2024

FUTURE OF ENERGY REPORT

YES - Europe
Young leaders in Energy and Sustainability

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About YES-Europe

Who we are

YES-Europe, created through an initiative of the EPFL University of Lausanne in Switzerland, brought together 50 students from nine European countries for the first annual conference organised in May 2016 to connect and find meaningful ways to make a difference in the energy field. Since then, YES-Europe grew inter- nationally to have an impact at the European level.

What we do

YES-Europe offers a platform to develop both international as well as nationalinitiatives to shape the future of energy in Europe and give a space for youth toact within this fundamental transition. Believing in individual as well as collectivecreativity, we support each other in brainstorming, developing & implementingideas. YES-Europe has the mission of catalyzing the energy transition by creatingan environment where youth are given a space to develop ideas, take on respon-sibility, build their local community and act for change.

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Introduction

Energy lies at the core of modern life, powering industries, driving transportation, and connecting communities across the globe. As the world transitions toward a sustainable future, energy remains one of the most vital resources, underpinning global economic growth, technological progress, and social development. Two centuries ago, the scientist Joseph Fourier laid the groundwork for our understanding of the greenhouse effect, revealing how atmospheric gases could have adverse effects on the planet—a realization that underscores the urgency of building sustainable, resilient, and equitable energy systems today.

Amid the global transformation of energy policies and technologies to meet their needs, countries are working to reduce their carbon footprint and diversify their energy sources, striving to achieve a balance between sustainability, accessibility, and affordability. As the next generation of leaders, thinkers, and innovators, young people bring fresh perspectives, digital proficiency, and a deep commitment to sustainability that are vital for accelerating energy transition. Involving youth in energy policy and technology development empowers them, while ensuring that their ideas shape a sustainable and equitable energy future.

This report by YES-Europe provides a comprehensive overview of Europe's current energy landscape, highlights key challenges and innovations, and emphasizes the pivotal role that young people can play in the path toward a resilient and carbon-neutral world.

1. The key highlights of COP28

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1. The key highlights of COP28

Executed by Daphne Sotirchou

The 28th Conference of the Parties (COP28) to the United Nations Framework Convention on Climate Change (UNFCCC) took place in Dubai, United Arab Emirates, from 30 November to 13 December 2023. The Conference ended with the conclusion of a climate plan, referred to as the "UAE Consensus”. The key highlights of the UAE Consensus can be outlined as follows:

The conclusion of the first Global Stocktake

COP28 marked the conclusion of the first ever global stocktake which was established pursuant to Article 14 of the Paris Agreement, aiming to assess the state parties’ collective progress towards achieving the purpose of the Agreement, as well as its long-term goals including cutting greenhouse gas (GHG) emissions to limit global temperature rise to below 2°C and ideally to 1.5°C.[1] The global stocktake is held every (5) five years whereas the state parties are required to prepare and submit their Nationally Determined Contributions (NDCs) with the aim of communicating the adoption of their domestic mitigation measures to achieve their mitigation targets.

Amongst the findings of the “key technical report on the global stocktake” [2], which was published prior to the convocation of the Conference, it was stated that the currently enacted policies and actions taken by the state parties fall short of reaching their targets when it comes to meeting their Paris Agreement goals. To this end, the report highlighted that state parties need to set much more ambitious targets within the context of their subsequent NDCs due in 2025, in order to reduce global GHG emissions by 43% by 2030 and further by 60% by 2035, so that the goal of net zero CO_2 emissions can be achieved by 2050 on a global scale.

Overall, the abovementioned findings underlined the urgency of the situation and provided guidance, so that the state parties’ will expedite action in terms of accelerating their climate policies and commitments in their upcoming NDCs.

“Transitioning away” from fossil fuels

Despite the fact that COP28 was the first COP to explicitly mention fossil fuels within a document, it did not further proceed with any drastic proposals to this regard.

In particular, under paragraph 28 (d) of the first global Stocktake, it is stated that state parties need to contribute to the effort of “transitioning away from fossil fuels in energy systems, in a just, orderly and equitable manner”. The selection of the wording “transitioning away” rather than the use of the more decisive and clearcut “phasing out” was not very well received by most state parties which considered such wording as lacking ambition since it does not mandate action, rather encourages state parties to transition away from fossil fuels.[3]

However, a positive outcome in relation to the future of fossil fuels is set out under paragraph 28 (h) where it is recognised that inefficient fossil fuel subsidies that do not address energy poverty or just transition need to phase out as soon as possible.

Combating methane pollution

According to the UN Environment Programme, it is pointed out that the warming potential of methane is about eighty (80) times more powerful than carbon dioxide over a twenty-year period. In addition, according to data from the United States National Oceanic and Atmospheric Administration, even though carbon dioxide emissions decelerated during the pandemic-related lockdowns of 2020, atmospheric methane accelerated.[4]

To this end, the Oil and Gas Decarbonisation Charter (ODGC) was launched at COP28 whereas more than 150 countries signed the Global Methane Pledge launched at COP26, highlighting the need to cut global methane emissions by 30% from 2020 levels in 2030.

Climate finance - Operationalization of the “Loss and damage fund”

On the 1st day of COP28, the "loss and damage fund", which was agreed at COP 27 in order to support developing nations which are disproportionately impacted by climate disasters, was operationalised. Several countries have contributed a significant amount of money to fill the fund with the total amount raised estimating at $700 million. Such an amount may sound satisfactory; however, it seems that is totally inadequate to cover loss and damages considering that losses and damages in developing countries amount to at least $400 billion a year.

It is also worth mentioning that one of the most important finance agenda items during the Conference was the New Collective Quantified Goal (NCQG), a new global climate finance goal, the framework of which shall be agreed at COP29. [5]

Framework for adaptation to climate change

The Global Goal on Adaptation (GGA) is a goal stipulated under Article 7.1 of the Paris Agreement with the purpose of “enhancing the world’s adaptive capacity, strengthening resilience and reducing vulnerability to climate change with a view to contributing to sustainable development and ensuring an adequate adaptation response” in the context of achieving the mitigation goal of keeping temperature rise to a maximum of 2°C or 1.5°C.

The GGA framework put forth at COP28 and referred to as the “UAE Framework for Global Climate Resilience” highlights the key areas that will require adaptation action in all countries, such as food and nutrition, health, ecosystems, infrastructure, poverty and livelihoods, and cultural heritage.[6]

COP 28 did not result in the end of discussions on the GGA framework, rather it highlighted the need for countries to implement actions in order to progress the GGA.

Inclusion of youth’s participation

COP28 was the first COP to appoint the first ever Youth Climate Champion (YCC), a position aiming to strengthen the presence of young voices reaching COP decision-making forums. COP28 also introduced the first-ever International Youth Climate Delegate Program which shall be overseen by the COP28 YCC in collaboration with the Official Children and Youth Constituency of the UNFCCC with the aim of ensuring that youth opinions and proposals are fully integrated into global climate policymaking.[7]

Overall, at COP28, certain key agreements were made to accelerate the transition to renewable energy, reduce greenhouse gas emissions, and enhance climate resilience. The Conference also highlighted the need for concerted efforts to address the impacts of climate change and safeguard the well-being of youths and future generations to come.

However, the ambiguity surrounding the “shift towards transitioning away from fossil fuels” as analyzed above, may not be sufficient enough to address climate change and foster the transition to renewables.

At the end, the success of such conferences is not solely based on the decisions or promises made, but largely on the progress being made in implementing those decisions and promises both at national and global levels. Therefore, whether such progress is made or not remains to be seen in COP29 which shall take place from 11 to 22 November 2024 in Baku, Azerbaijan.

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2. Energy security & Energy poverty

2.1 Navigating through the concept of energy security

Executed by Kalliopi Lennax

Energy is vital for survival. It is as an economic, ill-distributed and expensive good, present throughout human history, affecting human security and socio-economic growth. [1] Energy is also the driving force behind the functioning of societies, both at individual level, supporting movement, heating, and electricity related activities, and at state level, by being at the core of the industry. In terms of geopolitics, energy sources have historically been used as a negotiating tool to maximize influence, whilst resource scarcity can justify the use of force.

Humanity has exploited the two main energy sources to which it has access: finite fossil fuels, and renewable energy sources, the latter being both inexhaustible and more equitably distributed in terms of geography, offering greater credibility and security. However, energy resources, and especially conventional ones, are not as available as they used to be, intensifying national concerns about resource depletion and scarcity.

The widespread use of fossil fuels has created numerous challenges for the international community, including growing energy demand, price volatility, resource depletion, high reliance on energy imports, limited diversification of sources, the adverse effects of climate change, and environmental degradation. [2] These pressing energy issues, coupled with the growing awareness of environmental risks, reflect the urgent need for a shift toward clean energy sources and a transition to a more sustainable energy system. Such a shift is essential to redefine the human-environment relationship to a more viable one and enhance security.

When analyzing the broad issue of security, it is crucial to start by defining it. Indicatively, security can be linked to the absence of threats and the possession of sufficient means to confront all threatening actions. The concept of energy security emerged in the first half of the 20th century, due to the 1973 OAPEC's oil embargo to the West, the need for safe transport of fuels and resources, and the demand for security of stocks. The inclusion of energy issues in the concept of security emerged from the understanding that any disruption in energy supply or any impediment in the functioning of the energy sector and the global energy markets directly affects both national and global economies, trade, and citizens' sense of security.

Defining energy security

The International Energy Agency defines energy security as the uninterrupted availability of energy sources at an affordable price. [3] Nevertheless, given that everyone perceives security differently and interprets different issues as threats, a comprehensive definition does not exist. Indeed, exporting countries consider security of demand for energy as their fundamental preoccupation, since they reap large revenues, supporting their national economies. On the contrary, energy importing countries strive to ensure security of supply, with access to sufficient quantities and an unhampered flow.

In recent years, the concept of energy security has been enlarged to cover additional dimensions, as numerous theoreticians and researchers have dealt with this notion using a different "hermeneutic lens". Many, including IEA, associate energy security with availability, affordability, and accessibility of energy, while several prominent definitions are outlined in the table below.

Table 1: Popular definitions of energy security

Source	Perception of energy security
Bohi and Toman (1996)	Energy insecurity can be defined as the loss of welfare that may occur because of a change in the price or availability of energy. [4]
Asia Pacific Energy Research Centre (2007)	4 dimensions of energy security, known as 4As: Availability, the physical existence of energy, supply and reserves. Affordability, referring to the cost of energy. Acceptability, in terms of society and environment. Accessibility to energy resources, potentially hampered by geopolitical factors and upheaval. [5]
Jun et al. (2009)	Energy security can be defined as a reliable and uninterrupted supply of energy sufficient to meet the needs of the economy at a reasonable price. [6]
Hugues (2009)	4 actions needed to improve energy security, known as 4Rs: Review the problem. Reduce energy use. Replace energy sources. Restrict demand.[7]
Cherp & Jewell (2014)	Energy security is the low vulnerability of vital energy systems. [8]

Consequently, a comprehensive definition of energy security could be the reliable, stable and sufficient availability of energy at an affordable price - and an acceptable social and environmental cost. Therefore, one could argue that energy is much more than a mere means of survival, and, at the same time, that energy availability and security are inextricably linked.

Empirical examples supporting this affirmation can be observed in various factors from the late 20th to the 21st century that question energy security levels and put national energy security at risk [9]:

- Limited diversification, price volatility, and dependence on suppliers significantly undermine energy security, as a country becomes vulnerable to disruptions.
- Climate change has a direct effect on energy security, as its negative consequences—such as increasing temperatures, tropical cyclones, rising sea levels, storms, floods, and wildfires—can lead to rising demand for cooling and electricity consumption, energy infrastructure damages, GHG emissions and air pollution. Ultimately, these impacts drive up costs and reduce the availability of energy.

- The lack of necessary technology, expertise, and equipment for extracting energy resources forces countries to depend on others, such as private companies, for energy development. In this case, countries may find themselves at a negotiating disadvantage, potentially undermining their energy security.

- Geopolitical tensions and attacks on energy infrastructure also serve as a means of pressure.

- Finally, new energy players can disrupt supply chains and market dynamics, posing a danger to energy security globally. As new actors enter the market, they may create competitive pressures and cause price volatility and uncertainty.

In summary, energy security is a complex, dynamic, and multidimensional concept. While it is impossible to fully safeguard energy, prioritizing energy transition, energy efficiency, and energy conservation is imperative, with renewable energy sources playing an essential role. This transformation gives a unique opportunity to today's youth, who not only bear the impacts of fossil fuel dependence, but also hold the responsibility of innovating towards a sustainable energy future. Empowering this generation in taking the lead is crucial to build a resilient, secure, and equal global energy landscape.

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2.2 Water scarcity in Southern Europe; challenges and opportunities for the youth

Executed by Spiros Touloupakis

According to the Council on Foreign Relations, water scarcity is defined as the lack of sufficient clean water to meet daily demands [1]. In Southern Europe, this issue is becoming increasingly urgent, putting both economies and ecosystems at risk. The engagement of young people in addressing this crisis is not only important but essential for the future. Therefore, this contribution examines the causes of water scarcity in Southern Europe, explores the youth's role in water management, presents the challenges and opportunities the region's youth is facing, along with inspiring youth-led initiatives as well as the impacts of this crisis on each country in the region.

Causes of water scarcity

Starting with the region of Southern Europe, the water insecurity issue stems from a combination of natural and human factors. As natural factors, for starters, one can easily pinpoint the Mediterranean climate, with its hot, dry summers and mild, low-rainfall winters, which inevitably translates to limited water supplies and is exacerbated yearly due to climate change.

Additionally, the lack of sufficient large natural lakes and reservoirs compared to other regions leads to insufficient water storage. On top of that, extreme summer forest fires damage vegetation and reduce the land's ability to hold and absorb water, making an already difficult situation even worse.

As for the human factor, a variety of activities are to blame for the water crisis across the region. For starters, the over-extraction of water resources due to agricultural demand, along with the constantly increasing urbanization that also requires significant volumes of water has exacerbated the issue. Furthermore, these demands also contribute to pollution with chemicals from fertilizers, industrial waste, and untreated urban wastewater all affecting water quality.

Moreover, inefficient irrigation methods and poorly maintained water infrastructure result in water wastage and losses.

Likewise, tourism adds to the strain as well, with millions of visitors each year, which leads to skyrocketed water demand far beyond the region's natural capacity to replenish it.

Affected countries

Spain

Spain, one of the most water-stressed countries in Europe, illustrates this struggle, as nearly the entire country faces water scarcity issues. Andalusia is one of the most affected areas, as it has been enduring drought conditions for the last six years, while the latest hydrological year, between 2022-2023, marks one of the driest, with Andalusia's reservoirs, operating at 21% of their capacity.

The Guadalquivir River basin has also suffered, with the longest drought since 1970 [2][3]. Murcia and Valencia face the same fate, with the Segura River basin, a significant source of water for these regions, experiencing low flows over the years and currently facing an extraordinary drought, according to the Segura Hydrographic Confederation [4]. Water transfers from other regions help alleviate the situation but still showcase the extent of the crisis, with local farmers expressing their concerns about their region's future, fearing even desertification in a few decades.

Another interesting case is Catalonia that, for the very first time in February 2024, declared a drought emergency, as the reservoirs reached just 16% capacity, and imposed water restrictions, such as unwatered parks, dry fountains, and empty swimming pools. However, the restrictions were lifted after significant rainfalls a few months later [5].

Portugal

In Portugal, water scarcity is also an escalating concern, particularly in Alentejo and Algarve regions. Both regions are on high alert regardless of the rains that fell in January and February due to water shortages prompting the government to impose limits on water consumption [6].

Italy

Italy faces a water crisis similar to Spain's with many areas having serious water shortages. In Northern Italy, once known for its abundant water resources, extreme droughts have increased over the last twenty years, leading to conditions like those in Ethiopia and the Horn of Africa [7].

The consequences are also visible in the Po River Basin, where some of its sections are under extreme or moderate droughts impacting energy production and agriculture [8]. In Southern Italy the water crisis is even worse, with a state of emergency announced in 2023 due to the drought that allowed only 150mm of rain during that year. The situation has not improved this year with farmers struggling to feed their animals [9].

Greece

Greece is not out of the picture of water scarcity, as many of its regions face water problems. According to the National Observatory of Athens, between October 2023 and April 2024, the period when most rainfall occur except in parts of Epirus and Western Macedonia, total rainfalls in most of Greece dropped significantly. According to local news reports, Attica is water-sufficient for the next three years before emergency measures are needed [10]. In Thessaly, Greece's most productive agricultural region, the lack of water and consequently the desertification of the area are an immediate and severe risk [11].

Additionally, the situation is not better on the Greek islands, with limited precipitation three years in a row, especially in the Cyclades and Southern Crete. On Naxos, the biggest water reservoir has dried up while authorities in Karpathos have imposed restrictions on topping up swimming pools [12]. In Thassos, the situation's severity led authorities to seek for a desalination unit to make seawater drinkable. Also, Crete faces a growing problem, with numerous municipalities requesting a state of emergency to secure funding for necessary projects like drilling new wells and bypass bureaucracy [13]. The seriousness of Crete's lack of water is visible in its reservoirs with the Bramiana Dam in Ierapetra down by 34.3%, Faneromeni Dam Lake in Messara down by 53% and Aposelemis Dam down by 28% [14].

Cyprus

Cyprus also faces significant water challenges and is one of the EU countries with the least water available per capita. The World Resources Institute ranks Cyprus among the six countries worldwide known for extreme water scarcity, alongside nations like Bahrain and Kuwait. This stems from low water supply combined with high demand.

The UN's Food and Agriculture Organization has even projected that Cyprus could face some of the worst water shortages within 25 years [15] [16]. This dire situation is evident in the island's dams and reservoirs, which have seen dramatic drops in water levels this year, marking the third lowest inflow of water in a decade [17].

Water scarcity versus youth

Among the most efficient ways to deal with the issue of water scarcity is effective water management, in which the participation of youth could prove to be more than beneficial. Youth around the world are strong advocates for environmental issues, pushing for action and accountability while bringing fresh, innovative ideas. They can play a vital role in water management by raising awareness about conservation, promoting sustainable practices, advocating for policy changes, organizing educational programs, and even working on projects to develop new technologies, like advancements in desalination.

Southern European youth, however, face specific challenges when addressing the issue of water scarcity. Starting with the limited funding that makes it difficult to finance campaigns, while access to reliable information and data on water issues is often restricted. Additionally, limited access to formal platforms means that their voices are less likely to reach decision makers and influence policies.

Despite the difficulties, several opportunities are available for the youth to achieve a significant impact. Access to education, including university courses on sustainability and water management, provides essential knowledge. The technological literacy that youth de facto have allows them to use social media and digital platforms to organize, share information, and advocate online. Finally, organizations like the European Youth Parliament are the perfect common ground for young people to unite, collaborate, and amplify their voices on pressing issues like water scarcity.

Regardless of the obstacles mentioned above, the way forward has already been shown by several youth-led initiatives in Southern Europe attempting to make an impact. In Italy, Legambiente, one of the country's leading environmental organizations actively involves young people in campaigns to protect Italy's water resources. In Greece, the Blue Growth Initiative focuses on sustainable practices in marine and freshwater environments. Young participants contribute to projects that promote sustainable water use across coastal and island regions.

In conclusion, the water crisis poses an urgent threat across Southern Europe, demanding a multifaceted response that includes youth as an integral part of the solution. While young people face considerable challenges, they also bring the creativity and adaptability needed to make a real impact in sustainable water management. The initiatives highlighted above demonstrate that youth are more than willing to step up and tackle critical environmental issues to secure a better future for themselves and the generations to come. By effectively integrating youth into efforts to address water scarcity, not only can we make progress in mitigating the crisis, but we can also cultivate a generation committed to building a more sustainable and resilient future for the region.

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2.3 Energy Transition vs. Energy Poverty in the EU: The Youth Perspective

Executed by Zeinab Hassano

Understanding Energy Poverty in the EU

For years, the EU has worked to tackle many of the factors that lead to energy poverty. However, it mainly focused on individual aspects rather than the broader issue, as it was easier to address these smaller parts separately. It wasn't until recently that European institutions began looking at energy poverty as a whole. This shift was influenced by the pandemic, Russia's invasion in Ukraine, and the resulting rise in energy prices, which affected more people.

In 2023, the EU established an official definition of energy poverty in the updated Energy Efficiency Directive and the Social Climate Fund Regulation. This unified definition is crucial, as it allows the European Commission and member states to implement measures more effectively and evaluate their impact consistently across the EU. [1]

"Energy poverty is a household's lack of access to essential energy services that provide basic levels and decent standards of living and health, including adequate heating, hot water, cooling, lighting, and energy to power appliances, in the relevant national context, existing social policy and other relevant policies, caused by a combination of factors, including but not limited to non-affordability, insufficient disposable income, high energy expenditure and poor energy efficiency of homes."

Energy poverty occurs when a household cannot meet its energy needs. So, how many people in the EU are currently affected by energy poverty? This is difficult to measure because energy poverty is complex and there is a level of subjectivity in identifying who is affected.

In 2022, over 41 million people in the EU (9.3% of the population) couldn't keep their homes warm, and nearly 7% had overdue utility bills. In 2020, almost 15% of people lived in homes with leaks, dampness, or rot. The poorest 10% of European households spent 8.3% of their budget on energy in 2018. The energy crisis worsened due to Russia's invasion of Ukraine, pushing up fuel and electricity costs that had already been rising from post-pandemic recovery, high demand, and low supply. [2]

The European Commission has identified four key indicators to measure energy poverty [3]:

1. Arrears on utility bills - This indicator means that an individual or household is unable to pay energy bills on time due to financial constraints.
2. Inability to keep home adequately warm - This indicator checks whether a person or household can keep their home warm enough. Another sub-indicator looks at whether they can keep the house comfortably cool during the summer months.
3. Low absolute energy expenditure - This indicator assesses whether a person or household uses less than half of the national average energy consumption.
4. High share of energy expenditure in income - This indicator indicates that a person or household spends a larger share—twice the national average—of their income on energy bills.

In addition, energy poverty is tied to low income, high energy costs, and poor building efficiency, with market volatility and socioeconomic issues also playing roles. It impacts health, comfort, and well-being, leading to problems like poor indoor temperatures, air quality issues, and stress from unaffordable bills. The Energy Poverty Advisory Hub highlights the need for adequate warmth, cooling, and energy for a decent living. The European Green Deal aims to tackle energy poverty, ensuring affordable prices and supporting households through renovation programs and targeted measures for fair energy access. [4]

Understanding Energy Poverty among Youth

Young people, defined as those between 16 and 29 years old, have not been officially recognized as a vulnerable group by institutions, and the issue of energy poverty among them has received little attention in research or reports. However, from Generation Climate Energy's latest report analysis of the latest Eurostat data shows that young people are slightly more likely to experience energy poverty, such as struggling to keep their homes warm or falling behind on utility bills, compared to the general population. [5]

The EU-SILC database from EUROSTAT provides data on two main indicators identified by the EU Energy Poverty Observatory (EPOV): "Arrears on utility bills" and "Inability to keep home adequately warm." Up until mid-2022, it was possible to compare this data for young people (ages 16-29) with the rest of the population (those over 30) across all EU countries, except for 2020 when Italy's data was missing. Italy's data is particularly important for understanding energy poverty, so data from 2019, including all EU27 countries, was used as the most recent complete set. The resulting datasets are represented in Figures 1 and 2 and are from the Generation Climate Energy report.[6]

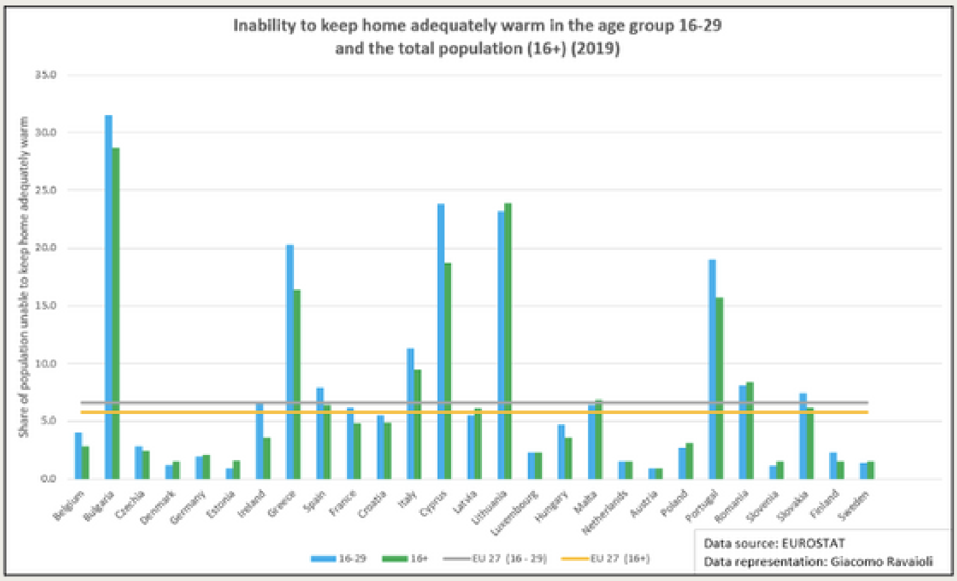

Figure 1. Indicator "Inability to keep home adequately warm" [7]

As of 2020, the countries with the highest percentage of young people unable to keep their homes warm were [8]:

1. Bulgaria: 29.6% among youth compared to 27.5% of the total population
2. Cyprus: 22.2% among youth compared to 21% of the total population
3. Greece: 18.1% among youth compared to 17.1% of the total population
4. Lithuania: 18.9% among youth compared to 23.1% of the total population
5. Portugal: 17.8% among youth compared to 17.5% of the total population

The countries with the lowest percentage of young people unable to keep their homes warm were [9]:

1. Austria: 1.3% among youth compared to 1.5% of the total population
2. Denmark: 1.4% among youth compared to 3% of the total population
3. Netherlands: 1.6% among youth compared to 2.4% of the total population
4. Estonia: 1.7% among youth compared to 2.7% of the total population
5. Finland: 2.1% among youth compared to 1.8% of the total population

Overall, the percentage of energy poverty among young people tends to follow the same pattern as the general population. In countries where energy poverty is high, young people are slightly more affected than the overall population. Conversely, in countries with lower levels of energy poverty, the percentage of young people experiencing it is actually lower than that of the general population.

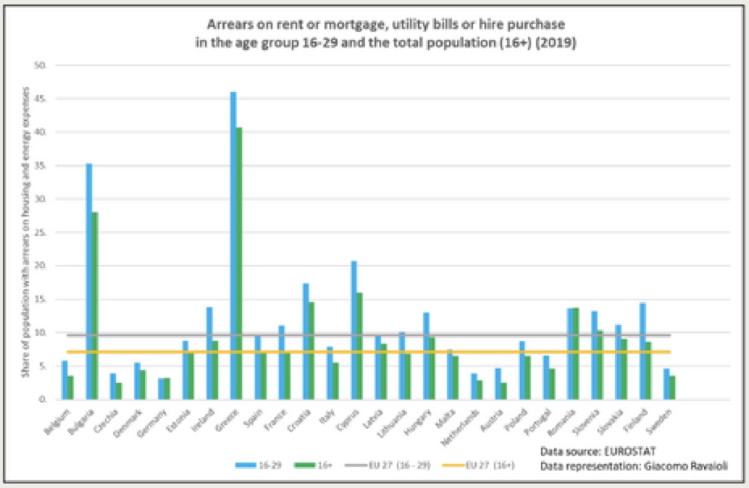

Figure 2. Arrears on rent or mortgage, utility bills or hire purchase [10]

As shown in figure 2, young people are especially at risk of energy poverty because energy bills take up a larger portion of their monthly income compared to older age groups. Additionally, they often have limited control over the condition of their housing and energy contracts. These factors combined make them more likely to face energy poverty.

The Role of Renewable Energy Policies in Tackling Energy Poverty

The EU has implemented various measures, including legislation, to address energy poverty and protect vulnerable consumers. While each Member State has its own approach, the European Commission has increasingly focused on energy poverty in relation to energy efficiency, decarbonization, and clean energy transition policies. The recent energy crisis and rising bills have further highlighted the issue.

The concept of energy poverty was introduced in the 2009 third energy package, as mentioned in the Electricity Directive (2009/72/EC) and the Gas Directive (2009/73/EC). These directives urged Member States to create action plans, define “vulnerable customers,” and protect them by measures like preventing disconnections and improving energy efficiency. The 2018 Governance Regulation required Member States to assess the number of energy-poor households and include targets and measures in their national energy and climate plans (NECPs). The 2019 updated Electricity Directive built on this by setting criteria for assessing energy poverty, allowing public intervention in price controls, and expanding reporting duties on energy-poor households. In 2023, a proposed update added provisions for regulated retail prices during crises and access to renewable energy sharing for consumers. [11]

In 2021, the Commission introduced a toolbox to tackle rising energy costs, offering immediate support like emergency aid, payment deferrals, tax cuts, and protections against disconnections. They also focused on longer-term solutions like increasing energy storage, investing in renewables, and boosting energy efficiency. After Russia's invasion of Ukraine heightened energy supply issues, the REPowerEU plan was launched in 2022 to diversify energy imports, promote conservation, and speed up the green transition. Earlier, the 'renovation wave' under the European Green Deal aimed to improve buildings, double renovation rates by 2030, and focus on affordable and social housing. [12]

The Youth Perspective: Challenges and Recommendations

Young people usually have lower incomes and many who don't live with their parents end up renting. This situation brings a few challenges. First, they have less money left after covering basic expenses. Second, they have limited choices when it comes to finding affordable energy options. Finally, they often live in homes that aren't very energy efficient. These issues make it difficult for them to keep their living spaces comfortable, which can affect their well-being and quality of life, leaving them more at risk of energy poverty.

Understanding current national policies and finding ways to improve them is essential. Offering recommendations that include a youth perspective can be very effective and appealing to policymakers. However, there are many different measures that can be suggested. Usually, a single policy is not enough to make a big impact; it often takes a mix of actions, including education, community involvement, and targeted subsidies, to bring about real change.

Members of the European Youth Energy Network (EYEN) have put together recommendations in five key areas: creating housing standards focused on tenants, launching incentive programs, involving NGOs, encouraging community engagement, and promoting a broader shift in how we address energy poverty among youth.

Their detailed recommendations can be found in their publication, EYEN Contribution to the 15th Citizens' Energy Forum. [13]

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3. Energy technology trends

3.1 Energy systems demystified

Executed by Medha Gayathri

A mundane action such as switching on a light at your home is not as simple as it sounds. There is a complex system composed of interacting elements that allows us to access electricity at the tip of our fingers. The electricity needs to be generated somewhere, stored in an appropriate medium, converted and distributed to the consumers. Often confused with a more fundamental concept of energy, electricity production is only one form of energy that we consume. In most industrial and domestic consumption, we also consume energy in the form of heat. Despite their differences, both electricity and heat go through a similar journey from generation to consumption. Many of the articles in our report deal with specific questions related to decarbonization and sustainability of energy systems. Before we can tackle the challenge of the energy transition, it is important to get a better understanding of its building blocks.

Through this article, we would like to transport you through the supply chain of energy and explain succinctly some of the key components that make up an energy system.

Energy conversion - Extracting usable energy from energy sources

At the core of any discussion about energy is the Sun. It is the sun's radiation that makes it possible for our planet to host life and for us to convert that energy through agriculture to sustain our society. The sun is also the reason for variations in wind and water flows and for the creation of fossil fuels. We all know the fundamental rule - ‘Energy can neither be created nor destroyed’. Then what we refer to as an energy source is just the method of accessing stored energy (or potential). The matrix below indicates possible energy conversions between forms.

TO \ FROM	ELECTRO-MAGNETIC	CHEMICAL	NUCLEAR	THERMAL	KINETIC	ELECTRICAL
ELECTRO-MAGNETIC		CHEMILUMINES-CENCE	NUCLEAR BOMBS	THERMAL RADIATION	ACCELERATING CHARGES	ELECTRO-MAGNETIC RADIATION
CHEMICAL	PHOTO-SYNTHESIS	CHEMICAL PROCESSING		BOILING	DISSOCIATION BY RADIOLYSIS	ELECTROLYSIS
NUCLEAR	GAMMA-NEUTRON REACTIONS					
THERMAL	SOLAR ABSORPTION	COMBUSTION	FISSION / FUSION	HEAT EXCHANGE	FRICTION	RESISTANCE HEATING
KINETIC	RADIOMETERS	METABOLISM	RADIOACTIVITY / NUCLEAR BOMBS	THERMAL EXPANSION / INTERNAL COMBUSTION	GEARS	ELECTRIC MOTORS
ELECTRICAL	SOLAR CELLS	FUEL CELLS / BATTERIES	NUCLEAR BATTERIES	THERMO-ELECTRICITY	ELECTRICITY GENERATORS	

Fig 1. Matrix of energy conversions. Where more possibilities exist, no more than two leading transformations are identified. Taken from Energy and Civilsation: A history by Vaclav Smil [1]

While human civilisation has harnessed the chemical energy in plants into thermal energy with controlled combustion, the use of coal in the industrial revolution transformed society. The steam engine was the first successful prime mover to transform the chemical energy of coal into mechanical energy for work. Today, we are still a society heavily reliant on fossil fuels such as coal and hydrocarbons such as crude oil and natural gas. They are burnt in combined power plants that produce electricity and heat. Fossil fuels are also the feedstock for an overwhelming number of items that we consume in today's world. It is safe to say that modern society is designed as a fossil fuel dependent entity. Fossil fuels are not only polluting to the environment when burnt but also have significant environmental impact during its extraction process. Often located deep underground, fossil fuel extraction through methods such as drilling or mining leads to land degradation, ecosystem damage and water pollution.

But why are we still heavily reliant on fossil fuels? The answer lies in the higher energy density of fossil fuels vs other fuels and an assured source of energy in terms of availability. But with major geopolitical events shaking the energy supply chain, the security of fossil fuel supply is under the radar.

Other primary energy sources are solar, wind, geothermal, hydro and nuclear. Radiation from the sun is converted into electricity using photovoltaic technology (PV) while the heat from the sun is converted to useful thermal energy using solar thermal systems such as a concentrated solar power (CSP) plant. In essence, a CSP plant consists of an array of mirrors and lenses that is used to concentrate solar radiation to a point and convert the thermal energy to mechanical energy - which is then used to drive a generator to produce electricity. Another source of clean, renewable electricity is wind power - Atmospheric pressure gradients create motion of air that is converted to rotational energy using the wind turbine blades. The movement of the blades then drives a generator that produces electricity. Wind turbines can be installed either on land (on shore) or in the seas (offshore) where higher wind speeds are prevalent. The source of energy for a geothermal power plant is the energy stored in the earth's crust in the form of naturally occurring steam and hot water. On the other hand, the source of energy for nuclear power plants is either the splitting of atoms (fission) or the joining of atoms (fusion). Fusion technology is still quite nascent, and fission reactors are the leading form of nuclear energy power plants. Hydro power plants capitalise on the potential energy present in water reservoirs at an elevation. The potential energy is converted to kinetic energy using water turbines that are then connected to a generator.

Hydrogen is quite the buzzword these days and it is often featured in discussions surrounding energy production. It is important to note that the way we intend to use hydrogen in a future energy transition scenario is in the form of an energy storage or energy vector medium - think of a bag to transport energy from one form to the other.

For example, in the case of green hydrogen, the energy from solar or wind power is used to split water to generate hydrogen which is then stored and used as a combustion fuel or in a fuel cell to produce electricity. While the energy generation methods discussed in this section are certainly not exhaustive, they cover most commonly used technologies.

And now we move to the next piece of the puzzle - Energy transmission and distribution.

Energy Grids - Bridging the gap between producers and consumers

Power generated, irrespective of the source, is converted to high voltage power to minimize losses during transmission. The high voltage power is then stepped down to low voltage power that we use at homes at a substation. All of this is possible due to an intricate network called the electricity grid. With increasing share of renewables that are often generated at a remote location, the expansion of the energy grid is as critical as expanding the share of renewable energy. For instance, the IEA observed that almost 3000 GW of renewable energy in the world was still waiting to be connected to the grid due to insufficient grid infrastructure. This was almost 5 times the solar and wind capacity added in 2022 [2]. In such scenarios, the renewable energy is curtailed and it is then a waste of installed capacity. Therefore, it is critical that grid infrastructure and expansion go hand in hand with decarbonization initiatives to prevent a delay in the energy transition.

Energy generation and consumption are not always synced with each other. In such cases, energy storage forms an integral part of the energy supply chain.

Energy Storage - An essential backbone of the energy transition.

Energy storage solutions are integral to ensuring a secure renewable power supply. Thermal and Battery energy storage solutions are the available options. Battery energy storage systems (BESS) receive electricity from the power grid, straight from the power station, or from a renewable energy source like solar panels or other energy source, and subsequently store it as current to then release it when it is needed. While battery backup with renewables such as PV can help in avoiding peak shaving and be less dependent on the grid, battery technology requires critical raw materials that are not easily available and most commercially available battery storage systems do not have a prolonged storage period. Thermal energy storage (TES) store thermal energy (equivalent to a BESS that stores electrical energy) in several mediums such as molten salts, aquifers or phase change materials. While TES helps to decouple heating and cooling demand from power generation, the performance of a TES system is highly dependent on the properties of the storage medium and energy extraction can be a low efficiency process. The IEA predicts global installed storage capacity to expand by 56% in the next 5 years to reach over 270 GW by 2026 [3] [4]. While this is a good sign for the times to come, there is still significant innovation and policy support required to achieve cost competitive long term energy storage systems.

As you reach the end of the article, we hope you can. While it is not possible to capture all the details in 2 pages, this article was an attempt to help you grasp the complexity of the energy system and appreciate the forthcoming articles better. The key takeaway is that the energy transition is here, and we need multiple stakeholders to collaborate and effective policy to create the synergy required to achieve our goal of energy security, sustainability and equity for all.

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3.2 The new EU market reform

Executed by Anuj Gopalsamy Sakthivel

Power to the People: Decoding Europe's Energy Revolution and Your Role in It

Have you ever felt frustrated by rising energy costs and a system that seems designed for a bygone era? Across Europe, young people are demanding a cleaner, more affordable, and equitable energy future – and their voices are being heard. Recent reforms are reshaping the energy landscape, empowering a new generation to take control and build a brighter future.
The 2022 energy crisis exposed the vulnerabilities of Europe's dependence on fossil fuels. It became painfully clear that the old way of doing things was not only expensive but unsustainable, leaving a daunting legacy for future generations. However, this crisis also ignited a powerful movement for change. [1]

Breaking Free from Fossil Fuels: A Market Designed for the Future

For decades, the energy market felt like an exclusive club, dominated by large corporations and outdated regulations. But recent reforms are democratizing energy, making it easier for renewable sources like solar and wind to outcompete fossil fuels and empower a new generation of energy consumers. [2]

Here's how these transformative reforms are reshaping the energy landscape:

- Paving the Way for Clean Energy: Imagine a streamlined, efficient grid designed to transport clean energy from where it's generated to where it's needed. Reforms are simplifying the process for connecting renewable energy projects, cutting through bureaucratic red tape and accelerating the transition to a cleaner, more sustainable energy system. [3] This includes promoting Power Purchase Agreements (PPAs), which allow businesses and communities to directly purchase renewable energy at stable prices, further driving investment in clean energy infrastructure. [4]

- Holding Polluters Accountable: For too long, fossil fuels have polluted our planet without bearing the true cost of their environmental damage. New policies are internalizing the cost of carbon emissions through mechanisms like carbon pricing, making polluters pay for their impact and leveling the playing field for clean energy alternatives. [5] This shift incentivizes investments in cleaner technologies and accelerates the transition away from fossil fuels. [6]

- Empowering Energy Citizens: Imagine a future where communities generate their own clean energy, reducing their reliance on traditional energy providers and fostering local resilience. These reforms are making this vision a reality by promoting community energy projects and enabling individuals to become "prosumers" – both producers and consumers of energy. [7] This empowers citizens to actively participate in the energy transition, shaping a more decentralized and democratic energy system. [8]

Beyond Lower Bills: The Ripple Effects of a Greener Grid

These reforms are not just about lowering energy bills; they're about building a more resilient, sustainable, and equitable energy future for generations to come.

- Price Stability and Predictability: The volatility of fossil fuel prices, often subject to global market fluctuations and geopolitical events, has long caused anxiety for consumers and businesses alike. As renewable energy sources, with their inherently stable costs, become increasingly cost-competitive, energy prices are stabilizing, providing greater predictability and affordability for everyone. [9]

- A Healthier Planet, A Brighter Future: The environmental impact of fossil fuels is undeniable, contributing to climate change, air pollution, and a host of other environmental problems. By embracing renewables, Europe is reducing its carbon footprint, improving air quality, and mitigating the effects of climate change – safeguarding the health of the planet and its people for generations to come. [10]

- Creating the Jobs of Tomorrow: The transition to a renewable energy economy is not just an environmental imperative, it's an economic engine. This burgeoning sector is creating a surge in new job opportunities across a wide range of fields, from designing smart grids and developing innovative clean technologies to installing solar panels and managing community energy projects. These green jobs offer a wealth of exciting and future-proof career paths for young people, ensuring a just and equitable transition to a sustainable future. [11]

The Future of Energy is Now: Seize Your Power

This isn't a distant dream – it's happening right now. As a young person, you're inheriting this evolving energy landscape, and your voice matters. By understanding these reforms and engaging in the conversation, you can help shape a cleaner, more affordable, and sustainable energy future for yourself and generations to come.

Here's how you can plug in:

- Stay Informed: Follow energy policy developments, research different energy sources, and educate yourself about the choices shaping our energy future.
- Support Renewable Energy: Consider switching to a green energy provider, advocating for renewable energy projects in your community, or exploring rooftop solar for your own home.
- Make Your Voice Heard: Contact your elected officials, participate in public consultations, and let your views on energy policy be known.

The future of energy is in our hands. Let's work together to make it a bright one.

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3.3 Energy Communities: Your Power, Your Neighborhood, Your Future

Executed by Anuj Gopalsamy Sakthivel

Tired of feeling powerless when it comes to energy? Like you're stuck with sky-high bills and a system that doesn't care about your future? Well, get ready to take charge, because a new energy revolution is sweeping across Europe – and it's happening right in your neighborhood. It's called energy communities, and it's all about putting the power back where it belongs – in the hands of the people.

Forget giant corporations and faceless energy giants. Energy communities are about people like you – students, young professionals, families – coming together to create a cleaner, more affordable, and more democratic energy future. Imagine a future where you and your neighbors generate your own clean energy, share the benefits, and build a more sustainable and resilient community. Sounds pretty good, right?

What Exactly is an Energy Community?

Think of it like a team effort for clean energy. Energy communities are groups of people – neighbors, friends, local businesses – who join forces to jointly own and manage renewable energy projects. This could mean installing solar panels on rooftops, building a community wind farm, or even creating a microgrid that shares energy locally. It's about taking control of your energy destiny and building a system that works for everyone, not just the big energy companies. [1]

Why Should Young People Care?

Because this is about YOUR future. Energy communities offer a ton of benefits that directly impact young people:

- Slash Your Bills, Boost Your Budget: Tired of those outrageous energy costs eating up your hard-earned cash? Energy communities can help you lower your bills and free up more money for the things you actually want to spend it on (travel, concerts, that new phone you've been eyeing...). [2]
- Create a Greener, Healthier Hood: Worried about climate change and the kind of world you will inherit? Energy communities are a powerful way to reduce your carbon footprint and create a cleaner, healthier environment for everyone. It's about taking action and making a real difference, not just talking about it. [3]
- Build a Community That Works for You: Energy communities aren't just about energy, they're about people. They bring neighbors together, create local jobs, and empower communities to take control of their own destiny. It's about building a stronger, more connected, and more resilient community, one solar panel at a time. [4]
- Be a Changemaker, Not Just a Consumer: Forget passively paying your energy bill every month. Energy communities give you a voice and a stake in the energy system, allowing you to actively shape a more sustainable future. It's about being part of the solution, not the problem. [5]

From Dream to Reality: Energy Communities in Action

This isn't some pie-in-the-sky idea – energy communities are already thriving across Europe. Check out these inspiring examples:

- Germany: Citizen-owned energy cooperatives have been a driving force behind the country's renewable energy boom, with thousands of communities generating clean power and sharing the benefits. They've proven that ordinary people can make a real difference in the fight against climate change. [6]
- Denmark: Community-owned wind farms have become a national icon, supplying a significant portion of the country's electricity and demonstrating the power of collective action. They've shown that it's possible to create a clean energy system that benefits everyone, not just the wealthy few. [7]
- Greece: Energy communities are helping to revitalize rural areas and islands, creating local jobs and boosting energy independence. They're proving that sustainable energy solutions can also be economically viable and socially just. [8]

Ready to Join the Revolution? Here's How to Get Started:

- Find Your Tribe: Connect with existing energy communities in your area or online. There are tons of resources and organizations dedicated to supporting these initiatives, like REScoop.eu, the European federation of citizen energy cooperatives. [9]
- Spread the Word: Talk to your friends, family, and neighbors about the benefits of energy communities. The more people who know about them, the faster they'll grow. Share information on social media, organize events, and get the conversation started. [10]

- Take Action: Attend community meetings, volunteer your time, or even consider starting your own energy community project. There's no limit to what you can achieve when you work together. Don't wait for someone else to fix the energy system – be the change you want to see! [11]

The future of energy is in our hands. Let's build a system that's powered by the people, for the people, and for a brighter future. Join the energy community movement today!

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3.4 Electric grids as part of the clean energy transition

Executed by Daphne Sotirchou

The energy crisis in Europe caused by Russia's invasion of Ukraine highlighted the importance of diversifying energy sources and accelerating the transition to renewable energy to reduce dependence on fossil fuels and promote energy independence. Indeed, there was considerable progress in the clean energy transition, with renewables rising to 44% of the EU's electricity mix in 2023.
However, for the EU to reach its renewable energy target, namely, to reduce net greenhouse gas emissions by 55% by 2030 and achieve net zero emissions by 2050, wind and solar power generation capacity should increase from 400 GW in 2022 to at least 1,000 GW by 2030, including a large build-up of offshore renewables up to 317 GW by 2050.[1]
For this to happen, one crucial question remains to be answered: Can electricity grids, as the backbone of our energy system, manage and support such accelerated energy transition, especially in terms of grid capacity, flexibility, and resilience?

Current electricity grid infrastructure

Pursuant to the report of the International Energy Agency (IEA) [2] on Electricity Grids and Secure Energy Transitions,it is stated that worldwide more than 50% of grid infrastructure in advanced economies is more than 20 years old, and solely around 23% is less than 10 years old. The age of electricity grids varies by country by taking into account several factors i.e. each country's historical development, grid modernization attempts etc. At an EU level, 40% of Europe's distribution grids are estimated to be over 40 years old.

Therefore, it is evident that the energy sector is currently facing a paradox: even though renewables have evolved rapidly, electricity grids have largely remained the same, thus there is an urgent need to expand and upgrade the grids in order to achieve a successful transition to clean energy.

How does the electricity grid work?

In brief, the electricity grid comprises three main components: power generation, transmission and distribution.

Grid operators are divided into Transmission System Operators (TSOs), who manage transmission systems (high voltage), and Distribution System Operators (DSOs), managing the distribution systems (medium and low voltage).

The transmission network consists of national transmission lines, which transport electricity long distances within a country, and cross-border lines, also referred to as “interconnectors”, which connect two neighboring electricity systems.

Challenges in integrating renewables to the electricity grid

Integrating renewables into grids poses various challenges, with the most prominent ones outlined as follows:

- Lack of grid capacity

Insufficient grid capacity has led to numerous renewable energy projects in certain EU countries facing notable delays in terms of being connected to the grid. For instance, in Greece, in 2020, 913 MW of new solar PV projects were installed, but by the end of 2020, only 459 MW of these projects were connected to the grid. The situation was similar in 2021, with 792 MW of new PV capacity installed but only 422 MW of connected to the grid at the end of the year.[3]

The recent Law 4951/2022 as in force and a series of delegated Ministerial Decisions that followed aimed to decrease grid congestion, by adjusting the capacity margins in congested areas and releasing grid capacity from existing plants that stop operating. Under the said law, it is stipulated that the TSO may stop accepting new grid connection applications for up to six (6) months in areas where the grid no longer has sufficient capacity for new connections.

- The “on-and-off” nature of renewables

Relying on natural sources to draw power means that renewables are often affected by multiple variables such as seasonal/weather conditions. Therefore, the fluctuating nature, the variability and the uncertainty of power supply generated by renewables and especially by wind and solar power, make it challenging to match supply with demand, thus posing significant challenges in terms of maintaining the grid’s stability and reliability.

- Costs for developing and upgrading existing grid infrastructure

The development of transmission lines for the integration of certain renewables i.e. offshore wind projects, involves higher costs and requires the use of more advanced technology, since the existing grid was designed for centralized power systems (mainly fossil fuels).

- Increased energy demand

As renewable technology becomes more widely used, the electricity grid will need to address new sources of energy demand due to the rise of electromobility, such as the charging of electric vehicles leading to uncontrolled increases in the grid’s load.

- Regulatory barriers

Regulatory frameworks should be revised to encourage investments in renewable integration and grid modernization. The complexity and inconsistency of certain regulations across EU members present significant challenges to integrating renewables into the electricity grid.

Supporting electricity grids roll-out

Acknowledging the above mentioned challenges, EU has established a legal framework to support grids rollout, with the revised TEN-E regulation, the revised Renewable Energy Directive and proposals for a Net-Zero Industry Act and a reformed electricity market design [4].

Amongst the most recent and significant steps towards grid optimization are the high-Level Forum “The Future of Our Grids: Accelerating the Energy Transition”, organized in September 2023 by the European Network of Transmission System Operators for Electricity (ENTSO-E) under the patronage of the European Commission, and the EC’s communication “EU Action Plan for Grids” released in November 2023 [5].

The said Plan sets out several actions to accelerate grids deployment which focus on the following:

- prioritizing the implementation of Projects of Common Interest and Projects of Mutual Interest
- enhancing long-term grid planning
- introducing a supportive, future-proof regulatory framework
- making better use of existing grids and smartening them
- improving access to financing
- ensuring faster and leaner permitting processes
- strengthening supply chains

Solutions for transitioning to renewable-powered grid

Transitioning to a grid powered by renewables highlights the importance of adopting effective grid management solutions.

To this regard, energy storage technologies, from batteries to the storage of green hydrogen, are vital for balancing the fluctuations in renewable output and ensuring a reliable and stable electricity supply.

In addition, technological innovation can play a pivotal role in addressing challenges related to renewable energy integration, including but not limited to the usage of new forecasting methods that can predict renewable output as well as the introduction of new grid technologies such as smart grids enabling automatic adjustments in energy production and distribution by using real-time data.[6]

Last but not least, the expansion of "interconnectors" provides a great opportunity for the exchange of energy supplies between EU member states. Interconnected grids offer numerous benefits such as improved stability, enhanced energy security, and increased flexibility in managing power fluctuations. They also support the integration of renewable energy sources by enabling the transfer of excess clean energy to regions with higher demand or limited generation capacity.

Finally, expanding the energy grid itself will contribute to overcoming challenges related to renewables' integration.
In light of the above, it becomes clear that the existing electricity grid is currently falling short of meeting the increasing demand for electricity and accommodating the variability of renewables, thus contributing to a secure and reliable energy transition.

To this end, the implementation of a clear and coherent policy framework for the grids' transformation, modernization, and expansion, the promotion of financing in grid infrastructure, and the introduction of new grid-enhancing technologies are deemed necessary so that electricity grids can keep pace with the deployment of renewables.

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3.5 Electrifying the Future: Spain's Path to a Sustainable Power Sector

Executed by Florentina Oldani

Electricity is at the heart of modern economies, and its share of final energy consumption is projected to rise from 20% today to over 50% in the Net Zero Emissions by 2050 Scenario, as electricity demand increases rapidly to decarbonize end-use sectors. Efforts to address climate change are rapidly electrifying various sectors, from transport to industry, implementing technologies such as electric vehicles and heat pumps, driving a significant increase in power demand and necessitating maximum generation from renewable sources. This is resulting in a dramatic transformation of global power systems, despite unabated fossil fuels still accounting for over 60% of total global electricity generation, it is expected to drop to below 30% by 2030, while the share of renewable energies is expected to increase. [1]

In 2023, for the first time more than a quarter of EU electricity (27%) came from wind and solar, allowing renewable electricity to reach 44% of EU electricity generation. Besides the share of renewable energies increased by 14% in the last seven years, that pace needs to almost double to reach 72% of generation target proposed in the REPowerEU. [2]

What is happening in Europe? The REPowerEU Plan

The REPowerEU plan is about reducing the European dependence on Russian fossil fuels by fast forwarding the clean transition and joining forces to achieve a more resilient energy system. The Fit for 55 package is a set of proposals to revise and update EU legislation aiming to provide a coherent and balanced framework for reaching the EU's climate objectives (including reducing net GHG by at least 55% by 2030). [3]

Through its implementation, it puts forward an additional set of actions to structurally transform the EU's energy system: save energy, diversify supplies, quickly substitute fossil fuels by accelerating Europe's clean energy transition and smartly combine investments and reforms.

Along with the actions proposed by the plan, Europe's strategic energy dependence is expected to be reduced. Is meant to accelerate diversification and more renewable gases, frontloads energy savings and electrification with the potential to deliver as soon as possible the equivalent of the fossil fuels Europe currently imports from Russia every year. Furthermore, the green transformation of the continent's energy system will strengthen economic growth, reinforce its industrial leadership and put it on path towards climate neutrality by 2050. [4]

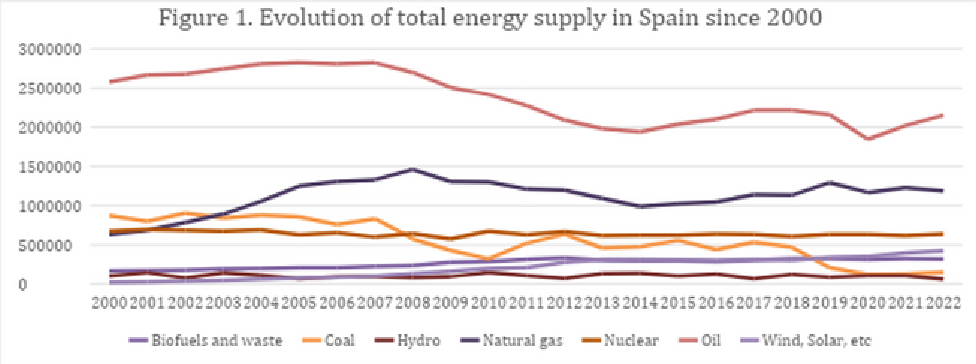
Spain's Energy Landscape: Current Trends and Future Outlook

Spain is at the forefront of the energy transition due to its progressive energy and climate change policies. The current Spanish framework for energy and climate is aligned with the 2050 objectives of achieving national climate neutrality, 100% renewable energy in the electricity mix, and 97% renewable energy in the total energy mix. In this context, the country is focused on the massive development of renewables, increasing energy efficiency, and improving electrification. Throughout the actions developed in each of the topics, the country will be able to improve energy security, support innovation and stimulate the economy by creating new jobs. [5]

The Just Energy Transition that Spain is working on, seeks to maximize the social gains of ecological transformation, focusing on elements related to supporting the economic sectors towards the green economy. This strategy is one of the pillars guiding the country's energy and climate policy, given that social justice needs to be linked to the energy transition. [6]

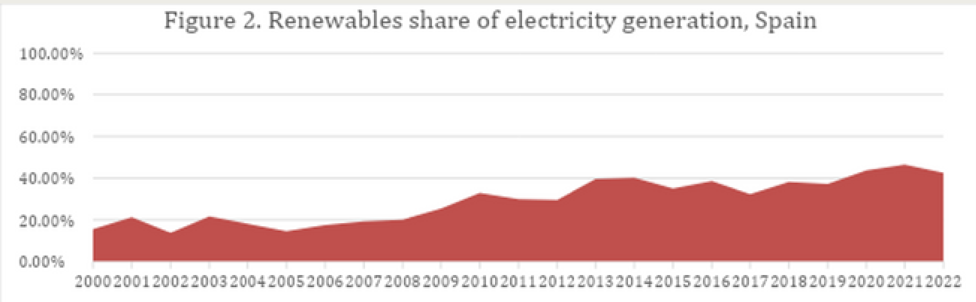
Nowadays, Spain's demand for electricity is increasing across all sectors as a result of its electrification strategy and industry, residential and services sectors consume similar amounts of electricity. To reach its targets, electricity generation in Spain has to notably decarbonized, as the share of production from fossil fuels decreased while the production of renewable energies increased. [7]

In Figure 1, if we analyze the evolution of the total energy supply in Spain since 2000, we can see that the total production is still pending a lot on Oil and Natural Gas, but that renewable energies such as wind and solar are increasing their participation in the share.



Data: Own elaboration based on data from the International Energy Agency

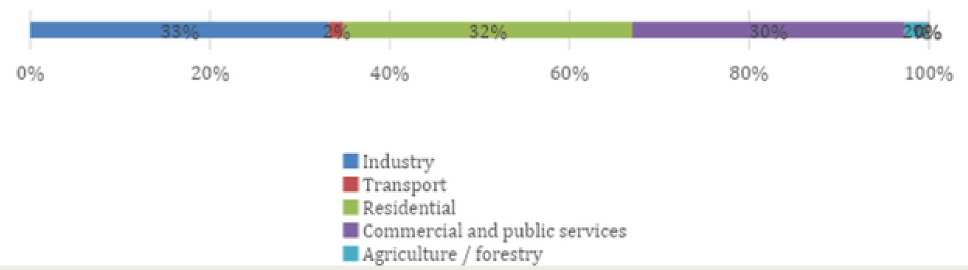
In this context, if we focused specifically on the electricity sector, we can analysed in Figure 2 that Renewables had increased their share in Spain to arrive at around 42.5% of the total in 2022, a change of 172% if you compare between 2000 and 2022.



Data: Own elaboration based on data from the International Energy Agency

Another dimension that has a huge impact on decarbonizing the energy sector, is the energy demand. Actions towards an improvement in energy efficiency (EE) are crucial enablers for making high levels of end-use electrification feasible and affordable. Measures related to these dimensions are needed across all end-use sectors. [8] In Figure 3, we can see how this energy was consumed in the year 2021. The demand of energy by sector in Spain is similar between the main sectors: Industry (33%), Residential (32%) and Commercial and Public Services (30%). Bearing that in mind, EE actions related to these sectors would have a great impact in reducing the energy demand from the society and, with that, in the reduction of GHG emissions.

Figure 3. Electricity final consumption by sector, Spain



Data: Own elaboration based on data from the International Energy Agency

With the electrification of these mentioned sectors, more demand for electricity is generated. Because of that, a constant demand rise is expected to be seen and, in the case of Spain, a 17% increase is expected. This trend will be the key lever in decarbonization across industries, and the consumption is set to increase substantially as electrifies technologies are introduced. [9]

Taking into consideration the international and European context, Spain has shown its commitment to tackling the climate crisis by making the Integrated National Energy And Climate Plan 2021-2030 (INECP) its priority. This plan is aimed at making progress with decarbonization, laying down a firm foundation for consolidating a climate-neutral path for the economy and society by 2050.

The measures mentioned in the plan are expected to reduce GHG emissions approximately one third of the current emissions, having the electrification of the different sectors as a key player in the consecution of this goal. For doing so, the penetration of renewable technologies is required, and is expected to be 74% of the total by 2030 to reach 100% by the year 2050. [10]

As a conclusion, this Plan is expected to have significant economic, employment, social and public health benefits. GDP is expected to increase, new jobs are going to be generated by the implemented measures and savings will be allowed due to the reduction in demand for imported fossil fuels, improving energy security for the country.

The implications of the youth generation in the Energy Transition

Considering the policies Spain is developing towards a cleaner energy mix in order to respond to socio economic impacts of it, deals such as the Agreement for a Just Energy Transition for Thermal Power Plant Closures are being developed. Its result is the relocation of workers and the search for alternative employment in the affected areas, to improve the problem of employability and to incorporate those workers in cleaner projects.

Business development and activities that help to create a more diversified and sustainable economic model are also being supported and are helping to create more than 1200 jobs in the areas affected by the closures. [11]

Spain views the energy transition as an engine for quality job creation, especially given that the country’s unemployment rate hovers around 15%, with the highest share of temporary workers in the European Union. Analysis by the Spanish government has shown that achieving strategic energy transition objectives will require the creation of between 235 000 to 348 000 new jobs with an overall reduction in the unemployment rate between 1.1% and 1.6%.

The Spanish Government recognises the green vocational training as an important element to reach the objectives established as there is a huge need to identify academic and professional knowledge gaps and incentivize the youth to close them. [12]

Also, an example of programs that are being implemented in Spain to promote and improve employment, entrepreneurship and the environment, the Empleaverde can be named. This program aims to leverage environmental opportunities to create good jobs and competitive companies by better aligning employment and environmental policy. Another example can be Energy Advice Points or Energia la Justa implemented in Barcelona, where job trainings were provided to address energy poverty through building retrofits, achieving energy efficiency improvements of homes, increasing the employability of vulnerable people, and empowering citizens. [13]

As a conclusion, Spain's approach to the energy transition reflects a proactive commitment to addressing both the socioeconomic impacts and the environmental goals associated with a cleaner energy mix. Given the high unemployment rate and the need for substantial job creation, the Spanish government recognizes the potential of the energy transition as a driver of economic diversification and long-term growth. By focusing on vocational training and strategic workforce development, Spain is positioning itself to achieve its clean energy goals while creating a more sustainable and inclusive labor market.

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3.6 Contrasting approaches to nuclear energy: A case study of France and Germany

Executed by Medha Gayathri

The global energy landscape is standing at the brink of a transformational change and while there are different expert opinions on how the future of energy will look like, one of the most divisive topics has been that of nuclear energy. On one hand, there are strong advocates of the technology owing to its low carbon footprint and reliability. On the other hand, the complex engineering of a nuclear power plant and the main concerns regarding safety following some incidents such as the 2011 Fukushima power plant have garnered a group of people skeptical about nuclear energy. In 2022, nuclear energy accounted for about 10% of the global electricity production. However, the distribution of this percentage is not uniform globally. For countries such as France, Belgium and Ukraine, nuclear accounts for more than 40% of their electricity production [1]. Within the EU, the stance on nuclear energy is quite polar with countries such as Germany that have completely phased out nuclear, and others such as France relying on nuclear for around two-thirds of its electricity production. The contrasting ideologies of the two neighbours is a result of different political and public perception of nuclear energy. A recent win for the proponents of nuclear energy within the EU, is the inclusion of nuclear power in its taxonomy of environmentally sustainable economic activities. Using France and Germany as a case study, this article aims to unravel the complex interaction of technology, policy and social acceptance of nuclear energy and the possible role it can play in the future energy mix.

Nuclear energy - The Technology

The energy stored in the nucleus of atoms can be harnessed in two ways: fission where the nuclei of atoms split into several parts or fusion - when nuclei fuse together. The nuclear energy produced today is nuclear fission and at the heart of a nuclear fission process is the reactor. The process of splitting the nucleus occurs in the reactor of a nuclear power plant and releases energy in the form of heat and radiation. The heat is then converted to mechanical energy to drive a generator and produce electricity much like a conventional natural gas or coal fired power plant. At the core of the reactor are the uranium fuel rods. Uranium, specifically the isotope U-235 is used because it can split easily and sustain a chain reaction. Other integral parts of a nuclear power plant are the coolant fluid which absorbs the heat generated by the fission process, the moderator and control rods which control the rate of the reaction, the pressure vessel and tubes and a steam generator. The most common form of a nuclear power plant design is the pressurized water reactor (PWR). As the schematic shows, a steam generator transfers the heat from the coolant fluid of the reactor to low pressure water to create steam that drives a steam turbine connected to an electrical generator. A typical nuclear power plant produces around 1GW of energy and has the highest capacity factor compared to other energy generation technologies (capacity factor is the ratio of actual energy produced to theoretical maximum energy production for a given period of time).

While the fundamentals of nuclear energy have been the same since the 1950's when the first nuclear reactor was operated to generate electricity, there have been some exciting advancements in reactor technology such as small modular reactors (SMR), molten salt or liquid metal cooled reactors, distributed nuclear power using microreactors operating in the scale of 1 MW.

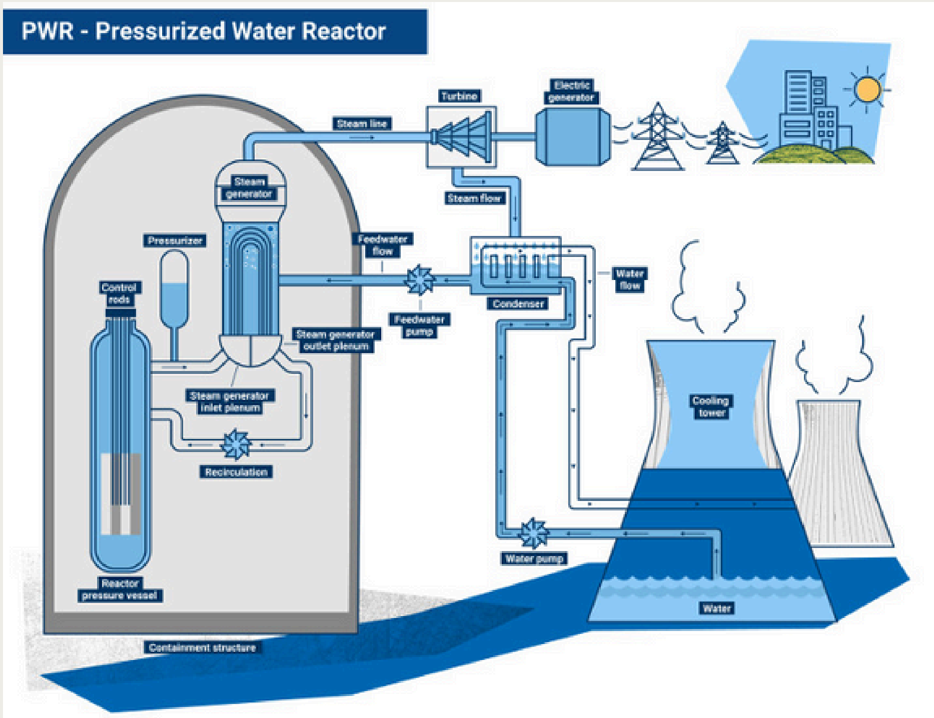

Fig 1. Schematic of a pressurized water reactor (PWR) [2]

A very important aspect of the lifecycle of a nuclear power plant is management of spent fuel. The used reactor material can remain radioactive for several years and if not handled properly can pose a threat to human safety. The waste from nuclear power plants can be categorised as low or intermediate level waste or high-level waste (HLW). Proven methods such as geological repositories for disposal of HLW ensure that harmful radiation will not reach the surface over time or during events such as earthquakes. While there is dearth of technological prowess to handle the safe disposal of nuclear waste, the challenge lies in public perception and approval of these methods.

A tale of two countries - Nuclear energy in France and Germany

In light of recent geo-political conflicts affecting the EU, the topic of energy self-sufficiency has become more prominent. Renewable energy technologies such as wind, solar and nuclear are possible answers to a secure and clean energy supply. A recent article on the future of nuclear energy in Europe estimated that about 50-150 new nuclear power plants would be required to replace Europe's natural gas plants [3]. For a continent divided in its view on nuclear energy, this is going to be a daunting task.

France has been an early advocate and pioneer of nuclear energy. Following the oil crisis of the 1970's, nuclear energy in France received a huge boost in a bid to ensure energy security of the country. Touted as the Messmer plan, the idea behind the push was captured through the slogan - "In France, we do not have oil, but we have ideas". Today, the country's 56 nuclear plants are managed by EDF, owned by the French government. The history of nuclear energy in France has had its fair share of challenges, for example the most recent 'Grand Carénage' refurbishment programme to update older power plants and the discovery of corrosion cracking in the units. Also, some of France's nuclear power plants have been forced to shutdown due to water shortages especially in the summer. Within the context of climate change and the impact on water supply, this occurrence is only going to become more common in the future. Despite the bottlenecks, the outlook for French nuclear power is strong with plans such as an investment of €52 billion to construct six new EPR (European pressurised reactors)-2 PWRs at three sites [4].

Not too far away from the France-German border is the site of Phillipsburg nuclear power plant. Located in Karlsruhe, it was one of the 18 nuclear power plants shut down as part of the nuclear phase out policy adopted by the German government in 2011 following the Fukushima disaster.

Fukushima disaster. While many of Germany's neighbours still have nuclear power plants in operation, Germany has adopted an anti-nuclear stance, relying heavily on natural gas imports from Russia and expanding its installed renewable energy capacity such as offshore wind farms. The energy transition plan in Germany dubbed as the ' Energiewinde' aims to turn Germany into a low carbon economy by reducing its dependence on fossil fuels. One of the key aspects of the Energiewinde is the phasing out of coal power plants completely by 2038. However, following the Russia-Ukraine crisis, Germany prolonged the operation of coal power plants sparking the debate if it was logical to phase out nuclear power while keeping coal plants alive. The decision to phase out nuclear power might seem like a knee jerk reaction to the Fukushima incident, but Germany has had a history of protests and public trepidation towards nuclear power particularly after the Chernobyl meltdown. While recent events have forced Germany to revisit their policies surrounding energy security, it is highly unlikely that nuclear power will make a comeback here. Nuclear power plants are high-cost projects and realizing them without government backed subsidies is extremely difficult. Germany has decided to place their bets on renewable energy and improving energy efficiency. Dubbed as the 'Achilles heel' of the energy transition, the most crucial piece in the puzzle is the expansion of the grid to transport renewable electricity primarily generated in the north to the southern regions of Germany.

While Germany might have taken a different approach than its neighbour to the west, it is important to remember that there is no silver bullet to the challenge of decarbonizing the energy sector. Nuclear energy is the only fossil fuel free base load operation solution and will remain a crucial part of the future energy mix. With the case studies of France and Germany, it will be interesting to witness the evolution of two contrasting solutions to resolving the energy trilemma: energy security, sustainability and affordability.

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3.7 Wind Energy in the EU: Evolution and Future Prospects

Executed by Florentina Oldani

The urgent task of transforming the energy system now unfolds in a more challenging and geopolitical context. Various scenarios reflect different assumptions about the actions needed in the coming years to shape energy systems and reduce energy-related carbon dioxide (CO_2) emissions. Another notable characteristic of this period is the world's increasing reliance on electricity. This rising electrification makes green technologies, among which wind energy, even more crucial in decarbonizing the power supply, and the frailties of fossil fuel age make the opportunities in the emerging clean energy economy grow fast. Despite this, many uncertainties remain about the risks to the security and affordability of transitions, and about whether the process of change will be rapid enough to avoid severe impacts from a changing climate. [1]

Wind energy capacity and installations

In this context, wind and solar power are the predominant sources of power generation in the Net Zero Emissions by 2050 Scenario. Annual wind capacity additions need to increase significantly by 2030 to stay on track with this goal pathway. Under existing policies and market conditions, the global renewable capacity is forecast to reach 7.300 GW, falling short to the goal of tripling it. To close the gap and reach 11.000 GW by 2030, each region must overcome various challenges. The specific obstacles vary depending on the characteristics of each country. The following can be named among the main ones:

- policy uncertainties and delayed policy responses to the new macroeconomic environment,

- insufficient investment in grid infrastructure preventing faster expansion of renewables,

- cumbersome administrative barriers and permitting procedures and social acceptance issues,

- insufficient financing in emerging and developing economies.

Despite the obstacles, in the main case forecast proposed by the IEA on its Renewables 2023 Report, almost 3.700 GW of new renewable capacity will become operational over the 2023-2028 period. Wind and solar energy will account for more than 95% of global renewable expansion, driven by supportive policies in more than 130 countries. [2]

2023 was a record year for renewables, with installations of 510 GW, nearly 50% increase compared to 2022. The year was historic for wind installations, adding 106 GW of onshore wind, and 10.8 GW in the case of offshore. However, this record year installation is not enough to fullfit the global goal of 1.5°C, nor to reach the triple renewable energy capacity. Having a primary role in these objectives, global wind growth must rapidly accelerate to meet 2030 targets, estimating that annual wind installations should pass from current levels of 117 GW to 320 GW per year. [3]

Short and Long-Terms Challenges in the Wind Industry

Nowadays, the global wind industry growth is facing persistent transversal challenges. Among them, the followings can be mentioned:

- Permitting timelines: the ease of obtaining the necessary permits, licenses and approvals for wind projects deployment.

- Availability of land and seabed for wind energy projects.
- Supply Chain Security: the cost effective and accessible supply of materials for the wind energy supply chain is one of the main issues suffered by the wind industry these days. The supply chain is facing disruptions and bottlenecks that impact negatively in higher costs and in the timeline of production.
- Grid and Transmission: The pace and scale of grid reinforcement, buildout and modernisation, ensuring sufficient grid availability to increase wind deployment to avoid bottlenecks that may lead to curtailment.
- Skilled workforce: The availability of a ready and able workforce with the necessary training and skills for the wind industry.

With the goal of tripling renewable energy in mind, collaboration between the global wind industry and stakeholders across the energy transition is a key factor in overcoming these challenges and seizing the growth opportunities ahead. [4]

Driving Growth: Key Incentives for the Wind Industry

Beside these challenges the wind industry is facing, there is a long-term optimism on growth driven by several factors that play a significant role in its development:

- Policies: There are now over 140 countries that support with different actions and policies the expansion of this green technology.
- Cost reductions: In the last decade, there has been a fall in the cost of electricity about 70% for onshore wind and 60% for offshore wind. Although the rise in cost in the recent years, the cost reductions have scaled up the deployment and technology innovation.

- Financing conditions: Tried and tested policy and regulatory frameworks have helped reduce financing costs by providing operators with a high degree of revenue certainty, usually through long-term contracts. [5]

These factors have been very positive for the expansion of wind power, helping to explain the year-to-year increase in the deployment of this technology. However, as mentioned before, this growth in generation is still limited if defined goals are taken into consideration.

Onshore and Offshore Wind Industry

While On-Shore is a develop technology, Offshore wind is at the early stage of expansion. Offshore reach is expected to increase in the coming years, as more countries are developing their first wind farms. [6] Europe installed 18.3 GW of new wind power capacity in 2023, where 79% of the new wind energy capacity built in Europe in that year was onshore and is expected to be ⅔ of the new wind installations up to 2030. The situation has been extended over the last 10 years, having in Europe a concentration on onshore power generation, while offshore still has much room for development. [7]

According to the latest report by WindEurope, the continent now has 278 GW of wind capacity (242 GW onshore and 35 GW offshore). During the first half of 2024, 6.4 GW of new wind power capacity was installed, with 83% of it being onshore. Restrictions in grid capacity, port capacity, and vessel availability are affecting the expansion of offshore wind, compounding grid bottlenecks, permitting issues, and challenging financial conditions, which also impact onshore projects.

Offshore wind farms are generally significantly larger than onshore wind farms, and construction tends to take longer. Europe has ambitious plans for this technology, as there is an abundance of shallow waters with excellent wind resources, particularly in the North Sea and the Baltic Sea. Governments across Europe recognize the value of offshore wind and are working to overcome the main barriers faced by these types of projects.

It is expected from Europe to install 207 GW of new wind power capacity over 2024-2030, which falls short to the 2030 climate and energy targets the continent has. To meet their targets, 33 GW per year are needed, and for doing so Governments must prioritize the expansion and modernisation of electricity grids, investments in port infrastructure and the full implementation of the EU's new permitting rules. [8]

Impacts on Youth and Future Opportunities

As mentioned before, in the idea of transforming the power mix Solar FV and Wind are projected to be the most significant contributors. Taking into consideration that one of the challenges faced by the wind industry is the availability of a ready and able workforce with the necessary training and skills for the wind industry, the youth has a great opportunity to be hired to work in this developing industry.

Offshore technologies will have a huge expansion as a lot of countries are working or planning to start working in the setup of their offshore wind farms. In this industry, one of the main challenges being faced is a shortage of skilled human resources. The investment in education and training programmes to develop these skills capable of supporting the construction, operation and maintenance of key clean electricity technologies is needed. [9]

Independently of the background, a path career in wind may be pursued, as a great number of talents are needed to deliver a green energy transition. According to Wind Europe [10], the following numbers are expected in 2030:

- 420 GW of wind energy capacity
- 514.000 Total jobs in wind energy
- 360.000 Direct jobs
- 38.000 Jobs in planning
- 141.000 Jobs in manufacturing
- 72.000 Jobs in installation
- 7.000 Jobs in decommissioning
- 61.000 Jobs in operation and maintenance

In a context where Global Employment is complex (and more for the youth), pursuing a career in the wind industry is a great possibility. This expected expansion is going to require a lot of people with different sets of skills, and being prepared for the expansion may give the youth great opportunities to succeed in this expanding industry.

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