Energy Journal

Issue 20 / October 2021

It's now Time to Make our Future Sustainable

With a statement by John Kerry for EJ

A magazine about energy and more by CESI

Energy Journal
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Editorial

What the World Requires Now Is Real Action

Starting from the present issue, our editorial is co-signed also by CESI's *new Chairman, Guido Bortoni* – former President and Commissioner of ARERA, the Italian Regulatory Authority for Energy, Networks and Environment. Mr. Bortoni' solid reputation and standing, as well as his profound experience – which spams across many decades – as one of Europe's top energy experts will provide an essential contribution to the future of CESI. In this issue of EJ, we publish an *interview* with him where he addresses the key challenges and opportunities of the energy transition.

Matteo Codazzi
CESI Group CEO

Guido Bortoni
CESI Chairman

Dear Readers,

We decided to focus this issue of Energy Journal to one central theme: sustainability. In the hope that national governments and regulators around the world, as well as local communities and other institutions, will collaborate through partnerships to foster real action. In this regard, our issue of EJ opens with an exclusive statement for our magazine by the Special US Presidential Climate Envoy, **John Kerry**: *"The impact of the climate crisis, from extreme heat to wildfires to intense rainfall and flooding, will only continue to intensify unless we choose another course for ourselves and the generations to come. All major economies must commit to aggressive climate action during this critical decade."*

Last year alone, the United States suffered 22 extreme climactic events that caused a total of US$95 billion damage to houses, companies, and public infrastructure. A study by the US Department of Energy has estimated that power blackouts cost as much US$70 billion a year to the national economy. The summer that just ended leaves us with a picture emblematic of the situation on our planet: The **NASA Fire Information for Resource Management System** published a dramatic map of gigantic global fires raging from Greece to Turkey, from Italy to California, from Australia to Siberia, the Amazon, and Africa.

In addition to the negative impact on people's health, in its recent "**Climate Change and Health**" Report, the WHO reaffirms that climate change has a high cost on the economy due to the damage it causes to both people and infrastructure. **McKinsey** forecasts that over the next 20 years, a medium-sized utility could lose up to US$1.7 billion in sales and maintenance costs.

We understand that just reinforcing energy networks may not be sufficient. In the foremost industrialized countries, those with technologically advanced networks, the greater resilience of electric systems is pursued through smart grid innovation, increased sustainable mobility, specific projects on energy efficiency, renewable generation plants, green energy storage, and investments to integrate low-carbon fuels including hydrogen as a new clean carrier and decarbonize key "hard-to-abate" sectors such as transport, steel, cement, and chemicals.

In the "Scenario" section, we report on how the increased competitiveness of green energy sources has driven IRENA Director General **Francesco La Camera** to introduce the results of the most recent **Renewable Power Generation Costs** Report with a simple sentence: *"Today, renewables are the most economic source of energy."* In 2020, according to the data in the report, 62% of the production of installed renewable energy (equivalent to 162 GW out of a total of 261 GW) was cheaper than that produced by new fossil fuel plants. Globally, the production of energy from ca. 800 GW of installed coal capacity costs more than the energy that will be produced by the solar photovoltaic and onshore wind farms that will be commissioned in 2021.

In line with the EU strategy for decarbonization, **CESI has produced a new study on the impact of hydrogen over the Italian future energy scenario**. Analyzing the impact that the Italian official hydrogen strategy will have on the national energy system, the study predicts that by 2030 hydrogen could provide a significant contribution to achieving the national decarbonization objectives. The CESI "**Italian Hydrogen Strategy: What Impact on the Power System?**" study, which is summarized in this issue of Energy Journal at page 34, concludes that 2% of the Italian demand for energy (ca. 25 TWh) may be satisfied by green hydrogen by 2030, in full accordance with the target set by the preliminary National Hydrogen Strategy. Moreover, to attain the target of annual green hydrogen production, a 5 GW of electrolyzer capacity is required for an investment of ca € 10 billion, excluding the investment on the additional RES power plants.

This exceptionally rich issue of Energy Journal also includes other articles of great interest. Besides John Kerry's statement, in the "Opinions" section, you will also find interviews with two prominent energy experts: **Massimo Garribba**, Deputy Director-General Responsible for the coordination of EURATOM policies – Directorate General Energy at the European Commission, and **Douglas J. Arent**, Executive Director of Strategic Public Private Partnerships at the National Renewable Energy Laboratory (NREL). In his interview, amongst various topics, Massimo Garribba has analyzed the strategy to make the EU carbon-neutral: a strategy based on three pillars, such as *"Prioritizing energy efficiency, with its great potential for energy savings; electrifying where we can, with a major focus on renewable energy; innovating where we cannot electrify, for instance with more low-carbon fuels and hydrogen."* On the other hand, Douglas J. Arent has offered an overview on decarbonization from the US perspective, underlying that *"Moving from an energy economy which is dominated by underground molecules to above ground resources and system dynamics implies a significant rethinking of countries' approaches to geopolitics, and is front of mind for many."*

Furthermore, the "One on One" section presents a comparison between green and blue hydrogen in which **Frans Timmermans**, Deputy President of the EU Commission, declares that *"Developing and implementing a green hydrogen chain of value, Europe will become a global pioneer and defend its leadership in green technology."* Finally, our "Top Story" is dedicated to the International Energy Agency's "**Net Zero 2050 Report.**" IEA published its Roadmap for the Global Energy Transformation towards net zero emissions that calls for reliable electric systems, energy efficiency, and sustainable investments to rapidly promote clean energy and reduce the use of fossil fuels, creating millions of new jobs, and driving economic growth.

Transitioning to a sustainable, greener global economy is our mantra at CESI. The world requires real action now. As trusted experts and advisors to key decision makers across the world, we are ready to embrace the challenge and provide our valuable contribution to a better world.

Guido Bortoni / Chairman, CESI
Matteo Codazzi / CEO, CESI

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

Issue 20 / October 2021

Contents

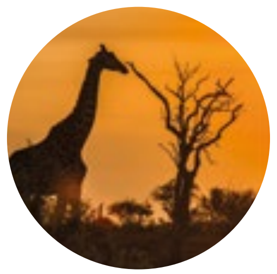
"The best way to predict your future is to create it."

***Abraham Lincoln**, 16th president of the United States*

News

Latest from CESI

South Africa



Renewables in South Africa: new study by CESI and RES4Africa.

RES4Africa Foundation, in cooperation with CESI SpA, released the study “Fostering RE within an Independent Network System scenario”. The report aims to present the most emblematic international case-studies of power sector reform and renewable integration in order to support the decision-making process that is currently undergoing in South Africa.Therefore, the study highlights how renewables can help South Africa to achieving ambitious goals in terms of capacity flexibility and deployment: the country is currently planning to add 6,000 MW of new solar PV capacity and 14,400 MW of new wind power capacity by 2030. In particular, the study by RES4Africa and CESI proposed a SWOT framework of analysis, and focused on some points of weakness, and potential threats affecting the electricity sector. The former comprises an inflexible and risk-prone generation mix, an insufficient and undermaintained transmission and distribution, difficulties in collecting payment and in curbing the theft of electricity assets and the abovementioned framework of political instability. For the latter, the report highlighted external threat elements represented by the stagnant economic outlook, the reliance on internationally-set commodity prices to GDP growth as well as the ever-pressing issue of environmental impact, exacting a toll in terms of lives and quality of living especially in disadvantaged areas.

> **“Fostering RE within an Independent Network System scenario.”**

E-mobility

New test bay for E-mobility components.

At KEMA Labs in Berlin (IPH) the commissioning of the new laboratory for testing automotive components has been recently completed. The brand-new design has been conceived for meeting the requirements of e-mobility market. Well-known automotive OEMs increasingly asked for facilities equipped with surge current generators to test DC switch elements like contactors, pyro-switches and fuses, with high current and most important very small inductance. The new system consists of 14 control cabinets with bidirectional DC power supply for charging and discharging the device under test up to a maximum of 1500 VDC, a capacitor bank up to 2 F to provide the necessary energy for a “shot”, an impulse generator, resistances and safety systems to set the current up to 35 kA. The unicity of this system is exactly the capability to provide high current (35 kA) at constant voltage (1500 VDC) for several milliseconds with an inductance < 10 μH. Furthermore, to ensure tests under severe environmental conditions, the test object can be placed within an explosion-proof climatic chamber. This new test system allows to switch the full current “on” and “off” several times without completely discharging the capacitor bank; in case the test object fails the circuit absorbs the entire energy of the capacitor bank without risks. Since at present there is no product standard for switchgears in electric cars, the requirements that relevant customers brought to KEMA Labs were decisive for the design and layout of the test bay.

> **“The brand-new design has been conceived for meeting the requirements of e-mobility market.”**

Guido Bortoni

CESI: Guido Bortoni appointed as new President of the Group

On October 1st, Guido Bortoni has been appointed as the new President of CESI SpA by the Board of Directors, following the appointment of the new Board by the Ordinary Assembly of the CESI S.p.A. Shareholders on July 14th. In the first Board of Directors meeting, which was held on July 15th, Matteo Codazzi has also been confirmed as Group Chief Executive Officer for the three-year period 2021 - 2023. “My gratitude goes to the CESI Shareholders, the new Board of Directors and the new colleagues who I hope to meet as soon as it will be possible,” Bortoni states, commenting on his appointment. “This is a return to the place in which my professional career moved its first steps – he adds – but, today, I come back to a much bigger, improved and more diversified CESI Group, which has the goal to support and inspire the players of the global energy transition through its testing and consulting services, integrated with civil and environmental engineering activities. This happened thanks to the know-how and expertise of those working at CESI and to the insight of the previous managements.” Previous to his appointment, Guido Bortoni has held several crucial roles in the energy sector for the EU Commission, Italian government, ARERA (of which he has been President from 2011 to 2018), Italian Electricity and Gas Regulatory Authority, as well as for several utilities in the USA and Électricité de France - études et Recherches (EDF), in Paris.

> **“This is a return to the place in which my professional career moved its first steps.”**

KEMA Labs

SF6 gas sustainable alternatives: solutions by KEMA Labs.

For decades, SF6 gas has been a crucial and effective element of HV technology. It is, however, highly pollutant, as it is the most potent greenhouse gas, having a CO_2 equivalent (GWP – Global Warming Potential) of 23,500. In terms of mass, the worldwide SF6 emission of around 9,000 tons per year is totally dwarfed by the 34 billion tons of total CO_2 emission recorded, but it still contributes to around 0.6% of the global greenhouse gas emission. As 80% of SF6 is stored in switchgear, mainly GIS, the electrical industry is moving away from SF6 and is searching for alternatives: in fact, bans of complete categories of SF6 switchgear by 2022, to begin with the secondary distribution level, are under discussion by the EU. In this respect KEMA Labs (CESI Testing, Inspection and Certification Division) has ample experience in testing all types of SF6 alternative and sustainable technologies in the medium- and high-voltage range. The availability of the SF6 alternative gases is then transferred to most existing manufacturers in the industry and is not the exclusive ownership of the product launching manufacturers.

> **“The electrical industry is moving away from SF6 and is searching for alternatives.”**

Opinions

John Kerry: Time is not on our side

In this statement, released in this format exclusively for Energy Journal, John Kerry – the first United States Special Presidential Envoy for Climate – says: «All major economies must commit to aggressive climate action during this critical decade. This is the critical decade for action, and COP26 in Glasgow must be a turning point in this crisis».

John Kerry

The first United States Special Presidential Envoy for Climate

On January 20, 2021, John F. Kerry was sworn in as USA first Special Presidential Envoy for Climate and the first-ever Principal to sit on the National Security Council entirely dedicated to climate change. In recent years, Kerry was the Carnegie Endowment for International Peace's first ever Visiting Distinguished Statesman, following his four years as the 68th United States Secretary of State.

From 1985 to 2013, he served as a U.S. Senator representing Massachusetts, and was Chairman of the Senate Foreign Relations Committee from 2009 to 2013. Secretary Kerry served in the U.S. Navy, completing two combat tours of duty in Vietnam for which he received a Silver Star, a Bronze Star with Combat V, and three Purple Hearts. He received his undergraduate degree from Yale University and his law degree from Boston College Law School.

«The latest IPCC Report, released last August, underscores the overwhelming urgency of this moment. The world must come together before the ability to limit global warming to 1.5 degrees Celsius is out of reach.
As the IPCC makes plain, the impacts of the climate crisis, from extreme heat to wildfires to intense rainfall and flooding, will only continue to intensify unless we choose another course for ourselves and generations to come. It doesn't have to be this way. We know that limiting warming to 1.5 degrees Celsius could help avoid future catastrophic changes.
But the report made abundantly clear that the international community's ability to do so is narrowing — requiring immediate, massive reductions in global greenhouse gas emissions, which must reach net-zero by mid-century — a scientific requirement to stabilize the climate and therefore our future. What the world requires now is real action. All major economies must commit to aggressive climate action during this critical decade. It's the only way to put us on a credible track to global net zero emissions by midcentury. We can get to the low carbon economy we urgently need, but time is not on our side. This is the critical decade for action, and COP26 in Glasgow must be a turning point in this crisis».

Scenario

A Global Challenge for Competitive Renewables

In response to the many studies and analyses that have confirmed the convenience of green energy, both in terms of technological and operative costs, the race for leadership in the renewables sector is intensifying. And the United States is back on the global scene.

The competitiveness of green energy sources is on the rise. So much so, in fact, that IRENA Director General **Francesco La Camera** presented these results with a simple phrase in the last issue of *Renewable Power Generation Costs: "Today, renewables are the most economic source of energy."* Data from the recently published report reveals that, in 2020, the use of renewable energy sources doubled. They now cost less than the cheapest fossil fuels. In fact, in 2020, 62% of the production of installed renewable energy (equivalent to 162 GW out of a total of 261 GW) was less expensive than that produced by new fossil fuel plants.

And this phenomenon has proven constant over time according to the annual IRENA study that highlights how the cost of renewable technology has diminished significantly, year after year. In particular, the report indicates (for 2020) a 16% decrease in the levelized cost of electricity (LCOE) from concentrated solar energy plants (CSPs), a 13% decrease from onshore wind farms, a 9% decrease from offshore wind farms, and a 7% decrease from the cost of solar photovoltaic energy as compared to 2019. Thus, the economic convenience that has been achieved by renewables provides both developed and developing countries with a valid reason to progressively eliminate fossil fuel resources and especially coal. According to the forecast of the International Renewable Energy Agency, new green energy projects implemented in 2020 will allow emerging economies to save as much as US$156 billion.

>

For further information on this topic, please contact:
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Total installed cost, capacity factor and levelised cost of electricity trends by technology, 2010 and 2020

	Total installed costs (2020 USD/kW)			Capacity factor (%)			Levelised cost of electricity (2020 USD/kWh)		
	2010	2020	Percent change	2010	2020	Percent change	2010	2020	Percent change
Bioenergy	2 619	2 543	-3%	72	70	-2%	0.076	0.076	0%
Geothermal	2 620	4 468	71%	87	83	-5%	0.049	0.071	45%
Hydropower	1 269	1 870	47%	44	46	4%	0.038	0.044	18%
Solar PV	4 731	883	-81%	14	16	17%	0.381	0.057	-85%
CSP	9 095	4 581	-50%	30	42	40%	0.340	0.108	-68%
Onshore wind	1 971	1 355	-31%	27	36	31%	0.089	0.039	-56%
Offshore wind	4 706	3 185	-32%	38	40	6%	0.162	0.084	-48%

In fact, the report highlights the convenience of renewables both in terms of technological costs and operational costs compared to coal plants in many countries, which means that energy produced from coal is no longer a valid economic alternative.

Here are some examples: In the United States, 149 GW, which correspond to 61% of the total coal plant capacity, cost more than the new capacity of renewables. Substituting these plants with renewable energy ones would allow the country to save US$5.6 billion/year and reduce their carbon footprint by 332 million tons. In India, 141 GW of installed coal capacity cost more than renewables too. In Germany, no operating coal plant has lower costs than solar photovoltaic or onshore wind farms. Globally, the production of energy from ca. 800 GW of installed coal capacity costs more than the energy that will be produced by the solar photovoltaic and onshore wind farms that will be commissioned in 2021. Thus, the gradual closing of coal plants will allow a saving of US$32.2 billion/year and avoid the creation of 3 billion tons of CO_2 a year, equivalent to 9% of the global CO_2 emissions produced by the energy industry in 2020, as well as 20% of the emission reduction objective by 2030.

Capacity of uneconomic existing coal-fired power plants and annual savings in coal-fired generation, electricity costs and CO_2 emissions, 2021

	Coal capacity with higher operating costs than new solar and wind		Annual savings from replacing coal with new solar and wind	Annual CO_2 emissions reductions
	(GW)	+USD 5/MWh renewable integration costs (GW)	(USD billion/year)	(Mt CO_2/ year)
Bulgaria	3.7	3.7	0.7	18
Germany	28	28	3.3	99
India	193	141	6.4	643
United States	188	149	5.6	332
Rest of the world	724	488	16.3	1 881
World	**1 137**	**810**	**32**	**2 973**

Source: IRENA analysis based on Carbon Tracker, 2018; Szabó, L., et al., 2020; IEA, 2021; Öko-Institut, 2017; Booz&Co, 2014; Energy-charts.de; DIW Berlin, Wuppertal Institut and EcoLogic, 2019; Gimon, et al., 2019; US EIA, 2021; and IRENA Renewable Cost Database

The Advantages of a Global Transition

This data must help us to understand that the transition will be advantageous to all countries. As Francesco La Camera emphasizes, "*renewable energy provides countries bound to coal with an economically feasible program for its gradual elimination, one that will satisfy the growing demand for energy at a cheaper price, increasing jobs, stimulating growth and respecting climate objectives.*" Moreover, the IRENA Director General also pointed out that "*After the last commitment made by the G7 – to reach a zero impact and halt global funding of coal plants abroad – it is also time for the G20 and emerging economies to provide adequate measures. We cannot afford a double track for the energy transition in which some countries are responsibly green, and others remain trapped in the old system based on fossil fuels. Global solidarity is key: from the diffusion of technology to financial strategies and support for investments. We must be certain that we will all benefit from the energy transition.*"

Moreover, in 2022, the trend that began in 2010 will experience a further decrease in the global cost of renewable energy with onshore wind energy decreasing by 20-27% compared to the new and cheaper option of energy generation through coal. In the photovoltaic sector, 74% of all projects commissioned over the next two years, competitively allocated through calls for bids and tenders, will also cost less than new energy produced from coal. This trend reveals how new low-cost renewables will provide the foundation for the global energy transition, involving the development of the electricity system, as well as the transport and industry systems, which will undergo a significant process of electrification.

After having analyzed the current energy context in terms of costs, benefits, and trends through the data provided by IRENA's *Renewable Power Generation Costs* Report, it is easier to understand why some countries attribute a strategic importance to global leadership in green policy and the development of the necessary technology.

The Geopolitics of Renewables

The current race for supremacy in the field of renewables is characterized by the different strategies fielded by the EU and other global powers, such as the United States and China, to take the lead. It's a competition played out on various levels. On the one hand, it is based on technological development; on the other hand, it is based on the policies fielded to establish the green objectives of the competitors. The results vary based on the individual investment programs, which, according to estimates by the **Bank of America**, could reach as much as US$4000 billion/year to revolutionize global production, technology, and employment.

In the last year, the geopolitics of renewables have undergone significant changes, especially in the United States. Following Donald Trump's presidency and its support for oil, natural gas, and coal, President **Joe Biden** has introduced staunch new support for green policy.

The meaning, the implementation and the consequences of this change are at the heart of the analysis published by **Matteo Codazzi (CESI CEO)** on Aspenia on-line, a forum in which experts debate key international affairs issues: "*Since the first day of his presidency, President Biden has made it clear that the fight against climate change would be a priority for the new administration. The announcement that the United States would rejoin the Paris Climate Agreement placed the global energy transition right back on track.*"

This was the measure that sealed Biden's commitment against climate change, just as he had promised during the electoral campaign. As the CESI CEO explains, "*the move to rejoin the Paris Agreement by the President of the United States is fully in line with the vision he delineated during his electoral campaign. During the race for the White House, Biden announced two main objectives to guarantee a more sustainable future for Americans: net zero emissions by 2050 and a carbon-emission-free electric sector by 2035.*"

The article also points out how the new administration's declarations were followed up with specific actions. At the end of March, President Biden presented the American Jobs Plan, a US$2300 billion package for employment and infrastructure to drive the economic recovery of the country after the Covid-19 crisis. The package is comparable to the EU €1800

billion stimulus package, of which 30% is dedicated to fighting climate change. Moreover, this is the second massive American economic stimulus bill following the US$1900 billion American Rescue Plan, which will provide economic support to United States citizens, as explained by CESI CEO Matteo Codazzi. The American Jobs Plan, which must still be approved by Congress, will invest ca. 1% of the US GDP a year, for eight years. The plan was symbolically presented in Pittsburgh, Pennsylvania, a city with a long industrial heritage.

Matteo Codazzi's analysis emphasizes how green electricity, sustainable mobility and energy efficiency are the pillars of the new American green policy, with the generation and storage of clean energy that will benefit from greater tax credits. Biden's plan also calls for a US$27 billion accelerator for clean and sustainable energy to mobilize private investments in distributed energy resources, energy efficiency for residential, commercial and municipal buildings, and green transport. Moreover, research and development will play a fundamental role in technological innovation for decarbonization. The plan calls for a US$35 billion investment for the reduction of emissions and showcase projects, including green hydrogen, industrial-scale energy storage, carbon capture and storage, advanced nuclear, and electric vehicles. In fact, electric mobility represents one of the major areas for investment mentioned in the American Jobs Plan with a dedicated budget of US$174 billion. The objective is to reduce the gap with China, where the penetration of electric mobility is at least three times that in the United States. In this context, there also is a specific focus on national production to avoid the loss of jobs that could be caused with the industrial shift from traditional vehicles to electric ones. The plan is based on the exploitation of the national battery and components supply system and subsidies to consumers for the purchase of American electric vehicles. Moreover, the bill will also provide subsidies and incentives for the creation of 500,000 electric vehicles charging stations throughout the country by 2030.

President Biden has also called for the creation of a **National Council on Workforce Development** to redesign the roadmap for employment and create 10 million new jobs in the green energy sector nationwide. And, yet another important element is the coordination of actions to contrast climate change that has been assigned to the newly created National Climate Task Force.

China's Contradictory Decarbonization Process

Besides the United States, China has also started maneuvering on the decarbonization front with a campaign of massive investments in renewable sources, which places it second to the EU in absolute values for the period 2010-19. Thanks to its strategy, China has conquered the renewables leadership in various sectors, from photovoltaic panels to electric vehicles and the batteries sector, most recently. China is also a global leader for offshore wind farms and has an enviable supply of rare earth metals (14 metals with peculiar electrochemical, magnetic, and optical properties) that are indispensable for green technology.

However, notwithstanding the fact that China is the greatest global producer of electricity from renewable energy sources and the government's recent approval of the 14th 5-year plan with energy and climate objectives, China's current position in terms of the energy transition appears controversial on account of its continued dependance on coal. Nonetheless, at the United Nation's **Climate Ambition Summit** in December 2020, President Xi Jinping announced that China would reach net zero emissions by 2060, as well as produce 1200 GW of wind and photovoltaic energy by 2030. Furthermore, in the spring, a new plan by the Chinese **National Energy Administration** (NEA) called for a marked increase in the quota of electricity generated from non-fossil sources.

The program aims to achieve 40% clean electricity by 2030, thanks to new wind farms and photovoltaic plants. According to forecasts by the NEA, the total consumption of electricity in China will increase from 7500 TWh in 2020 to 11,000 TWh in 2030, and renewables other than hydropower, especially wind and solar energy, will account for 25.9% of the mix of electric energy, as compared to 10.8% in 2020. The total installed capacity for wind and photovoltaic energy is forecasted to reach 1500 GW in 2030.

While these are the commitments made in terms of renewables, the situation with coal remains controversial. China currently accounts for half of the global coal consumption and is responsible for nearly 30% of global CO_2 emissions. Based on the program described above, green sources will satisfy a wide percentage of the rise in electricity consumption; however, while coal will account for less than 50% of the total generation mix, it will still remain a key element in the Chinese energy system. And this clearly clashes with the fact that by 2040, China should close down all of its coal plants to respect the objective of limiting global warming to 1.5 degrees.

The First EU Climate Bill: from Political Commitment to Legal Obligation

Under the guidance of **Ursula von der Leyen**, the EU has taken the lead as one of the undisputed protagonists of the global energy transition, thanks to the systematic approach for decarbonization promoted by the EU commission. The **Green Deal**, an action plan with investments addressing not only energy policy, but also industrial and agricultural policy, will guarantee a fair and inclusive transition. Moreover, the Commission has also significantly increased the ambition of its objectives, establishing that by 2030, CO_2 emissions must be reduced by 55% over 1990 (the previous goal was set at 40%), a measure that is considered necessary in order to achieve net zero emissions by 2050.

Indeed, the European effort appears to be bearing fruit based on the most recent data published by **Eurostat**. In 2020, in the European Union, for the first time, the electricity produced from renewable sources was greater than that produced from fossil fuels. Although the data is conditioned by the energy consumption anomaly engendered by the pandemic, clean energy still accounted for more than 1000 TWh last year[1]. Thus, nearly 30 TWh more were produced from renewables compared to fossil fuel generation, which decreased by 9.8% between 2019-20, reaching its lowest level since 1990.

This result was celebrated by the EU with the adoption of the bill setting the objective of European climate neutrality by 2050. **Charles Michel**, President of the European Council, commented on the achievement: *"Europe has its first climate bill. Our young men and women marched to ask us to act against climate change and the EU did so."* What used to be a political commitment is now a legal obligation for all EU member states.

The new bill is the foundation for the "climate package," which includes the first eleven legislative proposals that will transform the targets set in the bill into specific regulations for each sector. Besides the emission reductions set for 2030 and 2050, the climate bill also calls for the EU to adopt an intermediate climate objective for 2040 and an indicative carbon budget for the period 2030-2050. The budget will measure the approximate total volume of greenhouse gasses emitted over the period, so not to jeopardize the commitments of the Paris Agreement.

The bill is the result of the strategy fielded by the European Union during the crisis caused by the Covid-19 pandemic. The Commission managed to allocate a consistent part of the **Recovery Fund** to support the European Green Deal, calling for 30% of the **Next Generation EU Funds** (for a total of €1800 billion) to be spent to fight climate change. In parallel, national plans will be obliged to respect the **"Do No Significant Harm"** Principle (DNSH) and *"cause no significant harm to the environment."* The mobilization of these support measures will also boost the ecological transition in Eastern European countries - especially Poland, where coal and lignite currently satisfy 70% of the national energetic need – thanks to the funds allocated to implement the CO_2 emission reduction plan.

In terms of foreign policy, the EU will have to confront the return of the United States on the renewables front with President Biden. The European Union is aware that the renewed American participation in environmental issues is fundamental for the success of the Paris Agreement, but it also means it will have to share its hard-earned environmental leadership with the United States. What will its next move be?

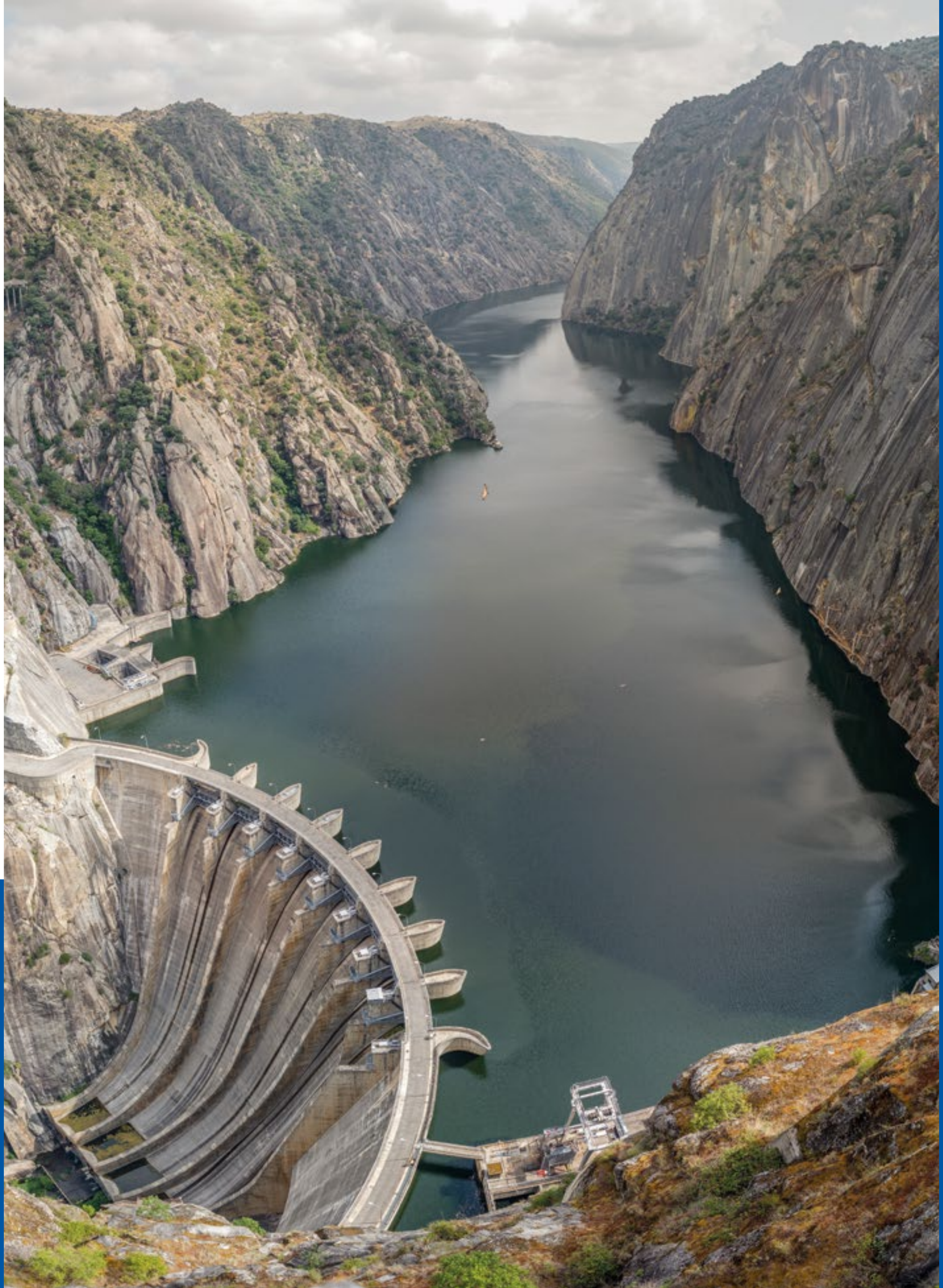
1. 1 TWh = 1000 GWh

Italy and the Recovery Plan Resources

The EU has approved Italy's **National Plan for Recovery and Resilience** (PNRR) which establishes how to use the funds provided by the European **Recovery Plan** and sets out the measures that will be implemented through the Next Generation EU Program.

The resources allocated to Italy are €191.5 billion, plus a further €13.5 billion from the **React-EU Program** (projects financed through the European cohesion funds) and €30.6 billion from the Italian **Complementary Fund**, allocated to implement all the projects and reforms necessary for the PNRR.

Thus, in total, Italy will receive €235 billion, in six phases, with €70 billion dedicated to the green revolution and ecological transition, €50 billion to digitalization, €34 billion to education and research, €30 billion to inclusion and €20 billion to health. In terms of expense quality, 61.8% of funds will be allocated to public investments, 12.2% to current expenses, 18.7% to entrepreneurial incentives, 5% to families and 2.4% to reduce company taxation.



Five Points for the Italian Ecological Transition

Here are some of the declarations made by Roberto Cingolani, Italian Minister for the Ecological Transition:

1. Italy can lead the global energy transition.
2. Without a "bureaucratic transition" the effectiveness of all our efforts may well be significantly reduced.
3. We are called to perform a rather complex operation: move from a well-defined Point A (the current situation) to a Point B composed of objectives. The issue is that we must plan this route, which includes a vast series of variables. On the one hand, we must think of the future as a country; on the other, contextualize it into a strategy for the entire planet.
4. We must be realistic. We cannot achieve the ecological transition overnight. We will need at least ten years.
5. The objective of reducing CO_2 emissions by 55% by 2030 requires a mix of realism and a technological wager on the future. We must proceed with the electrification of vehicles and drive the use of hydrogen-fueled ones. We are working to create a national center for the production of batteries to integrate into the European system and make us both independent and competitive. However, the PNRR will not produce miracles. In terms of culture, for example, we still see too many cars circulating with only one passenger, the driver. This is an issue.

Top Stories

The IEA Scenario: Changing the World by 2050

The International Energy Agency has published its "Roadmap for the Global Energy Transformation" that aims to achieve a net zero emissions by 2050. Reliable electric systems, energetic efficiency, and sustainable investments are the key points addressed by the report. Rapidly promoting clean energy and reducing the use of fossil fuels can create millions of jobs and drive economic growth.

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The achievement of zero emissions, net zero, in the energy sector by 2050 will require an unprecedented transformation in the way in which energy is produced, transported, and used at the global level. This is the scenario delineated by the **Net Zero 2050 Report** recently published by the International Energy Agency (IEA), which introduces the first **Roadmap for the Global Energy Transformation**. In the report, analysts indicate the steps necessary to shift to a zero-emissions energy system by 2050, whilst guaranteeing a stable and convenient energy supply, providing universal access to energy, and allowing a solid growth, in line with the Sustainable Development Goals set by the United Nations.

More specifically, the report identifies 400 solutions that are considered fundamental to implement the energy transition at the global level and achieve neutrality. As **Fatih Birol**, Executive Director of the International Energy Agency, points out, this strategy cannot be delayed: "Our roadmap identifies the priority actions that are necessary today to guarantee that the opportunity of achieving net zero emissions by 2050 – a limited opportunity, but one that is still within our reach – is not be lost. The magnitude and speed of the effort needed to meet this challenging objective – our best opportunity to slow down climate change and limit global warming to 1.5° C – may make this the greatest challenge ever faced by humanity."

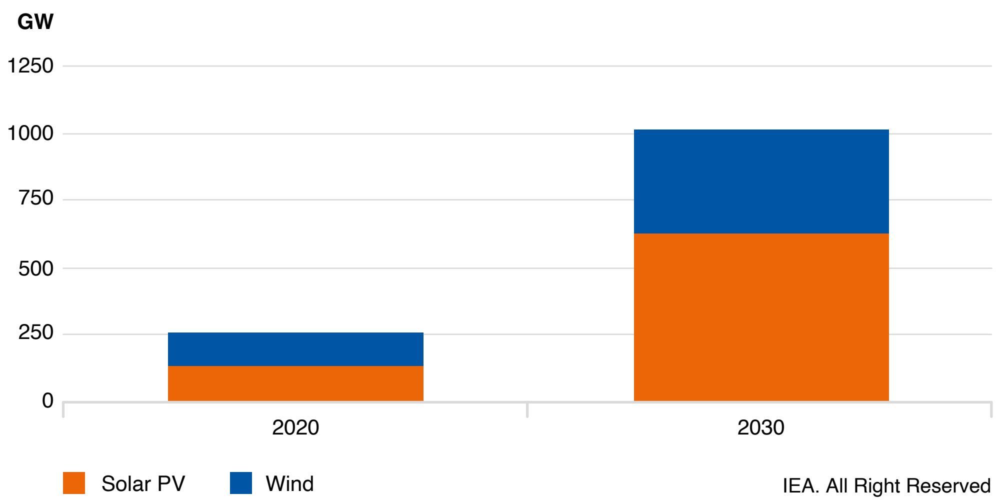
The key concept for the implementation of this roadmap is "invest in new technology." According to IEA analysts, the achievement of a clean and resilient energy economy, fueled by renewable energy such as solar or wind power, will require an end to investments in fossil fuels and new coal plants in favor of investments in energy efficiency.

Indeed, energy efficiency is forecast to improve globally by an average 4% until 2030. However, the report also points out that current technology will only guarantee a reduction of CO_2 emissions until 2030. Thereafter, half of the reduction in carbon dioxide emissions will depend exclusively on future technology that is currently still only being tested or exists only as a prototype. Thus, the implementation of the second phase of the transition (2030-2050) will require that countries increase their investments in research, development, and diffusion of clean energy technology.

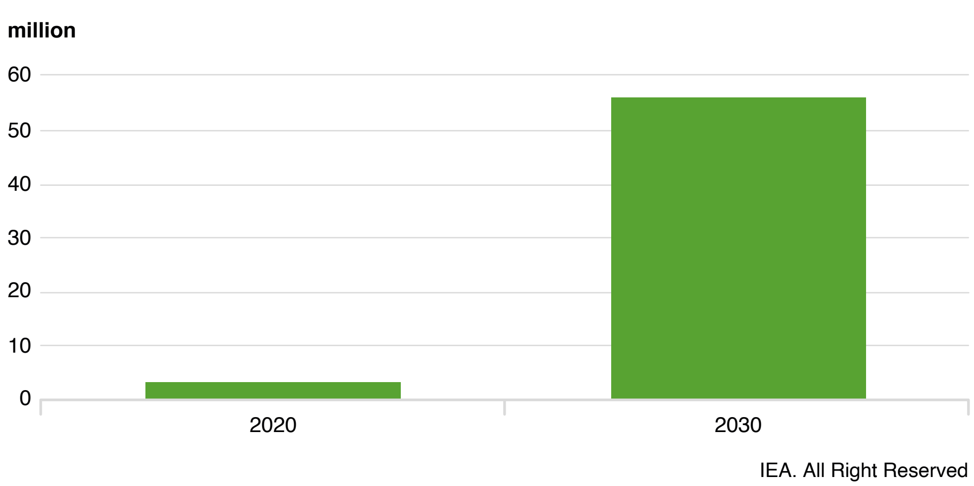
Indeed, the IEA Executive Director emphasizes the need to invest in the energy sector and the benefits that this will generate. “Our roadmap towards this brighter future will lead to an all-time surge in investments in clean energy with the objective of creating millions of new jobs and increasing global economic growth. Shifting the world onto this new path will require strong and credible political action by national governments in conjunction with a much vaster commitment for international cooperation.” The IEA Director also identifies the strategic sectors for the future: “Governments will have to create markets for investments in batteries, digital solutions, and electric networks that reward flexibility and allow an adequate and reliable electricity supply. Moreover, the rapidly growing importance of critical minerals requires new international mechanisms to guarantee a ready availability and sustainable production of such materials.”

Thus, in the short term, the roadmap requires a significant and widespread increase in the use of all clean and efficient forms of energy technology, together with further investments in innovation. If we look at the figures crunched by IEA analysts, by 2030, we will require 630 GW from photovoltaic solar and 390 GW from wind power, equivalent to four times the capacity measured in 2020.

Capacity additions in the net zero pathway, 2020-2030



Electric vehicle sales in the net zero pathway, 2020-2030



The forecast annual investments in energy will total five trillion dollars by 2030 to allow the transformation of the energy industry by 2050. Moreover, by 2030, the global economic scenario will be completely different from the present one. The global economy will expand by 40% and a population that will have increased by 2 billion individuals will use 8% less energy than today. Nearly 90% of electricity will be produced by renewable sources, with wind and photovoltaic solar power representing nearly 70% of the total. Moreover, nuclear power will account for a large part of the outstanding percentage. In terms of overall energy consumption, fossil fuels will account for a fifth of the total supply of energy. However, the contraction in the production of natural gas and oil will have far-reaching implications both for the countries and companies involved in the production of traditional fuels.

The shift from fossil fuels towards electric energy generated with low emissions is one of the most important elements in this transition. It will determine a ca. 20% reduction in emissions by 2050. The IEA projection calls for no new oil and gas fields to be opened as of 2021 (other than projects that are already underway) as well as no new coal mines or extensions of the existing ones. In short, at the global level, new investments in Oil & Gas will be limited to existing reserves and those under development. Indeed, the Net Zero Model indicates that constant political attention to climate change will lead to a marked decrease in the demand for fossil fuels. Thus, oil and gas producers will have to focus entirely on production and the reduction of emissions. What will this entail? According to the report, the demand for coal will fall by 98% and by 2050, it will represent less than 1% of total energy consumption. Demand for gas will decrease by 55% and that of oil by 75%, thereby dropping from 90 mb/day in 2020 to 24 million barrels per day.

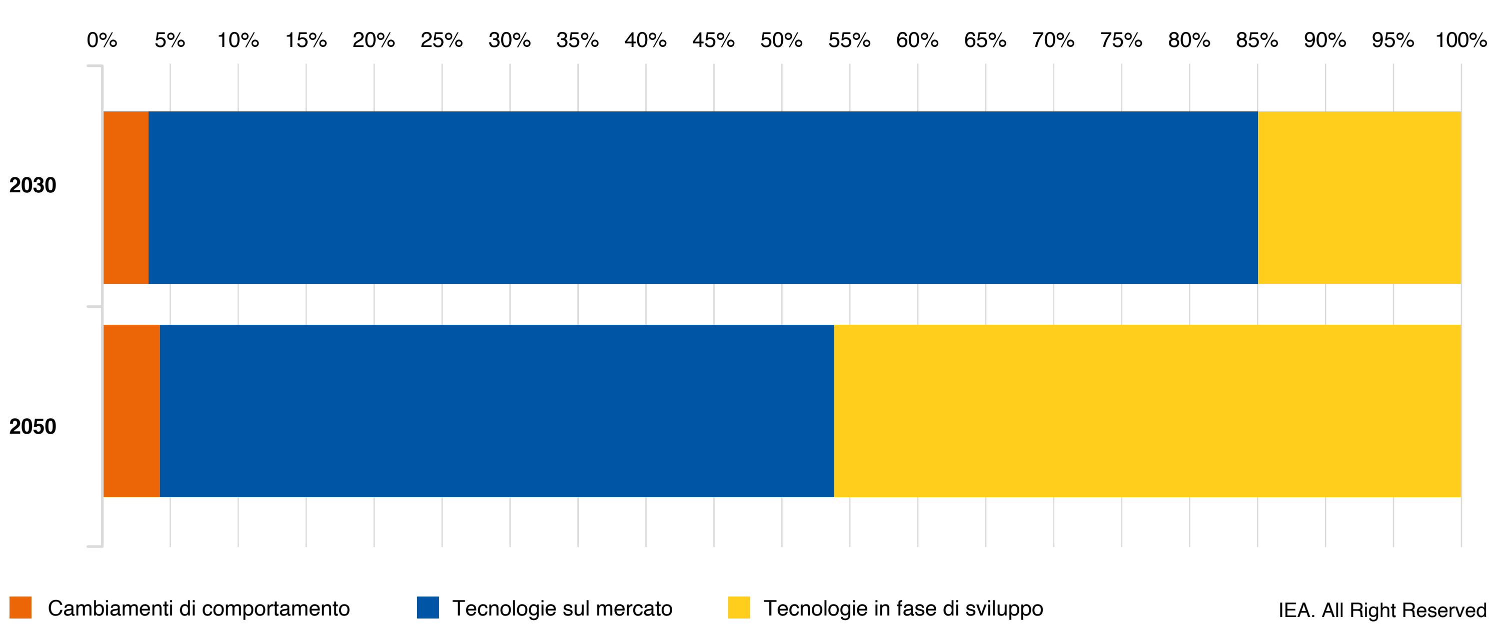
Taking a closer look at the drop in fossil fuels, the IEA forecasts that the price of oil will settle at US$35 in 2030 and then fall as low as US$25. Fossil fuels will go from providing four-fifths of the total current energy supply to just over one-fifth, mainly for products in which carbon is part of the product (like plastics), in plants with carbon capture mechanisms, and in sectors that have fewer low-carbon technology alternatives.

And what will the consequences be for the major oil exporters? The IEA warns that "the contraction in the production of natural gas and oil will have far-reaching implications for all the countries and companies involved in the production of these fuels. The roadmap towards Net Zero requires no further natural gas and oil reserves; supplies will concentrate on a smaller number of low-cost producers. In this reduced oil demand scenario, the OPEC share will increase from the current ca. 37% to 52% by 2050, the highest level in the history of the oil market."

The Net Zero Report also calls for resolute action in the mobility sector. By 2035, automotive makers will be required to stop selling new vehicles with traditional engines.

The IEA study marks a watershed in global energy policy. It comes with no alternatives to the described roadmap. Moreover, the report also points out that if all the climate commitments made to date were to be implemented, they would still be insufficient to reach Net Zero by 2050. If we were to continue with present policy, by 2050, there would still be 22 billion tons of CO_2 emissions and the rise in global heating would exceed 1.5 degrees centigrade. In fact, scientists forecast that – if we were not to follow the roadmap, but only implement current commitments agreed upon amongst countries, by 2100, the temperature on our plant could rise by 2.1 degrees centigrade.

Risparmi annuali di emissioni CO_2 nel percorso dello zero netto, 2030 e 2050, rispetto al 2020



The global roadmap envisaged by the IEA forecasts that the most advanced economies will reach the net zero emissions objective ahead of 2050, while it will be harder to align developing economies. "The IEA is willing to support governments plan their national and regional roadmaps," Birol ensures, "as well as provide assistance and promote international cooperation to accelerate the energy transition globally."

The report assigns a key role in the energy transition to electrification. Thus, electricity will be at the heart of the new global energy system. Investments in network infrastructure and enabling technology will be fundamental to transform it. According to the report, the annual investment in transmission and distribution networks will rise from the current 260 to 820 billion dollars in 2030. The number of charging stations for electric vehicles will increase from today's one million to ca. 40 million in 2030 through an annual investment of nearly 90 billion dollars in 2030. The annual production of batteries for electric vehicles will leap from today's 160 gigawatt/hour (GWh) to 6600 GWh in 2030. Moreover, significant resources will also be allocated to CO_2 pipelines and hydrogen-based enabling infrastructure, increasing from the current one billion dollars to ca. forty billion dollars in 2030.

With the rapid electrification of all sectors, electricity will also become strategic to guarantee global energetic security. This means that the flexibility of the electric system, which is necessary to balance wind and solar power with the currently evolving demand models, will increase fourfold by 2050. The **"The World's Roadmap to Net Zero by 2050"** Report indicates that the transition will call for a significant increase in all sources of flexibility: batteries, energy demand management and flexible, low CO_2-emission electric plants, supported by smarter digital electric networks. Moreover, ramping up the resilience of electric systems against IT threats and other emerging menaces will also be a priority to guarantee an uninterrupted and reliable supply of energy. According to the IEA, attention to energetic security will evolve in parallel with our dependance on renewable electricity and the decrease in the use of oil and gas. This will require a solution to potential vulnerabilities caused by variable supplies and IT security risks.

In short, technological innovation, investment mechanisms, and reliable electric systems will be the drivers supporting this process that will rapidly transform the global energy system. The IEA has plotted out the milestones in this transformation in great detail. It's high time to jump on the bandwagon and ensure a sustainable future for our planet.

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One on One

Hydrogen at a Crossroads

Italy can lead the way for the European hydrogen ecosystem. Hydrogen-related strategies, projects and technology for the decarbonization of key sectors (transports, steel, cement, chemicals). Green hydrogen vs. blue hydrogen.

According to **Deloitte's** July 2021 Hydrogen For Europe Report, hydrogen will be fundamental to the decarbonization of the European economy. The report, which prioritizes green hydrogen, indicates that until 2050 most of the demand will have to be satisfied by renewable energy sources. Moreover, it also points out how a diversified model could reduce the cost of developing a €2000 billion hydrogen value chain by 2050. In order to reach this objective, renewables will have to be markedly ramped up. In fact, experts estimate this will require ca. 1000-1700 GW of dedicated photovoltaic (PV) capacity, a similar capacity of wind energy, and 680-1500 GW of electrolyzers. The above estimation of PV and wind capacity is on top of the roadmap of new power plants installation based on renewable energy sources (RES), necessary to decarbonize the power sector.

In April 2021, analyzing the cost fluctuation of green hydrogen, BloombergNEF posited that, until 2030, it will not be economically sound to construct blue hydrogen production plants. The authors of the **"Hydrogen Levelized Cost Update"** Report forecast that the levelized cost of hydrogen (LCOH2) produced with renewable electricity will fall more sharply than previously estimated. On most markets, its cost will fall to less than US$2/kg by 2030 and then to less than US$1/kg in 2050. This new forecast is based on the trend of photovoltaic LCOE. BNEF believes that, in 2050, solar electricity will be 40% cheaper than what had been estimated two years ago, thanks to the greater automatization of the production process, the decreased use of silicon and silver, the greater efficiency of cells, and the increased productivity of bifacial modules. By mid-century, green hydrogen will be more competitive than hydrogen produced from other resources; in ten years, it will make investments in blue hydrogen (from fossil fuels, with carbon capture and storage) far riskier.

The Three Colors of Hydrogen

Hailed as one of the main pillars of global decarbonization, green hydrogen is gaining a foothold in both policy strategy and enterprise plans. Depending on how it is produced, hydrogen is labelled with at least three different colours: gray, green and blue. Currently, the most widespread system for the production of hydrogen – **gray hydrogen** – is based on steam reforming, a process through which hydrogen is extracted from hydrocarbons like methane, oil and coal. In comparison to other more "virtuous" methods, it costs less (€1.50/kg on average) and has a cost driver that is closely related to the cost of natural gas. The catch is that this process produces more carbon dioxide – 9 kg CO_2 for every kg of hydrogen produced – and this clearly penalizes it in the run to achieve a net zero production of CO_2 by 2050.

Although it currently is the most expensive type, the cost of **green hydrogen** is dropping rapidly thanks to technological innovation and economies of scale. The electrolysis of water is currently the most ecological production process provided that the electric energy required to break down H_2O molecules (into hydrogen and oxygen) is produced exclusively by renewable

sources such as solar and wind energy (producing no CO_2 emissions at all). In Europe, the cost of green hydrogen, which averages €3.2 to €7.4 per kg, is partly determined by the cost of electrolyzers and especially by that of renewable electricity (ca. 70%).

There is a further type of hydrogen that is emerging as a transitional element. This is the so-called **blue hydrogen**, which like gray hydrogen is extracted from fossil fuels. However, it is classified differently due to the use of integrated carbon capture and storage technology, which should make it practically neutral in terms of emissions. Alas, we say "should" because, currently, carbon capture and storage technology are neither very advanced, nor very efficient. The average cost of blue hydrogen comes midway between steam reforming (the cheapest process) and electrolysis (the most expensive): ca. €2-2.50/kg. The cost of gas remains its main cost driver, but the cost of CCS technology should also be taken into account.

At the global level, according to the **International Energy Agency**, the demand for hydrogen has increased threefold since 1975. While industrial complexes with dedicated hydrogen infrastructures can hybridize their plants, hydrogen is already used as a fuel in the chemical sector (to refine and synthesize ammonia and methanol) and will be used in metallurgy to produce steel (phase of direct reduction iron). In terms of decarbonization, hydrogen provides opportunities both to sectors in which the electrification of consumption is a complex operation – hard-to-abate sectors such as cement, steel, etc. – and as a fuel for heavy vehicles and long-distance transport. Last, but not least, as we will address further down, hydrogen allows greater flexibility and long-term storage for the electric sector, improving supply system security.

The EU Hydrogen Strategy

And what about Europe? At the beginning of July 2021, the European Commission officially presented its strategy: A Hydrogen Strategy for a Climate-neutral Europe. In line with the European Green Deal, the plan aims to extend the use of hydrogen in place of fossil

fuels, whilst also focusing on decarbonized production. In fact, Brussels defines "Renewable Hydrogen" not just as that obtained through the electrolysis of water (powered by photovoltaic or wind energy), but also as that obtained via biogas reforming or biochemical conversion from biomasses, as long as these processes **conform to sustainability requirements**.

The plan also acknowledges the possibility of employing other low-carbon emission processes during the transition phase. These include

> **The electrolysis of water is currently the most ecological production process provided that the electric energy required to break down H_2O molecules (into hydrogen and oxygen) is produced exclusively by renewable sources such as solar and wind energy.**

fossil fuel processes such as carbon capture and storage, as long as they are effectively implementable. According to the European Commission, the differentiation of the various types of hydrogen will allow support policy to be adapted to the benefits of carbon emission reduction. *"The new hydrogen economy can be a driver of growth and help us overcome the economic damage caused by the COVID-19 pandemic,"* explains Vice President **Frans Timmermans**. *"Developing and implementing a green hydrogen chain of value, Europe will become a global pioneer and defend its leadership in green technology."*

To guarantee a widespread use of this resource, the European Commission aims to halve the cost of electrolyzers, between 2030 and 2040, by ramping up their production. A more competitive green hydrogen, over a ten-year period, would not only replace gray and blue hydrogen, but could also substitute the fossil fuels used in industry and heavy transports. Indeed, burning in fuel cells, green hydrogen could replace the fuels that are currently used in trailer trucks, ships and, in the future, even airplanes.

In this context, the European Union has established a multiphase operational strategy to reach zero emissions by 2050 and drive the production of green hydrogen from 2% to 14% over a 30-year period:

- By 2024, the EU will support the installation of 6 GWs of electrolyzers to produce up to one million tons of renewable hydrogen in Europe.
- From 2025 to 2030, hydrogen will become an integral part of the EU energy system with at least 40 GWs of electrolyzers producing ten million tons of renewable hydrogen.
- From 2030 to 2050, a fourth of all renewable energy should be reserved for large-scale production of renewable hydrogen throughout Europe.

Moreover, besides developing policy and regulations to support the sector, individual member states will drive the development of a hydrogen economy through initiatives aiming to create a complete chain of value. Just like in Eastern Asia, Europe will witness the emergence of so-called **hydrogen valleys**: local, industrial ecosystems committed to the development of specific projects matching demand and supply. Out of a total of 40 such hubs around the world, twenty are in Europe (five of which in the Netherlands). As mentioned above, each project must embrace the entire hydrogen value chain. So, besides producing hydrogen, each valley will also be responsible for treating, storing, and distributing it via the green energy generation plants necessary to fuel its electrolyzers. The plan for these hydrogen districts is very ambitious and naturally also presents a few issues. Besides private funding, European hydrogen valleys will require adequate legislation, public funding to kick off the projects, and EU-based technology to avoid dependance on foreign supplies.

Italy as a Hub between the Mediterranean and Northern Europe

Italy is a very attractive market for the development of green hydrogen, given the widespread availability of renewable energy and the existence of a capillary network for gas distribution. Moreover, its location at the center of the Mediterranean as a natural crossroads between Northern Africa and the Middle East, other great potential exporters of hydrogen, and the countries of Northern Europe, large potential consumers, makes it an ideal hub for the distribution of hydrogen. *"Italy,"* explains **Stefano Grassi**, Head of Cabinet to the **European Commissioner for Energy**, *"has advanced companies operating in the energy sector with various technological solutions and a strong domestic potential, but it can also import hydrogen from abroad. Moreover, it also has the largest gas network in Europe, one which can also efficiently distribute hydrogen at a low cost. Thus, I believe that Italy may play a key role in the creation of a European hydrogen economy."*

The Italian Government headed by **Giuseppe Conte** (which preceded the current one) enacted a preliminary hydrogen strategy aiming to increase investments in this sector and hydrogen production and use, as per the EU strategy. According to the strategy, in the short term (2030), the objective is to make hydrogen gradually more competitive in selected applications: chemicals, mobility, and oil refinement; in the long-term (2050), the aim is to employ hydrogen to contribute to the decarbonization of hard-to-abate sectors (i.e., those consuming a very high amount of energy and aviation).

While experts estimate that by 2050 hydrogen could cover nearly a fourth of the total energy demand in Italy, they have also identified obstacles, even of a regulatory nature, to the full development of green hydrogen. In addition to the absence of legislation authorizing plants to produce green hydrogen through electrolysis, there also are no mechanisms in place to incentivize P2G plants, which are still far from being economically and financially sustainable. The **Italian Ministry of Economic Development** estimates that starting a low-carbon emission hydrogen economy in Italy and satisfying the hydrogen penetration demand objective will require 10 billion euro in investments between 2020 and 2030: 5-7 billion euro for production, 2-3 billion for distribution and consumption infrastructure, 1 billion for R&D, and infrastructural investments (such as gas networks) to correctly integrate the production of hydrogen into its final uses.

In the chapter on the ecological transition, the **National Plan for Recovery and Resilience** allocates €3.6 billion to promote the production, distribution and use of hydrogen, which is significantly more than allotted either by France (€2 billion) or Spain (€1.6 billion). In May 2021, Prime Minister

Mario Draghi explained that it is "evident that the transition should tend to employ green hydrogen. This will require an unprecedented efficiency in reaching our targets in terms of electricity generated from renewable resources."

Indeed, *"It will not be an instant shift, it will take years,"* added **Roberto Cingolani**, Minister for the Ecological Transition. *"This is a far more ambitious project than the simple post-pandemic recovery. The objective is to ready the country for the generations to come. If we want green hydrogen, we immediately need to produce 70 GW more energy from renewables. Otherwise, we will have to find other ways; we must align with European policy. Over a transition phase that will last 10-15 years, we must abandon coal as soon as possible, develop renewables and hydrogen, and use gas in the meantime. And new technology could arise, perhaps related to batteries. Everyone wants to be green, but they refuse to have wind turbines near their houses and wish continue to produce emissions by using social networks. The climate emergency requires sacrifice. We all need to do something."*

According to Claudio Descalzi, CEO of the ENI Group, there is no competition between blue and green hydrogen. *"Every time that one looks for a contradistinction, the energy system is slowed down. The energy system is not ideological. It's technological. It requires work on the impact of costs, the energy mix, and the short and long-term decarbonization objectives. This means we can't face the energy transition without CO_2 capture, without blue hydrogen."*

Francesco Starace, CEO of the ENEL Group, added *"We must invest as much as possible on increasing the amount of energy produced by renewable sources to electrify everything possible and produce the green hydrogen necessary to decarbonize hard-to-abate sectors such as steel, cement and chemicals. [Hydrogen] is a very small molecule that can seep through the crystalline structures of metal […] so, it must be compressed for transport. However, as this is very expensive, it is best to consume it where it is produced. If technological innovation continues as desired, we will be able to produce hydrogen without a CO_2 footprint and substitute the hydrogen we are currently using with green hydrogen. This will allow us to eliminate 830 million tons of CO_2 emissions a year. Producing blue hydrogen with carbon capture and storage requires extremely complex technology and the identification of stable geological sites where to stock it […] Adding hydrogen molecules to gas, thereby creating an enriched gas, is one way to transport hydrogen molecules, but these are then burnt with the gas and do not resolve the decarbonization issue […] In the end, I believe our best bet is to lower the cost of electrolyzers, rather than to bank on a decreased cost for carbon storage."*

The Path to 2050

In its "Net Zero by 2050 - A Roadmap for the Global Energy Sector," published in May 2021, the **International Energy Agency** looks to the future and foresees that, in 2050, two thirds of global energy and nearly 90% of all electric energy will be produced from renewable sources. While an increased solar and wind energy capacity, along with energy efficiency, will decrease emissions by 50% by 2030, electrification, hydrogen, and carbon capture and storage systems will provide

their true contribution in the subsequent twenty years. According to IEA analysts, hydrogen – just like bioenergy and carbon capture and storage – should be considered a safety cushion to **make the global energy system more flexible**, especially in hard-to-abate sectors (cement, steel, chemicals, and aluminum, as well as transports by sea, air, and truck) that are responsible for nearly one third of all global emissions. In terms of the production of electricity, hydrogen can provide an important source of flexibility, especially by substituting gas as fuel (or to produce mixtures) and reducing carbon dioxide emissions from gas by ca. 6% by 2030.

In order to explain the rate at which green hydrogen must expand over the coming years and to illustrate the most efficient scenarios and methods to use it, CESI has produced a study (July 2021) which analyzes the impact that the Italian hydrogen strategy will have on the national energy system and forecasts that, by 2030, hydrogen could play a fundamental role in achieving the national decarbonization objectives.

In short, the study explains how 2% of the energy demand expected in Italy in 2030 may be satisfied by green hydrogen. CESI estimates that, to achieve this objective, Italy will require electrolyzers having a total capacity of 5 GW with an yearly energy absorption of about 35 TWh fully generated by a mix of wind and PV power plants.

*(*) For further details on the **"Italian Hydrogen Strategy: What Impact on the Power System?"** see the article on "Future & Technology" (pg. 34 of this issue).*

Future & Technology

The CESI Comittment to Sustainable Energy

Tests for electric mobility, alternatives for SF6 gas, project consulting for the Governments of Kyrgyzstan and Oman, and environmental monitoring for the largest dams around the world, as well as a new CESI study on the impact of hydrogen on the Italian energy scenario. Here is an overview of CESI main activities. The common denominator is always a search for more sustainable energy.

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Research for greater energetic sustainability is one of CESI main activities. In fact, it is applied to all our actions: consulting, studies on how to integrate renewables on the grid, the design of interconnections to transport renewable energy to consumption centers and environmental studies. And the same holds true for testing, whether they are tests to increment network resilience or tests for the development of new components for electric mobility.

All these actions center around the current drive to decarbonization, as per the recent declarations made by Colin McKerracher, Head of Advanced Transport for BloombergNEF, which, in June 2021, published the new Electric Vehicle Outlook 2021, the first report to posit a scenario with net-zero emissions for road transport by 2040. “The growth of electric transport,” explains McKerracher, “represents an extraordinary success story and the future of the electric vehicle market is bright. There still are over 1.2 billion vehicles with internal combustion engines on our roads and the changeover is very slow. Reaching net-zero emissions by mid-century will require a full commitment; especially for trucks and other heavy commercial vehicles, a sector in which the transition has just begun.”

According to the report, we will require an investment of US$939 billion in charging infrastructure to install 504 million charging stations by 2040. In this scenario, the electricity employed to charge vehicles **would increase the global energy demand by 14% by 2040**. Moreover, the demand for lithium batteries will also increase drastically from the current 269 GWh (2021) to 2.6 TWh by 2030 and 4.5 TWh by 2035.

The widespread adoption of electric vehicles as sustainable alternatives to ICEvehicles is driving many countries to invest in charging infrastructure. The integration of charging stations into the network – especially rapid and high-power battery chargers – requires a series of complex activities, as the management of load profiles varies markedly from traditional commercial and industrial ones. As these loads require a significant quantity of high-power electronic components, power quality is essential to guarantee the overall interoperability and stability of networks, especially when the natural hosting capacity is reached or even exceeded.

Project TEPQEV and the Berlin KEMA Labs

In order to smoothly guarantee the integration of electric vehicle service equipment into the network and ensure the achievement of sustainability objectives, our **KEMA Labs in the Netherlands** are participating in a research project coordinated by a Dutch Consortium that aims, by October 2022, to scientifically evaluate EVSE supraharmonic emission levels. Indeed, creating models on the presence of supraharmonics will allow us to monitor the operation and reliability of any network, as well as to formulate proposals for the improvement of regulations and standards.

> **"KEMA Labs verify the reliability of electric vehicles (EV), charging systems and their interaction with the grid."**

The "Time proof Electricity grids by Power Quality improvement of Electric Vehicles" (TEPQEV) Project is supported by **Topsector Energy** (a subsidiary of the Dutch Ministry of Economic Affairs and Climate) and includes: ElaadNL (project coordinator), Eindhoven University of Technology, KEMA Labs, Heliox and Dutch energy distributors Enexis and Stedin.

The collected data will be fed directly into an analytical model developed by TU Eindhoven that aims to quantify the impact of these effects on the quality of energy during the simultaneous charging of a given number of vehicles on the public electric grid.

During the next measurement campaign, which will be completed before the end of the year, further tests will be conducted on the interaction amongst battery chargers to examine system stability and any undesired interaction by control devices (and, if possible, even the immunity of battery chargers to high frequency distortions).

Moreover, in terms of testing for sustainable mobility, last April, the **KEMA Labs in Berlin** concluded the overhaul of the new lab for testing automotive components providing it with a new design conceived to satisfy the needs of the electric mobility market. Automotive OEMs increasingly require the support of labs equipped with generators capable of providing extremely fast high current peaks to test CC switching elements such as contactors, pyro-switches, and fuses. Thanks to its Testing, Inspection and Certification Division, CESI can conduct these tests, evaluate the operation of components in extreme conditions and provide a wide range of inspection and certification services thanks to its offices and representatives around the world. KEMA Labs verify the reliability of electric vehicles (EV), charging systems and their interaction with the grid, guaranteeing high quality standards for the many products and services being developed by the market.

KEMA Labs Test Alternatives to SF6 Gas

In terms of sustainability, KEMA Labs have a vast experience in testing all types of **technological alternatives to SF6 gas**, which was highly appreciated in the past but is now considered an atmospheric menace. Sulfur hexafluoride (SF6), a highly efficient insulator, is commonly used in the energy transmission and distribution industry to insulate transmission and distribution devices. It is used as an arc suppressant to insulate electronic components such as switches and disconnectors. This stable and non-toxic gas, which has an excellent dielectric strength,

is a key component for the safety and efficiency of many systems.

Nonetheless, the use of SF6 also poses serious issues, including its marked **effect on global warming** and its high **toxicity during decomposition**. From an environmental point of view, the gas neither reduces the ozone layer, nor causes atmospheric pollution. However, as it is an excellent thermal insulator – it traps heat 24,000 times more efficiently than CO_2 – it is a very powerful greenhouse gas. Therefore, it is fundamental to monitor the level of SF6 gas in components and ensure there are no leaks. In terms of risks to people, the gas is not toxic and causes no damage to either humans or animals, but as the gas is heavier than air, if inhaled in high quantities, it can expel oxygen from our lungs and lead to asphyxia.

The electric industry is moving away from the use of SF6 to protect both workers and the environment and investing in research to identify viable alternatives. While the **European Commission** is discussing a ban on the use of SF6 for a wide range of electric devices from 2022 (beginning with secondary distribution networks), it is probable that its use will be disincentivized through heavy taxation and sanctions for leaks. Aware of this critical issue, the manufacturing industry is developing **SF6-free technology**. Innovation in this field is currently concentrating on low-GWP gasses and the creation of airtight components.

Recently, two candidates have emerged as viable alternative gases and have been used in high-voltage electrical panel components in pilot projects up to 170 kV. The first is a new conception mixture with 5% of fluoronitrile, while the second is a mixture known as AirPlusTM, which is very similar to natural gas but also contains 5% of fluoroketone.

Many of these new products have been tested in the KEMA Labs, where **the technicians are perfectly trained to carry out these dangerous procedures and adequately manage and dispose of all decomposition products safely**. The availability of SF6 gas alternatives is shared with most producers as there are no exclusive rights. Thus, newcomers

and start-ups are free to present innovative stereotypes that, following a series of in-depth tests, may be transformed into products and solutions.

Green Consulting in Kyrgyzstan and Oman

Sustainability also – or perhaps above all – means renewable energy. CESI provides consulting services to support energy system operators and international governments in planning network infrastructure, developing market analyses and studies for the integration of renewables on the grid, and designing smart networks and cybersecurity systems. At the end of 2018, CESI participated in **Project CASA-1000** to develop an important electric interconnection infrastructure uniting central and southern Asia by bringing green energy produced in Kirghizstan and Tajikistan to Pakistan through Afghanistan.

In 2019, the Government of the Republic of Kirghizstan commissioned CESI to draft a masterplan for its energy sector, defining the priorities and costs, as well as a schedule for the development of the sector. The masterplan, aiming to improve energy security and efficiency and expand generation and transmission networks in Kirghizstan, is based on bottom-up and top-down demand evolutionary scenarios for every energy sector and subsector, as well as the evaluation of policy to guarantee energy security and efficiency. Due to its inclusion in the IRENA roadmap towards 2050 as one of the solutions for decarbonization, energy efficiency plays a key role in Kirghizstan, too. An increase in energy efficiency will make up for losses along the network and improve the management of extreme climactic phenomena in the region, such as droughts, that influence the country's energetic wellbeing. The masterplan also includes an analysis of investment alternatives to satisfy the forecast demand (including the development of new generation and transmission systems, as well as import/export projects) and the development of a **"National Energy Holding Company"** (NEHC) that will train all personnel with the knowledge necessary to update the masterplan in the future. Moreover, the project also includes a specific feasibility study for the development of the **Kambarata Hydro Power Plant**, a fundamental plant to satisfy the growing energy demand of Kirghizstan.

The Highest Solar Energy Density in the World

CESI has also been conducting consulting services on the integration of renewable energy in Oman, the country

in the ArabicPeninsula with shores on both the Gulf and Indian Ocean. CESI has developed standards and regulations for the country's electric energy authority 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.

In Oman, the supply of electricity has increased by 140% over the past ten years to meet the greater demand. And, albeit at a slower rate, the demand will continue to grow as the population continues to expand. Notwithstanding its significant potential in renewables (solar density in Oman is amongst the highest in the world), the country continues to mainly depend on energy generated from conventional electric plants powered by fossil fuel. The Arabic Sultanate of Oman is now aiming to diversify its economy and looking with increasing interest at renewable energy and especially wind and solar electric generation whose development will be entrusted to private operators. And this transition will open the country up to new foreign investments.

One of the first strategic steps in this operation is a **new 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-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 (Objectives 7 and 13), as well as providing a reliable supply throughout the country, the integration of rural areas (Objective 10) and the development of non-conventional transmission assets to mitigate environmental impact (Objective 9).

CESI's Environmental Commitment

The activities that we have just described are a result of the know-how developed by CESI on environmental studies, modelling and consulting to generate a sustainable and circular business. Here are some of the most significant projects to which CESI has provided know-how and support for the design and monitoring of increasingly sustainable infrastructure.

The first involves EnerNex, the CESI subsidiary located in the USA, called by the Hawaiian Electric Company to help devise an overall strategy for network modernization based on scenarios that will allow the state to achieve a 100% production of renewable energy by 2045.

CESI was also selected to conduct a study on the environmental impact (EIA) for Project EuroAsia, a 2000 MW HVDC submarine interconnector, that aims to create an electricity highway between Israel-Cyprus and Greece (Europe) through which the European Union can securely be supplied with electricity produced from the available Renewable Energy Sources (RES), contributing at the same time to the completion of the European Internal Market.

In South America, CESI has conducted a preliminary study for Enel Generación Peru to identify new solutions to the issue of sand and other sedimentary deposits that limit the productivity and operation of the hydro power plants in Huampaní and Matucana.

Yet another consulting activity addresses a photovoltaic project. An electric company has asked CESI to evaluate the technical-economic sustainability of a project calling for the installation of floating photovoltaic solar plants on hydro power basins. Besides reducing their footprint on land, floating photovoltaic plants are more efficient than land-based ones. Based on its international experience on environmental sustainability issues, CESI analyzed the negative technological impact on the environment to understand if these locations were suitable to host floating photovoltaic plants.

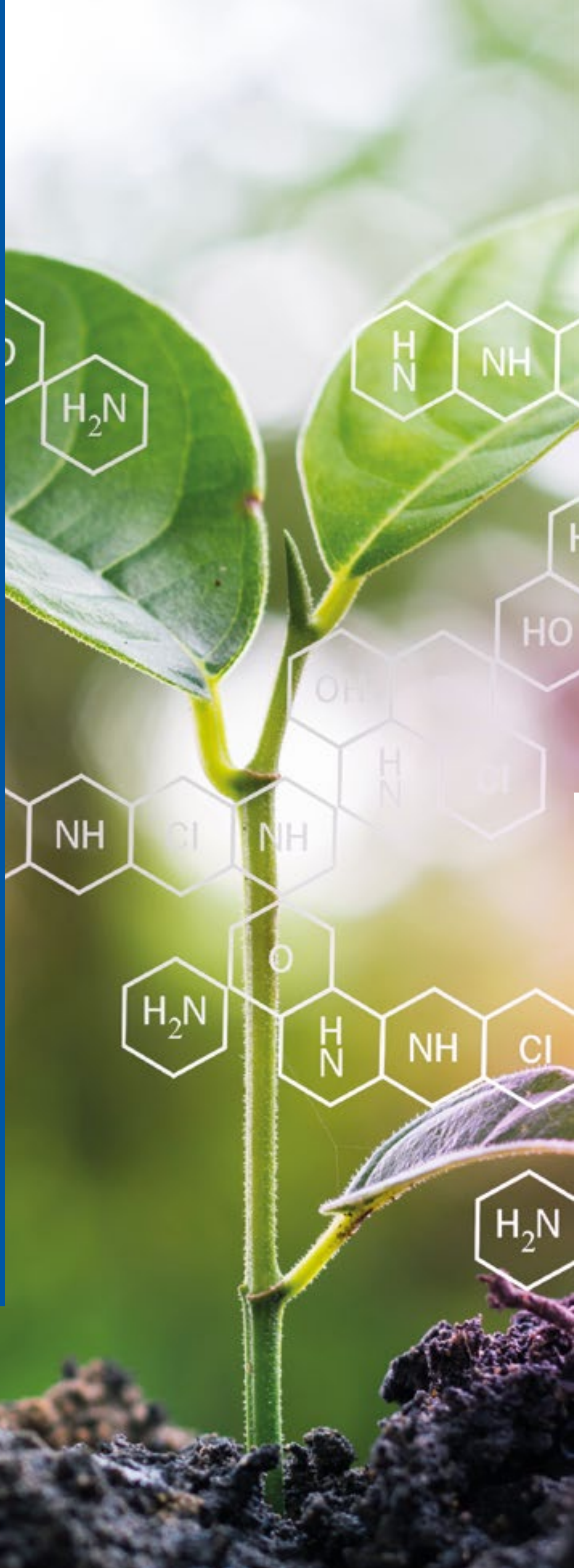
Finally, CESI is specialized in civil and environmental monitoring, also for the safeguard of cultural heritage. The company's experience in this sector started back in the 1950s with its first works on the Mole Antonelliana in Turin and evolved over the subsequent decades on some of the most significant Italian and international sites. Most recently, CESI has developed a monitoring system for the Santa Maria del Fiore Cathedral in Florence, the Baptistry and the entire area of Piazza del Duomo. Other CESI projects on cultural heritage sites include the San Marco Basilica and Santo Stefano Bell Tower in Venice, the Tower of Pisa, the "Cenacolo Vinciano" Museum in Milan, the Metropolitan Cathedral of Mexico City, the Chapel of the Holy Shroud in Turin, Ponte Sisto in Rome, and the Tower of Ravenna.

CESI Study on the Impact of Hydrogen

Green hydrogen has been identified as one of the main drivers of global decarbonization for the future energy panorama. In order to understand how its production must increase, as well as to trace the most efficient scenarios and procedures for its use, **at the beginning of October 2021, CESI published a new study** highlighting its possible impact on the Italian energy system based on various production models for green hydrogen. The analysis addresses the targets defined by the preliminary guidelines of the National Hydrogen Strategy that sets the objectives to be achieved by 2030 in terms of the production and use of this source of energy that is fundamental to decarbonize the economy.

The CESI study entitled **"Italian Hydrogen Strategy: What Impact on the Power System?"** – *this issue of Energy Journal only previews a few sections* – explains how, by 2030, 2% of the Italian demand for energy may be satisfied by green hydrogen. By comparing the different scenarios for the installation of electrolyzers and the location of further renewable energy power plants, CESI has estimated that **Italy will require a total of 5 GW in electrolyzers to produce ca. 700 kt of hydrogen with an investment of ca. €10 million**. This would allow it to reduce CO_2 by 8 million tons by 2030, as well as to create 200,000 temporary and 10,000 permanent jobs.

According to the European Commission's **A Hydrogen Strategy for a Climate-neutral Europe** Report, published in July 2020, hydrogen currently only represents a small percentage of the European and global energy mix. Furthermore, it is still largely produced from fossil fuels, especially natural gas and coal, which means it is responsible for the release of 70-100 million tons of CO_2 a year in EU member states. For hydrogen to contribute to climate neutrality, it must be produced from carbon-free sources. **While the electric sector is forecast to be fully decarbonized by 2050**, other sectors are not easily electrifiable and are still largely dependent on fossil fuels. Green hydrogen, which is produced with renewable energy sources, has a strong potential to solve this issue. It could be a fundamental clean fuel to be used in hard-to-abate sectors such as chemicals, heavy industry, and heavy transports. The rapid and widespread diffusion of green hydrogen is fundamental for the EU to achieve its most ambitious and economically advantageous climate objectives, in line with the aim to reduce greenhouse gasses by no less than 55% by 2030.



Four Scenarios

In view of the objectives set by the Italian Preliminary Strategy for Hydrogen, examining the impact on the electric system, the CESI **study describes four possible scenarios for the production, transport and consumption of H_2**:

1. *Decentralized off-grid scenario* – green energy is generated locally to fuel electrolyzers and is not connected to the grid.
2. *Decentralized network connection scenario* – green energy and hydrogen are produced near consumption centers with a connection to the grid.
3. *Transport of electricity scenario* – green energy is generated in the most suitable locations, while hydrogen is produced near consumption centers with electrolyzers that are powered by the grid.
4. *Transport of hydrogen scenario* – both green energy and hydrogen are produced in the most suitable locations; the hydrogen is transported via pipelines to the consumption centers.

	Off-grid	Connection with power grid		
	1. Decentralized	**2. Decentralized**	**3. Transport of Electricity**	**4. Transport of H_2**
DESCRIPTION	RES and electrolyzers are installed close to hydrogen demand sites. RES capacity factor depends on location of demand sites and surplus of generation or insufficient hydrogen production cannot be managed through the power grid	RES and electrolyzers are installed close to hydrogen demand sites. RES capacity factor depends on location of demand sites	RES are built in market zones with a high capacity factor. Electrolyzers are installed close to hydrogen demand sites	RES and electrolyzer are built in the same market zone (with a high capacity factor). Hydrogen demand sites are potentially located in different zones
PROS	No transmission network costs	Lower cost for additional investments in power transmission. No need of hydrogen transmission cost	RES can be installed in the most convenient sites enabling higher capacity factors. No need of hydrogen transmission cost	RES can be installed in the most convenient sites enabling higher capacity factors. Electrolyzers can better exploit zonal energy surplus avoiding RES curtailment and providing flexibility services
CONS	RES capacity factors could be lower in hydrogen demand locations. Higher need for storage for the simultaneity constraint. Oversizing of V-RES capacity to reach the target utilization factor of electrolyzers	RES capacity factors could be lower in hydrogen demand locations. Potential additional cost to export exceeding power from RES (installed RES > electrolyzer capacity)	Potential additional cost to avoid power congestions between RES generation and electrolyzers consumption	Additional cost for hydrogen transmission from electrolyzers to demand sites

Based on these scenarios, the authors of the study examined the **local effects and the land use** required to install new renewable energy power plants (to achieve the above-mentioned objectives). In relation to the reference scenario for the development of the electric system by 2030 (the National Trend Scenario), the initial phase of the study evaluated the **installed additional RES capacity for solar photovoltaic and wind energy**. While, on the one hand, the use of land for the installation of wind farms depends on the specific morphology and wind regime of selected sites (and therefore land use cannot be easily estimated on a large scale), on the other, the use of land for photovoltaic installations can be estimated based on various hypotheses.

In the scenarios hypothesized by CESI, solar photovoltaic would occupy most new installations, as also described in the National Trend Scenario. In focusing on the main technology adopted for solar photovoltaic installations, the CESI study analyzes **solar cells in monocrystalline (and polycrystalline) silicon and thin-film solar cells**. Based on the hypothesized technology, the authors of the study estimate that the **installation of new photovoltaic plants will require ca. 350 sq. km. of land** in addition to that identified in the National Trend Scenario. This means that the total land required would be equivalent to 1.3% of the surface of the Lombardy Region.

The study also analyzes the impact of electrolyzers on electricity markets – and especially on auxiliary services – revealing how a dynamic use of electrolyzers could contribute to a greater flexibility of the electrical system.

Conclusions

Overlooking the discussion on investments that is addressed in the report, it must be emphasized that the CESI study identifies the **"Connection with the Power Grid" (scenarios 2-4) as better solutions** than the "Off-grid" option (scenario 1). A connection to the grid will not only allow RES unused by the electrolyzers to be exported, but also allows for the **supply of further green energy to the electrolyzers should the local generation be insufficient to produce hydrogen**.

In conclusion, CESI emphasizes the importance of the national energy transmission network for the integration of the further RES required to achieve the decarbonization of the energy sector by 2030. Moreover, a greater real-time coordination between electrolyzers and RES could reduce the costs on the energy markets and influence the stability of the hydrogen supply to consumption sites.

Opinions

Energy Transformations occur over Decades

In this issue of Energy Journal dedicated to the topic of sustainability and the growth of the competitiveness of green sources, in addition to the statement (see page 10) issued exclusively for Energy Journal by John Kerry (the first Special US Presidential Envoy for Climate), we have asked the opinion of two authoritative experts in the sector: Massimo Garribba, Deputy Director-General Responsible for the coordination of EURATOM policies – Directorate General Energy at the European Commission, and Douglas J. Arent, Executive Director, Strategic Public Private Partnerships, National Renewable Energy Laboratory (NREL). Furthermore, in this section you will also find an exclusive interview with CESI's new Chairman, Guido Bortoni – former President and Commissioner of ARERA, the Italian Regulatory Authority for Energy, Networks and Environment.

New Perspectives for Decarbonization

Interview with Doug Arent

Douglas J. Arent, Executive Director, Strategic Public Private Partnerships, National Renewable Energy Laboratory (NREL). Dr. Arent focuses on strategic public and private partnerships with NREL to transform energy economies at speed and scale across the globe. Dr. Arent has worked in research on energy and sustainability for more than 30 years, publishing extensively on topics within clean energy, renewable energy, power systems, natural gas, and the intersection of science and public policy.

In addition to his NREL responsibilities, Dr. Arent is senior visiting fellow at the Center for Strategic and International Studies. He serves on the World Economic Forum Future of Electricity Working Group and advisory boards for the Post Carbon Transition Program at the Institute for New Economic Thinking at Oxford University, U.K.; the Smart Electric Power Association; and the Energy Academy of Europe, Netherlands. He is also a member of the Keystone Energy Board. Dr. Arent is the editor in chief for *Renewable Energy Focus* and is associate editor for the journal *Renewable and Sustainable Energy Reviews.* Dr. Arent has a Ph.D. from Princeton University, an MBA from Regis University, and a bachelor's of science from Harvey Mudd College in California.

1 ***Most countries around the world are competing to set challenging goals that lead to a drastic cut in CO_2 by 2030. However, if you look at the path taken in recent years, the real results are often not in line with expectations. In your opinion, what needs to be done for the energy sector to decarbonize as soon as possible?***

Energy transformations occur over decades. Transitions have begun in most if not all countries. Countries have taken a deep look at their power system, considered their geopolitical situations and looked at technology innovation, cost performance and resources. Combining all of that, most countries have made commitments toward decarbonizing their power system while simultaneously addressing affordability, equity, reliability, and security. Further, many national and global companies have all committed to decarbonization pathways. Also, we are seeing bold commitments being made in the transportation sectors and significant innovations come through for electric mobility, mobility as a service, biofuels, hydrogen and other low carbon transportation. Lastly, new innovations are under development for the harder to decarbonize sectors such as steel and concrete. Many see that we are at a tipping point in the transition toward a deep decarbonized energy system, with much work and deployment of new, low-carbon energy systems yet to occur.

2 ***The competition for so-called rare materials to produce batteries, photovoltaic panels, etc. could be a slowdown in the path towards greater sustainability of the energy industry?***

Sustainable material supply chains are front of mind for many in the research community, business community and of course, governments. There is concerted effort at the local, national and global scales to ensure sustainable supply chains, as well as considerable innovation and new approaches to design for reuse, recyling, and repurposing. NREL has launched a strategic set of activities in this area particularly focused on materials for energy systems. Globally, significant efforts are underway for reuse and recycling for photovoltaics, wind, and batteries, for example.

3 ***How much could the commitment to greater energy sustainability lead to a change in geopolitics balance?***

Much has been published on the ever-changing geopolitical dynamics of our energy economy, combined with increasing stressors from climate change and other stressors. Moving from an energy economy which is dominated by underground molecules to above ground resources and system dynamics implies a significant rethinking of countries' approaches to geopolitics, and is front of mind for many. It is likely there will not be a single approach followed for this as the resource base for each country is different and regional coalitions may bring both strength as well as vulnerabilities to be considered. Scholars have noted the complexities of energy, food, water, economic prosperity, and many other factors which all have to be taken into account when considering the ever-changing geopolitical dynamics.

4 ***There is no company in the world that does not claim to pursue objectives of greater sustainability. In your opinion, what must a company do to be really sustainable?***

Sustainability as a company includes many factors including diversity, equity, and care of employees, communities and the earth's resources. Smart companies look across these and many other factors as they think about sustainability.

About NREL

The National Renewable Energy Laboratory (NREL) is operated by the Alliance for Sustainable Energy, LLC, a registered 501(c)(3) research non-profit in the United States on behalf of the U.S. Department of Energy. From breakthroughs in fundamental science to new clean technologies to integrated energy systems that power our lives, NREL researchers are transforming the way the nation and the world use energy. NREL works with organizations - large and small - to expand the clean energy economy. Together with our partners, we can accelerate the movement of renewable energy and energy-efficient solutions into practical applications.

See www.nrel.gov

Making the EU Carbon-Neutral

Interview with Massimo Garribba

Current Responsibilities
Deputy Director-General responsible for the coordination of Euratom policy. The Deputy Director- General provides overall guidance, co-ordination and supervision of DG ENER's activities in the areas of nuclear safety, radiation protection, spent fuel and radioactive waste management, as well as nuclear safeguards inspections and verification activities, with a view to ensuring coherence in the implementation of the European Commission's responsibilities under the Euratom Treaty.

Previous Professional Experience
January 2014 – July 2020, Director for Nuclear Energy, Safety and the ITER project.

September 2004 – December 2013, Head of Unit for Euratom Coordination and International relations in the DG for Energy of the European Commission. Responsible for the post-Fukushima nuclear "stress tests" dossier; responsible for the adoption of the Euratom nuclear safety directive and its subsequent implementation.

From 1995 till 2004, DG Information Society of the European Commission as assistant to the Director in charge of strategy and political programming. For the period 2000 – 2004 Head of Sector responsible for the eContent programme, a community programme to support the production of digital content by small and medium size enterprises.

1989 – 1994, responsible for the plasma current and shape real time control system in the JET (Joint European Torus) fusion energy project (Culham, UK).

1 Most countries around the world are competing to set challenging goals that lead to a drastic cut in CO_2 by 2030. However, if you look at the path taken in recent years, the real results are often not in line with expectations. In your opinion, what needs to be done for the energy sector to decarbonize as soon as possible?

75% of emissions in the EU are due to the production and use of energy. The core objective of the European Green Deal's is for the EU to become climate neutral by 2050. This will not happen unless we can set ourselves on the right path in this decade. This is why there is such a focus on what we can achieve by 2030. Our current policies and national measures, if fully implemented, would take us to a 45% greenhouse gas emissions reduction. The recent IPCC report is sobering. Decarbonisation requires nothing less than a complete transformation of the entire economy and a fundamental change in our lifestyle. To do so, all partners across all sectors across the globe need to be more ambitious. The only way of achieving this ambition is to raise the level of public and private investment in the clean energy transition – like a new industrial revolution. Our strategy is threefold:

1. Prioritising energy efficiency, with its great potential for energy savings.
2. Electrifying where we can, with a major focus on renewable energy.
3. Innovating where we cannot electrify, for instance with more low-carbon fuels and hydrogen.

On the basis of this strategy, we have increased our climate and energy targets and now aim for a 55% reduction in carbon emissions by 2030. We are also updating EU legislation in order to meet our renewed targets. On 14 July, the European Commission adopted a package of 12 legislative proposals to reach the 55% target. It includes a targeted revision of EU directives on Renewable Energy, Energy Efficiency and Alternative Fuels as well as measures on energy taxation, forests, a Carbon Border Adjustment Mechanism and an extension to the Emissions Trading System. Concretely, we have proposed higher energy efficiency and renewable energy targets, with specific focus on sectors that are harder to decarbonise: building (including heating and cooling), transport and industry. We are proposing to put greater emphasis on electrification and alternative fuels as well. We are also encouraging the public sector to lead by example, such as with obligations to reduce energy consumption, increase energy efficient renovation and introduce systematic consideration of energy efficiency in public procurement.

By the end of the year, the Commission expects to propose more legislative alignment with our higher climate and energy goals, not least on the Energy Performance of Buildings Directive; on competitive, decarbonised gas markets, including renewable hydrogen; and on reducing methane emissions in the energy sector. There is wider environmental, economic and social rationale behind our measures to decarbonise. They would build on the 1.5 million jobs in the EU related to clean energy technologies, with an estimated annual turnover of EUR 160 billion, and improve living conditions. They would enable services and businesses to grow using less energy and support investments in energy that would mobilise an additional €392 billion per year. While decarbonisation has a positive economic and job creation impact in the longer term, the transition process is not without difficulties for certain sectors, regions or individuals. That is why the EU puts major emphasis on fairness of the transition and has set up a separate just transition pillar of the European Green Deal, paying particular attention to carbon intensive regions. Specific accompanying measures have been in place for most exposed industrial sectors. For the first time, the Commission has now also proposed a specific fund to assist vulnerable households. The newly proposed Social Climate Fund will help

energy poor and other vulnerable households to invest in energy efficiency measures and sustainable mobility solutions thus to avoid having to face a price hike due to carbon pricing of fossil fuels. To make a noticeable difference, we need global action to reduce greenhouse gas emissions to net zero. 80% of global emissions come from the G20 economies. We are ready for COP26, and call on all other countries to demonstrate their highest possible level of ambition.

2 *The competition for so-called rare materials to produce batteries, photovoltaic panels, etc. could be a slowdown in the path towards greater sustainability of the energy industry?*

Ensuring sustainable and resilient supply chains will help us to achieve climate neutrality and the objectives set out in the European Green Deal. The EU is dependent on several raw materials that are essential for green transition such as those used to produce solar panels. We estimate a 4-fold increase in demand for silver and up to a 12-fold increase for silicon by 2050. For cadmium, gallium, indium, selenium and tellurium the change in the demand will increase up to 40 times in 2050. The highest demand in 2050 is expected for germanium, which might increase up to 86 times compared to 2018 values. Addressing strategic dependencies is an opportunity to ensure that the EU has access to the raw materials it needs to translate the green transition into a competitive advantage. Policies that incentivise a more circular economy can help reduce the EU's dependence on several products. Consequently, these policies could boost EU's resilience, with a clear benefit for the environment, but also for the benefit of the EU industry and the economy as a whole. Several initiatives are ongoing to address strategic dependencies and build capacity, ultimately supporting the European Green Deal, for instance:

- The Raw Materials Action Plan and the European Raw Materials Alliance (2020) supporting investment to reduce dependency on raw materials.
- The Action Plan on the Circular Economy (2020) targeting how products are designed, promoting circular economy processes, encouraging sustainable consumption and aimed at ensuring that waste is prevented and that the resources used are kept in the EU economy for as long as possible.
- The European Battery Alliance (2017) aiming for 15 gigafactories in Europe offering enough battery cells by 2025 to power 6 million electric cars.
- The European Clean Hydrogen Alliance (2020) proposing concrete projects that deliver a robust foundation for the hydrogen value chain in the EU.

3 *How much could the commitment to greater energy sustainability lead to a change in geopolitics balance?*

In the past and at present, global energy exchanges cover mostly fossil fuels, like oil, natural gas or coal. Most countries in the world depend on imports of fossil fuels from other countries or from the world market. This is very much the case for the EU. Over the years, we have seen instances where certain countries exporting fossil fuels have exploited such dependence as a political instrument. At the same time, there are many countries where the economy depends largely on income generated through the export of fossil fuels or just on the transit of such fuels, notably natural gas. The move to a climate-neutral economy, fuelled by renewable energy and needing less energy due to the significant increase of energy efficiency, will undoubtedly have an impact on geopolitics. But it will not happen overnight. Like the previous industrial revolutions, the changes will take place in the course of a generation (or more). But they are inevitable and the ones that benefit most will be those that embrace these changes, rather than those that try to perpetuate the fossil fuel economy. Another aspect of the new geopolitics is the increased dependence of our economies on several raw materials that are essential for the green transition. We need to get prepared for these developments, helping to make countries,

in particular within the EU, less dependent on fossil fuels, address new "green" dependencies and cooperate with non-EU countries currently depending on the export of fossil fuels to mitigate the possible negative effects of the transition.

4 *There is no company in the world that does not claim to pursue objectives of greater sustainability. What must a company do to be really sustainable?*

In order to be sustainable, a company should orient itself towards environmentally sustainable activities, and refrain from engaging in activities that do significant harm to our environment. For example, in the field of energy, a company should orient itself towards clean, in particular renewable energy, and stop investing in activities involving solid fossil fuels, known to be very harmful for the environment. Even in the development of renewable energy, attention must be paid to all relevant environmental aspects, e.g. avoiding significant negative effects on water or biodiversity. At the core of the Commission's work on sustainable finance is to define "sustainable" or "green" activities and develop tools to clearly identify technologies and businesses that contribute to our European Green Deal objectives. Most notably, in April, the Commission adopted a series of measures that enable investors to re-orient investments towards more sustainable technologies and businesses. The measures will be instrumental in making Europe climate neutral by 2050. One of the measures, the EU Taxonomy, is a tool for companies and investors, providing them with a common understanding of the green economic activities that can make a substantial contribution to the aims of the European Green Deal and avoid greenwashing. The EU Taxonomy also introduces an obligation for some investors and companies to disclose their share of Taxonomy-aligned activities. Also, in April, the Commission proposed a Corporate Sustainability Reporting Directive to improve the flow of sustainability information in the corporate world, with more companies obliged to report on sustainability and Taxonomy alignment. This reporting would make it easier to compare companies and investments in terms of the environmental performance and can guide investors in their investment decisions. Companies and project promoters can also choose to meet the criteria of the EU Taxonomy in order to attract investors interested in financing green activities.

Climate Change: it's Time to Speak about Mitigation and Adaptation

Interview with Guido P. Bortoni, CESI Chairman

Guido Bortoni is Chairman of the Board of Directors at CESI SpA. Mr. Bortoni, has been Chairman of ARERA – Italian Regulatory Authority for Energy Network and Environment – from 2011 to 2018. Previously, he was Chief Executive at the Energy Department of the Italian Government (2009-2011); Head of the Energy Markets Department at the then Italian Electricity and Gas Regulatory Authority (1998-2009); Engineer for Power Grid Studies at CESI/Enel (1987-1998), where he committed to long-term internships at several US utilities and at Électricité de France - études et Recherches (EDF), in Paris. From July 2019, he held the role of Senior Advisor - Regulatory at the Directorate-General Energy of the European Commission. He graduated in Electric Engineering at the Università degli Studi in Pavia and obtained a Masters' Degree in Administration and Corporate Management at the Politecnico University in Milan.

1 ***John Kerry told us that "time is not on our side". Do you think we still have time to fight the climate crisis?***

The ongoing climate change is a global phenomenon caused by the widespread warming of the planet's atmosphere, the so-called 'greenhouse effect'. At first glance, this might seem a marginal event, as it raised global temperatures by a few degrees Celsius over the course of a couple of centuries, from the industrial revolution through today. However, such change is recognized as being responsible for weather-related consequences that are becoming more and more extreme, with a very negative impact on the quality of life on Earth as well as possible catastrophic results for life itself. Nowadays, every person on the planet is experiencing these extreme events in their daily lives, and alarming reports come from all over the globe.

The reasons behind this global change have been clarified by science, and there is an almost unanimous agreement on them at a worldwide level. In this respect, it emerges that climate change comes from emissions produced by human activities (mostly the production of CO_2, but also the emissions connected to other gases, such as methane extracted from hydrocarbon fields and spread into the atmosphere), which are the main causes of the deterioration of our climate. The recurring reports by the Intergovernmental Panel on Climate Change (IPCC) on the status of climate, with the analysis of future scenarios, are the 'alarm bells' for everyone: not only because they show the progressively worsening trend of the global ecosystem parameters, but mostly because they forecast a future in which several areas on the planet will be incompatible with life as we know it today. And this is set to happen very quickly. The time to act on and react against these trends is running out with our generation: this is what John Kerry referred to when he said that staying still and 'buying time' in the fight against climate change, only means that such phenomenon will be soon out of hand, thus becoming irreversible.

I have just said "act and react". When fighting climate change, it is necessary to intervene immediately and on a large scale, both in terms of emissions reduction (in order to avoid further emissions and to absorb the ones already present in the atmosphere) and in terms of adapting to the different conditions in lifestyle and productive activities (therefore reacting in order to conform to the changing ecosystem, as the Darwinian lesson has taught us).

From our part, act and react means studying and implementing several effective strategies that can be useful and valuable on different levels in the fight against climate change. It might sound obvious, but it really isn't! Allow me to explain. Since it is necessary to intervene by introducing action and reaction measures that can have an impact on economy and society,

such measures must be financially and socially "sustainable", in the most symbolic sense of the word: in Latin, the verb *sustineo* means to stand up and stay up right. Therefore, the strategies that need to be introduced must not disrupt the economic, productive and social fabric, otherwise they will fail. We often hear that we need to act immediately and radically, through simple and easy-to-digest recipes: usually, such claims obtain huge media attention and consensus across-the-board, with many being unaware of the unfeasibility of what is promised. Without confining these interventions within 'the boundaries of the all-around sustainability', we take a big risk to miss our targets. In other words, the most radical and hasty measures, paradoxically, often end up being 'half measures', destined to fail and, above all, bound to waste precious time in the fight against climate change.

On the contrary, relying on all-around sustainable measures, those that may not seem brave enough to some audiences, we could actually find the real key to achieve our objectives in the short time left.

There is another crucial aspect I would like to focus on: it is the meaning of "our" in the sentence "time is not on our side." "Our" recalls to me a global meaning, specific to all countries and citizens of the world. It sets the pace for the problem, which represents the "largest" possible challenge on a global collective level. As far as the solutions are concerned, the most virtuous entities, the 'top of the class' in the fight against climate change, such as Europe with its goal of having the EU become the first carbon-neutral political area in the world by 2050, can lead by example. At the same time, they must look for participation with the rest of the world, instead of imposing solutions that may be valid in Europe but inapplicable elsewhere. In short, sustainability has a geographical nature that depends on the "local" characteristics of the specific realities that must be absolutely respected and used. If not carried out together, as one, the fight against climate change will not exist at all.

2 *What are the fundamental actions the energy sector must carry out to this end?*

The complete energy value chain, from production, transport to end uses, is responsible for 75% of the greenhouse gas emissions in the EU. Representing ¾ of the problem, the EU's energy needs to embrace the largest part of the solution: there are no exceptions to this approach. As I said earlier, in the energy sector it is equally fundamental to adopt the dual approach according to which it is necessary to act (mitigation) to reduce the amount of CO_2 already present in the atmosphere (i.e. to intercept the flow of new CO_2 emitted or tackle its stock in the atmosphere, which now exceeds 410 ppm compared to about 300 ppm, the previous data that had been stable for several millennia)

> **"In terms of mitigation, the current technological scenario and the foreseeable developments related to it clearly point to the necessity of emissions reduction."**

and react to make the energy systems suitable for the phenomena resulting from climate change.

This underscores the necessity to make the energy sector more resilient, therefore more prone to resist or quicker to restore supplies after weather-related events, which may be unforeseeable during the design phase of the project or more devastating than anticipated. In terms of mitigation, the current technological scenario and the foreseeable developments related to it clearly point to the necessity of emissions reduction, aiming at net-zero as far as the energy value chain is concerned.

In fact, carbon removal and carbon sink technologies are currently at an embryo stage and in need of a titanic effort to reorganize the current business models (think for example about the agriculture and land use sectors which, by definition, could be the main solution to this problem).

Energy, due to its double nature as a source and carrier at the same time, is almost the ideal sector in the process of strong, intrinsic decarbonization and, at the same time, its use is key to decarbonize many other productive and social sectors. Consider, for example, the use of renewable sources to replace fossil fuel-based ones (renewable and fossil primary energy sources as such are not easily usable as energy carriers to cover large territories whilst delivering a reliable supply, except for natural gas). Nonetheless, they have an extraordinary convertibility with the electricity vector (the energy carriers are not sources in the sense that they are the result of the transformation of primary energies, again apart from natural gas), therefore a very strong decarbonizing potential thanks to the massive electrical penetration in the final uses of energy, in several fields.

The new hydrogen vector, the low carbon fuels derived from it and biomethane - as well as being decarbonized - are also "synthesized" vectors meaning that they are energy transformation outputs, so much so they are called *manufactured fuels*. Such clean fuels cover an important function in the decarbonizing process whereby the only feasible penetration relies on molecules for energy use, although their impact is – in terms of percentage – quite lower when compared to that of electrification, at least for the state-of-play in the EU.

Based on what I have said so far, the crucial steps the energy sector must take consist of upstream integration with decarbonized sources, and downstream integration with the end-use sectors, to allow the penetration of decarbonized vectors in the consumption phase. Moreover, it is also paramount to include in this paradigm the midstream integration amongst vectors, which is a virtuous coupling amongst decarbonized vectors, such as electricity and hydrogen.

What comes to light from this is a power sector in which the old paradigm – made of vertical, mono-vector transitions that created a waterproof "silo" of the various commodities – is replaced by a new integrated system, based on diagonal and multi-vector transitions that create a supply chain co-dependence.

Let me offer you an example. An energy transition may start from renewable energy sources, move through the power network, be converted into hydrogen through electrolyzers and utilized, as such, in the so-called hard-to-abate sectors (such as iron, cement, chemical, long-distance and heavy transport industries). And there is more. Implementing such innovation would also widen the energy market and, therefore, increase the efficiency and security of supplies.

This whole process can become reality over the course of the next decade, presenting us with an energy sector that is substantially renewed and designed for decarbonization. Therefore, energy transformation necessarily depends on the above-mentioned integration, which has paramount value in the decarbonization process.

The other key element for the energy sector to play a crucial role in the future of energy is represented by adaptation. It is a matter of relying on those techniques of reinforcement and, when necessary, of redesigning of infrastructures and energy markets, which are preparatory to the resistance and resilience of a system under the new weather phenomena.

One last note, this is quite obvious: it is self-evident that mitigation and adaptation in the energy sector will generate a flow of new investment, which can make the real difference for a season of economic growth in the countries willing to embrace such strategies. Let's hope that Italy will walk the path of sustainable development, in every way.

3 *Can environmental sustainability go hand in hand with economic sustainability?*

They must go hand in hand! It's not a nice-to-have option, but a necessity, as I said in my first answer.

New Skills

Green Jobs: Electrical Engineer

What are the key activities of an electrical engineer? Why have they become such crucial figures within the energy transition and in the field of sustainability? Here, you will read a brief overview on one of the most sought after jobs connected to the Green Economy.

Electrical Engineers: the most in demand

Italy needs over 340,000 more engineers and technicians. Although electrical engineers are the most in demand (the national unemployment rate for electrical engineers is 3.6% as compare to 8.2% for engineering, in general) and the best paid (annual pay exceeds €33,000), universities are finding it difficult to fill their degree programs in electrical engineering. A report on the lack of electrical engineers produced by the research center at the “Fondazione Consiglio Nazionale degli Ingegneri” (Italian National Engineering Council Foundation) points out that although electrical engineers are in high demand, they only represent a small percentage of engineering graduates (2.4% in 2017).

Electrical Engineering: Applications

Electrical engineering has a vast range of applications including the design of electrical components, the study of systems to convert electrical energy into mechanical energy, the development of new technology for sending, receiving and analyzing electric signals for the transmission of information, and research on new applications and uses of electricity for telecommunications, transports, and industrial plants.

For further information on this topic, please contact:

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Electrical Engineers: Tasks

In general, an electrical engineer works on electrical devices of all types and sizes. Electrical engineers design motors, transformers, electric alternators and generators, household appliances, lighting systems, electrical systems for civil and industrial buildings, computers and telecommunications systems, and substantially anything else that requires electricity to operate.

Installation, Testing and Requalification

The tasks of an electrical engineer also include the installation of electrical systems, circuits, production lines and networks; testing, diagnostics, and maintenance of complex electrical systems; requalification of electrical systems in public and private buildings. Furthermore, electrical engineers may also be required to produce technical reports and plan ordinary and extraordinary maintenance of electrical devices.

Renewables Engineer

Thanks to their specialized technical know-how, electrical engineers are also often assigned managerial positions, such as the management of operative teams or monitoring electric plants and other energy generation plants (hydropower, solar, wind).

Electrical Engineers: in the Lab

Lab activities mainly include the design and development of components, devices, and electrical and electronic circuit diagrams. Electrical engineers analyze the characteristics required by a product, based on client specifications, and produce technical diagrams with CAD software. Then, they develop prototypes and test them through laboratory analyses and computer simulations, gathering data, examining results, and determining the operative standards required to operate the product correctly.

News & Events

Upcoming Energy Events

ASEAN Sustainable Energy Week | Renewable Energy Asia

October 14-16, 2021

Bangkok, Thailand

www.asew-expo.com/2021/

The ASEAN Sustainable Energy Week will focus on the latest trends in design and alternative engineering, data collection, renewable technology, energy management and supply systems, industrial cogeneration devices, monitoring and evaluation systems, electric plants, and thermal storage.

EU Sustainable Energy Week

October 25-29, 2021

On-line event

www.eusew.eu/

The 16th edition of the event (on-line) will be organized by the European Commission to address the issue of "Towards 2030: Remodeling the European Energy System." The initiative will provide an opportunity to debate green energy and the efficient and sustainable use of energy in Europe. In turn, this will be useful to understanding successful policy and investigating the development of innovation to reach the EU's energy and climate objectives.

Workshop on Attacks and Solutions in Hardware Security

November 19, 2021

Seoul, South Korea

http://ashesworkshop.org/

The main goal of the ASHES workshop is to provide a speedy and focused venue for hardware security solutions and research, covering both theory and practice. ASHES is mainly interested in developing and molding new challenges throughout the early stages of development.

Wind Europe – Electric City 2021

November 23-25, 2021

Copenhagen, Denmark

https://windeurope.org/ElectricCity2021/

The event will not only address the onshore and offshore wind sector, but also involve the protagonists of mobility, storage, industry, and hydrogen in the debate on how to develop a green economy through new business models and advanced technology.

SEERC Conference

November 29-December 02, 2021

Vienna, Austria

https://cigre-seerc.org/

The aim of the conference is not only to share the latest research, but also to give an outlook of the future of electricity grids and electricity markets within the SEERC Region. This conference should also be a place to strengthen existing partnerships and start new cooperation.

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).

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