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Perspective

Transition away from fossil fuels toward renewables: lessons from Russia-Ukraine crisis

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ABSTRACT

The world's progress towards net-zero ambitions will bring down fossil fuel utilization and imports over time. However, crises such as COVID-19 and the Russia-Ukraine conflict have raised questions about the reliability of non-renewables and what actions could be taken by policymakers to immediately mitigate reliance on fossil fuels for vulnerable importers. The responses to the recent crises could reorient energy geopolitics by the decentralization of the global energy system and speeding up renewables deployment. These superb targets require a concerted and sustained energy policy effort across multiple industries, alongside strong international communication on energy security. Clear dialogue between governments, the green power generation industries, and consumers is also a crucial element for successful renewable energy implementation. The world's energy crisis has unveiled that the transition to renewable energy has been too slow, and serious efforts are required to speed up the transition away from fossil fuels toward renewables.

1. Introduction

Since 2020, the economic consequences of COVID-19 have demonstrated an adverse impact on the development of renewables. In early 2020, Hosseini [1] pointed out that in post-COVID-19, when the economy is returned to its trajectory, the governments should accelerate the deployment of renewables before another worldwide economic shock. Now, in 2022, the Russian-Ukraine crisis is a new shock that could menace the energy security of the world.

After the U.S, Russia is the world's largest natural gas (NG) and oil producer, providing 13% of oil and 17% of gas globally in 2020. Approximately 40% of Europe's gas is supplied by Russia [2]. About one-third of European NG demand used for electricity generation, industrial production, and winter heating is supplied by Russia. Moreover, more than 25% of the European Union (EU) crude oil import is from Russia, making the EU more dependent on Russian fossil fuels. In 2021, the EU imported an average of over 380 million cubic metres (mcm) per day of NG by pipeline from Russia, or about 140 billion cubic metres (bcm) for the year. Furthermore, approximately 15 bcm was supplied in the form of liquefied natural gas (LNG). Nevertheless, some EU states such as Spain and Portugal use little Russian fossil fuels, while Germany, as the largest European economy, provides more than 30% of its crude oil and 50% of its NG demand from Russia. Although most of the electricity demand in France is generated by nuclear power, it still relies on Russian fossil fuels to prepare its energy requirements. One of the main reasons for increasing this dependence on Russian fossil fuels is attributed to the plans that the EU made to phase out coal and nuclear power plants [3]. In this context, a new Russian pipeline under the Baltic Sea to Germany named "Nord Stream 2" was completed in late 2021. Remaining highly dependent on Russian gas and oil, a large-scale Russian invasion of Ukraine has the potential for major disruptions to the European energy market. Russia depends on revenue from Europe, while Europe depends on Russian fossil fuels, therefore Europe's reliance means that imposing tougher sanctions on Russia burdens a severe dent in its energy supplies. Although the sanctions imposed on Russia did not target its NG and crude oil, on March 2, Brent was trading above $110 for the first time since 2014. In the short term, the main challenge in the EU energy supply is what strategy should be considered if Russia cuts off the EU natural gas supply. The first and immediate reaction is re-operating coal power plants, although its infrastructure has been gradually decommissioned in recent years. Due to this anticipation, Germany has kept its coal power plants on standby to be ready for any unexpected scenario. However, if Germany reverted to coal-fired power plants in any circumstances, it would go against its promise to phase out coal-based power generation by 2030. The other quick reaction to this scenario is diverting more LNG ships from the US and Qatar [4].

On the other hand, by intensifying sanctions on Russia, financial institutions will refuse financing Russian transactions, opening letters of credit, or approving payments, and consequently, the role of Russian NG and crude oil on the world's energy mix decreases. Nevertheless, mitigating reliance on Russian fossil fuels is not simple for the world (especially the EU), needing a concerted and sustained policy across various sectors, alongside strong international dialogue on energy markets and security. To decrease reliance on Russian fossil fuels by over a third and support the European green deal, the IEA announced 10-Point Plan to EU. Based on the IEA's 10-Point Plan, signing any new gas contracts with Russia is suspended; and gas supply from other sources is maximized. It is stipulated that the low emission energy projects in nuclear energy and renewables should be accelerated, and energy efficiency in homes and businesses should be ramped up [5].

Besides these short-term policies, a firm decision or a consensus about the world's future energy is required to ensure the energy security of the EU and the world. The European leaders have concluded that Russia's invasion of Ukraine is an opportunity to expedite the transition to renewable energy and nuclear power generation. Germany is aiming to accelerate the growth of its solar power generation plus onshore/offshore wind projects. In other words, the faster expansion of renewable energy is the key to mitigating Germany's dependence on Russian oil and gas. Nuclear power is another option on the table. Nuclear power generation increased by 6% in 2021 compared to 2020 and became the largest contributor to the EU electricity generation since 2014. However, the main issue with operating nuclear power plants is that they are at the end of their operational lifetime (approximately 40 years), and it is not affordable to rebuild them. Hence, if the world really wants to ensure its energy security, it must focus more on renewables, and it should be done immediately.

2. Development of renewables to secure energy

Although the world wants to transition away from fossil fuels toward renewable energy, the crucial issue is that non-renewable energy is not going away anytime soon. In recent years, the total amount of renewable energy has grown very fast; however, the development of renewables is lower than the increase in global energy demand overall. The transition from fossil fuels occurs someday, but currently, renewables are not keeping pace with increasing energy demand; therefore, the non-renewable energy supply is still growing. The cost of power generation using renewable technologies has continued to fall year by year. Recently, solar photovoltaic (PV) price has fallen by 7%, concentrating solar power (CSP) by 16%, offshore and onshore wind by 9%, and 13%, respectively. In the United States, the cost of 149 GW or 61% of the total coal capacity is more than the new renewable energy capacity. Retiring these coal power plants with renewables would cut expenses by USD 5.6 billion annually and save 332 million tonnes of CO_2, decreasing emissions from coal in the United States by 33%. Globally, more than 800 GW of existing coal power generation costs more than new onshore wind or solar PV projects commissioned in 2021. Replacing these plants would decrease power generation costs by USD 32.3 billion per year and avoid about three gigatonnes of CO_2 per annum, corresponding to 9% of global energy-related CO_2 emissions in 2020 or 20% of the emissions mitigation required by 2030 for a 1.5°C climate pathway outlined in International Renewable Energy Agency (IRENA) [6]. The global renewable energy generation will grow by 35 gigawatts from 2021 to 2022, but global power demand will increase to 100 gigawatts over the same period [7]. According to International Energy Agency (IEA), in 2022, global electricity demand will be rebound by 4% while the amount of renewable-based electricity generation increases more than 6%. However, despite this rapid growth, renewable energy is expected to serve only half of the growth in global electricity supply in the same year. The main issue is that the governments do not invest enough to fulfill the future energy needs. Transition to green energy is picking up; however, it is not adequately fast to meet increasing demands for energy in a sustainable manner [8].

In terms of energy, all energy importers do their best not to be vulnerable to potential disruptions from one energy supplier. They need to diversify their energy supplier to end their dependency on one country and build up their renewable energy capacity. In 2021, Europe installed 17 GW (11 GW in the EU-27) of new windmills (81% were onshore wind), which is not even 50% of what the EU should be installed to be on track to deliver its 2030 energy and climate goals. Sweden, Germany, and Turkey established the most onshore wind while the UK had the newest offshore wind installations. Europe now has 236 GW of wind capacity. Although EU countries have ambitious national goals for the expansion of windmills, permitting has become a crucial bottleneck. Europe does not issue the permit for the volumes of new wind farms required, and almost none of the Member States meets the deadlines for permitting procedures needed in the EU Renewable Energy Directive. The main issue is that the permitting authorities are not always adequately staffed, and the permitting procedures and rules are complex [9].

In 2020, despite the severe influences of the COVID-19 globally, the year still met 138.2 GW of solar installed, which was 18% growth compared to 2019. This enhanced the world's cumulative solar capacity to 773.2 GW, a 22% growth. By increasing the vaccination rates, the solar market has been retrieved, and the silicon supply issue has been solved. Hence, the coming years are supposed to be very strong for solar energy worldwide. In 2022, it is expected that the global solar market will grow by 25% to 203 GW. This will be the first time annual PV installations will cross the 200 GW level, which was previously anticipated to be accomplished in 2024. With this growth rate, reaching 2 TW of global solar power generation in 2025 is achievable. With the right frameworks in place, Europe can reach 1 TW of solar capacity. To become independent from importing fossil fuels, the EU aims to deploy solar power over 30GW, involving 1.5 million solar rooftops, by the end of 2022. In response to the Russia-Ukraine crisis, the European Commission has decided to pave the way for smart solar and hybrid projects to expedite the deployment of EU solar PV manufacturing capacity [10].

The Russian-Ukraine crisis made European Commission accelerate the development of the rooftop solar power generation systems and increase it by 15 terawatt-hours this year to save 2.5 bcm of gas. The plan is that by the end of 2022, almost 25% of Europe's current energy generation comes from solar energy [11]. Part of the plan would speed up permitting green energy procedures for on and offshore wind capacity. Tripling the capacity of wind and solar power

generation by 2030, adding 480GW of wind and 420GW of solar energy could save 170 bcm a year. Furthermore, the installation of 10 million heat pumps over the next five years could decrease the amount of gas burned to heat buildings [12]. The EU plans to accelerate its "Fit for 55" rule, bringing forward the timetable to reduce greenhouse gases (GHG) by 55% from 2035 to 2030. Fit for 55 involves the roll-out of a massive campaign of expansion of renewables and electricity storage, electrification, the development of renewable hydrogen technology, and investment in wide-ranging energy efficiency measures. Under "Fit for 55" plan, total EU gas consumption is anticipated to fall 23% [13]. The EU aims to generate 50% of its electricity demand by wind energy by 2050, which means expanding offshore wind from 16 GW to 300 GW and onshore wind from 173 GW today to 1,000 GW. The recent crisis has indicated that more than ever, the EU needs to tap into its wind energy resources. Speeding up the development of wind power is essential to obtaining energy security [9].

Geothermal is another renewable source of energy that can be harvested anywhere on Earth. Theoretically, just 0.1% of the Earth's energy can provide all human power requirements for 20 million years. Compared to solar and wind energy, geothermal energy has a minimal footprint above ground because most actions happen underground. Up to 12.5% of Europe's power can be supplied by geothermal sources, and based on the European Commission report, approximately 25% of the European population can cost-effectively deploy geothermal heating [14]. Tidal power [15] and hydropower [16] are other green sources of energy that have been attracted more attention after the Russian-Ukraine crisis.

Biofuels, including ubiquitous biogas (from anaerobic fermentation), liquid biofuels (bio-jet kerosene, biodiesel, biogasoline,…), and solid biofuels (fuelwood, wood residues, wood pellets, animal waste, vegetal material, ...) are the serious candidates for the substitution of a part of fossil fuels. The EU countries use various feedstock to produce biogas. Manure, field crops, agri-food industry waste represent about 75% of the feedstock used for biogas production, a share that has tripled since 2010. Landfills and sewage sludge represent the last 25%. The Europe biogas market size grew from USD 1.67 billion in 2020 to USD 1.87 billion in 2021 and it is projected to meet USD 3.4 billion in 2028 [17]. Due to the recent crisis, the EU Commission has called for a huge ramp-up in biogas to minimize reliance on NG from whatever source. The European Commission has doubled the bloc's production of biomethane made from waste by 2030 to reach 35 bcm per year to bolster the bloc against a looming fossil fuel crisis, according to a new world's conditions. By 2050, this potential can be tripled, growing well over 100 bcm and supplying 30-50% of the future EU gas demand [13]. The European liquid biofuel industry is categorized into two distinct sectors, biodiesel and bioethanol, with various feedstocks to produce fuel. Rapeseed oil was the most common feedstock for biodiesel production (accounting for 44%in 2017); however, its portion is reducing significantly due to the deployment of using palm oil, recycled vegetable oil, and used cooking oil (UCO). Bioethanol is mainly produced from grains and sugar beet derivatives in the EU. Wheat is employed in north-western Europe, while corn is predominantly favored in Spain and Central Europe. In Europe, the largest share of solid wood is dedicated to the residential sector (27%), followed by the industrial application of wood chips in installations above 1 megawatt (22%) and the small-scale utilization of woodchips at 14%. Also, using pellets in modern appliances is developing fast, representing 6% of the EU's total wood energy consumption [18].

One problem with renewable energy which has been raised by some energy policymakers, is that renewables are at the mercy of the weather. It is claimed that if the solar, wind, or water required for solar panels, wind farms, and hydro reservoirs is not provided based on the initial plans, the renewable energy missed its functionality. Therefore, counting on renewables as a sole energy source is not recommended, and considering a reliable energy supply such as NG as a backup for renewables is proposed [7].

On the other hand, hydrogen fuel is a promising energy carrier that could be substituted for NG in the future, supplying the world's energy demand and mitigating greenhouse gases. The energy yield of hydrogen fuel is around 122 KJ/g which is 2.75 times bigger than hydrocarbons. The capabilities of hydrogen fuel in transportation, whether in the fuel cell engines (FCE) or internal combustion engines (ICE) have been attracted more attention in recent years. The development of hydrogen-powered vehicles decreases dependence on fossil fuels and reduces tailpipe emissions. Hydrogen can be produced from various primary energy sources such as non-renewable (coal, oil, natural gas,…) and renewables (biomass, solar, wind,…) via different production technologies that make hydrogen an attractive fuel for energy policymakers [19]. The grey hydrogen (hydrogen from NG without carbon capture and sequestration (CCS)) is cheaper than the blue hydrogen (hydrogen from NG with CCS) and green hydrogen (hydrogen from renewables). The grey and blue hydrogen production depend on the availability of NG, and their prices are impacted by NG price. As one of the main producers of NG, Russia aimed to supply 20% of the world's hydrogen market by 2030 [20]. However, after the Russia-Ukraine crisis and the sanctions against Russia, this target is under question. Hence, the "Hydrogen Accelerator" program has been developed by the European Commission to encourage more storage, port, and transport infrastructure for hydrogen fuel. In this program, additional 15 million tons of green hydrogen will be available by 2030 on top of the 5 million tons already planned. On the other hand, Australia has the capability to become one of the main producers of green hydrogen due to its huge potential for renewable energy. The Australian hydrogen fuel industry stepped up a notch with its collaboration with the German government. The two countries have decided to work together to minimize the cost of producing green hydrogen and speed up the innovation process in both countries. In addition to Germany, the Australian government has signed hydrogen fuel agreements with the UK, Japan, South Korea, and Singapore. International partnerships play a crucial role in opening new market opportunities for renewable hydrogen production and helping the world to ensure its energy security and achieve net-zero emissions [21].

3. Conclusion

Despite all development in renewables, the amount of generated renewable power is still not adequate to fulfill the increasing energy demands. The Russian invasion of Ukraine has exposed that the dependence on non-renewable energy is insecure and economically damaging. The vulnerabilities should be addressed, and a ramp-up in domestic renewable energy should be triggered. Achieving net-zero emissions by 2050, based on the Paris Agreement, would require an acceleration in green energy transition-related investments. Non-renewables may dominate the energy markets today; however, the future of energy is renewable. The governments can make that future reality sooner by increasing investment in renewables and establishing incentive programs to encourage individuals and corporations to adopt, implement, upgrade, and demonstrate meaningful use of renewable energy.

Ethical issue

The author is aware of and complies with best practices in publication ethics, specifically with regard to authorship (avoidance of guest authorship), dual submission, manipulation of figures, competing interests, and compliance with policies on research ethics. The author adheres to publication requirements that submitted work is original and has not been published elsewhere in any language.

Data availability statement

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Conflict of interest

The author declares no potential conflict of interest.

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