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New Technologies and the Geopolitics of the Global Oil Economy in the Age of Energy Transition

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ABSTRACT

Currently, the global community is on the threshold of a transition from fossil fuels due to transformations such as climate change, entailing the strict implementation of carbon setoff policies, and quick progress in green technologies. A transition to clean, low-carbon energies will disrupt the global energy system and impact the global economy and political dynamism within and outside all states. Based on these transformations, the present work asks how the energy transition will impact the geopolitical future of the global oil economy. The authors hypothesize the following in answer to this question: Given the superior, more advanced position of economic powers such as China and the US in clean energy technologies, we are likely to witness the weakening of traditional oil powers in a post-carbon world, such as the Middle East, North African countries (MENA), and Russia. In contrast, the balance of power will tilt heavily toward current energy consumers. Technology-savvy countries have the knowledge to reproduce and stabilize their power in the global economy. However, the traditional countries of the energy sector face shortfalls in their infrastructure and modern technologies and will lose their geopolitical position to a large extent.

1. Introduction

Today, great efforts are directed toward a move to clean energies. A transition to a post-carbon era is looking increasingly possible, especially after the 2015 Paris Climate Agreement, in which over 195 countries committed to preventing a rise of more than 2 °C in the earth's temperature in the present century. The global community aims to reach a steady phase of net-zero carbon dioxide emissions by 2050 or shortly after that.

Countries are committing to an energy transition when the world is still 85% dependent on fossil fuels for its energy supplies. Nevertheless, climate change and political pressures are driving the international community toward low-carbon energy sources. As such, many technology-savvy counties have adopted policies

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to replace fossil fuels. The EU, China, Japan, and the US have made significant investments in clean fuels. As a result, fundamental changes in the global energy system are forecast, which will impact nearly every country with widespread geopolitical outcomes. The present article asks how the energy transfer will impact the geopolitical future of the global oil economy. Given the existing macro trends, the theory of this article can be set out as follows. Significant progress in clean fuel technologies will reduce the world's dependence on oil, natural gas, and coal to a large degree in the future decades. Apart from having a significant impact on the global economy, the transition will also significantly affect the geopolitics of global energy. China, and to a certain extent the US, are the likely winners of this enormous change. On the other side, Russia and the traditional petroleum powers in the Middle East and North Africa will be the great losers.

The trend analysis technique has been used to elucidate this theory. To this end, by identifying the macro trends in the energy market, efforts are made to analyze the world's geopolitical future during the transition period. The article comprises three parts. The first part includes a conceptual framework that can serve as an input to analyze future trends in the global energy market and its geopolitics. In the second part, the authors have tried to use influential macro trends impacting the future of the energy market to trace the geopolitical landscape of energy. Finally, in part three, the future of global geopolitics in the energy transition era will be discussed. To this end, the station of actors such as China, the US, Russia, the EU, and the Middle East and North Africa (MENA) will be analyzed. In the final part, the outcome of tracing such changes in this landscape will be explained with the trend analysis technique.

2. Conceptual framework: knowledge and power as the structures of the international political economy (IPE)

Technology has always played an essential role in the global community's economic, political, military, and cultural development. Human society has successfully continued to improve production and development in the global economic system with modern technology. This technology has brought about unprecedented change in economic prosperity and has improved the lives of billions of people while also extending the scope of global destruction and armed conflict by manifold. Prime examples of this are nuclear weapons and cyber warfare. Regrettably, many technologies have had significant and rather unwanted side effects, such as environmental pollution, global climate changes, and biodiversity loss. Technology has ceaselessly shaped the structure of the global system, its actors, and their interactions, and vice versa. Thus, the role of technology as a decisive factor in explaining changes in global affairs has remained understated. Technology has often been seen implicitly as a passive factor in international relations and international political economy theories. However, the evolution of technology has diverse implications for global affairs.

Among analysts of international relations and international political economy, Susan Strange has paid particular attention to the role of knowledge in political and international changes. She argues that exerting relational power—the ability to force someone to do something they would not otherwise do—is far less effective than exerting structural power. She considers structural power as the ability to shape and set out the structures of the global political economy within which other countries, their political institutions, economic entities, and most importantly their scientists and other experts must work. Structural power has more meaning beyond setting agendas for discussing or designing international regimes, laws, and customs, which are meant to manage international economic relations. Structural power, in short, is the power of decision-making on how to have things done and the power to shape frameworks within which countries interact with one another, with people, or with large, relevant corporations (Strange, 1994: 24–25). Based on Strange's conceptualization of structural power, the role of knowledge and technology in the future of the international economy, especially in the energy sector, can be assessed.

Strange considers four dimensions for IPE: security, production, finance, and knowledge. Strange states that none of these dimensions necessarily supersedes another in advance; instead, the importance and superiority of each one must be recognized in terms of historical context and fabric. All the resources of structural power are interconnected; in other words, what happens in one structure impacts events in the others. The domination of one structure means the domination of its logic over the other structures. For instance, when production was the dominating factor (mainly in the 20th century), research and development were seen as an input for manufacturing new goods. With the domination of knowledge and technology in the 21st century, this is no longer just input but has turned into a product to buy and sell (Breznitz, 2007).

Strange reiterates that the power of knowledge on international political economy has been ignored or less noticed. To a certain extent, this is since knowledge is linked to beliefs, cognitive matters (what is understood or imagined), and the channels through which knowledge and beliefs are transferred or limited. Therefore, assessing its role and effect is difficult. The importance of the structure of knowledge in power is as great as the power to deny knowledge, exclude others, or transfer knowledge (Strange, 2015: 115). The framework presented by Strange presents an integrated and convincing theory on the position of knowledge in IPE. Her theory's elements help explain changes in the international power structure by considering the variable of technological progress. By relying on the capability of the mentioned conceptual framework, structural changes on various economic, political, and security levels can also be assessed in their broader sense which encompasses the ecosystem, environment, and energy sector.

3. New innovations in energy technologies

3.1. A step toward energy transition

The energy transition is a major structural change in the energy system. It refers to changes in the global energy sector, from the production and consumption of fossil fuels, including oil, natural gas, and coal, to renewable energy sources such as wind, sun, and lithium-ion batteries. "Energy transition" is a crucial provision of the 2015 Paris Climate Agreement, in which over 195 countries committed to preventing a rise of more than 2 °C in the earth's temperature in the present century and to making efforts to limit the temperature rise to under 1.5 °C compared to its pre-industrial level. In the agreement, countries undertook to reach a steady phase of net-zero greenhouse gas emissions by 2050, or shortly after that: an objective which has already been accepted by the EU, the UK, and Japan.

The main driving forces behind energy transition include the increasing use of renewable energies in the combined energy supply basket, better power supply, and improved energy storage. Reaching the objectives of the energy transition era may be time-consuming and challenging, but existing macro trends give a clear picture of the future. A future driving force for the future of global energy is the development of new technologies in the renewable energy sector. This factor, alongside more global awareness of the adverse effects of using fossil fuels on health and welfare, has focused on energy transition as a global reality. In recent years, a larger number of renewable energy plants have been set up worldwide compared to coal and gas. Photovoltaics[2], and wind energy, in particular, have become the most critical new energies of the 21st century. The International Renewable Energy Agency (IRENA) report published in June 2020 demonstrates that renewable energies are increasingly cheaper than fossil fuels. The cost of producing renewable energies in 2019 showed that over half of the renewable energy capacity added in this year cost less in electricity than the cheapest new coal plants (Renewables Increasingly Beat, 2020)[3]. In terms of investment, the renewable energy sector is currently significantly ahead of traditional energy technologies.

3.2. New energy technologies and the prospects of reducing global demand for oil

In recent years, the world is likely to reach a peak in oil demand in a short period due to advancements in clean fuel technology, increasing use of electric vehicles, improvements in efficiency, and environmental restrictions applied to the manufacture of plastics and greenhouse gas emissions, estimated to happen from the mid-2020s until 2040, or even sooner (Figure 1). After this stage, oil demand will decline due to emerging new technologies for clean and renewable fuels.

Companies, including certain oil and gas companies, have promised to reach net-zero carbon emissions, and major pension funds are increasingly incorporating the goals of the Paris Climate Agreement in their investment criteria. Banks are also cutting down on loans for traditional energy projects, and the automotive industry is working on projects to manufacture all-electric cars in the 2030s. Nevertheless, history shows that energy transfer is time-consuming. For instance, during the first important transition from wood to coal, coal took nearly two centuries to become the world's top fuel (from discovering coal in 1709 to the late 19th century). When oil was also discovered in western Pennsylvania in 1859, it was only a century later, in the 1960s, when it replaced coal as the best energy source in the world (Yergin, 2020).

[2] Photovoltaics is the technology to convert (energy) light into electricity by using semiconductors displaying the photovoltaic effect. This phenomenon is studied in photochemistry, physics, and electrochemistry. The photovoltaic system is used in solar panels which are made of solar cells and can produce electricity.

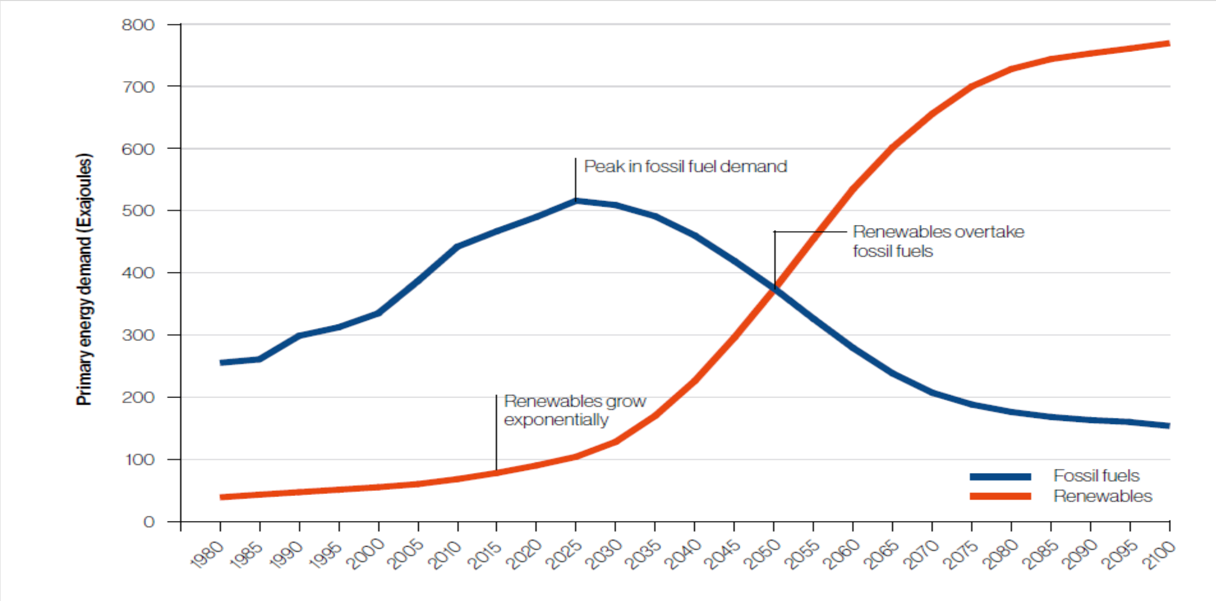

Figure 1. The energy transition framework.

Source: IRENA and DESA (2019)

Although the capabilities of countries in the energy transition are presently by far superior to previous centuries, the global community now has access to progressive technologies and better financial resources than in the past. Nevertheless, countries face even more complexities than before. Currently, the world has an 84% reliance on fossil fuels for its energy (BP, 2020). Oil and gas, and their byproducts, continue to make up the largest share of human primary energy resources. Raw oil and natural gas provide 31.9% and 22.5% of the world's primary sources of energy respectively (Motaghi, 2019: 63).

Hence, the transition will be no easy task. Concurrently, state budgets allocated to moving the transition forward may face limitations in the coming years due to the negative effects of crises like the COVID-19 pandemic. Setting a 2050 deadline for a net-zero carbon goal in the Paris Climate Agreement, climate change, and shifting global political pressures toward low-carbon energy sources all lead us to analyze the geopolitical effects of technology on the future energy market. Therefore, this work endeavors to analyze the future of global energy geopolitics and the global energy economy within the timeline set in the Paris Climate Agreement (2050) by taking into account fundamental driving forces such as progress in clean technologies and strategic issues such as the vulnerability of countries in terms of energy security.

3.3. Energy transition and the geopolitical future of the global economy

Undoubtedly, oil has been at the base of global energy geopolitics since WWI. The discovery of oil in the Middle East played a vital role in transitioning from coal and transformed the Middle East into a critical geopolitical hub. Oil also became the principal national security issue to such an extent that it can be claimed that the control of oil resources played a crucial role from the second half of the 20th century in several wars, such as the Iraq–Iran War (1980–1988), the Persian Gulf War (1990–1990), and the Iraq War (2003–2011). Over the past few decades, tensions increased between oil producers and consumers and reached a peak during the oil crises of 1973 and 1979. As a result, the price of oil was fixed at USD 32bp in 1980. However, geopolitical tensions about oil continued in the following decades and, as demonstrated during Iraq's attack on Kuwait in 1990, prices doubled in a matter of a few months, leading to an economic downturn in the US in the early 1990s.

It is also worth noting that natural gas has always played a vital role geopolitically in some parts of the world, such as Europe. In Europe, natural gas markets have been established since the 1960s based on large pipelines connecting Russia and other producers, such as Norway and Algeria, leading to a significant dependency of Europe on Russia's natural gas. Even if this did not lead to geopolitical concerns—not even amid the Cold War—it is considered a major geopolitical threat to Europe today, similar to the events of 2006–2009, when differences over the price of natural gas between Russia and Ukraine disconnected Russian natural gas supplies to Europe via Ukraine. The construction of the Southern Gas Corridor to transport gas from the Caspian region to Europe via Turkey is a prime example of this.

Suppose oil and natural gas have been at the center of the geopolitics of energy for more than half a century. In that case, it is perfectly logical to conduct a feasibility study on how its role will pan out in the global energy transition: a process which will act as a driving force through carbon offset policies, the rapid progress of technology for renewable energies, and the manufacture of electric cars.

Regardless of when the post-carbon era will take effect, it is evident that the transition from fossil fuels to renewable energies or net-zero carbon will transform relations between global powers and the geopolitics of the 21st century. This geopolitical transformation pertains to fossil fuel producers and those consumers who also possess technology. If the world is prosperous in its carbon offset policies, oil-producing countries will suffer losses in several ways. Firstly, they will suffer significant capital losses they have invested in the past decades in fossil fuels. Secondly, they will suffer secondary economic losses because their treasuries can no longer cover public sector costs through fossil fuel rents. Moreover, last but not least, they will lose their relative geopolitical advantages because, despite access to fossil fuels, these countries are not in a good position when it comes to alternative energies, such as wind, sun, water, and other zero-carbon resources.

In contrast, countries with renewable energy technologies, such as China, the US, Germany, and Japan, will move into a better position. Europe, China, and Japan are presently highly dependent on the import of fossil fuels. Nevertheless, as the share of renewable energies grows, they will be able to promote their energy independence and reduce the geopolitical risks with reduced imports of oil and gas through clean energy technologies. Those countries innovating in renewable energies, batteries, and electric cars will be able to reap the industrial and financial benefits of the transition with job creation and economic growth (Tagliapietra, 2019).

Given the relatively dark landscape of climate change, new economic realities, and the need for sustainable energy, the future of most advanced countries investing in the infrastructure of local renewables is apparent in the geopolitics of energy. These countries, mainly large consumers of fossil fuels, have laws that promote the optimal use of alternative energies (REN21, 2015: 7). China, the US, and Germany have created impressive capacities for renewables and are trying to divert their needs entirely toward renewable energies by 2050.

Developing the technology for renewables creates a system of knowledge through which the owners can exert power. This structure of knowledge will not only serve as a platform to exert power, but it will also help in reproducing power. Countries with technology for renewables, like China, the US, the EU, and Japan, will find it easier to stabilize their power in the geopolitics of the world economy by using the technology. For a better understanding of the position of countries in the energy transition era, it is best to look at the landscape of energy producers and consumers based on the current trends governing their situation.

3.4. The Chinese landscape in the age of energy transition

Presently, China is in a position where it appears to reap the most benefits from a future energy transition. Although it has a large oil industry and is, in fact, the fifth biggest oil producer in the world, its production does not fulfill its demand as the second largest economy in the world. China imports an estimated 75% of its oil and is by far the biggest importer. Beijing has assumed a leading position in the leading technologies related to low-carbon industries because of an active strategy that is a combination of domestic support for innovation (a third of patents on low-carbon technologies belong to China) (IRENA, 2019), industrial policies, and transfer of technology as a condition for direct foreign investment (Eyl-Mazzega and Mathieu, 2020: 37).

A supply chain of rare, yet vital, metals has allowed China to stabilize its economic superiority on its large domestic market and abroad. It owns rare, vital metals, special alloys of special metals, innovation, and technology production and assembly (90% of solar panels and over 50% of onshore wind turbines), which have caused its superior position. Moreover, it has Generation III nuclear reactors (its first project is under construction), batteries, private and public transport using electricity or hydrogen (Voïta, 2018), and G5 technology. Its technologies related to artificial intelligence will soon put China in a superior position in the geopolitics of global energy.

As reiterated by its former minister of technology, Wan Gang, China is set to take strategic control of the development of electric vehicles, and it has already done so in part. Nevertheless, it is not simply the environment or air pollution propelling China toward clean fuels. The authorities in Beijing are fully aware that China cannot compete with the world's biggest automotive companies manufacturing cars with internal combustion engines. Therefore, it can overtake the most prominent global automotive companies by selling electric cars, which will be in demand in a post-carbon world as its relative advantage and a leader in global markets. It should be noted that China is currently a world leader in producing lithium (the primary substance used in electric car batteries), with more than 80% of the world's battery production capacity in the global electrical energy supply chain. The world, which is increasingly moving toward solar energy, is expected to run on made-in-China goods in the future. Moreover, its robust infrastructure for producing solar energy over the past decade has significantly reduced the cost of solar energy, and China is now manufacturing nearly 70% of the world's solar panels (China's Solar Panel, 2019).

Overall, statistics show that China leads in renewable energy installations with a capacity of about 758.6 GW (Figure 2). This is considered a strategic victory against its rivals, especially the US and can be better understood in terms of the Malacca Dilemma. Presently, the threat remains for Beijing that if it is involved in a face-off with the US over Taiwan or the South China Sea, the US Navy may close the Strait of Malacca on Chinese tankers importing oil from the Middle East and Africa and paralyze large parts of the Chinese economy and military might. Therefore, reducing its reliance on imported oil will be a tremendous strategic victory for China, that, as a world leader in renewable energy technology, will benefit more from the energy transition than any other country.

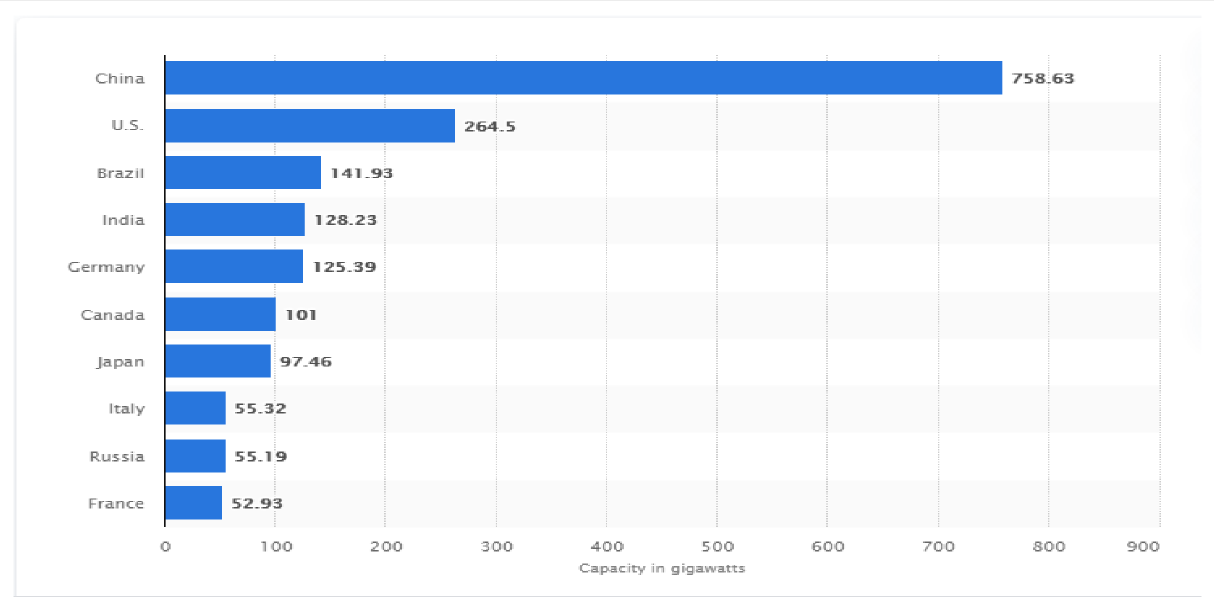

Figure 2: Leading countries in installed renewable energy capacity worldwide in 2019 (in gigawatts).
Source: Sönnichsen, 2020

3.5. The US landscape in the age of energy transition

Currently, the US ranks second in the world in terms of greenhouse gas emissions. More than 80% of the country's greenhouse gas emissions pertain to its energy sector. In recent years, however, the US has had significant achievements in the transition to clean energies. According to the US Energy Information Administration (EIA), carbon dioxide (CO_2) emissions have declined from 2.4 to 1.8 gigatons from 2008 to 2017 (a reduction of more than 25%) as a result of extensive investments and rise in the use of solar and wind energies, and reduction in the use of coal. In 2019, the annual US energy consumption rates for renewable sources exceeded coal consumption for the first time (EIA, 2019) (Figure 3).

Nevertheless, the US still depends greatly on oil, particularly shale oil, which will be its Achilles' heel in future energy market developments. If shale oil production is not financially feasible, it will indicate a reduction in the US oil production and unemployment in this sector (Shokri and Esmaeili, 2019: 19).

After the end of Donald Trump's unilateral policies and the US rejoining the Paris Climate Agreement, it appears that it will have more concrete policies in moving toward an energy transition. At the moment, it is in a strong position in terms of scientific research and the development of new energy technologies. Achieving the goal of net-zero carbon by 2050 requires innovations in the fields of chemistry, physics, and materials science; it also requires advances in carbon sequestration, hydrogen fuel, digitization, production, artificial intelligence, robotics, software, data analysis, and other technologies. The US has excellent advantages in these areas, thanks to scientific innovations in the technology ecosystem that are unique. The country has 17 national laboratories belonging to the Department of Energy, universities, research institutes, and countless companies and startups. It also has an advanced financial system that can attract more investment to more innovations in clean fuels. For instance, it has over sixty advanced nuclear energy projects in its private sector today. The Department of Energy spends over USD 6.5 billion annually on research in basic sciences, which will be the cornerstone of future technologies (Yergin, 2020).

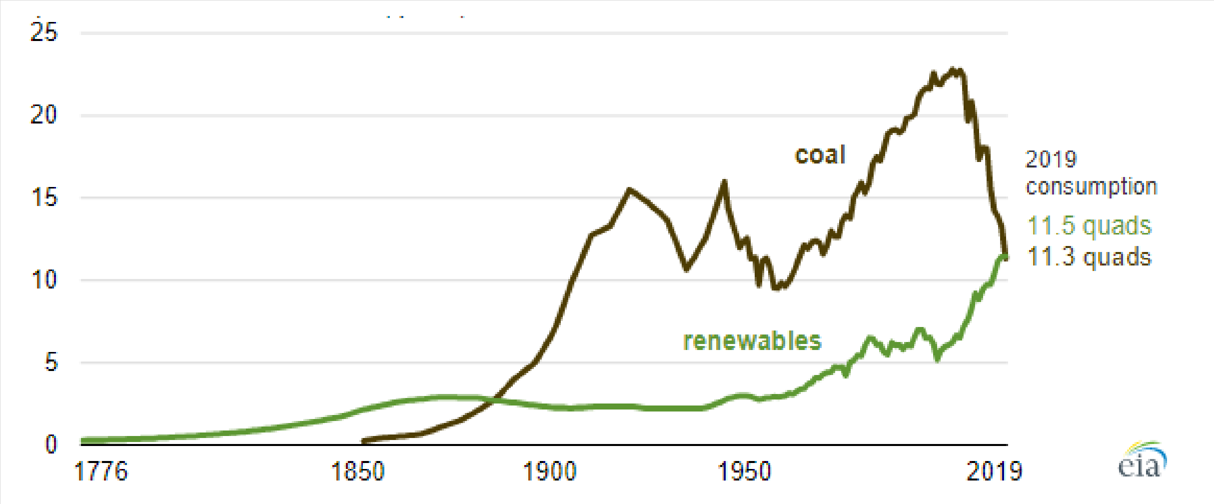

Figure 3: US coal and renewable energy consumption (1776–2019).

Source: The US EIA (MAY 28, 2020)

China is the staunch rival of the US in the post-carbon era. Relying on its shale oil resources for energy will allow China to overtake clean technologies, especially lithium batteries for electric vehicles. The importance of this issue clarifies because the transport sector in the US has the largest share of energy consumption. Since the country lags behind China in producing electric vehicles, it appears to have lower energy geopolitics than China.

3.6. The EU landscape in the age of energy transition

The EU is another substantial region in the puzzle of geopolitics. The impact of energy on the union as one of the three poles of the economy is very important. The EU is poor in fossil fuels. It has been strongly tilting toward carbon offset policies, except for a few sectors that continue to produce coal (East Europe and Spain).

Since the Treaty of Lisbon (2007), the EU has improved its energy, climate, and environmental policies. It set sustainable energy goals for 2020, which must be achieved; it actively participates in the 2015 Paris Climate Agreement process. Presently, the EU is leading clean fuels with a 10% share of carbon dioxide emissions. A growing consensus has taken shape in the EU since 2018 to achieve the climate goals by 2050. To this end, the union has established working mechanisms to support the energy transition: The European Investment Bank, Emissions Trading System (ETS), several infrastructure investment funds, and funds and innovation programs such as Horizon 2020 (Eyl-Mazzega and Mathieu, 2020: 30).

In addition, the EU presented the "Clean Energy Package for All Europeans" in 2018 to bring together the energy market and policies about the transition of energy. This is a comprehensive and complex tool that brings improvements to the functions of domestic energy markets. The package encourages innovation and creates a more active role for the consumers of energy. With this project, the EU is effectively fulfilling its climate commitments. Key EU objectives for 2030 include:

- A reduction of at least 40% in greenhouse gas emissions (since 1990 levels);
- An increase of at least 32% in the share of renewable energies in the energy basket;
- An increase of at least 32.5% in energy efficiency (EU 2030, 2020);

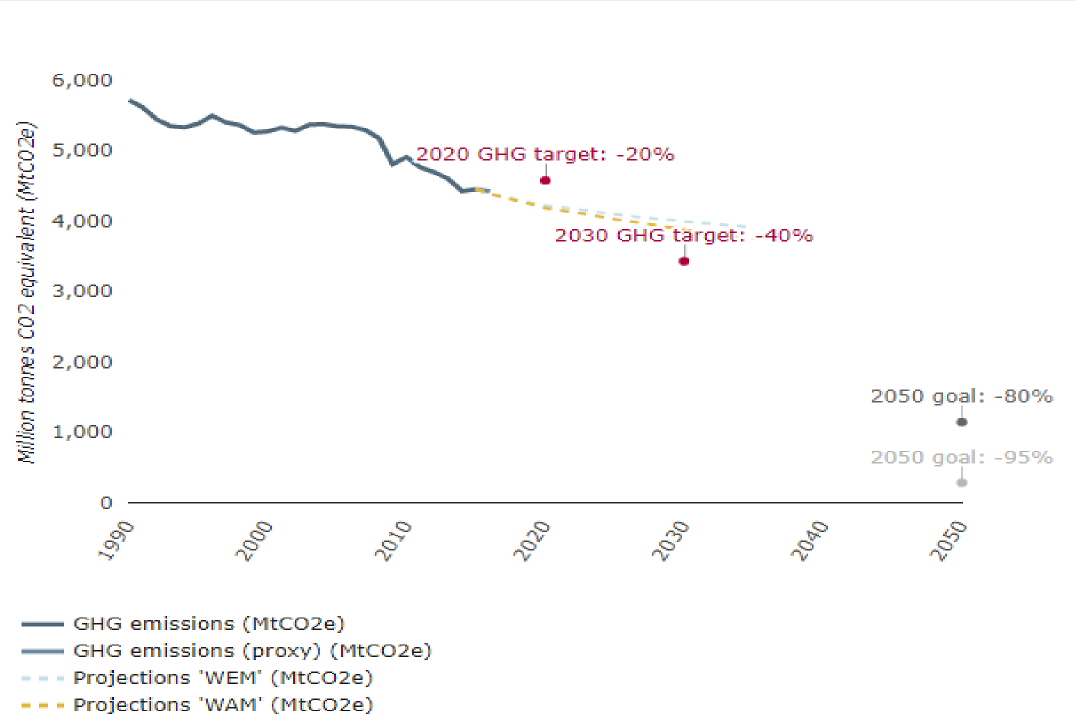

Figure 4: Greenhouse gas emission trends, projections, and targets in the EU.

Even though the EU member states have a suitable position in renewable technologies, the union still faces challenges on the path to the energy transition. The cost of supporting renewable energy projects is increasing; social resistance to renewable energies and transmission lines with a wind velocity of over 40,000 miles installed in Germany and 8,000 miles installed in France is growing. More importantly, the EU's carbon setoff policies have been focused mainly on the electricity sector and are not yet noticeable in the transport and industrial sectors. The EU's new landscape for 2030 accelerates reduction in the share of fossil fuels to produce electricity but does not eliminate it in thermal power plants and transport because reaching them would be difficult and will be met with the resistance of the automotive industry (Eyl-Mazzega and Mathieu, 2020: 32). The level of commitment and political will among member states is also debatable. In fact, the members are reluctant to leave such a strategic issue solely to the EU; therefore, it can be stated that growth trends and results obtained for the EU's energy transition vary among its member states. For example, Italy and the UK have two different approaches: Italy's policies are mainly pursued through government-based programs, while the policies of the UK are predominantly market-based. As a result, these two countries are experiencing two different trends in energy transition (Hafner and Raimondi, 2020). Given the challenges ahead, the EU's future energy geopolitics is ranked after the US and China.

3.7. The Russian landscape in the age of energy transition

Contrary to China, the US, and to a certain extent the EU, with suitable standings in the future of the energy transition era, perhaps Russia can be seen as the biggest loser in this arena. The fact is that Russia has a good position in the geopolitics of global energy today due to its abundant energy resources and its role in the global energy market. Russia is one of three big oil producers globally and the second largest producer of natural gas; it remains the biggest exporter of gas, the second exporter of oil, and the third biggest exporter of coal. The country produces energy equivalent to 1,470 million tons of oil (Mtoe) and exports more than half of its primary energy production; it supplies 16% of the interregional energy trade, making it the world's leading energy exporter (Makarov, Mitrova, and Kulagin, 2019). Its strategic behavior in the energy transition is essential for the country itself and the rest of the world.

Russia's present-day power in the geopolitics of global energy will incidentally also be its Achilles' heel in the post-carbon era. Russia's energy intensity[1] of GDP remains high despite relatively low energy prices and high capital costs in recent years. In contrast, the share of clean fuels, such as solar and wind energies, remains negligible in the energy combination and is not forecast to reach above 1% by 2035 (Henderson and Mitrova, 2020: 95).

Regarding the geopolitics of energy, as a country rich in resources, Russia is constantly accused of abusing its power as an energy exporter (natural gas in particular). The energy strategy of the Russian Federation until 2030 explicitly states that energy exports must help improve the country's foreign policy (Tynkkynen et al., 2017). The reality, however, remains that Russia lags far behind other rivals in the domain of clean fuel technologies. Therefore, the energy transition will create long-term challenges for the country and the sustainability of its economy, which is highly dependent on the income from hydrocarbon exports. The 2008 economic downturn and the lack of dollar revenues from energy sales, which led to a decline in GDP, clearly witness the deep structural problems in the country's economy. In recent years, oil and gas revenues from exports have also declined between 2008 and 2012 due to lower hydrocarbon prices (Trading Economics 2018).

Russia's reliance on its oil and gas revenues is another strategic vulnerability. A transfer from fossil fuels to low-carbon energy resources can lead to a 16% reduction in fuel exports and an 8% decline in primary fuel production over the next two decades. Overall, until 2040, this can reduce the value added of fuel and energy by a quarter due to a decline in investments in this sector. As a result, it is forecast that the average GDP growth in Russia will decrease from 1.7% to 0.6% per year between 2016 and 2040, and the share of the energy sector in GDP will fall from 25% to 14%, indicating the end of fossil fuel dominance in the Russian national economy during the energy transition period (Hafner and Tagliapietr, 2020: 100).

Aware of this strategic weakness, Russian authorities have been stressing the need for change, diversity, and reduction in oil and gas dependency for nearly two decades. According to the draft for Russia's energy strategy for the period leading up to 2035 (prepared by the Ministry of Energy of the Russian Federation, 2017), the share of renewable energies in Russia's total primary energy consumption must increase from 3.2% to 4.9% by 2035. The plan intends to increase its photovoltaics, wind energy, and geothermal capacity to 5.9 GW by the end of 2024 (Power Technology, 2018).

Nevertheless, Russia appears to face many challenges. As a country with enormous natural gas reserves and the second most extensive thermal coal reserves globally, it does not see an energy transition from fossil fuels to net-zero carbon resources as viable. Despite the country's massive potential for wind and solar energies and the expanse of land ready for development, the availability of oil, gas, and coal overshadows clean fuel policies, making it difficult to diversify the energy combination and direct it more toward net zero-carbon resources. The low price of hydrocarbons, the adverse geographical dispersal of renewable resources (located mainly in unauthorized areas at long distances from consumption centers), and their relatively high costs primarily due to compulsory localization requirements, often lead to non-competitive costs per unit and act as a barrier to their development in Russia, making the country vulnerable to the global energy balance.

3.8. Countries in the Middle East and North Africa

The role of oil-producing countries in the Middle East and North Africa cannot be neglected in the age of energy transition. The Middle East has played a pivotal role in the geopolitics of global energy since the second half of the 20th century. The MENA region contains most of the world's oil reserves: 48.3% of the world's oil resources are in the Middle East and 3.7% in North Africa (BP, 2019). The region also ranks high in gas resources in global energy geopolitics. Nearly 38.4% of the world's natural gas resources is located in the Middle East and 4% in North Africa. It should be noted that the high-quality energy resources of this region are mainly

[1] Energy intensity is the measure of energy inefficiency in a country's economy and is calculated as units of energy per unit of GDP.

located in large reservoirs with developed infrastructure and close to export routes (Mills, 2020: 117). However, this geopolitical position has been dramatically diminished in recent years with the emergence of the US as the world's largest oil producer. Oil remains essential for the economic power of the countries in the region, and the energy transition will weaken this power.

Traditional energy powers in the Middle East and North Africa will have four essential reactions to the energy transition. First, they will renew their economic structure to fit lower prices and reduce hydrocarbon rents in the long run. Second, they will try to safeguard the future of their hydrocarbon industries, and third, they will take gradual measures to speed up the reuse of their domestic energy systems for a low-carbon future. Fourth, they will counter the new geoeconomic transition.

Many MENA countries have defined a landscape for a future energy transition. Nevertheless, since the budget for their non-oil projects depends on oil revenues, the energy transition can end up being very costly. The Saudi Vision 2030 Document under the leadership of Mohammad Ben Salman (MBS) is one of the newest and most important documents in the region. It focuses more on technology, tourism, and social change and less on the oil sector. The main Saudi objective for the energy sector is to abolish energy subsidies by 2025 (which was supposed to take place by 2020) (Mills, 2020: 124). However, achieving the objectives of Vision 2030 without reliance on oil revenues will be a difficult task. In an International Monetary Fund (IMF) report, oil makes up over 40% of its GDP, nearly 70% of its revenues, and close to 80% of its exports. Additionally, its non-oil activities heavily depend on state funds provided through oil revenues (IMF, 2019). Therefore, changing the economic structure of MENA countries that are heavily dependent on oil revenues will be difficult in any case.

A transition from fossil fuels to renewables will also entail significant geopolitical consequences for countries in this region. Increasing focus on clean fuels by the international community raises concerns for the traditional energy market actors over their reduced strategic importance. A number of MENA countries have turned to clean fuel technologies in recent years. For instance, in its Economic Vision 2030, Bahrain emphasizes diversification with a focus on potential sectors and tries to transform its economy in the long run through new opportunities. Algeria has also endeavored to increase its non-carbon exports to 9% of its total exports by 2019 in its new economic growth model (2016–2019). In its Sixth Development Plan, Iran has stressed reducing the oil share in its budget to 22%. In its Vision 2030, Saudi Arabia is also trying to increase the share of its non-oil exports in its GDP from 16% to 50% (Tagliapietra, 2019: 3). However, the overwhelming dependence of these countries on their oil and gas revenues, coupled with weaknesses in modern technology, will prevent them from playing a role in global geopolitics like before. While countries of the Persian Gulf have at least stated a vision for diversification and taken impressive steps toward realizing it, other MENA countries exporting carbohydrates are facing problems. Presently, Iran enjoys a relatively diverse economy and has been pushed toward increasing self-sufficiency and less dependence on oil revenues by the sanctions.

Nevertheless, this has led to a severe downturn in its economy. Iraq is trying to progress in the oil, gas, and electricity sectors but is somewhat limited in going beyond these. Algeria is also making efforts to maintain its oil exports with an extensively bureaucratic system and by fighting foreign investors. Of course, international wars in Syria, Libya, and Yemen impede long-term economic progress in these countries (Mills, 2020: 125). This situation will pose a challenge to the region's geopolitical future.

4. Conclusions

The progress of technology for renewable energies can change the geopolitics of energy dependency between the current producers, consumers, and transit countries. In recent years, a decline in oil price is not expected to propel the situation toward renewable energies because it has not affected investments in renewables to date. Indeed, these energies are used in the electricity sector, where oil is seldom used. Further, developments in renewable energy technologies, such as photovoltaic systems, have led to a sharp reduction in global prices. It should be noted that planning for wind or solar installations is calculated in circles of 20 to 30 years. Therefore, decisions in this area are less sensitive to cyclical changes that can affect the overall context. However, investments in oil have a planning horizon of 1–3 years due to high volatility. Under such circumstances, a drop in oil price cannot be expected to turn into a negative competition for renewable energies in the medium term. Given the geopolitical models, it can be stated that the development of technology for renewable energies will have a significant impact on global geopolitics. Such technology creates a structure of knowledge in which the owners, namely developed countries, can easily exert, reproduce, stabilize, and guarantee their power in the global economy. In a post-carbon era, countries with fossil fuels, such as those in the Middle East, North Africa, and Russia, will no longer determine equations in the energy market like before. In contrast, countries that are currently consumers and possess the modern technology for renewables, like China, the US, and European countries, will find themselves in a better position.

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