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Change of Pace: From Fossils to Renewables

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Editorial

A World Renewed: From Fossil Fuels to Renewables

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The energy transition has not been blocked by the pandemic. As a matter of fact, it has accelerated some of the trends that were already underway and that will usher us into the future. It has been a complicated period. The health emergency has forced us to react and devise strategies for economic recovery, as well as to reflect on the culture and philosophy that will underlie the coming decades. Now, our challenge is to forge the current standards of well-being with the energy transition and shift from finite and concentrated sources (gas and oil) that produce emissions to sources that are available around the world. Renewables. According to a new IEA Report, nearly 90% of the increase in global energy capacity in 2020 has been produced by renewable sources, and this figure will increase further in 2021. The energy capacity of China and the United States will increase by 30% this year thanks to green sources, especially solar and wind energy; while next year, India and Europe are expected to experience the greatest increase in terms of energy capacity produced from renewables. This new issue of Energy Journal analyzes the energy transition that is underway and focuses on the scenarios, technology, and government policy of countries that are promoting green initiatives and allocating funds to fight climate change. However, as wind and solar energy are variable and more uncertain than conventional sources, it will be necessary to modify energy system planning and operations to achieve these objectives. As we have already pointed out various times, the sudden increase in generation from non-programmable resources over the past twenty years will require an even greater flexibility of the electricity system in the future.

In this issue, the "Future & Technology" Section reports on how CESI, in order to guarantee efficiency and reliability to the sector, is looking to the future by continuing to enrich its system flexibility testing activities and conducting the impact analyses and conformity studies required to integrate VRES into transmission systems. This reflects a new approach that will allow us to achieve our clients' objectives thanks to cutting-edge resources and high-level skills. In terms of technology and future, we also look at the project analysis developed by CESI and ENEL for the development of an important interconnection system in a rather complex geographical context between Chile and Argentina.

Our Top Story addresses how, in the first semester 2020, renewables gained an edge on fossil fuels in Europe, where wind, solar, hydroelectric, and bioenergy generated 40% of the electricity consumed by the 27 EU member states, compared to the 34% produced from fossil fuels.

In the "Industries & Countries" Section, we look not only at Europe, but also study China, the United States, and the many other countries that are shifting their energy systems towards renewables. Indeed, notwithstanding the abrupt slowdown caused by the economic emergency, in 2025, renewables will be the greatest global source of electricity generation, ending coal's fifty-year run as the main source of energy. Moreover, in an article entitled "Timeless Energy," we address how humans have always had to face the same issue: how to obtain the most energy from available resources. Thanks to a series of studies and reports, we will learn how, in the last decade, the world has been addressing the new energy transition. In "Opinions," we review the ideas of Hans Bruyninckx, Executive Director of the European Environment Agency, a prominent figure in the debate on the relations between environmental impact, use of resources, and climate change.

Along with the dramatic effects of the pandemic, two recent events have influenced geopolitical strategies related to energy. Speaking about the European Green Deal in her September speech on the State of the Union, Ursula von der Leyen did not hesitate to emphasize the fundamental importance of the energy transition, at a time when public opinion is far more captivated by the Covid-19 emergency than the climate one. "We need to act better and more rapidly in order to become the first zero climate impact continent by 2050," the EU President declared. The other pivotal event is the election of Joe Biden to the Presidency of the United States. In his campaign, President-elect Biden promised to invest nearly 2 trillion dollars in clean energy and low-carbon-emission infrastructure, albeit without setting a precise objective for the reduction of emissions. Nonetheless, climate change, will be a cornerstone of the administration's economic and foreign policy, national security and social justice objectives.

We hope that this issue will help you to concretely understand the current dynamics at play for the future of energy sources. To quote the authors of the "Renewables 2020" Report, we may say that "humanity is at a crossroads in its commitment to address climate change. By focusing on investments in clean energy to drive the economic recovery, governments can guarantee that 2020 will not be remembered only as the year of a temporary drop in emissions caused by the recession." China, the United States, and Europe, countries at the forefront of the energy transition, have the opportunity to contribute to a permanent shift from fossil fuels to renewables. And it's not just the storytelling that will change, but the consequences of a "revolution" that the planet wholeheartedly invokes.

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Issue 18 / December 2020

Contents

"The secret of change is to focus all of your energy not on fighting the old, but on building the new."

Socrates, Greek philosopher








News

Latest from CESI

KEMA Labs

A step into the future: KEMA Labs' Remote L@b experience

In the current "new normal" times, KEMA Labs (CESI's Testing, Inspection and Certification Division) is committed to offer even more cutting-edge services that allow clients to conduct testing campaigns without moving from wherever they are, saving budgets and taking care of their employees' health and safety. In this respect, Remote L@b experience allows local assembling of the test objects by qualified experts remotely guided by the client engineers, test execution with real-time data shared and qualified experts fully available to support in case of unexpected tasks. With this initiative, Augmented Reality, digitalization, remote assistance and online video tools become part of a new way for testing at KEMA Labs. Through the adoption of interactive glasses that provide an untethered mixed reality device with apps and solutions that enhance collaboration, our customers can now connect with us via web to become active part of the testing process directly from anywhere they are. Furthermore, the augmented reality offers the opportunity to increase interactivity, due to presence of specific commands, such as head-tracking, that allow the user to bring application focus to whatever element they are perceiving. This new testing solution enables quality control and business continuity by collaborating closely between the KEMA Labs, utilities, and the manufacturer without compromising on quality.

"Augmented Reality and digitalization are a new way for testing at KEMA Labs."

White Paper

New KEMA Labs LV White Paper: IEC 61439-1 :2020 WHAT'S NEW?

As the IEC 61439 brought to the Low Voltage market several news for the low voltage switchgear assembly manufacturers, KEMA Labs (CESI's Testing, Inspection and Certification Division) has had a crucial role in the evolution of such technical standard. In this respect, KEMA Labs experts have been involved in National Committees (DKE and CEI) and International Committees (IEC), giving an important contribution for this standard. In fact, after several years, the type-testing still plays the most important role but is in need of continuous improvement. Therefore, after the first update in 2011, the third edition of the standard has been officially published in May 2020. In this context, "IEC 61439-1 :2020 What's New?", the new KEMA Labs LV White Paper focuses on IEC 61439-1:2020. It lays down the general definitions and service conditions, construction requirements, technical characteristics and verification requirements for low-voltage switchgear and control-gear assemblies. Moreover, the new KEMA Labs White Paper intends to give clients an overview of the most important changes of the third edition when compared with the Edition 2 (2011-08) about essential and test-relevant changes.

"An overview of the most important changes of the third edition."

CASA-1000

CESI's support in determining the operational strategy of the CASA-1000 Interconnector

CESI has been recently confirmed as technical consultant to support the CASA-1000 Secretariat in determining the operational strategy of the CASA-1000 Interconnector: from developing its technical code, assuring its harmonization with the Countries existing grid regulations, as well as preparing the technical procedures required to safely and efficiently operate the infrastructure. This assignment further enlarges the role that CESI is already providing as Owner's Engineer for the two HVDC converter stations in Tajikistan and Pakistan and the ffl500kV HVDC transmission line between them crossing Afghanistan. This is a crucial part of the $1.2 billion CASA-1000, one of the most important Power Transmission projects in Central and South Asia, which will enable the flow of electricity from hydro-electric power plants in Kyrgyzstan and Tajikistan to consumers in Pakistan. The interconnection is a cornerstone of Pakistan's strategy to meet its increasing demand for electricity and will allow Kyrgyzstan and Tajikistan to exploit their abundant hydro resources. CESI is supporting the National Transmission Companies of the CASA countries with a full range of Owner's Engineering services, including design review, contractor's management, quality assurance, construction supervision and witnessing during testing and commissioning of the infrastructure. The CESI consultancy assignments are financed by World Bank and United States Agency for International Development (USAID).

"Interconnection is a cornerstone of Pakistan's strategy."

EnerNex

EnerNex supports MISO's architectural services

EnerNex, a CESI company, is partnering with Midcontinent Independent System Operator (MISO)'s architectural services team to produce an Enterprise Architecture (EA) process and corresponding architectural products that can be scaled independently to other domains within MISO. The project is focused on the development of architectural artifacts which demonstrate enterprise-level value to MISO leadership while concurrently developing and maturing the architectural services practice. Architectural artifacts are being produced related to MISO's Reliability Portfolio to catalog and visualize the current state of various Tier 1 systems and applications as well as architectural assessments related to principles, standards, and quality attributes. MISO's ultimate objective is to transition to a future state as part of their Operations of the Future initiative.

"MISO's ultimate objective is to transition to a future state."

Scenario

Timeless Energy

Throughout history, mankind has faced the same issue: how to reap the most energy from the resources at hand. A series of studies and reports reveal how, over the past decade, the world has been addressing the new energy transition.

"The secret of change is to focus all of your energy, not on fighting the old, but on building the new," said Socrates. And this principle, which has been applied to the use of energy sources since time immemorial, is valid and useful advice for the current energy transition, too. The epochal change that is currently affecting the energy sector - fueled by an increase in the demand of energy, driven by technological innovation, altered by geopolitical change, and deeply affected by the health and environmental emergencies – is nothing new. There have been phases, cycles, transitions and even revolutions throughout history as mankind has repeatedly faced the same issue: how to reap the most energy from the resources at hand.

And the history of the use of energy sources began with the very renewables that are now at the center of the energy transition: fire, wind and water. Back in the days of stilt houses, firewood was the main source of thermal energy. The power of the wind was first harnessed for navigation in 2000 BC and, from 644 BC, the Persians used it to power their windmills. Similarly, water drove the watermills in Anatolia (100 BC). Fossil fuels entered the picture in 1400 when coal began to replace firewood in England, while oil did not come on stage until 1650, when it was used to lubricate cartwheels and to fuel the first oil lanterns. Then, new machines and large factories drove a true energy revolution. It was ushered in by Papin's pressure cooker (1680) and Watt's steam engine (1765). The world accelerated even further with the introduction of J. Henry's electric motor (1831) and turbines. In 1882, the first electric plants allowed the streets of London and New York to be illuminated. And, in 1895, a hydroelectric plant was opened at Niagara Falls. The twentieth

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century and its cars accelerated the demand for oil, introduced nuclear energy and perfected modern renewable energy sources. These include geothermal energy (Larderello Plant, Tuscany, 1904), wind energy (aerogenerators in the United States,1930) and solar energy (photovoltaic cells converting solar energy into electricity in 1954 and solar panels producing hot water in 1970).

Renewables on the Rise since 2010

We have been using renewable energy sources for ages, while the incessant exploitation of fossil fuels only began two centuries ago. However, in recent decades, we have grown aware that our oil, coal and natural gas reserves are finite. The new energy transition will lead us towards the exclusive use of zero carbon emission renewables: water, sun and wind. Indeed, data for the period 2010-2020 reveals a steady growth trend for renewables. And a large amount of data and many studies document this phenomenon. The "Renewable Capacity Highlights" published by the International Renewable Energy Agency (IRENA) in March 2020 reports that, in terms of global renewables for the generation of electricity, the installed capacity generated from renewable sources has more than doubled since 2010. Plants for electric generation from renewables totaled 2537 GW in 2019. Hydroelectric was the most common renewable source, producing over 1190 GW, followed by photovoltaic (623 GW) and wind energy (586 GW). Percentagewise, this means that hydroelectric increased by 30%, wind energy tripled, and photovoltaic has increased fifteen-fold. Viewing this data from a geographical perspective, 44% of renewable energy plants are located in China, 23% in Europe and 15% in North America. IRENA points out that the electricity sector is undergoing the most dynamic decarbonization process. This is due to the technological progress made in the field of renewables, especially wind and photovoltaic, that are economically more competitive than fossil fuels. Indeed, the International Energy Agency (IEA) Renewables 2019 Report emphasizes how the competitiveness of renewables has increased over the past decade. Since 2009, there has been an 81% reduction in the cost of photovoltaic energy and 46% reduction in that of onshore wind energy.

Analysts at Bloomberg New Energy Finance (BNEF) have reached similar conclusions in their "Power Transition Trends 2020" Report that analyses electric generation and capacity over the last ten years. Indeed, the BNEF Report also helps to understand another phenomenon that has taken place over the same period: how the continuous growth of renewables is related to the global decrease in fossil fuels. According to the Report, in 2019, photovoltaic and wind energy accounted for 67% of electric capacity, while fossil fuels plummeted to 25%.

Moreover, according to IRENA's "Renewable Capacity Highlights" Report, 2019 was also the eighth consecutive year (with the exception of 2014) during which more renewable energy plants were installed than fossil fuel ones. Renewables plants now amount for a record 75% of the installed capacity, while the annual increase in fossil fuel power capacity was under 70 GW, the lowest level in over twenty years. The drop in new fossil fuel plants for the generation of electricity is a trend that began about ten years ago, reducing the new net installed capacity by 50% and accelerating the process of decarbonization in the electricity sector. This trend has also been influenced by the closure of obsolete coal-powered plants in the United States and Europe over the past decade.

A Record for Green Investments

A careful reading of the many published analyses also sheds light on another aspect of the green revolution: its accelerated rhythm is driven by a true boom in investments in renewables. Over the past ten years, the installed capacity of renewables has increased fourfold. Similarly, over the same time period, €2500 billion have been invested in renewables, as is reported by the UN Environment Programme (UNEP) "Global Trends in Renewable Energy Investment 2019." According to REN21 – Renewables Global Status Report, thanks to this funding, 2019 was a record year for the installed capacity produced by renewables which increased by over 200 GW. And 175 GW were related to new wind and photovoltaic power plants.

China is at the top of the list of renewables investors with US$758 billion from 2010 to mid-2019. The United States places second with US$356 billion, followed by Japan at US$202 billion. Then comes Germany (US$179 billion), Great Britain (US$122 billion), India (US$90 billion) and Italy, which places seventh, with US$82 billion. Thus, Italy has invested more than Brazil, Australia, France, Spain, Canada, Holland, Mexico, Belgium, Sweden, South Africa, Turkey, Chile or Denmark. The breadth of investments in renewables capacity is another element that should be taken into consideration. In this case, too, 2019 sets a new record: 29 countries have invested over one billion dollars, as opposed to 25 countries in 2017 and 21 countries in 2016.

Turning our attention to Europe, over this green decade the old continent has invested a total of US$698 billion in renewable energy capacity, an effort led by Germany and the United Kingdom. The energy transition, which is very closely related to environmental sustainability and innovation, is firmly supported by the EU that has committed to a zero environmental impact of the European economy by 2050. EU President Ursula von der Leyen explains: "The European Green Deal is our strategy for growth. It will allow us to reduce emissions and create new jobs."

Many sector operators believe that photovoltaic energy will be the true driver for this transition. The IEA 2019 Renewables Report indicates that solar energy will represent 60% of the increase forecast between 2019 and 2024 for utility-scale and distributed generation installations. According to IEA analysts, commercial and industrial installations, rather than residential ones, will drive the photovoltaic segment. Indeed, they will account for three quarters of all new plants over the next five years. Moreover, according to the forecasts published in the report, by 2024, the number of solar installations on household roofs should double, reaching over 100 million installations. Australia, Belgium, California, the Netherlands and Austria are the main markets in this context.

An altogether different case is the decarbonization roadmap for the power system adopted in China, which is based on hydro, wind and sun resources. The ambitious hydro project on the Yangtse river, the "Three Gorges Dam," was timely completed in 2012 with an installed capacity of 22.5 GW. Furthermore, China intends to install 10 GW of offshore wind energy to allow the development of economic centers along the coast of the Province of Jiangsu.

Thus, there will be a steady increase in the energy produced by water, wind and sun in China. And not China alone.

Top Stories

The Turning Point

According to recent research, during the first semester of 2020, renewable energy sources topped the use of fossil fuels in Europe. As employment continues to grow in the renewables sector, we may be on the brink of a third industrial revolution driven by three horizontal axes: communications, energy, and electric mobility.

"We have reached a turning point in the energy transition. Renewable energy is increasingly the cheapest source of new electricity offering tremendous potential to stimulate the global economy." This is how IRENA Director General **Francesco La Camera** commented in the publication of the 2019 *Renewable Power Generation Costs Report*. In this report, which was published in June 2020, analysts from the International Renewable Energy Agency estimate that over half of the new installed potential of renewables in 2019 (56%) produced electric energy at a cheaper price than coal plants. And more specifically, new solar and wind plants are more competitive than coal plants. This trend was also confirmed in mid-October by the IEA **World Energy Outlook 2020** that crowned solar as the new "King of Electricity." The IEA report indicates that renewable energy has become a protagonist on the energy scenario and solar takes frontstage. This is the result of a support policy and technology that allow cheap access to this type of energy. According to IEA researchers in most countries, solar photovoltaic is cheaper than new coal-powered and gas-powered electricity production plants; indeed, solar projects provide the cheapest electricity ever. The forecast for the next decade is that renewable energy will satisfy 80% of the global increase in electricity demand. And while hydropower remains the principal renewable source, solar is the main driver of growth followed by on-shore and off-shore wind energy. IEA Executive Director **Fatih Birol** is very optimistic about the results and forecasts published in the Outlook 2020: "I believe that solar will become the new market king of global electricity. Based on current plans, it will mark record levels for each year after 2022." Turning to fossil fuels, the analysis posits that the demand for coal will not reach pre-COVID-19 levels. In fact, it will account for less than 20% of total energy consumption by 2040. And this is the first time that this will occur since the Industrial Revolution. In terms of oil, demand will definitely slow down after 2030; however, a slight increase may be driven starting in 2023 by emerging countries and especially India. Nonetheless, the report emphasizes that until then, "it will remain vulnerable to the principal uncertainties provoked by the pandemic."

The most recent IEA Outlook confirms that **renewable sources will top fossil fuel sources**. The news has been published by Forbes, Le Figaro, Bloomberg, and the World Economy Forum based on the results provided by **Ember**, an independent think-tank on the climate, focusing on the acceleration of the global electricity transition, and supported by organizations such as *The European Climate Foundation and The Environmental Defense Fund Europe*. Crunching the data collected by the transmission system operators of the European national networks in the Entso-E Association, the Ember analysis reveals how, in the first semester of 2020, wind, solar, hydropower, and bioenergy were employed to generate 40% of the electricity in the EU27 against the 34% produced by fossil fuels. This means that renewable energy has increased by 11% during the first half of this year as compared to the same period in 2019. The green sources are driven by wind (+11%) and solar energy (+16%). Together, these two sources have achieved a new market record generating 21% of all electricity in Europe. The highest levels were touched in Denmark (64%), Ireland (49%), and Germany (42%). Similarly, the hydropower market produced 13% of European electricity, increasing by 12% over the same period of the previous year. Moreover, bioenergy marked a 6% increase in the production of electricity in Europe. Last, but certainly not least, according to the English report, this record period for renewables has reduced CO_2 emissions by 23% compared to the previous year.

A Drop in the Fossil Fuel Market

The constant increase in the generation of renewable energy has reduced the market quota of fossil fuels, which has also been influenced by the reduction in demand for electricity brought about by the restrictive measures adopted for the Covid-19

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emergency. Ember analysts indicate that compared to 2019, there was an 18% reduction in the production of electricity from fossil fuels during the first six months of 2020. In particular, the most marked decline affected coal with an average 32% decrease in the European Union. In Portugal, where coal plants were shut down two year earlier than planned, there has been a 95% reduction. In Spain, coal generation has been cut by 58%, while in Germany it has decreased by 39% (and was the hardest hit by the fall in demand for energy). Indeed, it also was the first time that Germany produced electricity by burning less coal than Poland which generates the same amount of energy from coal as the other 25 EU countries (excluding of course, Germany). In Italy, the use of coal has decreased by 25%.

Electricity produced with gas is also decreasing. In the first semester of 2020, it fell by 6% and decreased in 11 EU member states, especially in Italy where it plunged by 16%. Commenting on the report results, **Dave Jones**, a Senior Analyst at Ember, defined the primacy of renewable sources over fossil fuels as "a symbolic moment in the transition of the electricity sector in Europe" and added that "The Next Generation EU economic recovery plan will help member states to accelerate the energy transition by investing in wind and solar. The **Just Transition Fund** will help states to drop the use of coal."

> **The European Green Deal is the perfect opportunity to reduce environmental pollution by over 50%, cut our dependence on energy imports, become technological protagonists of the global green sector.**

In her speech on the State of the Union, **Ursula von der Leyen** emphasized these two key tools for the **European Green Deal**. The EU President underlined the importance of the energy transition phase, notwithstanding the fact that public opinion is currently far more preoccupied about the Covid-19 emergency than the climate emergency. President von der Leyen claimed that we need "to act more efficiently and more rapidly" in order to become the first climate neutral continent by 2050. She also announced that the EU Commission will increase the reduction of emissions from 40 to 55% by 2030. This objective will be pursued by using two distinct tools, the **Next Generation EU** and the **Just Transition Fund**, as described by the President: "37% of the Next Generation EU will be spent directly on our European Green Deal objectives. And I will ensure that it also takes green financing to the next level. And I can today announce that we will set a target of 30% of Next Generation EU's 750 billion euro to be raised through green bonds. Secondly, Next Generation EU should invest in lighthouse European projects with the biggest impact: hydrogen, renovation, and one million charging points for electric vehicles." And this doesn't include the Just Transition Fund, "thanks to which," she added, "we will support the regions facing the most extensive and expensive changes."

In her address, President von der Leyen emphasized that the climate neutrality objective will not only be advantageous in climactic terms, but also for the European economy. "While emissions have dropped by 25% since 1990, our economy has grown by over 60%. The difference is we now have more technology, more expertise, and more investment. And we are already embarking towards a circular economy with carbon neutral production."

In summary, the European Green Deal is the perfect opportunity to reduce environmental pollution by over 50%, cut our dependence on energy imports, become technological protagonists of the global green sector, and create millions of new jobs in the renewables sector.

Employment Upswing in Renewables

The importance of the positive employment trend in the renewables sector is acknowledged by the seventh ***Renewable Energy and Jobs 2020 Report*** published by the International Renewable Energy Agency. According to the report, renewable energy created 11.5 million jobs globally in 2019. In 2012, when the first edition of this report was published, 7.3 million jobs had been created. The increase in employment has especially been driven by the photovoltaic sector, which created 3.8 million jobs last year (33% of all jobs in the renewables sector). China tops the list with 38% of personnel employed in this sector. Wind energy accounted for 1.2 million new jobs in 2019. This mostly concerns on-shore projects, but countries with off-shore projects increased to 18 (from 10 just a decade ago). By contrast, the hydropower sector, which directly employs nearly 2 million people, has slowed down. The IRENA Report highlights how these new job opportunities are one of the fundamental reasons that drives countries to plan low-carbon emission economic growth. According to the agency, many governments have prioritized the development of renewables not only to reduce emissions and achieve international climate objectives, but also to purse wider-ranging socio-economic benefits.

In his last book entitled "**The Green New Deal**," **Jeremy Rifkin**, President of the Washington **Foundation on Economic Trends** and Professor at the Wharton School of Finance and Commerce, argues that renewables create more employment. The book addresses a third industrial revolution that will drive new enterprise, employment, and investments thanks to the global green new deal powered by the convergence between Internet communication and a new green network, that of renewables, connects millions of individuals who can produce their own solar or wind energy right where they live and work. These two networks, energy and communications, are already beginning to develop a new Internet that of mobile electricity powered by sun and wind energy. "The convergence between these three internets," writes Rifkin, "will constitute the core of a new Internet of Things for the management and transport of goods, services, and the supply of energy, for the economy of a third industrial revolution." And this revolution will be horizontal, digital, intelligent, and inclusive.

The Connection between Social and Environmental Issues

One of the effects of a transition towards a low CO_2-emission economy by promoting renewable energy sources is the contribution made to fighting climate change. The last measurements made in May 2020 by the **Global Monitoring Laboratory (GML) of the National Oceanic and Atmospheric Administration** have revealed that CO_2 concentration in the atmosphere has increased from 280 ppm in pre-industrial times to the current 417 ppm. And this concentration of CO_2 has had a disastrous effect; it is a greenhouse gas and drives one of the main phenomena causing global warming. And this is one of the main worries of the scientific community. Global warming is causing the polar caps to melt, sea levels to rise, increasing extreme weather conditions, droughts, forest fires, floods, damage to ecosystems, and the loss of biodiversity. In order to limit the increase in temperatures to under 2 degrees centigrade, we will need to transform various parts of our energy system, according to the report of the European Commission's **Joint Research Center** (JRC) entitled "*Global Energy and Climate Outlook 2019, Electrification for the low-carbon transition – GECO*." The report was produced by JRC, the Chinese National

Center for Climate Change Strategy and International Cooperation (NCSC) and the Energy Foundation China (EFC).

Based on research, the report advances four necessary measures: decarbonization of energy production systems by using low-carbon sources and technology (such as renewable energy) and reducing the use of fossil fuels; electrification of the energy system; increase of energetic efficiency for final use, promoting electrification; and development of new technology to better manage greater quotas of intermittent renewable electric energy, such as load management and energy storage.

Moreover, it is useful to understand how the risk related to climate change may interest entire geographical areas and related economic sectors. This issue was tackled by a recent study produced by the **Euro-Mediterranean Center on Climate Change** entitled "Risk Analysis. Climate Change in Italy." The study applied high-resolution climate models to the Italian data to forecast climate scenarios in Italy. This information was then applied to risk analysis for a series of Italian socio-economic sectors. Notwithstanding geographical differences, the study reveals that climate risk poses a threat to all Italian regions, especially in terms of extreme events. Over the next decades, risk will rise nationally with a consistent economic-financial toil. Its impact will affect all sectors and especially the most disadvantaged categories, especially infrastructure, agriculture, and tourism. The worst scenario hypothesized by the study calculates that in 2100, climate change will cause a 7-8% loss in pro capita GDP. The economic divide between the north and south of the country will grow wider, as will the differences between the poor and rich. In this scenario, equality indicators will fall by 16% in 2050 and 61% in 2080. The analysis underlines how climate change will require large investments to sustainably manage the environment, reduce its impact, and strengthen resilience. Otherwise, the increase in average and extreme temperatures, the greater frequency (and duration) of heat waves, and heavy downfall will cause children, elders, the disabled and other fragile members of society to suffer the greatest repercussions. The numbers explain how social and environmental issues are increasingly interconnected without any geographical and anthropological distinctions.

Future & Technology

Renewables and the Growing Integration of Systems

CESI is at the forefront of the drive to guarantee efficiency and reliability in the energy sector. Its forward thinking is currently directed at improving network flexibility testing activities, as well as impact and certification analyses for the integration of VRES into transmission systems.

In a world harried by climate change, the surge in energy generated by non-programmable renewables over the past twenty years requires. and will even more so in the future, a greater flexibility of the electricity system. In October 2020, at the presentation of the "**Energy Technology Perspectives 2020**" Report, IEA Executive Director **Fatih Birol** explained that "notwithstanding the issues caused by the Covid-19 crisis, various recent developments allow us to be optimistic about our ability to accelerate the transition towards clean energy and achieve our energy and climate objectives. Nonetheless, we still face important issues." The challenge ahead of us is significant nevertheless the fact that a wide range of innovations and renewable energy models are being developed around the globe.

One of the elements that allows us to improve system flexibility is energy storage. Electrochemical accumulators, together with Demand Side Management (DSM), represent a solution to our needs. Indeed, batteries are already being installed in solar parks and wind farms producing renewable energy. This trend is particularly relevant for "hybrid" companies that can store energy both for services and as balancing energy. According to the **Energy Storage Outlook 2019**, one of the greatest promises of batteries is the ability to store and input energy into networks, independently of when it is produced.

In any case, in order to allow a sustainable transition of the energy sector, policy support is fundamental. Governments must support green initiatives and provide funding against climate change because solar and wind energy tend to be more variable and uncertain compared to conventional energy

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sources. In fact, achieving these objectives will require changes to be made to the planning and operation of energy systems. Efficient network integration methods will allow us to reap the best cost-efficiency benefits from the incorporation of variable renewable energy sources (VRES) into energy systems maintaining and increasing their infrastructural stability and reliability.

"Notwithstanding the many references," explain the authors of the "**Getting Wind and Sun onto the Grid**" Study published by IEA in 2017, "the discussion on the integration of VRES has often been tarnished by wrong ideas, by hearsay, and also in some cases by misinformation. Common misconceptions include that energy storage is a requirement for the integration of VRES and that conventional generators will require significant additional costs as VRES quotas rise." The report indicates that such misconceptions may distract policymakers from the real issues and slow down VRES implementation.

A Renewable Future

In this context, the scenario presented in the **last report published by IRENA**, the International Renewable Energy Agency, on the integration of VRES into energy systems is rather interesting. The study analyzes the solutions that promote the diffusion of renewables (solar and wind energy) in relation to four dimensions of innovation: enabling technology, business models, market development, and system operation. The synergy amongst these four elements reduces the integration cost for significant quotas of VRES and increases the flexibility of energy production, transmission, and use.

According to the estimates presented by the IRENA "Roadmap to 2050," the decarbonization of the global energy sector, as established by the objectives of the Paris Agreement, will require 85% of all energy produced to be renewable by 2050. At that point, VRES should represent 60% of power generated worldwide. The shift to a new phase in which the massive, but economically advantageous, increase of renewables will be fundamental; the transformation of the energy sector will be catalyzed by innovative trends in digitalization, decentralization, and the electrification of final use sectors. "Understanding and learning from the experiences of countries leading in the integration of VRES," explains IRENA, "is fundamental to replicate and reinforce the innovation that can accelerate this transformation."

The authors of the report posit that the EU28 may lead the way towards integration with its 15% quota of VRES in the annual production of electricity, a figure which should increase to 50% by 2050. The three largest energy systems in the world, China, India, and the United States, will double their VRES quotas to over 10% by 2022.

Flexibility and Storage

The scenario described above points to how the energy sector has embarked on a fundamental twofold role. On one hand, it is driving the decarbonization process through important investments in renewables, while on the other, it is **addressing, managing, and solving energy security issues caused by climate change and the fall in electricity demand brought about by the Covid-19 emergency**. In fact, the isolation measures adopted during the first semester of 2020 were the main cause of the reduction in electricity consumption in Italy (-25%), France (-20%), and the United Kingdom (-12%) during the period March-April 2020 compared to 2019.

As one of the main actors working to guarantee the efficiency and reliability of the energy system, this summer CESI published a study (addressed in the previous issue of Energy Journal) revealing how the current crisis has unveiled what may happen in about 5 years in terms of the penetration of renewable energy sources respect to the load: 44% in 2020 as compared to 30% in the same period during 2019. By observing what occurred during the lockdown, we understood what would happen to the Italian energy system if the necessary flexibility was not introduced to manage a system with a high percentage of renewables. In fact, this is the time to speed up the process of integration by identifying the fundamental strategies and guaranteeing safe conditions for a significant injection of VRES quotas into the network. "With regard to the fundamental testing, inspection and certification activities," explains CESI CEO **Matteo Codazzi**, "CESI and KEMA Labs provide services for all the main energy system components. This new approach allows us to achieve objectives that efficiently satisfy the needs of our clients, employing our cutting-edge resources and high-quality competences around the world."

At the **Flex Power Grid Laboratory** in Arnhem (Netherlands), KEMA Labs helps producers test and verify energy storage systems in realistic but controlled conditions. Through a connection to a flexible network (that imitates grid conditions and allows parameters such as frequency and tension to be varied), the tests conducted at the Flex Power Grid Laboratory reveal

for example the principal role played by inverters in determining the network performance of energy storage systems. Another use is to verify the behavior of systems, both in standard and extreme conditions, by varying frequency, over and under-voltage, network pollution, etc.

Integration Analyses and Studies

At the international level, besides providing consultancy services to support the investment strategies of energy sector operators, CESI also conducts profitability analyses (to identify necessary regulatory operations and simplify the development of roadmaps for future investments), impact analyses, and studies both on market opportunities and the development of the technical requisites required to integrate non programmable renewables into transmission systems.

Given the complexity of these systems, CESI has developed a series of electricity market simulators that identify the need and profitability of investments in storage systems (from forecasts to market regulations, from the performance of batteries to the evolution of technology). CESI's quantitative simulations allow us to ascertain which services are more profitable for storage and to conduct advanced risk analyses. Moreover, CESI uses these tools to conduct global-level studies to identify a range of parameters, including the key role played by batteries in the integration of non-programmable renewable energy in electricity networks.

One of these custom-tailored analysis was conducted for **Project Renewable Integration Development Project** (RIDP) in Ireland and Northern Ireland. In this case, it was fundamental to optimize both the transmission network in the two countries and their control systems in order to reduce the risk of dispersion of non-programmable renewable energy to a minimum. In other studies, such as that conducted in sub-Saharan countries (Ethiopia, Kenya, and Zambia) for **Res4Africa** and the Enel Foundation, it was essential to evaluate the role of hydric and electrochemical storage systems for long periods of drought. A further objective of these activities concerns the integration of non-programmable renewable energy sources into the countries' electric systems. The growing penetration of wind and photovoltaic technology was analyzed both over the medium (to 2025) and long term (to 2030) for their impact on the reliability, integrity, and efficiency of the electric system. In this context, the exploitation of the great renewable energy potential of sub-Saharan countries can be accompanied by the development of new transborder interconnections which provide a key strategic driver for the exportation of energy towards more expensive energy markets.

Looking at the Mediterranean, as part of the program managed by the World Bank, CESI has recently conducted a study on the Turkish-Cypriot energy sector to promote the development and integration of renewable energy in the system. Through a plan to increase generation at a minimal cost and execute statistical, dynamic and reliability analyses over 2020-40, the study reveals the economic advantages and technical feasibility of developing VRES and moving away from oil for the production of energy on the island. In the Middle East, CESI conducted feasibility studies for the Arab Fund for Economic and Social Development (AFESD). The objective was to evaluate the benefits of energy trading incentives through investments in renewable generation and new electric interconnection infrastructure amongst the 20 member countries of the Arab League and define common strategies for the development of the regional energy market, both in terms of infrastructure and market regulations.

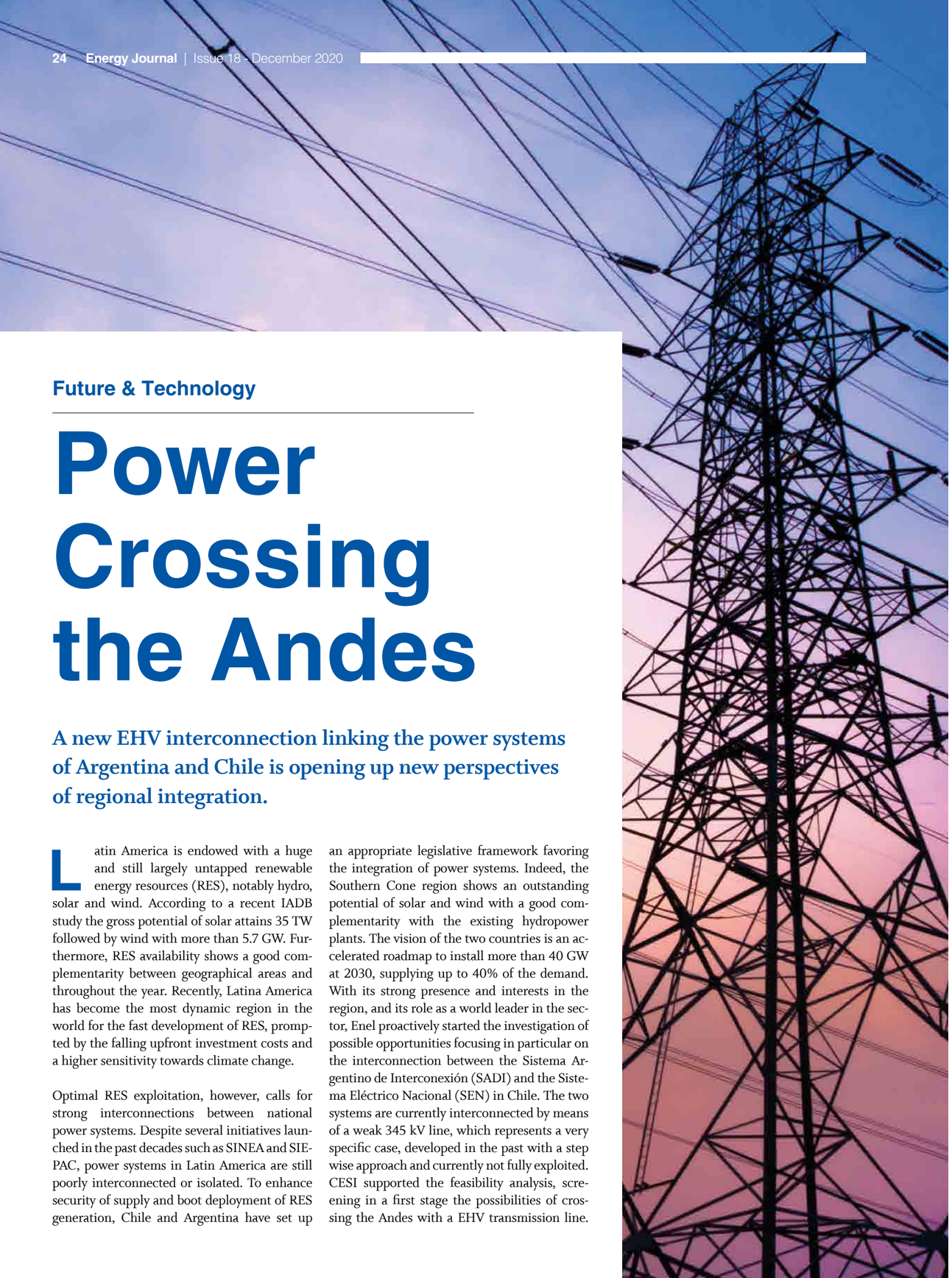
Furthermore, as part of its mission to promote the implementation of EU policy objectives by funding solid investment projects, the European Investment Bank has signed a framework agreement with CESI for consultancy services in "Power Generation, Transmission, and Distribution." This includes the fundamental role of investments in green energy to promote the European decarbonization process over the coming years.

An Outlook on Impact

In order to analyze the critical issues related to the ongoing evolution of power systems, CESI organized a webinar on "**Renewables: New Connection Requisites and Main Network Issues**" to provide an outlook on the various types of impact (system, network, market) and to address specific issues such as network code requisites, regulatory amendments to manage the transition, and the measures needed to enable the connection of VRES to transmission and distribution systems.

Francesco La Camera, Director General of IRENA, has recently explained how "countries in Europe and worldwide are working to overcome the economic impact of Covid-19. In this context, the transformation of the energy system must be at the forefront of this effort." According to the Director, public expenses, implementation policy, and a framework of regulations promoting the use of renewable energy are fundamental to guarantee that the transition will drive economic recovery, disconnecting economic growth from the increase of emissions.

"What we need," he concluded, "is policy promoting the integration of VRES into the electricity network, together with industrial policy exploiting and improving the national potential of every country."



Future & Technology

Power Crossing the Andes

A new EHV interconnection linking the power systems of Argentina and Chile is opening up new perspectives of regional integration.

Latin America is endowed with a huge and still largely untapped renewable energy resources (RES), notably hydro, solar and wind. According to a recent IADB study the gross potential of solar attains 35 TW followed by wind with more than 5.7 GW. Furthermore, RES availability shows a good complementarity between geographical areas and throughout the year. Recently, Latina America has become the most dynamic region in the world for the fast development of RES, prompted by the falling upfront investment costs and a higher sensitivity towards climate change.

Optimal RES exploitation, however, calls for strong interconnections between national power systems. Despite several initiatives launched in the past decades such as SINEA and SIEPAC, power systems in Latin America are still poorly interconnected or isolated. To enhance security of supply and boot deployment of RES generation, Chile and Argentina have set up an appropriate legislative framework favoring the integration of power systems. Indeed, the Southern Cone region shows an outstanding potential of solar and wind with a good complementarity with the existing hydropower plants. The vision of the two countries is an accelerated roadmap to install more than 40 GW at 2030, supplying up to 40% of the demand. With its strong presence and interests in the region, and its role as a world leader in the sector, Enel proactively started the investigation of possible opportunities focusing in particular on the interconnection between the Sistema Argentino de Interconexión (SADI) and the Sistema Eléctrico Nacional (SEN) in Chile. The two systems are currently interconnected by means of a weak 345 kV line, which represents a very specific case, developed in the past with a step wise approach and currently not fully exploited. CESI supported the feasibility analysis, screening in a first stage the possibilities of crossing the Andes with a EHV transmission line.

The Andes reach a maximum height of almost 7,000 meters near Santiago and finding an appropriate route turned out to be a multidisciplinary challenge, addressing transmission grid impact, technological solutions and the key priority to preserve the priceless landscape value as well as the inestimable archeological sites.

Different alternatives for a new international interconnection were investigated, identifying the best solution in terms of achievable Net Transfer Capacity (NTC), impact on the operation of the power systems and constructability. The analysis was very complex as it required the application of a network model representing the whole system with the two countries, which were usually studied separately and with different software. Following in-depth static and dynamic simulations, the best interconnection alternative turned out to be a 500 kV single circuit line connecting the Los Condores substation in Chile to Rio Diamante in the Mendoza province. Maximum power transfer is in between 300 and 800 MW depending on the direction of power flows and the network arrangements in the internal grid of the two countries and the power dispatch of Chilean and Argentinean generation fleets.

In parallel, detailed analysis have been performed for the definition of the line routing and the preparation of the basic design of the line and the substation.

Line routing selection

One of the most important activities in the design of a merchant line is the identification of the most favorable route, comparing different alternative solutions and selecting the most favorable ones on the basis of environmental criteria, technical constraints and economic impact of the different alternatives. The methodology used is the Analytical Hierarchical Process (AHP): a certain set of criteria and sub-criteria have been identified and for each of them a qualitative evaluation scale and a weight has been determined. Each solution, compared and ranked with a total score, obtained in the various criteria and sub-criteria, indicates the best alternative from the environmental feasibility point of view.

The selection process has considered five different route alternatives and two different pairs of electrical nodes (Polpaico "CL" – Gran Mendoza "AR" and Los Condores "CL" – Rio Diamante "AR"). Moreover, the final route decision was driven by multiple aspects such as the length of the viable alternatives, the electrical losses, the complexity of the ending sub-stations and the reactive power compensation needed for each solution. The final routing is shown in Figure below, the two receiving-end sub-stations are Los Condores, on Chile's side, and Rio Diamante on Argentina's side. The hypothesis at Polpaico (CL) – Gran Mendoza (AR) nodes was rejected essentially due to the high social environmental impacts.

The selected line has a total length of 312 kilometers and a maximum altitude of 2,700 meters. The main challenge in the route selection was represented by the difficulty in the Andes crossing, mainly due to shortage of crossing routes/corridors and high density of environmentally sensitive areas.

Interconnection Design for Authorization Process

Once the most favorable alternative was selected. CESI developed the overhead line and receiving end substation design, in order to fulfil the requirements of the Authorities for the application of construction and operation permits. The HV line design is unique along its length, making it necessary to consider both Chilean and Argentinean contemporary technical Standards and Regulations, as far as the main International Standard. The line design was mainly driven by the route's high altitude, of up to 2,700 meters. Considering the purpose of the merchant line, it was required to optimize line losses considering both investment cost and capitalized losses along a 15-20 year period. The resulting optimized

Map legend

- 1 - Baja
- 2 - Media
- 3 - Alta
- **4 - Muy Alta**
- **Portezuelo del Viento**

- **Region del Maule (Chile)**
- **Mendoza (Argentina)**

> conductor is a four wire per phase configuration AAAC type. This result was mostly driven by the limitation of corona losses, which may become very high considering the combination of voltage, 500 kV, and altitude up to 2,700 meters. Moreover the design considered in detail the high mountainous environmental conditions such as minimum (-15°C), maximum. (+25°C), and average ambient temperatures (+8°C), wind action (30 m/s 10 minutes 50 year return period), ice (20 mm thickness), earthquake severity (0.48 g), keraunic level (7 flashes/ km2 per year), pollution level. The outcomes of this activity were the definition of the conductors and ground wire, towers outline with a maximum height of 51 meters, the selection of an insulator string of 7.5-8.5 m meters and right of way restrictions.

In a similar way, the HV substations at line sides were also designed, in order to define: single line diagrams, layout and sections, technical description with main electrical parameters. The substation design was in accordance with each country's Regulations and Standards as far as major International Standards. The substation in Los Condores (Chile) is a greenfield GIS (Gas Insulated) sub-station with 500 kV (1 ½ breaker scheme) and 220 kV sections (double busbar), three single phase transformers 500/220 kV 286 MVA rated and three single phase 500 kV reactors 40 MVAr rated. The GIS choice was mainly driven by space constrains and altitude (1,450 meters). The substation in Rio Diamante is a brownfield substation AIS (Air Insulated) type with 500 kV and 220 kV sections, both with 1 ½ breaker scheme. The interconnection line will be connected to an existing 500 kV diameter, which shall be extended with HV line connection equipment and line shunt reactance 500 kV, rated 3 x 40 MVAr. Shunt reactance section will also be equipped with a forth reserve reactor connected to a quick exchange system allowing the connection of the spare reactor without reactor movement.

For the Chilean portion of the line only, both for Electrical Concession authorization and EIA requirement, it was necessary to define HV tower positioning and line profile. Moreover, considering the lack of detailed topography of the area, it was necessary to perform a drone survey campaign in order to acquire the ground profile.

Environmental Impact Assessment

On the basis of the outcomes of the Regulatory Analysis, a set of environmental and technical studies has been defined for each country. The high-level structure of EIA is similar for both countries and it is mainly composed of: study of the environment as is; definition of the project influence area; definition of project impact; definition of mitigation; compensation and monitoring.

The main difference between Chile and Argentina lies in the degree of detail and depth of the analysis required by the relevant authorities. Chilean requirements are more demanding both in terms of studies to be prepared and the number of site campaigns needed. Almost each specialty requires a site campaign, moreover Flora, Fauna and Limnology require seasonal campaigns in order to investigate the project area in all the seasons. The extended observation period is one of the reasons for the long time and the effort required to prepare the EIA on the Chilean side.

The preparation of the EIA also gave some chances to fine-tune the line route and/or tower positioning in order to solve some interferences and critical points discovered along the preparation process. For example, on the Chilean side, some towers have been moved from their original position, so as not to be placed in the middle of a highly sensitive flora area or near the inundation area of water streams. Another sensitive study is the archaeological one that requires site inspection of the entire length of the line. During the inspection of the Chilean portion, some obsidian stones were detected.

As of today, EIA for the Argentina portion has already entered the evaluation process, while the Chilean one is still under preparation.

Consultancy Support along the Process

As a part of its consultancy, CESI is supporting Enel throughout the whole authorization process, drawing on the experience acquired in the field of authorization procedures for high voltage power line interconnections. The authorization procedure is composed of multiple processes and complex timing, which requires a coordinated strategy to be effective.

The authorization procedure has led to many interactions with Chilean and Argentinian Authorities, both before and after the permit application. In both cases, CESI has assisted Enel with technical support during the various meetings.

Q&A Gianluca Marini (Consulting Division Executive Vice President – CESI) and Fabrizio Scaramuzza (Head of Global Origination & Merchant Lines – Enel).

Gianluca Marini: Considering your experience, which is the biggest obstacle to the development of interconnecting power lines in South America?
Fabrizio Scaramuzza: The biggest obstacle is the limited experience of all the stakeholders involved in the development of such infrastructures, and especially in the authorization process of private interconnections. Consequently, the regulatory framework is not fully developed and especially not harmonized among the various Countries.

Marini: How did you cope with the major difficulties encountered during the development of the initiative?
Scaramuzza: A globally coordinated working group has been created with the countries of interest and led by Enel Global Trading, with the technical support of CESI, alongside the best local technical expertise. In recent years, a new legislation was enacted in Chile, introducing for the first time the possibility or a private company to construct and to own electricity interconnections, and we had to continuously surf through the process.

Marini: How do these types of infrastructures contribute in terms of benefits brought to the System and related markets?
Scaramuzza: The main benefits of these initiatives include facilitating the integration of markets by promoting trade exchange between less interconnected countries, supporting the development of new renewable capacity and the possibility of optimizing various generation technologies as well as obtaining a more resilient network.

Marini: What are the markets and borders that could attract the major projects in the future?
Scaramuzza: We are currently monitoring various borders, also in order to support our local operations in leveraging on commercial and cross-border trading opportunities, as well as evaluating some projects in Central and South America. In particular, the countries of greatest interest are Chile, Argentina, Brazil, Peru, Colombia and Panama.

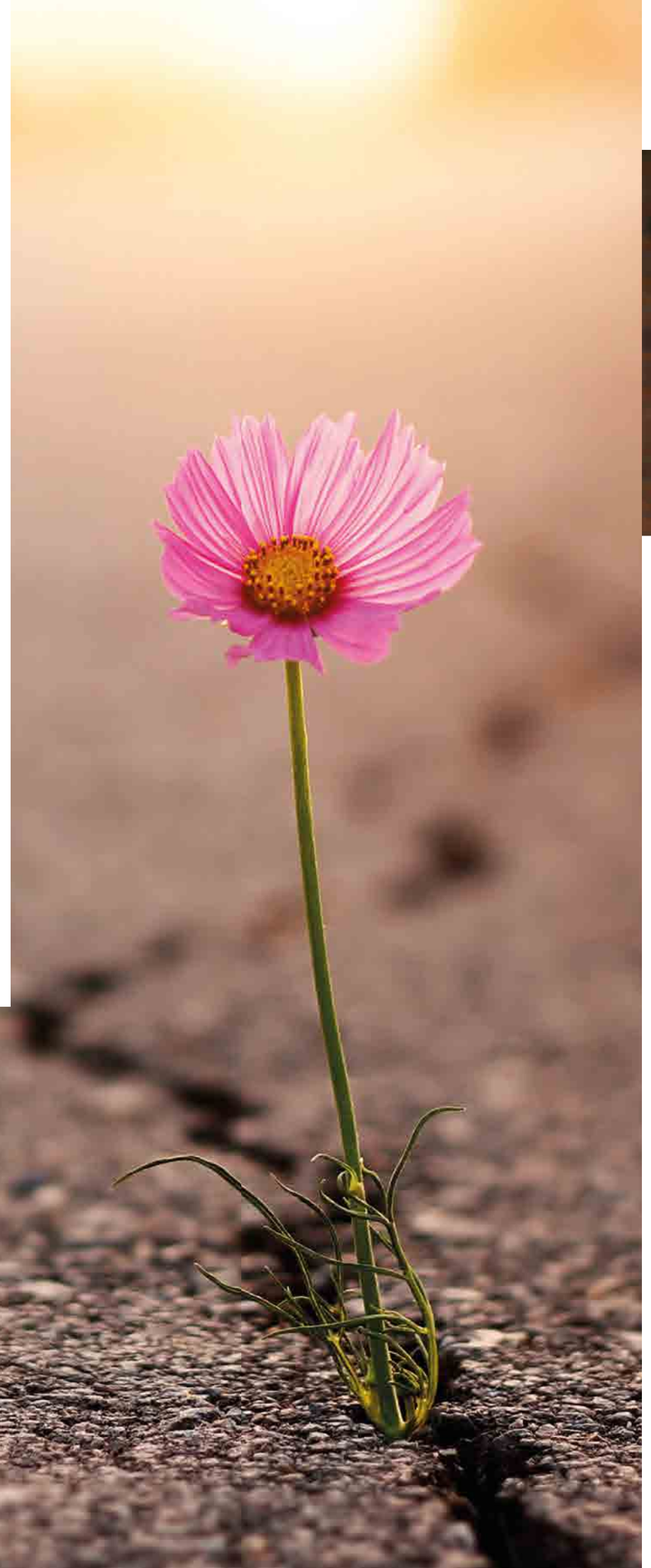
Gianluca Marini
Consulting Division Executive Vice President – CESI

Fabrizio Scaramuzza
Head of Global Origination & Merchant Lines – Enel

Opinions

Making Europe Resilient and Sustainable

By providing pertinent and reliable information, the European Environment Agency (EEA) promotes sustainable development and the energy transition by pursuing a significant and measurable improvement of the environmental issues that are increasingly important to the crucial decisions required for the future, as well as to drive the economic recovery of the countries impacted by the Covid-19 emergency. In this section dedicated to interviews, Energy Journal reviews the ideas of Hans Bruyninckx, Executive Director of the EEA, a figure at the forefront in the discussion on the relations between environmental impact, use of resources and climate change.



Hans Bruyninckx

Hans Bruyninckx is a Belgian political scientist and international relations scholar specialized in international environmental governance and European environmental politics. He is the Executive Director of the European Environment Agency (EEA) in Copenhagen.

Nine months ago, many European countries introduced restrictive measures to block the Covid-19 pandemic. Following the initial shock caused by this massive and sudden change, we now have the first analyses that allow us to examine the full impact of these measures and to identify solutions to mitigate them.

"Let's start with the impact on health," explains Hans Bruyninckx, Executive Director of the European Environment Agency. "Long-term exposure to air pollutants — even at low concentration levels — and other contaminants can damage human health and cause chronic diseases, subsequently making people more vulnerable both to existing and new diseases like Covid-19. Our recent report on 'Healthy Environment, Healthy Lives' highlights that one in eight deaths in Europe can be attributed to poor-quality environments. Two key reports were published in September 2020: Global Biodiversity Outlook 5 from the Conference on Biological Diversity and the World Wildlife Fund's Living Planet Report 2020. They both highlight the alarming rate of decline in biological diversity and call for decisive and urgent action on a global level. The same worrying trends can be observed in Europe. They affect nature's resilience, productivity and ability to maintain a state of equilibrium. Enhancing nature's resilience at the global level by protecting, preserving and restoring natural areas (and shifting towards a sustainable food system) will not only probably reduce the risks associated with zoonotic diseases but also ensure our long-term wellbeing."

The Coronavirus crisis has shed further light on Europe's need to face environmental issues. This will lead not only to environmental benefits, but also to benefits for the health and well-being of society as a whole.

"The Covid-19 pandemic provides a clear example of how fragile our societies and economies can be in the face of a major shock. The coming months will be critical to the definition of recovery and investment plans. In order to contribute to these discussions, EEA is organizing a series of on-line debates to bring expert knowledge and reflections to a wider audience. Change will happen in one way or another. Faced with uncertainty and a range of challenges, our only practical option is to guarantee that every decision we take, during this critical period, brings us closer to our goals in terms of society and sustainability."

During the lockdown, the restrictive measures enacted in various countries to limit the diffusion of the new coronavirus also cut carbon dioxide emissions, thereby reducing air pollution and improving the quality of the air we breathe.

«According to our monitoring of the weekly average concentrations of nitrogen dioxide and particulates, in the Iberian Peninsula, the lockdown led to a record decrease in emissions. During the week of March 16-22, in Barcelona, average nitrogen levels dropped by 55% over the same period in 2019, while a 40% decrease was recorded over the previous week. Madrid recorded similar drops of 41% and 56%, while Lisbon registered a 51% and 40% reduction. This data precisely reflects the decrease in air pollution, especially due to the reduction of traffic in cities. According to a briefing report published by our agency at the beginning of November, the Covid-19 pandemic and the consequent restrictive measures enacted to halt the virus had a positive short-term impact on the European environment. This included a temporary improvement in air quality, less greenhouse gas emissions and a respite from acoustic pollution. Nonetheless, the analysis also emphasizes that there were negative consequences such as an increase in the use of disposable plastic and that we should concentrate on remodeling our non-sustainable production and consumption systems to achieve long-term environmental benefits."

The European Union and its member states have fielded recovery plans to counter the effects of the health emergency and the deep economic crisis. The question, however, is "How can we recover from this and avoid that other crises – environmental, climactic, economic and public health – occur in the future?

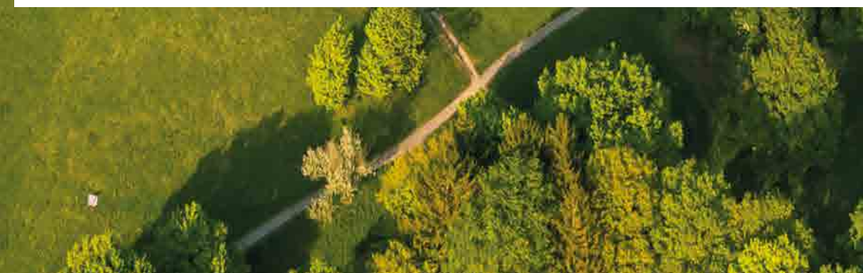
"We can build a resilient society driven by a green economy. The restrictive measures introduced sudden and enormous changes to the European way of life. There were fewer vehicles on our streets and hardly any commercial flights. Many activities were moved on-line, further reducing the need for mobility. The impact on the environment was evident: air quality in cities improved in just a couple of weeks. Naturally, as the restrictions are lifted and economic activities resume, we risk returning to pre-Covid pollution levels. The countries that acted quickly and decisively generally had lower infection and mortality rates, even amongst the more vulnerable categories. Significant lifestyle changes and the use of digital tools provided a short-term solution, but only decisive action triggering fundamental change in our production and consumption systems will make a true difference.

Europe's long-term strategic policy is described by the European Green Deal, its strategies and action plans. The State of the Union Address by the President of the European Commission Ursula von der Leyen not only confirmed that Europe is committed to achieving these objectives, but also further concentrated on climactic issues.

"As I said, the coming months will be fundamental. These objectives must be achieved through a fair transition focusing on inequality and social justice on par with climactic objectives. Governments are allocating public funds to mitigate the worst aspects of the crisis and jumpstart the economy. Will these funds be used to just return to our pre-Covid habits, or will we develop a fair and sustainable world? The European Commission's recovery plan is based on sustainability. Europe has chosen to become a green, digital and resilient continent. In the European Green Deal, the Commission had already proposed an ambitious transition towards long-term sustainability, focusing on the environment and the climate. These priorities are also clearly reflected in the multi-annual EU €1.1 trillion budget proposal for 2021-27. As part of a recovery plan from this economic crisis, a new, additional, €750 billion financial instrument called 'Next Generation EU', has been proposed by the European Commission. Framed by well-defined policy targets, these funds can help Europe transform its economy while achieving climate-neutrality and sustainability and addressing social inequalities. Throughout the transition period, knowledge will play a key role in guaranteeing that these funds are allocated to coherent actions towards this shared vision."

Analyses conducted by the European Environment Agency reveal that industrial pollution has decreased over the past ten years thanks to a reduction of the emissions released both into air and water. Thus, it is highly probable that EU policy tools will continue to reduce industrial emissions, although pollution will most likely continue to have adverse impacts on human health and the environment.

"EU industrial policy strategy calls for the ongoing development of a strong industry, producing a low level of carbon emissions and based on the circular economy. According to a recent EEA analysis, the use of the best available techniques and the implementation of the most ambitious directives on industrial emission would bring about a substantial reduction in emissions: 91% for sulfur dioxide, 82% for particulates and 79% for nitrogen oxide. Certainly, the transformation of the economy is key to reaching long-term climate objectives. Without a profound transformation of our production and consumption systems, any reduction of emissions triggered by economic crises will most probably be short-term and have an extremely high cost on society. Europe aims to achieve carbon neutrality through a gradual and irreversible reduction of emissions, not through sudden shocks. The solution to the global challenge of sustainability cannot be a massive shutdown of society and enterprise. I believe that a planned and fair social transition, implemented over the long term, is the only way to achieve a resilient society with a strong and sustainable economy.



Industries & Countries

The World is going Green

Europe, China, United States: an overview of the countries privileging renewable sources for their energy systems. Notwithstanding the slowdown caused by the economic emergency, wind and solar power are gaining an edge.

Thanks to the increased use of wind, hydropower, and solar in 2020, renewable energy sources will provide nearly 90% of the increase in global energy capacity. In 2021, if these sources continue to develop more rapidly than they have over the past six years, by 2025, they will represent the greatest global source of electricity generation putting an end to coal's fifty-year run as the main source of energy.

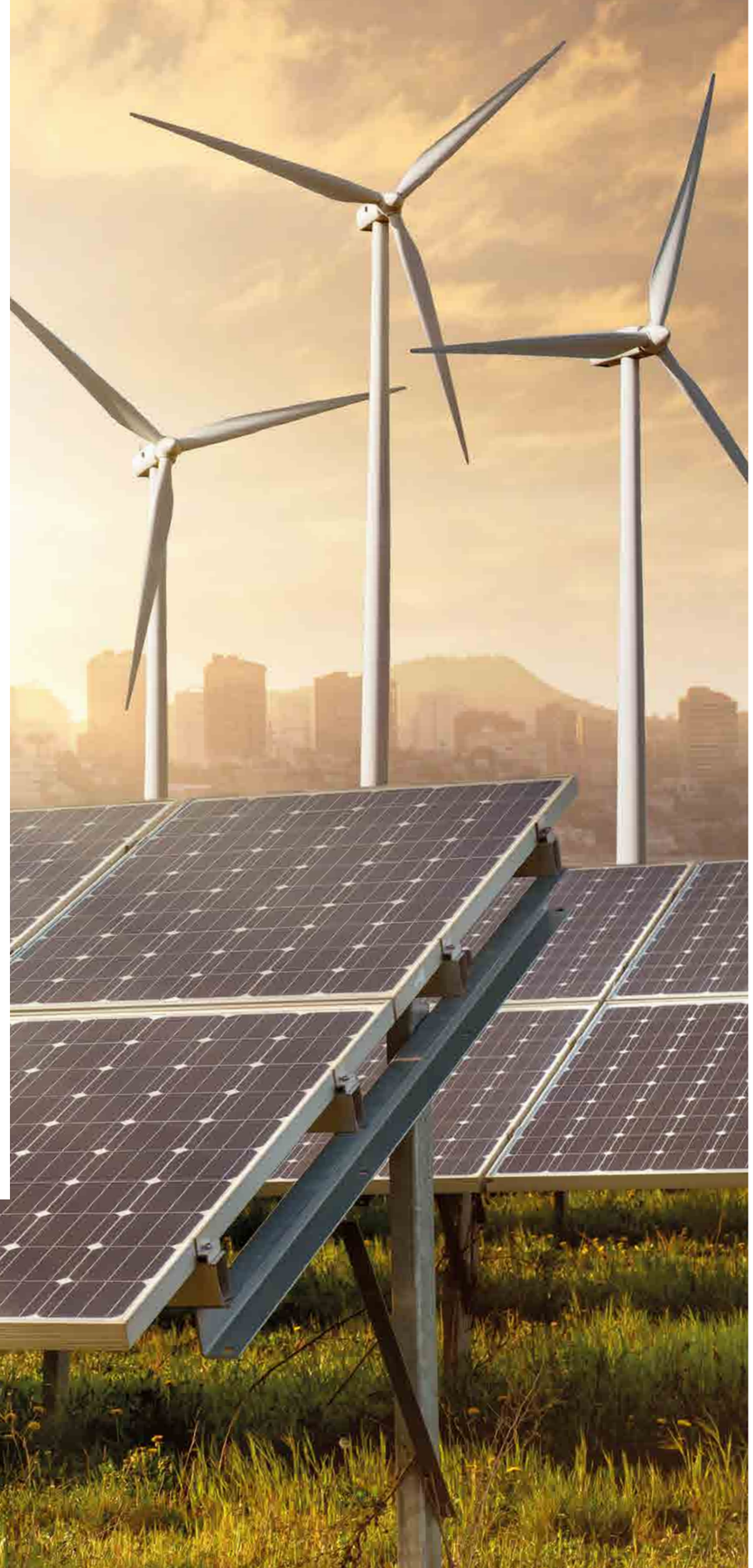
This is the picture that emerges from the "Renewables 2020 – Analysis and Forecast to 2025" Report published in mid-November by the International Energy Agency (IEA). Thus, in contrast to the sharp decline caused by the Covid-19 emergency in many energy sectors (such as oil, gas, and coal), in 2020, the use of renewable energy sources, driven by the United States and China, has been increasing worldwide. This year, global installed renewable capacity will reach a record 200 gigawatt.

However, before addressing the data provided by the "Renewables 2020 – Analysis and Forecast to 2025" Report, let's take a look at the IEA's "Global Energy Review 2020." The latter explains how, in the first trimester 2020, renewable electricity production has increased by 3%, especially because of the new wind and photovoltaic plants completed in 2019. The global quota of renewable electricity production has climbed to 28% (first trimester 2020) from 26% (first trimester 2019). Variable renewable sources (photovoltaic and wind) have satisfied 9% of the overall demand, as compared to 8% (also first trimester 2019).

In line with the European Green Deal, which aims to make the "old continent" the first with a zero impact on the environment by 2050, Eurostat data reveal that, in the period 2004-2018, the quota of renewable energy in Europe nearly doubled. Wind energy was the most important renewable source of electricity and over one fifth of energy used for heating and cooling was provided by renewable sources. In 2018, renewable energy represented 18.9% of the EU total gross energy consumption, compared to 9.6% in 2004. These figures reveal how rapidly wind and photovoltaic solar capacity has developed in many countries, thanks to support policies and the marked reduction in technological costs.

Challenges for the Future

In its "Energy Outlook" published in October 2020, IEA analyzed the impact that Covid has had on energy consumption in 2020. This year, we will consume 5% less energy than in 2019. Oil demand will fall by 9%, coal by 7%, and natural gas by 3%, while renewables will only be minimally affected



For further information on this topic, please contact:

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(1%). As a consequence of the reduction in fossil fuel consumption, IEA estimates that, in 2020, greenhouse gas emissions will decrease by 7% over the previous year. Moreover, renewable sources will play an increasingly important role. Over the next decade, 80% of the additional demand for electricity will be provided renewables, mostly wind and solar. And solar energy is now defined as the new "King of the global electricity market."

The global increase in the use of renewables is portrayed somewhat less positively by the Renewables Global Status Report (REN21), a collaborative report produced by over two thousand experts with a vast collection of data and forecasts. According to the authors, renewables had another record year of growth in 2019: installed capacity increased by over 200 GW, including 175 GW of wind and photovoltaic power, the greatest increase ever recorded. Installations and investments in renewable energy are now widespread in all countries around the world, including developing and emerging ones. Moreover, in the private sector, Power Purchase Agreements for energy produced by renewable sources are also on the rise. However, there have also been delays in the quota of renewables that should satisfy the consumption of energy for transports (32% of final consumption) and heating and cooling (51%). This affects the total percentage of renewables used in final global energy consumption. Notwithstanding a 26.4% quota (2017), the consumption actually only represents 17% of final energy use.

Indeed, these pros and cons had already been described by the International Renewable Energy Agency (IRENA) at the beginning of the year in their "10 Years: Progress to Action" Report illustrating recent global progress and describing the measures required to increase the use of renewable energy sources. In order to reach the Sustainable Development Objectives and proceed towards climate security, the authors explain that renewable electricity will need to provide 57% of the global demand by 2030, compared to the current 26%. This means that the quota of renewable sources used in global energy production would have to double, as would annual investments, which, redirecting planned investment in fossil fuels, would have to increase from the current US$330 billion to nearly US$750 billion in clean energy.

"We have entered a decade of action for renewables, a period during which the energy system will undergo an unprecedented transformation," explains IRENA

Director General Francesco La Camera. "In order to guarantee that this takes place, we have to urgently address the issue of stronger policy and drive a significant increase in investments over the next 10 years. Renewable energy is key to sustainable development and it is fundamental for economic and energetic planning worldwide." IRENA underlines that the cost of solar photovoltaic energy has decreased by 90% over the past ten years and that the price of onshore wind turbines have nearly halved. The costs of wind and photovoltaic solar energy are increasingly competitive compared to traditional energy and these two types of technology could satisfy over a third of global energy needs.

Renewables around the World

Presenting the Energy Technology Perspectives (ETP) Report in September, IEA Executive Director Fatih Birol explained that "notwithstanding the difficult situation, recent developments in the energy sector allow us to be optimistic about our ability to accelerate the green transition." One of the reasons behind this optimism is the cost of photovoltaic energy. Electricity produced by silicon panels is currently amongst the most economically competitive. It costs 82% less per kWh produced than it did in 2010. And this phenomenon is no longer restricted to the Chinese, European, and North American markets who drove the growth of this technology. New projects are now underway around the world: from Vietnam to the United Arab Emirates, and from Egypt to Brazil. To give you an idea of the magnitude of the growth of photovoltaic energy, it increased by 22% in 2019 and currently satisfies 2.7% of global electricity consumption (720 TWh/year). Excluding hydropower, renewable solar energy comes right after wind energy. In fact, Fatih Birol emphasized that "thanks to substantial technological improvements, wind energy now accounts for 5% of all produced electricity."

In mid-November, the "Renewables 2020 – Analysis and Forecast to 2025" Report pointed out how, notwithstanding the uncertainty caused by the Covid-19 pandemic, renewables continue to do well. Thanks to the completion of projects that had been delayed or interrupted due to supply issues, green energy will be driven by India and the European Union with a record 10% expansion of the new global renewable capacity, the most marked increase since 2015. During the initial months of 2020, China, India, and the European Union increased the total renewable energy capacity up for auction by 15%, compared to the same period in 2019, a record in concessions revealing that medium-term and long-term expectations for a marked increase in the demand of renewable energy are concrete. In terms of electricity, in 2020, the energy produced by green technology will increase by 7%, supported by new record increases in capacity, notwithstanding the 5% drop in annual energy demand, the greatest decrease since the second world war.

The IEA Report also reveals that outside of the electricity sector, renewable sources have been impacted by the Covid crisis. Biofuels used in transports are expected to undergo the first annual decline in two decades, driven by the vast decline in fuel demand in this sector as well as the low cost of fossil fuels that reduces the economic advantages of biofuels. Moreover, the economic crisis has also decreased industrial demand for bioenergy. The net result of these drops, in combination with the rise of renewable energy sources in the electricity sector, is an overall 1% increase in the global demand for renewable energy in 2020.

China

The Chinese government is one of the top global investors in renewable energy. However, although ca. 25% of its energy is produced from green sources, the country also continues to employ enormous amounts of fossil fuels to produce energy, which is naturally also linked to the increase in CO_2 emissions. On account of energetic security issues (as well as economic opportunity), the Chinese government has been promoting policies that favor renewable energy sources. In the first trimester 2020, 392.34 billion kWh of electric energy were produced from renewable sources, 3.84 billion kWh more than during the same period in 2019. Now, after the economic and social crisis triggered by the Covid-19 pandemic, China is working to consolidate its role as a major green player by driving a strategic energy program based on the gradual abandonment of coal. The involved ministries have already announced that the most polluting and obsolete coal plants will be progressively shut down. And although new coal plants are still scheduled to be developed, the government in Beijing trusts that it has firmly undertaken a transition towards

energy production models based on renewables that will ramp up the production of energy from hydroelectric, wind, and solar sources. This is also corroborated by Chinese investments and funding in green energy which totaled US$34.6 billion until 2009, reached US$88 billion in 2019, and are expected to exceed US$300 billion in 2020. According to data from the National Energy Administration, in the first trimester 2020, China's renewable energy capacity increased by 8.4% annually for a total of 802 million kW.

> **The Chinese strategy calls for an acceleration in the mass electrification of transports together with the use of green hydrogen as a clean fuel in key sectors.**

However, this also means that over the course of four years (2019-2023), the electricity consumption of Chinese data centers, infrastructure that is currently mainly fueled by coal and is extremely polluting, will increase by 66%. Nonetheless, China has also greatly ramped up its use of wind, hydroelectric, and photovoltaic energy and government policy aims to encourage private companies to increase their use of renewables through direct market purchase or in-house production with solar panels. In order to provide energy and cool down their data centers, major players such as Alibaba, Baidu, Chindata, and GDS have turned to wind and solar energy. Indeed, during the first three months of 2019, Alibaba, Baidu, Huawei, Tencent, and Chindata purchased 400 GWh of renewable energy, the amount of energy consumed by the entire city of Beijing in 24 hours.

To date, China is also the greatest investor in low carbon emission energy sources and has an enviable technological know-how. Its industrial supply chains support the main industries working to create wind, solar and nuclear plants. In September 2020, the government announced a brave new plan to make its economy carbon-neutral by 2060 through a combination of renewable energy, nuclear energy and carbon capture, and storage. With an outlook to completely overturn the existing system, the Chinese country will have to eliminate its dependance on coal and develop a breathtaking level of wind and solar capacity. According to The Guardian, securities firms have estimated that China may need to install 80-115 GW of new solar capacity every year to reach this objective, besides annually increasing wind energy from 36 GW to 45 GW. And this is in addition to the current Chinese industrial capacity for 241 GW of wind power and 180 GW of solar power. Furthermore, as the challenge of decarbonization is directly linked to dependance from oil, the Chinese strategy calls for an acceleration in the mass electrification of transports together with the use of green hydrogen as a clean fuel in key sectors.

According to the "Renewables 2020" Report, humanity is at a crossroads in its efforts to face climate change. By investing in clean energy to drive the economic recovery, governments can guarantee that 2020 will not solely be remembered as a year during which the recession caused a temporary decline in emissions. Indeed, this is why an acceleration in the Chinese energy transition, incorporated directly into the next five-year plan, could lead to a critical turning point for China and drive international efforts towards a solid global transition.

United States

The United States are the second greatest global consumer of renewable energy after China. In the attempt to achieve energetic independence and reduce energy imports from abroad, the production of renewable energy in the United States has inched ahead of coal as the primary source of energy. A first in a sector that has been dominated by fossil fuels for over 130 years. However, only 18% of energy in the United States is produced from renewable sources and this figure could drop further. In the United States budget for 2020, funding for renewable energy has dropped to US$700 million from the US$2.3 billion allocated in previous years. In its Energy Outlook published in June, the United States Energy Information Administration affirmed that energy generation from renewable sources should increase by 11% annually, while coal production should fall by 25%, which means that a greater quota of energy will be produced from renewable sources than from coal in 2020. While the shift to clean and renewable energy starts to take hold, the United States are in fifth position, globally, for installed solar photovoltaic power and have the second highest installed wind energy capacity worldwide, Americans are now facing issues related to their excessive dependence on China for the minerals necessary to develop clean energy systems. China provides nearly 80% of the raw materials used by the United States to reap wind power and produce solar panels, as well as batteries for electric cars, cellphones, computers, medical equipment, national defense systems, and even oil and gas technology.

Before the Trump presidency began in 2016, the United States had committed to reducing emissions by 26-28% (compared to the 2005) by 2025, an objective that currently seems out of reach. Now, however, climate change will be a major point on Joe Biden's agenda, starting on January

20, when he is officially sworn in as President. During his electoral campaign, Biden promised to invest nearly 2 trillion dollars in clean energy and low carbon emission infrastructure without, however, setting a specific objective for the reduction of emissions.

Climate change is a key issue for the President-elect and his administration will center the economy, foreign policy, national security, and social justice around it. The greatest risk is that these efforts may be diluted. Biden will have to address a number of issues, including fracking and its potential for employment. Indeed, some observers believe that the United States should continue both to invest in oil and gas, as well as to allocate significant public funding for the energy transition, to change the very story about the United States as a fossil fuel superpower.

Europe

In 2019, the production of electricity from renewable sources in Europe satisfied 35% of the total annual demand. Production from renewable sources, excluding hydropower, climbed to 24% from 22% in 2018. In some European countries, electricity produced

from renewable sources already satisfies a high percentage of the demand: Sweden (64%), Denmark and Austria (60%), Portugal (55%).

In general, based on the quota of renewables on the total consumption of energy, the most virtuous European countries are those in the North. This is not only due to a more favorable distribution of primary resources (i.e., hydropower in Sweden), but especially to their propensity to consume conscientiously and safeguard the environment and national territory, as well as their lower population densities. Iceland's geographical characteristics make it the global leader in the generation of renewable energy. It produces more electricity pro capite than any other nation. Nearly 100% of its energy is produced from renewable sources: hydropower and geothermal energy satisfy 95% of the country's heating requirements. Iceland currently produces ca. 19 TWh of electric energy per year, which makes it the greatest global generator of electricity with 55,000 kWh per person (the EU average is 6000 kWh). Norway also satisfies 98% of its internal demand through renewable sources thanks to the extraordinary availability of hydropower resources (95% of the demand), while wind power satisfies the remaining 3%.

Let's take a closer look at the most significant countries in this sector.

Sweden, Finland and Denmark

Sweden stands out in Northern Europe thanks to its 64% quota of renewables. The country has fully exploited its two greatest treasures: water and forests. The first provides hydropower, its main source of energy generation, while the second produces the biomasses that are used to heat houses. Thus, it should not come as a surprise that every Swedish citizen produces 25% less CO_2, on average, than an American citizen. If the world were more like Sweden, the solution to global warming would be at hand. There also are other virtuous cases in the European Union: Finland, Latvia, Denmark, and Austria all have a quota of renewables exceeding 45%.

Denmark, which aims to completely eliminate fossil fuels by 2050, is the home of wind energy. On average, one day of wind is sufficient to produce 140% of the country's daily requirement and allows for surplus energy that can be sold to neighboring countries.

> **In 2019, the production of electricity from renewable sources in Europe satisfied 35% of the total annual demand.**

This achievement is made possible by an industry that leads the world in the design and production of wind power generators, selling turbines, and exporting know-how worldwide. Finland, one of the foremost eco-sustainable countries in Europe has declared war on coal, oil and fossil fuels and plans to completely eliminate their use by 2030. Norway produces 98% of its energy from renewable sources. Hydropower is its primary resource, but wind and thermal energy are also important for the production of electricity in Norway.

Germany

Germany has been a pioneer on the issue of renewables since the 1980s. Thanks to its forward-looking policies encouraging photovoltaic energy, it can now reap the benefits. It is a global leader in solar photovoltaic capacity, and amongst the most industrialized countries, it satisfies the greatest daily demand for electricity from renewable sources with a record 78%. In 2019, Angela Merkel further ramped up the country's green objectives by adopting measures to close nuclear and coal plants and definitely abandon these energy sources by 2038. Based on data published by the German Association for Energy and Water (BDEW) and the Baden-Wuerttemberg Research Centre on Solar and Hydrogen Energy (ZSW), in the first three months of 2020, Germany produced more than half of its electricity from renewable energy sources. Moreover, for the first time, the quota of renewable energy reached 52%, providing most of the energy needed during the first trimester of the year. Between January and March 2020, clean energy was produced from the wind, in particular, as well from the sun, biomasses, hydropower, and other sustainable sources. Comparing the first trimester of 2020 to that of 2019, there is a marked increase over the 44.4% gross internal

consumption of electricity registered last year. This was also driven by the drop in total energy consumption, especially in industrial activities, caused by the Covid-19 emergency.

United Kingdom

For the first time in 2019, the United Kingdom, the birthplace of the Industrial Revolution, produced more energy from coal-free sources (renewables and nuclear) than from fossil fuels. The energy generated from wind, water, sun, and nuclear (the National Grid includes this as a renewable) represented 48.5% of the total, compared to 43% produced from fossil fuels. (The remaining 8.5% is generated from biomasses and waste.) In 2019, projects for the development of renewable plants reached an unprecedented peak (269 wind, solar, and bioenergy plants, equivalent to 75% more clean energy projects compared to the requests presented over the last three years) and in 2020, Great Britain celebrated two months of coal-free electricity generation, the longest period in over 140 years.

As the Financial Times reported, the United Kingdom has recently announced and fielded more green commitments and objectives than any other major global power. In line with its zero-emissions by 2050 objective, London and the rest of the country have recently stopped the activity of power plants powered by coal and other fuels that have historically provided the lion's share of energy to British citizens (75.5% in 1990 and similar quantities in subsequent years). According to the plans of the British government in 2020, only three old coal plants will still be active, and these will be closed in 2025. Moreover, in order to allow the shift to a zero-carbon emissions system, the UK National Grid has planned to invest nearly 10 million pounds sterling in gas and electricity networks over the next five years. In October 2020, the UK government announced that it intends to become a global leader in the generation of low-cost clean energy, cheaper than coal and gas. In this context, off-shore wind power, which indeed is already the top renewable resource in the United Kingdom, will be key. Today, Great Britain has an installed offshore capacity of 10 GW, a value that could increase fourfold in the short term.

France

In France, in 2019, power produced by nuclear energy slightly declined, the use of coal fell steeply, while gas consumption increased, and renewable sources did even better, according to the report presented in February by RTE, the company managing French transmission networks. In particular, wind and photovoltaic power respectively generated 34 and 11.6 TWh last year, increasing by 21% and 7.8% over the previous twelve months.

The French government aims to transform photovoltaic energy into the cornerstone of its national electric system, increasing its production to 35-44 GW by 2028. In April 2020, the French Ministry for the Energy Transition published the National Energy-Climate Plan (PNIEC) that is based on two key elements: the national decarbonization strategy (Stratégie nationale bas-carbone) and a long-term energy program. The latter includes a 50% reduction of the nuclear energy quota by 2035, a 33% increase in the use of renewables by 2030, and a 40% reduction in the use of fossil fuels by the same date. In the context of clean energy, France aims to double its installed capacity for renewable electricity, reaching 101-113 GW by 2028 (34.7 GW will be produced from onshore wind farms).

Italy

Over one third of the electric energy produced in Italy is generated from renewable sources. As of September 2019, alternative sources satisfied 36.1% of the national demand for electric energy, as reported in the Terna monthly report. In fact, this represents a slight decrease from 2018. In 2019, 500 GW less energy was generated from renewables and, in total, renewables satisfied 40.5% of the demand against 41.8% (2018). In the EU, Italy performs well in terms of energy needs. It is the third producer of green energy on final gross consumption and second for the production of green electricity. According to the GSE Report (published in 2019 and based on data from 2018), hydropower, solar, wind, bioenergy, and geothermal sources satisfied 17.8% of the final gross demand. And this is significant given that in 2018, Italy was the only major country in the EU (along with Germany, France, Spain, and the United Kingdom) to exceed the established European target. In greater detail, renewable energy in Italy accounted for 33.9% of electricity production, 19.2% of the thermal demand, and 7.7% of the energy requirement for the transports sector. The main contributor to the production of renewable energy is hydropower (42% of the total), followed by solar photovoltaic (20%), bioenergy (17%), wind (16%), and geothermal energy (5%). Nonetheless, the result that emerges from the Ernst & Young "Renewable Energy Country Attractiveness Index" (published at the beginning of the year) on the attractiveness of green investments in the country is not altogether positive. Italy is only seventeenth in terms of investments in green energy. The most "renewable" country is China, followed by the United States, India, France, Australia, Germany, and other countries. And if, on the one hand, Italy promotes difficult-to-spot micro plants, policy and public opinion are against industrial-sized plants.

One on One

Renewables vs. Oil: How Energy is Changing Society

Recent forecasts and published data reveal new equilibria between renewables and fossil fuels with consequences that are not only economic but social too.

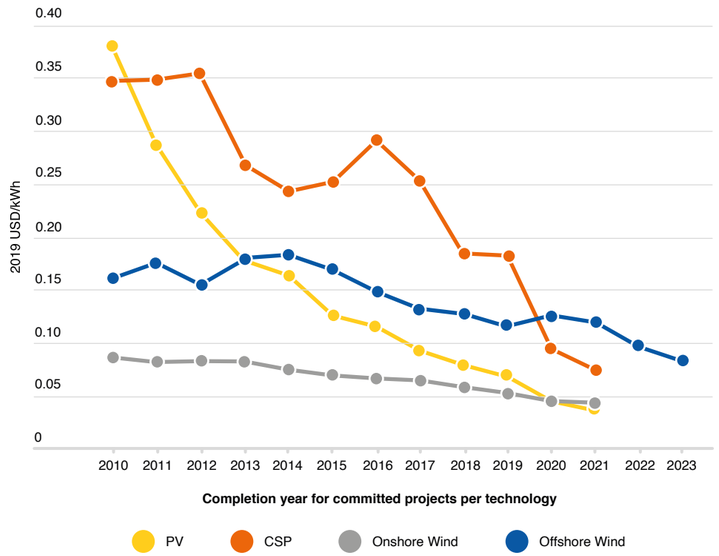
Dozens of research papers, analyses, studies, and reports confirm that the energy transition is underway, and the trend is progressively shifting towards sustainable energy sources. There is a general agreement about the timing of the transition: fossil fuels will not suffer a quick demise, but rather they will fade out over the course of a few decades. Another point on which analysts agree the consequences that the Covid-19 pandemic has had on the traditional energy sector which was already extremely vulnerable. The economic crisis triggered by the pandemic, the many sectors that ground to a halt and reduced mobility, led to a rapid decrease in the demand for fossil fuels. Even more importantly, experts believe that the demand will never again match the peaks reached in 2019. Why? According to various studies, when the economy begins to recover, the bulk of energy demand will be satisfied directly by renewable sources.

The Issue of Cost: Competitive Renewables vs. High Fixed Rates for Fossil Fuels

A study published last June by the State Street Global Advisor, one of the top three largest mutual funds worldwide, highlights the competitive cost of technology for renewables which has decreased by over 90% since the financial crisis that began in the first decade of the 21st century. Indeed, in many countries, it is already cheaper to produce electricity from renewable sources than from fossil fuels. Meanwhile, the fall in the cost of fossil fuels is not viewed as a factor capable of stimulating a structural recovery of demand, not only because of the high fixed costs of production plants, but also on account of the competitiveness of renewables and the rapid evolution of technology. The latter is considered a key element in the diffusion of renewables as it leads to reduced costs year after year. On the contrary, the research points out that below certain thresholds, the production of certain fossil fuels is not economically sustainable.

The "Renewable Power Generation Costs in 2019" Report, also published in June by the International Renewable Energy Agency (IRENA), points out that in 56% of cases, renewable energy is cheaper than any electric capacity generated by fossil fuels. The global average LCOE (Levelized Cost of Electricity) of utility-scale photovoltaic dropped to US$0.068/kWh in 2019, a 13% decrease over the previous twelve months. The values of on- and off-shore wind energy have respectively decreased to US$0.053/kWh and US$0.115/kWh over 2018. According to IRENA, the cost for fossil fuels is currently estimated at between US$0.05-0.177/kWh with the lower value representing the value of new coal plants in China.

Costs continue to fall for solar and wind power technologies



For further information on this topic, please contact:

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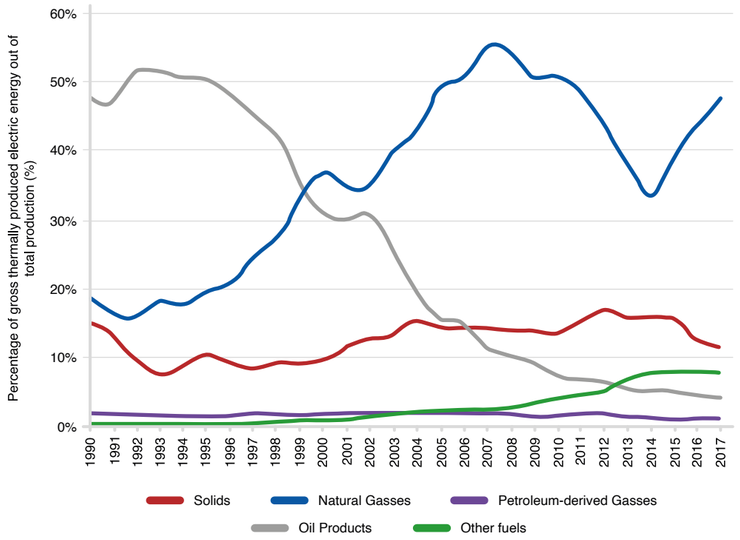
The Relation between Oil Products and Renewable Energy in Italy

A publication entitled "*Fattori di emissione atmosferica di gas a effetto serra nel settore elettrico nazionale e nei principali Paesi europei*" (Greenhouse Gas Emission Factors in the Electric Sector in Italy and Main European Countries) by ISPRA (Advanced Institute for Environmental Research and Protection) sheds light on the evolving relationship between renewables and oil products in Italy. The study, which addresses a number of issues, also examines the gross thermal electricity production trends for various types of fossil fuels. Up to the nineties, oil products, and especially fuel oil (mazut), played a key role contributing to the generation of ca. 50% of all thermally produced electricity. From the latter half of the nineties, a combination of environmental policies seeking to reduce pollution, the increase in oil prices, and the greater efficiency of combined cycles over traditional burners have determined a progressive fall in the use of oil products in the thermoelectric sector and an increase in the use of natural gas.

The rapid decline of oil products translated into an increase in the use of natural gas, which in turn, led to an increased usage of electricity, which grew from less than 20% in 1990 to a peak of 55% in 2007. Then renewables began to take over. However, recently natural gas has made a comeback. In fact, in 2017, it accounted for 47.4% of total electricity production (67% of thermoelectrically produced energy).



Trend of Thermoelectric Energy Produced per Type of Fuel.

The CO_2 Emissions of Oil Products

According to the extensive study by ISPRA, through the first half of the nineties, CO_2 emissions caused by oil products accounted for a significant percentage of the total emissions released by the thermoelectric sector in Italy. In 1995, emissions caused by oil products amounted to 61.1% of total emissions in this sector. Since then, the percentage of CO_2 produced by oil products has diminished constantly falling to 8.3% in 2017. Nonetheless, we must keep in mind that oil products also include gases produced through gasification that have been steadily used since 2000. When examining fuel oil alone, its quota of emissions fell from 61.1% to 1.5% (1995 to 2017), while those produced by natural gasses increased from 18.3% in 1995 to 57.2% in 2017.

Carbon dioxide emissions produced by the thermoelectric sector for the production of electric energy per fuel (Mt CO_2)

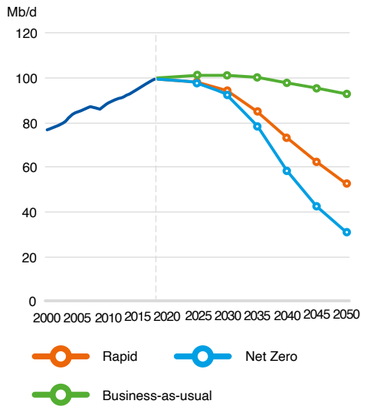
FUELS	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	*2018**
Solids	28,1	20,8	22,4	40,1	35,3	39,1	42,4	39,8	38,1	38,9	31,9	28,4	*26,3*
Natural Gasses	21,0	24,4	48,7	59,1	59,3	55,1	49,6	40,2	34,9	40,4	46,4	51,7	*47,5*
Petroleum-derived Gasses	6,7	6,4	6,4	11,1	7,8	8,8	7,4	5,4	5,5	3,6	4,6	3,7	*3,5*
Oil Products	70,2	81,4	61,2	31,8	15,0	12,3	11,8	8,8	8,3	7,6	6,7	6,3	*5,9*
Other fuels	0,1	0,2	0,5	1,8	3,0	3,2	3,1	3,0	3,1	3,3	3,0	2,9	*2,9*
TOTAL	**126,2**	**133,2**	**139,2**	**144,0**	**120,4**	**118,5**	**114,3**	**97,2**	**89,9**	**93,4**	**92,5**	**93,0**	***86,2***

**Preliminary ISPRA forecasts.*

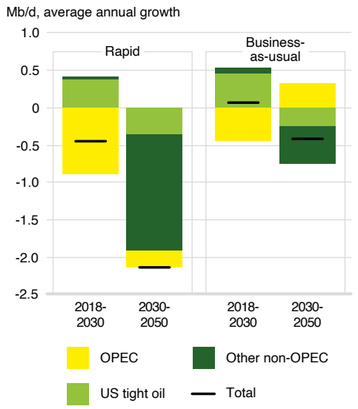
The Pandemic Introduces New Scenarios for the Renewables and Oil Sectors

The first wave of the Covid-19 pandemic in 2020 marked the acceleration of renewables over fossil fuels, as is confirmed by the BP Energy Outlook 2020, the most recent report published by former British Petroleum. In the report, analysts hypothesize that demand for oil may never recover from the impact of the pandemic. Moreover, they posit that it may begin to fall in absolute terms for the first time in modern history since reaching its peak in 2019. According to the British company, oil will be substituted by renewable energy sources which BP analysts consider the fastest growing energy source ever taking into consideration wind farms, solar parks, and hydroelectric plants. The BP Report proposes three different scenarios, only one of which, the Business as Usual Scenario (BAU), posits that the consumption of oil will remain constant until 2035 before beginning to decrease. The company sees no scenario in which the demand for oil increases. The "Rapid" Scenario forecasts a 55% drop in the demand for oil over the next 30 years and the achievement of the objectives established by the Paris Climate Agreement (to keep global temperature increase since pre-industrial times under 2 degrees centigrade). The most environmentally-friendly scenario, NetZero, describes a situation in which countries manage to limit temperature increase to 1.5 degrees centigrade and the demand for oil falls by 80% by 2050.

Liquid fuels consumption



Liquid fuels supply growth



Moody's, OPEC and IEA: Outlook for the Oil&Gas Sector

Moody's outlook on the oil sector is not as bleak. In October, it updated the outlook for the Oil&Gas Sector from "negative" to "stable." The international rating agency explained in a note that the average cost of oil will stay in the US$40-45/barrel range in 2021, while the EBITDA (Earnings Before Interest, Taxes, Depreciation and Amortization) indicator will remain unchanged between June 2020 and June 2021.

In fact, examining the EBITDA indicator for the second trimester of 2020 in the oil industry, Moody's underlines that the 70% fall of this indicator is due to the low cost of oil and the diminished demand for fuel during the lockdown. Therefore, it is unlikely, according to the analysts, that the big oil companies will recover positive margins during the next 12 months. As a matter of fact, they expect a further reduction in Oil&Gas investments in 2021. The sector outlook could only turn positive, according to Moody's, if the cost per barrel were to increase to US$45-65 over the medium term.

These forecasts may also be compared to those made by OPEC in its monthly report. In October, the Organization of Petroleum Exporting Countries reduced its global oil demand forecast for 2020 by 400,000 barrels/day (lowering its earlier forecast of 9.5 million barrels/day to 9.1 million barrels/day). For 2021, OPEC estimates a rise in demand of 6.6 million barrels/day, although this too is 400,000 barrels/day less than its previous forecast.

The IEA also takes an interesting stance on this issue in its most recent monthly report which raises various doubts on the "fragile re-equilibrium of the oil market" and lowers its oil demand forecast by 300,000 barrels/day for 2020, estimating a contraction equivalent to 8.4 million barrels/day. In fact, the IEA points out that with 91.7 million barrels/day, the demand for oil has fallen to the levels of 2013. According to the IEA, these negative estimates are largely caused by the decreased demand for oil by China and India, together with the ongoing challenges of the second wave of the Covid-19 pandemic.

The Geopolitics of Energy Transformation

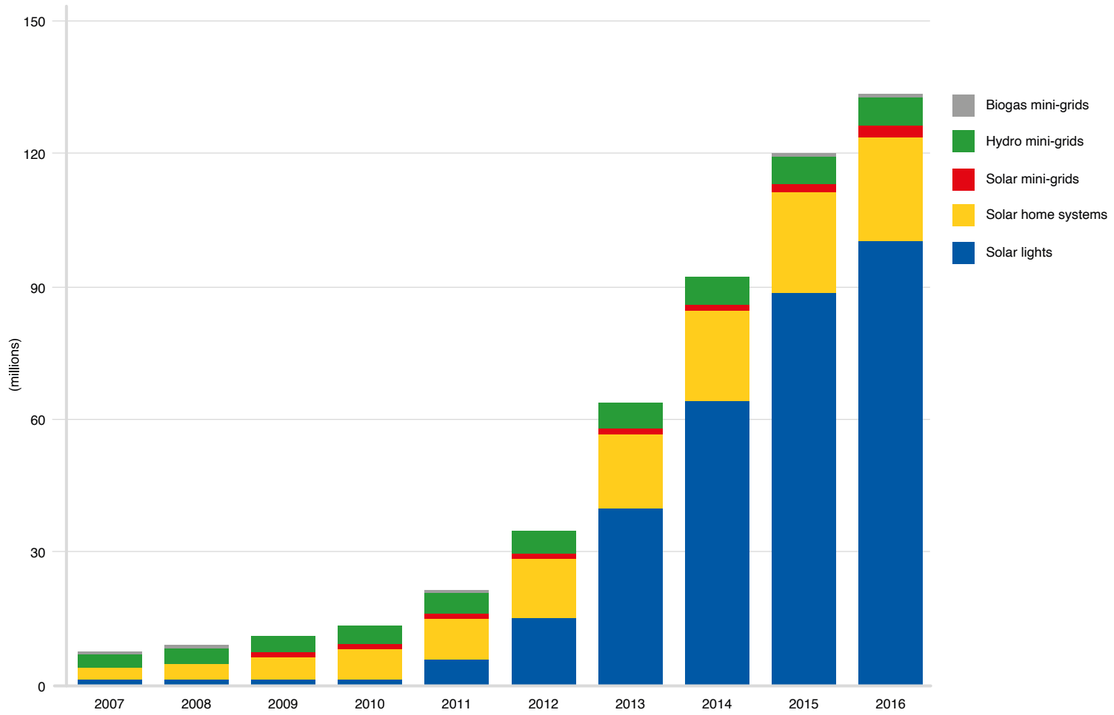
Finally, in order to conclude this comparison between renewables and the oil sector, we must mention the "A New World – The Geopolitics of Energy Transformation" study published in 2019 by IRENA. According to the study, the (already competitive) price of electricity produced by renewables will continue to fall, especially in the solar and wind energy sectors. The diffusion of renewables will determine a leap forward for electrification (also in the transports sector) and a more equally distributed global use of renewable sources over fossil fuels.

This scenario will change the energy system and make it more democratic. It will no longer be founded on large centralized infrastructure for transport and production, but it will open up to local production. And as locally produced energy will be harder to transport and stock, it will be largely consumed locally and regionally.

IRENA's analysis ends with a focus on the new dynamics that are set to shake up the geopoliticalenergy transformation scenario. Oil exporting countries are destined to be hit hard, unless they adapt to the new conditions that have arisen. On one hand, there will be fewer reasons to unleash wars to control natural resources and on the other, geopolitical tension will be determined by the control and protection of increasingly intelligent electricity networks. In this context, it is important to underline the increasing importance of energy provided by renewable sources to isolated networks (see figure below) that allows rapid access to electricity to large parts of the population especially in Africa.

Finally, the collapse in the demand for oil will drive the importance of the countries that first invested in renewables (such as China) and those that have a greater availability of natural resources such as wind, sun, and water.

Population served by off-grid renewable energy solutions



Source: IRENA.

> **The diffusion of renewables will determine a leap forward for electrification and a more equally distributed global use of renewable sources over fossil fuels.**

News & Events

Upcoming Energy Events

International Conference on Renewable Energy and Conservation (ICREC 2021)

January 3-5, 2021

Shenzhen, China

www.icrec.org

The sixth edition of ICREC 2021 will be dedicated to renewable energy network infrastructure, technology, project engineering methods and industrial best practices. Speakers will share studies and research conducted on the generation of energy, transmission and distribution networks, storage, electrification and security.

World Sustainable Energy Days (WSED)

February 24-26, 2021

Wels, Austria

https://www.wsed.at

The 2021 edition of the event, which hosts over 600 participants from more than 60 countries each year, will address the economic recovery from a green point of view, starting with the energy transition. Conferences will be held over the course of three days, including: European Energy Efficiency Policy Conference, European Pellet Conference, Industrial Energy Efficiency Conference and Smart E-Mobility Conference.

ICRCE 2021 11th International Conference on Renewable and Clean Energy

February 26-28, 2021

Shiga, Japan

http://www.icrce.org

This conference provides an opportunity to learn more about advanced technology and the most recent trends in research and application of green, renewable energy. Scientists, engineers, industry leaders, researchers and other professionals from around the world will be able to share the results of research and develop new collaborations.

World Renewable Energy Congress & Exhibition 2021 – WREC 2020

March 15-19, 2021

Lisbon, Portugal

https://wrec2020.tecnico.ulisboa.pt/

The World Renewable Energy Congress & Exhibition is a biennial event organized by WREC, a non-profit organization that since 1990 works to transfer knowledge and technology concerning renewable energy from industrialized countries to developing countries. WREC allows researchers, producers, economists, scientists and sociologists to present and share studies and research through plenary and technical sessions and to participate in debates and seminars.

VII World Forum on Energy Regulation (WFER)

March 2021

Lima, Peru

http://icer-world.net

This is the main international conference dedicated to the issue of energy regulation. The event, which is held every three years, involves all the principal actors of the energy sector: political leaders, academics and regulators that meet to define new strategies for the energy sector.

The World Future Energy Summit 2021

April 5 -7, 2021

Abu Dhabi

www.worldfutureenergysummit.com

The World Future Energy Summit is one of the most important international events promoting an acceleration towards sustainability and the global transition towards green energy. The event showcases the latest sector technology, acts as an investment incubator and also hosts important conferences, uniting major companies, scientists and investors to share ideas and projects for a sustainable future.

Shaping a Better Energy Future

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