processes and domestic heating are still heavily based on fossil gas and the main source of energy in the transport sector is still oil. Electric mobility may thus represent a driving factor; in fact, the sale of electric vehicles is forecast to rise by a factor of twenty.

In terms of energy production, the report looks to renewables, green hydrogen and sustainable biomasses, or the use of technology for carbon capture and storage (CCS). In total, these three options can help us reduce emissions by 49%, while the remaining 6% should be achieved through CCSs applied to the production of fossil fuels (for a total 36.9 gigatons reduction in emissions). In order to achieve these results, the renewables penetration rate must increase from the current 14% to 40% by 2030. And, in order to do so, according to analysts, we will need to increase the installed renewable power threefold, each year, allowing green hydrogen (produced by renewables) to develop beyond its embryonal phase and become a true market.

A specific appeal for more incisive action on energy efficiency was launched at the beginning of June, in Sønderborg, Denmark, where climate experts from 24 countries participated in the 7th IEA Annual Global Conference on Energy Efficiency. The summit emphasized how an immediate global drive on energy efficiency and related areas could allow us to save an enormous amount of energy by 2030, a saving equivalent to China's current annual consumption of energy. IEA Executive Director Fatih Birol recalled the significant international progress achieved in energy efficiency following the 1970s oil crisis, underlining the need for a similar response to today's far more ample and global crisis. "This is our greatest historical opportunity in 50 years to renew our attention to energy efficiency and grasp the enormous potential it presents. I am optimistic about the fact that we will consider this conference as a turning point for energy efficiency."

Supply Security and Affordable Prices

In mid-June 2022, Gazprom announced that it would reduce gas supplies to the EU through the Nord Stream 1 pipeline by 40%. The Russian energy corporation declared that this reduction was the result of the EU sanctions that led to delayed maintenance work on components at the Baltic Portovaya Compression Station. The following day, Gazprom announced



that it would decrease gas supplied through the pipeline between Russia and Germany by a further 33%.

The current state of tension has had significant repercussions on western energy markets. The conflict in Ukraine has highlighted the European Union's reliance on fossil fuels, an issue has been evident since 2020 and the crisis caused by the Covid-19 pandemic and extreme climactic conditions. Analysts estimate that, in 2020, more than 50% of the EU energy demand was satisfied by energy imports, and nearly one third of EU countries rely on non-EU sources for over 70% of their energy supply.

In this scenario, market turbulence has generated a significant increase in the cost of energy, a phenomenon that the European Commission has begun to address through a series of actions for member states. In fact, the development of efficient recovery tools is a fundamental issue for all European countries. In order to halt the rise in inflation, in mid-June, the EU Council approved a proposal to limit the cost of Russian gas imports, a first step in what analysts believe will be a long-term process.

The strategy to reduce energy dependence first began taking shape in October 2021 when the European Commission published a package of measures to address the increase in prices and reinforce the resilience of energy systems against future turbulence. These short-term actions, aiming to safeguard consumers and enterprises, included support to vulnerable families through income support and tax cuts, the temporary deferral of bill payment deadlines, financial support to enterprises, and the use of safety measures to avoid disconnection. In the medium term, always



envisaging the energy transition as the best protection against price increases and promoting a greater independence of third countries, the measures indicated by the European Commission concern **fast-tracking investments in renewables and energy efficiency**, as well as the development of **flexible solutions** such as batteries and hydrogen, a possible review of the electricity market, and the evaluation of a possible voluntary joint bid for gas supplies by member states.

In March 2022, after the invasion of Ukraine and a further spike in energy prices, the European Commission published a communication on supply security and affordable energy prices. Amongst the immediate options, in preparation for the coming winter, a further distinction is made between retail and wholesale markets. The former will be able to take advantage of forms of income support, temporary state aid, and tax cuts; the latter will be supported through the establishment of a maximum price for generation from fossil fuels and a limit to the cost of electricity as a potential measure against price increases. In the medium term, the EU has proposed the establishment of price limits for the exchange of gas amongst European member states and the creation of a task force for the purchase of gas at a continental level, an action similar to that fielded for purchasing Covid-19

vaccines. Other structural operations include the development of **interconnections to integrate energy markets**, actions to promote the installation of renewable plants, and measures to drive energy efficiency and supply diversification.

The EU leaders' decision to end dependence on Russian energy imports has taken shape in the REPowerEU Plan, published on May 18, 2022. The EU will need a further €210 billion in investments to achieve independence from Russian gas imports; however, this will allow a saving of nearly €100 billion a year, mostly related to the importation of gas. Short-term measures in the plan include joint purchases of gas, LNG, and hydrogen via an EU energy platform, the creation of new energy partnerships with reliable suppliers, the rapid implementation of solar and wind projects, and an increase in the production of bio-methane. Moreover, citizens and enterprises will be provided with recommendations on how to save energy, while gas storage units will have to reach 90% of their maximum capacity by November 1, 2022, to guarantee adequate supplies for the winter. Other actions to implement by 2027 include quicker authorizations for renewables, which will increase from the previous goal of 40% to 45% of the EU energy mix by 2030, while energy saving objectives will increase from 9% to 13%.

There also is another scenario that troubles system operators: the supply system for the main components necessary to the manufacturing industry, heavily hit by the lockdown in many areas around the world, has still not entirely recovered. This has caused a significant delay in the delivery of products; particularly so in Europe, a geographical area that relies heavily on the importation of component fundamental for sustainable mobility and green technology. Moreover, the second semester of 2021 has witnessed a sharp increase in the price of raw materials that has further stressed economic recovery. (The average price of wholesale natural gas reached almost 350 €/MWh several times during last August, compared to 15-20 €/MWh in August 2021). This generalized increase in the cost of raw materials, in conjunction with the ongoing delay of the supply chain from the far east to Europe, has been even further compounded by the war in Ukraine that began in February.

In this context, the REPowerEU Plan emphasizes the **importance of critical raw materials for the energy transition**, to avoid transferring the issue of energy dependence to the supply system. This will entail a specific EU proposal to guarantee the access of industry to these materials. In the REPowerEU Plan, besides underlining the importance of investments to integrate and increase the



efficiency of gas and electric networks, the European Commission has also presented a regulatory framework for hydrogen, calling for the installation of 17.5 GW of electrolyzers by 2025, and aiming to achieve a 10 Mt production of green hydrogen by 2030.

Redesigning the Market

On account of these circumstances, and the many other turbulent issues that are interesting Europe, policy makers and analysts have begun looking into how the current market model may be modified to protect the EU from vulnerability and geopolitical storms. In mid-May, the European Commission enacted a series of **market review measures** that aim to accelerate the **diffusion of production from renewable sources throughout Europe**. This would allow a threefold objective: a reduction of the vulnerability to external shock, a supply of cheaper energy, and the pursuit of the roadmap towards a **carbon-free continent**. More specifically, these are the three key measures:

Reinforcing markets over the long term, as already mentioned, and introducing funding measures that extend even beyond ten-year periods to accommodate the massive initial investments necessary to drive the energy transition.
Developing new mechanisms, even with public funds, to support and stabilize the multiannual revenue allotted for green plants. These mechanisms may be differentiated in terms of the type of technology, as long as they are market-based and include funding from all possible renewable technology.

• Promoting the long-term liquidity of markets through market makers to allow effective competitiveness amongst market operators.

In general, well-structured and operative markets with sufficient liquidity are fundamental to attract investments, especially for the generation and energy storage sectors that have been fully deregulated. The importance of accelerating the penetration of renewable energy is also emphasized in the RePowerEU Plan that recommends an increase in the relation between renewable energy and energy demand from 40% to 45% by 2030, increasing the objectives set in the "Fit for 55" package. This would allow the EU to achieve a total capacity (electric plants and renewables) of 1200 GW by 2030.

The importance of the widespread acceleration of green energy has already been addressed by CESI through a specific analysis (see dedicated article in Top Story on Page 20) aiming to identify solutions to gradually eliminate Russian gas imports. The installation of 40GW of photovoltaic and wind plants by 2025 – together with 5.7 GW of storage and full exploitation of gas from other assets (pipelines and LNG plants) – would allow the EU full independence from Russia.

The Italian Scenario

In Italy, the first measures addressing the gas market, approved by the government in September 2021, entailed a reduction in general charges and the application of reduced 5%VAT for domestic and industrial use. Moreover, on the electric market, general system charges were eliminated for domestic use and for small commercial and industrial sites (up to 16.5 kW). At the beginning of 2022, this measure was extended to benefit larger clients. For 2022, the Italian government has also decided to raise utility discounts for individuals in financial hardship or with serious medical conditions. Other measures include tax credits for energy-intensive companies, taxation of unexpected income, and a 30 cent/liter reduction on the price of car gas, as well as other structural actions to accelerate the installation of renewable plants and regassification units.

In mid-June, opening the OECD works in Paris, Italian Premier Mario Draghi emphasized his government's intentions to contrast the cost of





energy. "The emergency situation must not be an excuse to forsake our climactic objectives, but rather a reason to redouble them. Speeding up the energy transition is fundamental to shift towards a sustainable model and reduce our dependence on Russia. We must promote the growth of renewables, as well as research and development in new clean, green energy solutions. This entails reinforcing our hydrogen architecture and developing intelligent and resilient networks." On the same day, the Italian Minister for the Ecological Transition, Roberto Cingolani, defined a possible European price cap on gas as a transitory, but necessary measure, "to avoid the fluctuations that drive the cost of energy sharply upwards and damage both citizens and enterprise."

The Italian Government is also interested in business with Libya and Algeria. The latter will provide Italy with 9 billion cubic meters of gas a year via the **Transmed pipeline**, while Libya can supply Italy with a further 2 cu m. of gas through the **Greenstream pipeline**. Moreover, in the short term, Italy can exploit its internal production totaling 2 billion cu. m. LNG (liquified natural gas) from the Adriatic Sea and imports from Egypt and Qatar (3 billion cu. m.), Congo (5 billion cu. m. starting in 2023), and Angola and Mozambique in the medium-to-long-term (2 billion cu. m.).

In terms of LNG regasification plants, Minister Cingolani indicates two new structures – LNG carriers – that should be ready by the end of 2023, one in Piombino, the other in Ravenna. These will bolster existing plants (La Spezia, Rovigo, and Livorno) and those still under construction in southern Italy and the islands.

The objective is to avoid facing the winter with half-empty gas storage facilities, a dread that has been hanging over Italy for a couple of months and, now that Russia has cut supplies, appears even more concrete. If utility bills continue to rise, notwithstanding the tax cuts implemented by the government, families will have to watch their consumption. In mid-June, the cost of gas set for July on the Amsterdam Ttf reached €122/MWh, a sharp increase over the ca. €80/MWh euro it cost just a few days earlier. Indeed, the cost of gas has reached and surpassed the 300 €/MWh in August that the government has forecast if gas supplies from Russia were to be interrupted completely. However, if supplies are decreased, Italy may be forced to use its reserves even during the summer. If gas storage does not reach an 90% level by November, it will probably be rationed both to families and enterprises by the end of the year. Fortunately, certain EU countries such as Italy and Germany have already reached their targets.

This is a complex scenario. In order to concretely decrease dependence on fossil fuels and particularly on Russian gas, Italy needs to find truly efficient solutions in the short-term, but with a long-term outlook. This is the only way, together with a process of decarbonization, to make Italy truly energy independent; and also to develop a solid and resilient energy system, one that is less vulnerable to external factors and focused on the climate neutrality envisaged for 2050.

Top Story

Sustainable Solutions to Avert the Need for Russian Gas

Three scenarios in a recent analysis by CESI to assess how a greater penetration of renewables – solar and wind energy – in the Italian electric system can reduce the importation of natural gas. The debate on a price cap. rom a constructive point of view, the current crisis may serve as an opportunity to accelerate the decarbonization of our energy systems. In the medium term, in order to replace Russian fuel imports, address the high cost of energy, and overcome our dependence on fossil fuels, we will need to identify structural solutions blending energy storage solutions with an increase in the production of renewable energy.

As was confirmed by Prime Minister Mario Draghi in a recent address to the Senate, the war in Ukraine has highlighted the fragility of Europe's dependence on Russian gas. And this dependence makes Italy particularly vulnerable as, in 2021, 38% (29 bcm) of the gas consumed in our country was supplied by Russia. Following the events that have taken place in recent months, Italy has acted rapidly to diversify its gas supplies. However, a faster development of renewable energy, in the medium-to-long term, has also emerged as a fundamental strategy, both to improve the sustainability of our productive models and to protect the country from market volatility and the risks related to the importation of energy produced by fossil fuels.

The impact of the Italian dependence on gas is evident in much of the data that we have analyzed in this period. In March, for example, the average price of gas in our country had increased sevenfold over twelve months earlier, reaching nearly €130/MWh, compared to €18/MWh the previous year. Due to their interconnection with the gas market, even spot electricity markets were affected by significant increases in price. In March, the PUN¹ registered an average \in 300/MWh, while on March 8, it reached a record €688/ MWh, compared to €60/MWh just one year earlier. These dynamics are also affected by the increase in the price of CO₂ that has more than doubled from \in 33/tCO₂ in January 2021 to \in 75/tCO₂ last March, with peaks nearly reaching $\in 100/tCO_2$.

1. PUN: the single national price applied to end users

For further information on this topic, please contact:

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

Luca Migliorini (Energy & Automation Competence Center – CESI) luca.migliorini@cesi.it

Various solutions have been proposed to solve these issues, most of which are based on the key concept of supply diversification. Increased imports of Algerian gas from Transmed, following the agreement signed on April 11, 2022, could reduce Russian gas imports by 9 bcm, although not earlier than 2023-24. Naturally, this partnership between European member states and the North African country is not completely risk-free - there is a long-standing alliance between Russia and Algeria - and should be weighed carefully. Another solution calls for a short-term increase in gas imports from Azerbaijan via the TAP pipeline; however, the TAP potential is limited to 1.5 additional bcm. In addition to these solutions, there also is the opportunity to fully exploit Italy's regassification plants, which are currently working at only 60% of their potential. This would allow the country to replace a further 6 bcm of gas that is currently imported from Russia. Moreover, investing in new regassification plants would allow a further significant reduction in the need for Russian gas (10 bcm), but would require more time (reduced in the case of offshore plants) and further investments (especially for onshore ones). Lastly, the exploitation of national gas reserves, or equivalent energy saving measures

on final consumption, could generate a further 2 bcm reduction.

These are all valid alternatives; however, they still entail dependence on other countries for energy and bind us to the cost of gas, a cost which may well continue to be extremely volatile in the future, due to the wide demand for a limited supply. We must understand that the necessary independence from Russia comes at a cost, unfortunately. In the short-term, there will be a trade-off between "security of supply" and "low cost," while in the medium-long term this situation may be avoided. Renewables are not only low-cost, but also widely available in Italy. And the supply is guaranteed, also from a geopolitical point of view. Therefore, we believe that the **development of** renewable plants is the best structural, feasible and sustainable solution to make us independent from gas imports, besides fast-tracking the ecological transition that will allow our country to enjoy even greater energy independence.

Recently, Elettricità Futura (EF) presented a new plan for the gradual development of renewables that aims to produce 85 GW of green energy by 2030 in order to meet the







requirements of the EU "Fit for 55" package and the even more stringent targets of the REPowerEU Plan - enacted after the beginning of the Ukrainian crisis – which sets the penetration of renewables over final energy consumption at 45% by 2030. The new EF plan - considered credible and favorably welcomed by Minister Cingolani - hypothesizes 30GW of additional renewables by 2025 (40 GW by 2026) with the installation of new storage infrastructure for 12 GWh. According to our simulations, this plan would allow Italy to save 7 bcm of gas in 2025, which, together with gas supply diversification measures, would be sufficient to become independent from Russian gas imports. It would, however, leave a minimal security margin in case of further unexpected - but not improbable - issues such as reduced hydropower caused by drought (a reality that has already emerged this year), reduced energy from French nuclear plants due to prolonged maintenance (this has already occurred, too), or delays in the authorization process or completion of new regassification plants, including offshore plants. Such security margin could require as much as a further 8 bcm of gas in a worst-case scenario (in the case that more than one of the above-mentioned issues were to occur at the same time).

At CESI, we have examined three scenarios to evaluate the extent to which a greater penetration of renewables – solar and wind energy – in the Italian electric system could contribute to reducing our natural gas imports, especially from Russia.

The simulation is based on the 40 GW of additional renewables by 2026 described in the EF Plan. The 40 GW are simply a starting point for our simulations; in reality, the added renewable capacity necessary to replace gas could be greater or minor.

In addition to 40 GW from renewables, our first scenario posits 5.7 GW of storage systems, the phase-out of coal, and a cost of \in 70/t for CO₂. The second scenario is identical to the first but entails a deferral of the coal phase-out. The third scenario

simulates the effects of a significant rise – over $\in 100/t$ – in the cost of CO_2 . We then simulated the mechanisms of the Day-Ahead Market and the Ancillary Services Market thanks to tools that we have developed in-house to verify the effects of gas savings in various cases.

Based on results, the first scenario, characterized by a phase-out of coal generation, would lead to a net saving of gas inferior to the full potential of renewables. Indeed, in this case, the 65 TWh produced by added renewable capacity would be used to replace the decrease in the production of thermoelectric energy caused by the coal phase-out (ca. 12 TWh). In general, this scenario presents an overall saving of 9 bcm of gas and would allow the country to pursue the decarbonization process established by the Integrated National Plan for Energy and Climate (PNIEC).

The second scenario, which hypothesizes a deferral of the carbon phase-out, would lead to a net saving of 11 bcm of gas, as the added renewable production would not be used to replace carbon generation. However, besides not respecting the decarbonization process envisaged in the PNIEC, this scenario is potentially exposed to risks related to the quotation of CO_2 offsets. In fact, unless EU policy were to be modified, the continued use of coal to produce energy would lead to an increase in the cost of CO_2 .

So, we examined the effects of CO_2 emissions priced above $\notin 70$ /ton. According to our analyses – assuming that the price of gas (in 3-4 years) may return to $\notin 40$ /MWh and that of coal to $\notin 14$ /MWh – it would be sufficient for CO_2 to cost $\notin 100$ /ton to make coal generation less competitive on the electric market than combined-cycle power plants. On the contrary, if prices were to remain high – $\notin 80$ MWh for gas and $\notin 40$ /MWh for coal – a $\notin 120$ /ton cost of CO_2 would be



sufficient to make coal less competitive than gas. Naturally, this would lead to a greater request of gas from Russia. For example, hypothesizing a price of gas at ≤ 40 /MWh and that of CO₂ at ≤ 100 /ton, gas savings would be halved to 5.5 bcm in comparison to the second scenario (and to 8 bcm if CO₂ were to cost ≤ 120 /ton with high prices for coal and gas).

In conclusion, 40GW of added renewables could generate ca. 65 TWh of electricity, corresponding potentially to ca. 13 bcm less of Russian gas (-44%). Taking into consideration the coal phase-out and all the market mechanisms (especially the Ancillary Services Market) and residual curtailment notwithstanding storage, the effective savings in gas would be reduced to 9 bcm. If, instead, the coal phase-out was to be deferred, the savings would amount to ca. 11 bcm. In the latter case, however, the risk that an excessive use of coal may lead to a significant increase in the price of CO_2 (a plausible hypothesis if ETS policy were not modified), could produce a paradoxical effect: the electric generation market would privilege gas over coal.

Thus, in order to avoid a colossal "own goal" in favor of Russia, we must make a few final considerations on the price cap that has been a major subject of discussion in Europe over the past weeks. A price cap would provide true benefits to consumers. If the price cap were imposed on the wholesale market, the theoretically most efficient solution would be to limit spot gas transactions (TTF Index). A price limitation would also transfer – through indexing mechanisms for gas supply contracts - to the electric market via a reduction of the marginal price set by CCGT gas plants. However, in implementing this mechanism, which would certainly help control the prices of both gas and electricity, it is important to take two factors into account: the possibility that part of the supply may withdraw from the TTF market, counterbalancing the effect of price control, and above all the price trend of CO₂ related to the Emissions Trading Scheme (ETS). Therefore, it may be appropriate and possibly even necessary to coordinate the introduction of a price cap on gas with a temporary policy reform of the ETS system to reduce the cost of CO₂. Indeed, this would also help the European manufacturing sector to contain the inflation generated by the increase in energy costs.



Industries & Countries

Global Solutions to Face the Energy Crisis

The production of oil has increased, during this transitional phase, to counter the problems caused to the energy sector by the Russian invasion of Ukraine; the outlook remains positive for the development of renewables, an objective for many countries, including those in the Gulf Area.

t only took 11 minutes, according to the Bloomberg News Agency, to sanction the need for an immediate, massive increase in oil production to counter the global energy emergency. Indeed, that was how long the videoconference meeting lasted, on June 2, between the 23 Opec+ members who accepted the request of many western states to increase the production of oil to counter the growing cost of energy, a result of the Russian-Ukrainian conflict. Headquartered in Vienna, Opec+ is the Organization of Petroleum Exporting Countries which, since 2016, includes ten new states. (The original organization was simply known as Opec.) Opec+ controls over half of the global production of oil and ca. 90% of all known reserves. The new agreement reached in June calls for the production of a further 648,000 barrels/day, both in July and August, over the 432,000 barrels/day increment decided just a few months ago to help contain prices. In practice, the increase in production that was scheduled for September was >implemented immediately.



For further information on this topic, please contact: Ulderico Bagalini (RES Integration & Interconnections Product Leader) ulderico.bagalini@cesi.it



OPEC and OPEC + Member Nations, 2019



The need to increase oil production > is yet another flag of the serious energy crisis engendered by Russian invasion of Ukraine. It entails a return to the use of fossil fuels that seems to contradict the commitment of many countries to implement an energy transition, with governmental programs and immense investments to support the development of renewable energy. In reality, this is a transitional phase, introduced by an unexpected political and (consequently) energy crisis for which the world - still under shock due to the consequences of the pandemic emergency - was not ready. Indeed, this crisis has provided a severe lesson on the vulnerability of the states that are energetically dependent on other countries and the need to overcome energy dependence through greater investments in renewables.

The IEA, which has often indicated how green energy will emancipate us from any type of energy blackmail, confirmed it in its May report entitled: "Renewable Energy Market Update". The study reveals how the Russian invasion of Ukraine has introduced a new priority: the need to fast-track the energy transition and reduce dependence on Russian fossil fuels. Thus, according to the International Energy Agency, the development of renewables has become a strategic imperative for many countries, also based on the competitiveness of renewable technology, in terms of cost, compared to the high cost of fossil fuels.



the results achieved during a complicated year like 2021. Added renewable capacity increased by 6%, reaching a record of nearly 295 GW, notwithstanding the supply chain issues caused by the pandemic, construction delays, and the record cost of raw materials. Moreover, while there was a 17% global decrease in annual added wind capacity, this was compensated by an increase in solar photovoltaic power and the development of new hydroelectric plants.





Net Renewable Capacity Increase by Country and Region, 2019-2021

IEA. All Right Reserved



Increased Renewable Capacity in China, European Union, United States, and India, 2019-2023



China Leads the Renewables Outlook for 2022-23

In its geographical analysis of the global energy scenario, the IEA points out that China accounts for 46% of the added renewable capacity worldwide. This means that new Chinese capacity dropped by 2% on an annual basis due to a decrease in the installation of wind farms (-55%) and solar photovoltaic plants (-22%) compared to the record levels of 2020, when many projects were completed to meet the deadline for state subsidies. However, this negative aspect was compensated by annual additions in offshore wind energy, residential solar photovoltaic power, and bioenergy, which reached new records thanks to the availability of subsidies through 2021. Moreover, the commissioning of various units at

the Baihetan Plant contributed to accelerating the production of hydropower. And this positive trend is expected to continue. According to the IEA study, China has the best outlook for 2022-23, notwithstanding the gradual elimination of the incentive program for renewable energy. This is due to both to the market and national factors. In terms of market, generation costs for solar photovoltaic and onshore wind power are inferior to the cost of coal in most Chinese provinces. At a national level, the Chinese government has announced large-scale onshore wind and solar photovoltaic projects for 450 GW in the Provinces of Xinjiang and inner Mongolia. Thus, over 2022-23, China will account for 45% of the global added renewable capacity thanks to the commissioning of over 140 GW/ year on average. In this context, China is fully aligned with the objective to achieve an installed capacity of 1200 GW of wind and photovoltaic power by 2030.

Increase in Average Added Renewable Capacity by Country and Region, 2016-2023



Europe Fast-tracks the Development of Renewables. French Nuclear Power does not Stop Its Commitment for Solar Energy.

After China, the European Union was the second market, in 2021, in terms of largest renewable capacity. Many states - such as Germany, the Netherlands and Portugal announced plans to fast-track the development of green sources, increasing the ambition of their plans or advancing the initial objectives to reduce their energy dependence on Russian gas. The IEA believes that it will not be possible to evaluate the impact of these new policies before 2023, as large-scale projects require development over more than 18 months. In addition to the initiatives fielded by individual member states, the European Union has decided to enact new measures to rapidly counter the turbulence on the global energy market caused by the Russian invasion of Ukraine. The main objectives of the new plan - REPowerEU – include the production of green energy, energy saving actions, and the diversification of energy supplies. The EU believes that the transition towards green energy will help contain the cost of energy and reduce the dependence on energy imports from other countries.

Thanks to the new plan, the European Union aims to boost its 2030 objective for renewables from the current **40% to 45%**. Thus, REPowerEU should increase the total production capacity of renewables to **1,236 GW**, by 2030, over the **1,067 GW** planned in the "Fit for 55" package. Moreover, the EU strategy promotes the integration of a further **320 GW** from new solar photovoltaic installations by 2025 – double the current level – and nearly **600 GW** by 2030. From this supplementary capacity the EU should be able to consume a further **9 bcm** less of natural gas per year by 2027, compared to today's levels.

The plan also calls for greater energy efficiency, increasing the objective from 9% of energy consumption to 13% by 2030. And further measures aim to substitute coal, oil, and gas in industrial processes to drastically reduce dependence on Russian fossil fuels and promote the transition towards cleaner energy resources, bolster industrial competitiveness, and support the EU's technological leadership at an international level.

The European Commission believes that electrification, energy efficiency, and a wider use of renewables will allow industry to consume **35 bcm** less of natural gas by 2030, a result that exceeds the objectives of the "Fit for 55" package. According to the estimates, the greatest gas reduction – **ca. 22 billion cubic meters** – will be achieved by the non-metallic minerals, cement, glass, and ceramics industry, as well as chemical products and refineries. A further objective pursued by these measures is the decarbonization of steel production in the EU by 2030 through the use of **renewable hydrogen**. Moreover, a new European energy platform will play a fundamental role in aggregating demand, coordinating the use of infrastructure, negotiating with international partners, conducting joint purchases of gas and hydrogen, and cooperating on green technology and innovation. In the meantime, the data crunched by analysts confirms that **solar photovoltaic** presents the greatest potential for the EU. In fact, last year it registered the greatest increase in Spain, France, Poland, and Germany. And the forecast is for continued growth, driving photovoltaic growth over 2022-23 in Italy and the Netherlands, too. The forecast is negative instead for onshore wind power due to the authorization delays experienced by various projects in Germany, Poland, and Italy.



Average Annual Production of Electricity from Natural Gas, 2016-2021, and Increase in Production from Renewables in Member States, 2021-2023

The story is altogether different for offshore wind power. Strong winds blow across the North Sea, where a large wind farm will be developed to produce 65GW by 2030, equivalent to over half of the European Union's current total installed capacity. The project, which involves Germany, Holland, Denmark, and Belgium, aims to increase regional offshore wind energy capacity tenfold, with private sector investments totaling €135 billion. Once completed, the plant will provide electricity to 200 million families. Moreover, besides providing energy for domestic consumption, the wind farm will satisfy industrial energy demand, providing electricity to the steel industry, for example, which aims to stop using oil and gas. The project also entails the production of hydrogen that will also be distributed through the reconversion of the existing pipelines in which Germany has invested heavily.

Another important aspect of the European scenario is represented by the French energy market. Indeed, France is the only EU country that makes a wide use of nuclear energy, which supplies it with three quarters of its electricity. Nonetheless, the use of nuclear energy has not solved the issue related to the diversification of sources as electricity only accounts for 25-30% of French energy consumption. Thus, France is committed to the development of solar photovoltaic, too. The advantages of French nuclear energy include cheap electricity, as the plants have been in operation for decades, the initial investments have been completely amortized, and operational costs are contained. New plants, however, such as the Flamanville 3 Plant, which was initially forecast to cost €3 billion, pose a problem. Electricité de France claims to have spent €12 billion, while the French Court of Audit claims that €19 billion were spent on the plant. A further issue concerns the time necessary to deliver the plant for which construction work began in 2007. It should finally be completed in 2022, after many delays.

Nuclear energy, which has been proposed to be included in the new EU taxonomy for sustainable activities, generates very few greenhouse gas emissions in the production of electricity. However, the increasingly frequent and intense heat waves and droughts brought about by climate change pose a serious problem to the operation of nuclear plants, and this is exactly what occurred in France during the months of May and June. As nuclear plants pump in cold water from rivers (or the sea) to cool reactors and then pump out warm water (based on temperature-controlled limitations), the significant drop in the water levels of the Garonne and Rhone rivers led French electric utility EDF

to forecast a reduced production of energy. And while this issue previously only caused interruptions during the height of summer, it now occurs in May, too.

United States: A Negative Outlook for Renewables, but LNG Exports to EU Grow

According to the IEA, the forecasted development of renewables in the United States has been slowed down by political uncertainty and trade measures that hinder a short-term increase in wind and solar photovoltaic energy. In fact, not only are there still doubts on national incentives, but the import of polysilicon from companies in Xinjiang, China have also been forbidden (due to the suspect of forced labor). Just a few months ago, the United States Department of Commerce initiated a new investigation to evaluate whether solar cells officially from southeast Asia (Vietnam, Malaysia, and Indonesia) were actually being produced with Chinese components and therefore subject to the duties imposed in 2018. This would imply additional tariffs and further reduce the availability of photovoltaic solar modules. Thus, the IEA lowered its expectations for solar photovoltaic in the United States by 17% for 2022 > and 9% for 2023.



2022 and 2023 renewable capacity forecast revisions, December 2021 vs May 2022

IEA. All Right Reserved

Declining Share of Fossil Fuels in U.S. Power Generation

In the power sector, the overall market share for fossil-fuel generation—coal, gas, and petroleum liquids has been shrinking, while renewables—utility-scale solar, wind, and hydro—continue to rise.

Source: U.S. Energy Information Administration

In order to better understand the America scenario, this description should be supplemented by the long-term forecasts included in the Institute for **Energy Economics and Finance's (IEEFA)** new "U.S. 2022 Power Sector Outlook - The Renewable Energy Transition Takes Off" Report. While wind, solar, and hydroelectric energy currently represents ca. one fifth of energy production, IEEFA expects this quota to rise to one third by 2027, concluding that between renewable energy and nuclear plants, the United States could generate more than half of its electricity from carbon-free sources by 2027, a massive transition compared to just five years.

According to the IEEFA Report, the production of electricity from natural gas in the United States probably peaked in 2020, as wind and solar energy – which are both cheaper – are eliminating gas generation from the electric network.

The war between Russia and Ukraine, which has led to a global energy crisis, is changing the scenario. The United States, a global leader in LNG (Liquified Natural Gas) exports, has offered to provide the European Union with the fuel necessary to become independent from Russia. A significant percentage of American gas is produced by (hydraulic) fracking, a drilling technology for the extraction of natural oil and gas from deep underground. The process entails the injection of liquids and other materials, at a high pressure, to extract the fossil fuels by creating fractures in shale rock formations, a porous stone that stores natural gas and its liquid components. In 2019, the United States became energy independent thanks to its production of shale gas and shale oil. This was a true energy revolution for the United States. indeed, between 2007 and 2016, the annual production of US oil increased by 75%, while the production of natural gas rose by 39%, thanks to technological progress in horizontal drilling and fracking.

While, notwithstanding all of these results, the current additional gas demand required to help European countries has increased its price in the United States to the highest levels in the last 13 years, the United States still seems capable of avoiding the use of coal, a trend that has been sparked by the energy crisis worldwide. In fact, the use of coal continues to decline in the United States and many major electric companies, including the Tennessee Valley Authority, Duke Energy and Georgia Power, are planning to completely eliminate coal by 2035 and shift to the cheaper renewables.

Latin America and Africa: A Marked Increase in Photovoltaic Energy

The IEA expects a significant rapid growth of photovoltaic energy in other regions of the world, especially in Latin America, with a sharp rise in the distributed photovoltaic market in Brazil. The forecast is also outstanding for sub-Saharan Africa, where development banks are driving the development of industrial photovoltaic, wind, and hydroelectric projects.

Increased Renewable Capacity in Brazil, ASEAN, Middle East and Africa, 2019-2023

At the presentation of the "African Energy Outlook 2022" Report, at the end of June, IEA Executive Director Fatih Birol pointed out that, in reality, only 7% of the total climate-related funding provided by advanced economies to developing countries is destined to African countries. "I believe," Birol explained, "the greatest obstacle to African economic development is its lack of access to energy." According to the IEA Report, ca. 600 million people in Africa (43% of the population) have no access to electricity. Universal access to power could be achieved by 2030 with an investment of US\$25 billion/year, equivalent to just 1% of the total global investment in energy. However, analysts at the International Energy Agency point out that although the necessary funding is minimal at a global level, Africa would need to produce a further 90 bcm/year of natural gas by 2030 to industrialize the continent.

Diversifying Energy in the Oil-producing Gulf Countries

It is interesting to note that the IEA forecasts excellent results for solar photovoltaic in the Middle East, the area with the greatest global oil reserves: 833.8 billion barrels at the end of 2019, or nearly half of the total reserves worldwide. And the **Gulf Area has the greatest reserves**: Saudi Arabia (ca. 300 billion barrels), Iran (155.6 billion), Iraq (145), Kuwait (101.5), UAE (97.8) and Qatar (25.2). **This region accounts for one third of global oil production**. Saudi Arabia is first in the region – and second globally after the United States – with an average daily production of 11.8 million barrels per day in 2019, followed by Iraq (4.7), United Arab Emirates (3.9), Iran (3.5), Kuwait (2.9) and Qatar (1.8).

Notwithstanding their enormous wealth in oil, both Saudi Arabia and the United Arab Emirates, especially, have been seeking to diversify their economies. An illustrious example is **NEOM**, the futuristic Saudi city on the Red Sea that will host the world's largest plant for the production of green hydrogen. In the meantime, 2019 also witnessed the inauguration of Sakaka, a 300 MW solar plant in the Province of Al Jouf, while the objective of the grand Saudi *Vision 2030* Project is to produce 40 GW of photovoltaic and 2.7 GW of thermodynamic solar energy. The United Arab Emirates **aim to produce 44% of renewable energy by 2050**, and they are working on the development of the **largest plant for the production of solar energy worldwide**: the Mohammed bin Rashid Al Maktoum (MBR) Solar Park, with a productive capacity of 5 GW. In June, the UAE confirmed their commitment to sustaining the energy transition through national and international investments amounting to US\$163 billion to diversify the country's energy mix.

The energy policies of the UAE and Saudi Arabia seem to address two complementary levels: the development of renewables as a priority for the production of energy for domestic consumption, while exploration and exploitation of oil for exports continue at full speed to satisfy the external demand (that has markedly increased with the Russian-Ukrainian war). However, in order to gain a complete picture of what is happening in the Gulf Area, it is important to emphasize the use of natural gas as a transition fuel. In this case, the UAE continue to rely on natural gas imports from Qatar, while Saudi Arabia satisfies its demand internally.

Future & Technology

Innovation and Reliability: Moving Beyond Fossil Fuels

CESI activities contribute to overcoming reliance on fossil fuels and developing flexible, interconnected, and sustainable energy systems.

f we continue to postpone our objective of limiting global warming to one and a half degrees, the risk is that it may become impossible to achieve." At the beginning of June 2022, Francesco La Camera, Director of the International Renewable Energy Agency (IRENA), emphasized the fact that the Ukrainian crisis should be construed as a scenario factor to fast-track renewables. "Reactivating coal plants or intensifying the extraction of natural gas," he explained to the Green&Blue monthly, "could have a negative impact on our fight against climate change, when it really should push us to increase the use of our unlimited and clean natural resources. Notwithstanding our reliance and the weaknesses of the energy system, the trend towards renewables is clear and indisputable. In the United States, coal plants are being shut down. Issues with wind and photovoltaic energy? Italy has the tools necessary to produce all the energy it requires from these sources. However, Italian renewables auctions do not function efficiently because enterprises must face all the costs for the development of plants. We all need to work in the same direction."

According to IRENA, in order to respect the Paris Agreement, the installed capacity of renewables must be tripled every year. While in 2020, 260 GW of new renewables were added (50% more than the previous year) and,

in 2021, 295 GW were added, La Camera believes that we are still far behind the current need. The pandemic and consequent lockdown allowed us to reduce CO_2 emissions and increase the use of renewables, with an impact even on the energy sector. If, as many parties believe, we have the opportunity to convert the current crisis into an opportunity to transform the energy sector into a more "resilient" system, one that can adapt to and survive a constantly changing scenario, then recent technology contributing to the energy transition must play a fundamental role.

The measures enacted during the pandemic have also highlighted the need to create smart networks that can counter the sudden changes imposed by extreme scenarios, based on a concept of resilience that no longer only addresses climate change and extreme atmospheric events (hurricanes, droughts, freezing temperatures). Due to the unprecedented variations in the demand for power and the generation mix during the lockdown, all countries were forced to make rapid changes to counter the extreme conditions and allow their electric systems to ensure the stability of networks and continuity of service. In conjunction with the urgent actions needed to make the systems more flexible, countries must also avoid the worst consequences of climate change. They must continue to reduce CO_2 emissions with technological innovations promoting the transition of the energy market.

Flexibility and Resilience

At the forefront in the development of a flexible and resilient energy market, CESI provides its stakeholders with a wide portfolio of innovative solutions. With regard to fundamental testing, inspection, and certification activities, at its KEMA Labs Division, CESI provides services for all the main components of electric energy transmission and distribution systems, based on a new system that efficiently satisfies client demands through cutting-edge resources and high-level skills worldwide.

In its seven KEMA Labs (from Holland to Italy, and Germany to the United States), CESI evaluates the development of the most important electromechanical components for the electric system – cables, switches,

For further information on this topic, please contact:

Alessandro Bertani (Services & Smart Technologies Director – CESI) alessandro.bertani@kema.com Bruno Cova (Advisory Services & Studies Director – CESI)

bruno.cova@cesi.it

Stefano Malgarotti (Engineering Consulting Director – CESI) stefano.malgarotti@cesi.it electrical panels and control cabinets, transformers, and insulators, from low to extremely high voltages. The tests aim to verify the correct operation of the products from an electrical, mechanical, and climactic/ environmental point of view, during both the initial research, development and prototyping phase, and the more advanced production stage. The tests guarantee the security and resilience of networks and the electric system as a whole. Every year, KEMA Labs are called to test over 200,000 components for over four thousand clients, worldwide.

At the Flex Power Grid Laboratory in Arnhem (Netherlands), KEMA Labs helps producers to test and verify energy storage systems in realistic, but controlled conditions. Through a connection to a flexible network (that imitates grid conditions and allows parameters such as frequency and tension to be varied), the tests conducted at the Flex Power Grid Laboratory reveal, for example, the principal role played by inverters in determining the network performance of energy storage systems. Another use is to verify the behavior of systems, both in standard and extreme conditions, by varying frequency, over and under-voltage, network pollution, etc.

Market Impact Analyses

At the international level, besides providing consulting and business strategy services for energy sector investors, CESI also conducts analyses to identify recommended regulatory action and smooth the roadmap for future investments in the sector. In addition, CESI develops the necessary technical requisites for integrating non-programmable renewable energy sources in transmission and distribution systems, as well as impact analyses and studies on conformity to network regulations for new plants driven by renewables. Considering the complexity of future electric systems, CESI has developed a series of electric market simulators that allow it to identify both the need for and profitability of investments in storage and other systems to make electric systems more flexible, based on the forecast of market scenarios and regulations, as well as the performance of batteries and the evolution of technology in general. The simulations conducted by CESI identify the most profitable services between storage and other systems increasing network flexibility (i.e., vehicle grid integration) and allow an accurate risks analysis. CESI also uses these tools to conduct global studies on various elements, including the key role of batteries for the integration of non-programmable renewables in the power grid.

In other studies, conducted in sub-Saharan countries (such as Ethiopia, Kenya, and Zambia) for **RES4Africa** and the Enel Foundation, it was important to evaluate the efficiency of electrochemical and hydraulic storage systems during periods of extreme drought. Another objective concerned the integration of non-programmable renewables in the national electric systems. The growing penetration of wind and photovoltaic technology was analyzed over the medium and long term (Horizon 2025 and 2030), assessing its impact on the reliability, durability, and efficiency of electric systems. In this context, the exploitation of the vast potential of renewable energy

in sub-Saharan countries can be driven with the development of new cross-frontier interconnections as a key strategic driver for the exportation of energy towards areas that lack such resources and in which the cost of energy is consequently higher.

In mid-June 2022, at the South Africa Conference, CESI presented a number of studies that the Group is conducting for RES4Africa on the issue of the penetration of renewables in the South African electric system. The idea is to support an increase of renewables through geospatial RES modelling, keeping in mind unbundling costs related to production, transmission and distribution networks, and the sale of energy. Together with the presentation of the case studies most emblematic of the "revised" energy sector and the integration of renewables, CESI presented a geospatial analysis (with a resolution greater than 5x5 kilometers) that can be used to explore the value of green energy sources throughout South Africa. The objective is to support the identification of the most appropriate network connection options and opportunities to plan the layout of the network.

In the Arabian Peninsula, in Oman, CESI is providing consultancy services for the integration of renewables. The activities, which concern the development of standard and regulations for the country's electric energy authority, aim to guarantee that the solar photovoltaic plants connected to the distribution network do not affect the security and reliability of the electric infrastructure and supply quality. One of the first strategic steps in this operation was the project commissioned to CESI to update the masterplan for the transmission system of the **Oman Electricity Transmission Company** (OETC) to 2040. The objective is to define the best technical and economic options for the long-term development of the transmission system, based on the OPWP (Oman Power and Water Procurement Company) generation plan, and promoting an integration with > RES capacity. In terms of sustainability,

the CESI plan is aligned with the United Nations' SDGs. In fact, the guidelines call for an increase in the production of emission-free energy from wind and photovoltaic plants with a flexible network capable of countering intermittent generation, as well as providing a reliable supply throughout the country, the integration of rural areas and the development of non-conventional transmission assets to mitigate environmental impact.

Energy Storage to Drive Renewables

Testing is fundamental to guarantee that the entire ecosystem reach the maximum level of efficiency and reliability, thereby allowing decisions to be made more rapidly on the basis of real-time data and processes that satisfy the needs of clients. Industrialized countries with advanced technological networks, like Italy, have a greater resilience of electric systems is pursued through smart grid innovation. Energy storage is a particularly efficient tool to drive the exploitation and integration of renewables. Batteries (both utility-scale and behind-the-meter) and hydrogen (renewable power-to-hydrogen) allow vast quantities of non-programmable renewables to be stored; the energy can then be released subsequently per a schedule.

CESI activities for grid modernization include a project developed for HECO, the Hawaiian utility, through which EnerNex, our American subsidiary, contributed to the development of a plan that will allow Hawaii to reach the objective of using 100% renewable energy by 2045, notwithstanding all the issues related to managing an isolated network. Moreover, CESI has also worked with EnerNex with Southern California Edison (SCE) on implementing smart grid applications as an integral part of the plan for the modernization of networks in the United States. Indeed, CESI has also helped various European TSOs identify the storage plants requisites necessary to provide essential network services.

HVDC and Offshore Wind Power

The energy transition challenge is based on the convergence between technological innovation and the new interconnections between economic systems and countries. Notwithstanding the many innovative solutions that interest the entire supply chain of electric energy, from generation to final users, the significant role of network infrastructure is firmly bound to the issue of the interconnections required to connect the energy demand of consumption centers to the areas that produce the greatest quantity of renewables. While these lines are currently used for cross-frontier energy exchanges as a result of short-term market mechanisms, in the future, as the use of renewables increases for the generation of power, they will have to be more carefully monitored.

In terms of offshore wind power, one of the new frontiers in the quest for renewables, according to the European Commission, by 2050, we will need between 240 and 450 GW of offshore wind energy from European seas and coasts to keep the increase in global temperature below 1.5°C. The plan is to expand offshore wind power produced in the North Sea by 300GW by 2050. However, special variables like weather conditions and long distances, present unprecedented challenges to the development of new transmission lines, both in terms of maintenance and the availability of components.

The growing number of interconnections (between different countries or within larger

countries) calls for an increase in HVDC technology to transport energy over long distances, even via submarine cables, in order to generate greater resilience for electric networks and a less significant technological-environmental impact than traditional AC lines. In this context, HVDC switches will become fundamental components for the management of complex systems, guaranteeing the selectivity against failures in large offshore HVDC systems. Furthermore, the increasing dimension of offshore wind farms, their turbine capacity, and their (consequent) distance from the coastline will also drive an increase in operating voltages in order to guarantee the transmission of high power with little dissipation.

Based on its experience with a wide range of technology, as well as cables and overhead lines, CESI can support its clients over the entire lifecycle of HVDC infrastructure. In this context, CESI activities are especially significant for the PROMOTIoN Plan (Progress on Meshed HVDC Offshore Transmission Networks), launched by the EU in 2020 to guide the development of new generation networks. In terms of interconnectivity, which allows massive energy flows between different areas, the last ENTSO-E Ten-year Network Development Plan calls for a 35 GW increase in cross-frontier capacity by 2025 and 93 GW by 2040. KEMA Labs plays a pivotal role in the plan as it tested three types of HVDC switch technology - from 80 to 350 kV - in its high-power lab. Moreover, the KEMA Labs in Arnhem (Netherlands) conducted a long-term test on a GIS HVDC (320 kV).

Furthermore, in May, KEMA Labs conducted the first TOV (Transient Over Voltage) test on a system of 525kV CC cables, produced by the Prysmian Group R&D. This new and important milestone for the HVDC cable sector was achieved by KEMA Labs Mannheim HVDC. These are the first tests of this kind in Europe, and they are fundamental to guarantee the increasingly vital role of offshore HVDC networks and achieve the EU objective of total decarbonization by 2050.

Opinions

A Route to Independence that's not trouble-free

The European Commissioner for Energy has proposed an action plan to prepare for the winter in case Russian gas supplies are interrupted. In this issue of Energy Journal, in the section traditionally dedicated to interviews, we have summarized the outlook of four institutional representatives on the current geopolitical and energy scenarios.

Hydro

zero

resenting the EU Commission proposal addressing the reduction in Russian gas supplies, EU Commissioner for Energy **Kadri Simson** announced that next winter will represent a test for the European Union's energy system and Europe as a whole. "The emergency plan entails a 15% reduction in the consumption of gas, from the first of August to the end of March, on a voluntary basis, as compared to our average consumption over the past five years."

We also extracted some declarations by **Michael Regan**, Administrator of the United States Environmental Protection Agency. Speaking about regulatory tools, Regan believes that modifying the regulations on coal-driven plants would make some of them too expensive to operate and many would have to shut down. "The best tool to reduce greenhouse gas emissions is to convince investors to put their money elsewhere. This would allow old plants to be shut down ahead of schedule."

In an interview with Italian daily *La Stampa*, **Thierry Breton**, the European Commissioner for the Internal Market, reviews the key points of the plan to enact in case Russian gas supplies were interrupted. The solutions include LNG, new gas supplies from North and East Africa, and support for biomethane, wind, and solar energy.

In conclusion, we present a few short extracts from the analysis of **Thierry Bros**, Professor of Energy and Political Science at the University of Paris. Bros addresses how the world might need to expedite its plans for green energy, after having overlooked clean energy options when fossil fuels were readily available.

bgen H_2

emission

Kadri Simson

EU Commissioner for Energy

In early May 2022, speaking about sanctions to Russia, Kadri Simson announced a possible two thirds reduction in Russian gas imports by the end of the

year: "By 2030, we aim to eliminate 100% of Russian gas. In this context, renewables are a key aspect; we need a faster plan. Following the recent interruption in Russian gas supplies to Poland and Bulgaria, it is evident that all member states must have plans in place to counter a possible total interruption of supplies."

In June, the EU Commission signed a joint declaration with Norway for a 9% (or 100 TWh) increase in gas supplies (compared to 2021) to the European Union. "Norway has significant oil and gas reserves and is capable, through new explorations, discoveries and improvements to continue acting as a long-term European supplier, even beyond 2030," Simson declared. "The Scandinavian country already satisfies the equivalent of ca. one four-th of EU gas consumption. CO_2 and methane emissions from the Norwegian upstream are less than half that of the global average."

At the end of June 2022, the EU Commissioner for Energy presented a six-point plan to the EU Council to prepare for winter in case Russian gas supplies were interrupted. "First, we need to guarantee monitoring and strengthen coordination, even during the summer months. Secondly, insofar as possible and without jeopardizing our objectives, we have to compensate for the consumption of gas with other fuels, in industry, but also for electricity and heating. Thirdly, we need to increase preventive savings and energy efficiency for industry, as well as families. And we have identified a series of measures that could rapidly reduce our consumption of oil and gas by 5%. Fourthly, member states must update their emergency plans and close all pending solidarity agreements. The fifth point is that the Commission will present a coordinated plan to reduce demand, including an updated scenario analysis for next winter together with a set of good practices and guidelines to promote gas savings, especially in industry. The last point is that we must redouble our efforts to diversify supplies, without competing against each other."

On July 20, Kadri Simson presented the EU Commission proposal to address the reduction in Russian gas supplies. "Next winter," she declared at a press conference together with the President of the European Commission, Ursula von der Leyen, "will be a test for the EU energy system and for all of Europe. A full interruption in Russian supplies would leave a 30 bcm gap between demand and supply in the EU. The emergency plan entails a 15% reduction in the consumption of gas, from the first of August to the end of March, on a voluntary basis, as compared to the average consumption over the past five years." If this were not sufficient, the Commissioner added, we many have to oblige member states to reduce their consumption levels.

Michael Regan

Administrator of the United States Environmental Protection Agency

According to the Financial Times, in March, Michael Regan, the Administrator of the Unite States Environmental Protection Agency, pointed to the

fact that the increase in the cost of oil was a signal of how the United States were, to a certain extent, held hostage by fossil fuels. And that an increase in the production of renewable sources would leave the country far less exposed to future risk. If we were to invest money in clean energy, Regan pointed out, American citizens wouldn't feel the brunt of the economy every time they have to fill up their cars.

The EPA Administrator has also been active on the regulatory front. At the end of June, at a panel organized by the Aspen Ideas Festival, Regan explained that following a recent pronouncement by the Supreme Court (which limited EPA's scope to fight climate change), the EPA had presented a further series of regulations to the energy sector addressing water, waste, and air quality. Compared to natural gas and coal plants, which produce ca. 30% of national carbon dioxide pollution, the Biden administration aims to halve CO_2 emissions by 2030 and guide the energy sector towards the net zero emissions objective by 2040.

"While the decision of the Supreme Court may slow down our commitment to achieve these objectives," the EPA Administrator warned, "it has not taken away our right to regulate greenhouse gasses." Regan declared that the agency would adopt an even more aggressive approach against other polluters (such as vehicles and the Oil & Gas Industry), limiting the use of hydrofluorocarbons, the chemical substances causing global warming used in air conditioners and refrigerators.

Modifying regulations for coal-fueled plants may make some plants too expensive to operate, and many would end up shutting down. "The best tool to reduce greenhouse gas emissions is to convince investors to put their money elsewhere. This would allow old plants to be shut down ahead of schedule."

Thierry Breton

European Commissioner for the Internal Market

In an interview with Italian daily *La Stampa*, **Thierry Breton**, the European Commissioner for the Internal Market, pointed out that the energy

mix depends exclusively on the decisions of member states. "Today, we are facing a difficult situation. Europe imported 155 bcm of gas from Russia; Italy, alone, purchased 20% or 30 billion bcm of Russian gas. Some states were more prudent and diversified, guaranteeing the security of supply. Italy decided to insert 40% of gas in its mix, more than a third of which is supplied by Russia. This dependence is the result of such a choice."

As Commissioner for the Internal Market, Breton had to devise a plan to face a possible interruption in Russian gas supplies. "There are two different tables," he explained. "The first concerns sanctions. The heads of state governments decide whether to block Russian gas supplies, as its purchase finances the war with US\$800 million a day. Or perhaps, Russia might interrupt supplies to punish the European Union. Our plan calls for the substitution, by the end of the year, of 50 bcm of gas with an increase in LNG supplies, although we obviously have to upgrade our regassification capacity. Moreover, we can reduce consumption by lowering the temperatures on our heaters and air conditioners, thereby saving ca. 14 bcm of gas. Lastly, we could save a further 25 bcm by fast-tracking biomethane and wind and solar energy projects."

These measures would allow the substitution of ca. 100 of the 155 bcm that Europe imports from Russia every year. However, if supplies were to be suddenly interrupted, there would still be a 50 bcm gap. "Extreme situations," Breton answered, "call for extreme measures. I'm referring to coal-fueled plants. We could decide not to close them or reopen them. This would allow us to provide a further 20 bcm of gas, 14 of them from Germany. The same is true for nuclear plants, which could guarantee the equivalent of 12.5 bcm of gas. We live in difficult times. There is a war underway, and countries need to agree on common purchases and storage strategies."

Thierry Bros

Professor of Energy and Political Science at the University of Paris

Thierry Bros, Professor of Energy and Political Science at the University of Paris, has a view similar to that of Commissioner Breton. He is worried that

the world may be forced to temporarily delay its green energy plans, after having snubbed clean energy solutions when there was an abundant supply of fossil fuels.

"Low-carbon emissions power sources represent less than 40% of the global production of electricity, a significant percentage, but one that remains insufficient. Moreover, compared to the average growth of renewables over the last ten years, in 2021, the upswing slowed down. And, unfortunately, that which is still not in production will not help us in the coming months ... My recommendation is to put the climate crisis on hold and immediately make use of everything we have available. Then, when the prices of fossil fuels begin to drop, we can invest in green technology. Cancelling years of progress on climate change may appear drastic, but we are facing a military crisis, an economic crisis, an energy crisis, and a climate crisis. We need to solve them one at a time, or we won't solve anything ..."

In short, Thierry Bros believes that Europe should fully substitute coal, oil, and Russian gas as rapidly as possible. "In this radically altered context, the European Union must recognize its energetic errors and take bold action. The only option is to initiate a three-phase embargo on the importation of Russian raw material into the EU: coal (immediately), oil (in the coming weeks), and gas (by the end of the year). Energy policy requires not only decades to be implemented, but also a thorough analysis of all aspects. The lack of a long-term outlook is the unforgiveable fault that has generated an increase in the demand for gas - from 25% in 2012 to 40% in 2019 well above the 33% quota set by European regulations on security of supply. It is our heavy dependence on Russian gas that prevents us from rapidly changing the situation: at least 25% of current gas imports cannot be replaced in the short and medium-term. And this makes Europe weak against Putin's policies and the use of energy as a weapon."

Photo thierrybros.com

News & Events

Upcoming Energy Event

EUSEW 2022

September 26-30

V Hybrid event

https://eusew.eu

The European Sustainable Energy Week is an annual event dedicated to renewables and the efficient use of energy in Europe This new edition is dedicated to "Going green and digital for Europe's energy transition" and includes a series of activities and conferences: a policy conference with sessions and debates on safe energy for future European generations; the presentation of the prestigious EUSEW Awards for European sustainable and renewable energy champions in four categories (Innovation, Local Energy Action, Woman in Energy and Young Energy Trailblazer).

WindEnergy Hamburg

September 27-30

Hamburg, Germany

www.windenergyhamburg.com

The biennial showcase for the wind and offshore sector will be hosted at the Hamburg Fair, where 1400 designers, producers, service suppliers and innovative companies working in the wind energy sector will meet to present products, solutions, and services. There will also be areas dedicated to technology and services for the hydrogen sector.

43rd ENERGY INTELLIGENCE FORUM

October 4-6

Q London, UK

www.energyintelligenceforum.com

A three-day forum gathering energy sector leaders to define sustainable solutions for the new challenges posed by the 21st century. Moreover, this year's event will have to address whether geopolitics and energy can be separated, as this issue is now at the top of all agendas. The Forum 2022 will provide energy sector decision makers and innovators from finance, politics, and civil society to discuss how to face the volatility and uncertainty of creating a reliable, cheap, and clean energy system for the future.

EXPOMOVE 2022: the Italian Expo on Electric Mobility

October 5-8

Florence, Italy

www.expomove.it

Sharing Mobility, public services and freight, components, and technology... these are just a few of the key issues that will be addressed by EXPOMOVE 2022, the Italian event dedicated entire to electric and sustainable mobility. In particular, the expo will focus on increasingly green innovative services for mobility in more enjoyable cities. There will also be test drive areas in which to try out the latest electric car, scooter, bicycle, and overboard models.

ZEROEMISSION MEDITERRANEAN 2022

October 12-14

Rome, Italy

www.zeroemission.show

This is the second edition of this international exhibition dedicated to the electrification of consumption, the decarbonization of energy, and environmental sustainability. This one event gathers all the supply systems related to energy generated from renewables to review innovation and sustainable technology through a complete overview of plants materials, development techniques, and innovative services and products. The program also includes conferences and workshops dedicated to new technology, regulations, and trends in the energy sector.

ENERGY TRANSITION NORTH AMERICA

November 9-11

Houston, USA

https://events.reutersevents.com/

The event brings together the main protagonists of the American energy sector, industry, and government to understand how to achieve net-Zero North America. In the aftermath of COP27, the event will help define strategies for the supply of safe, clean, and cheap energy, examining issues of leadership and finance. A special focus will be dedicated to technology and the innovations available to manage an electrified and decarbonized power network.

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

