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Understanding the Geopolitical Aspects of Renewable Energy Transition

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Abstract

Energy-rich countries, particularly in the 1970s which had vast oil reserves, held significant influence in global geopolitics, leveraging their resources to dominate and shape international alliances. These nations used their energy wealth as a tool to exert influence, aligning with or pressuring other countries to secure favourable terms, ensuring their dominance in global affairs like OPEC countries. The OPEC oil embargo was an indication to the world to initiate processes that would shift the dependence of economies on oil. The 1992 Rio Declaration set the topic of Climate Change on the world stage. Since then the inception of Conference of Parties in 1995, adoption of Kyoto Protocol, Copenhagen Accord and finally, the Paris Agreement have been important events through which the need for a renewable energy transition has evolved. The paper acknowledges that deteriorating climate conditions have created awareness about the need to shift to renewable energy. However, it extends the discussion to more relevant drivers of renewable energy transition. Each of these drivers put emphasis on a global consensus that acknowledges unequal vulnerabilities of the transition, the infrastructural and financial imbalances yet prioritises environmental security. The paper further discusses the role of these drivers in Energy Diplomacy of two major economies of the world that is China and the European Union. The paper concludes with an understanding of how power differentials and geopolitical rivalries hinder a smooth transition. Moreover, how even an era after transition would see such rivalries and monopolies, though the players might change.

Keywords: Renewable Energy, Common but Differentiated Responsibility, Energy Transition, Geopolitical dynamics

1. Introduction

An emerging topic that examines the relationship between international relations, global politics, and renewable energy technology is called "geopolitics of renewable energy." It focuses on how the switch from fossil fuels to renewable energy sources will affect politics, the economy, and geopolitics in reshaping the world's energy landscape. The geopolitics of renewable energy is gaining attention as the world grapples with pressing concerns such as climate change and the need for sustainable energy sources. This has implications for international relations, resource allocation, and strategic decision-making. The world's energy systems have changed dramatically over the last few decades as countries have realized the risks to their economy, security, and the environment that come with relying too much on fossil fuels.

The shift to renewable energy is thought to have been initiated by the potential of renewable energy sources as alternatives to traditional fossil fuels, which are becoming less expensive and more efficient. However, a complicated mix of political, economic, and strategic aspects determines the geopolitics of renewable energy. Governments are beginning to understand that switching from fossil fuels to renewable energy sources not only combats climate change but also presents substantial opportunities to improve energy security, economic competitiveness, and geopolitical influence. New dynamics in global power politics are arising as countries endeavour to develop and use renewable energy resources, which are changing conventional energy hierarchies and reallocating geopolitical leverage.

2. Literature Review

This article employs a theoretical framework and conceptual model to engage with the debate surrounding renewable energy. It examines the multifaceted factors that influence decision-making and resource allocation among nations aiming to achieve climate goals. The study builds on the principle of Common but Differentiated Responsibilities (CBDR), articulated in Principle 7 of the Rio Declaration during the 1992 Rio Earth Summit. This principle asserts:

"In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command." (Development, 1992)

Historically, developed nations have relied on technological advancement and fossil fuels to drive economic growth, whereas countries in the Global South have experienced delayed development. To address climate change equitably, the CBDR principle placed a greater burden on developed nations to reduce emissions. Over time, however, this principle has faced criticism from developed countries, leading to a contentious geopolitical discourse on renewable energy.

The geopolitics of renewable energy revolves around the persistent divide between the Global North and South. Challenges such as the high costs of capacity building for renewable energy, reliance on economically viable fossil fuels, and the pressing need for poverty alleviation in developing and least-developed countries act as significant barriers to the energy transition.

The study draws on Overland's (2019) assertion that "renewables will change the premises for international energy affairs." (Overland, 2019) Unlike fossil fuels, renewable energy is more evenly distributed, potentially enabling a less geopolitically contentious international energy system. This transition could result in a more equitable distribution of economic and security benefits while minimizing risks associated with technological bottlenecks.

However, the shift towards renewable energy is hindered by unequal access to technology and financial resources, further complicating the global energy transition. The paper highlights the disruptive potential of renewable energy to reshape existing geopolitical dynamics, which may explain the hesitance of certain nations to fully commit to this transition.

Finally, the study delves into emerging energy diplomacy, characterized by the interplay of soft power and intellectual property rights. It presents case studies of China and Europe to illustrate how renewable energy might shift global competition from physical resource control to technological and intellectual property dominance.

3. The Conventional Energy Landscape

Fossil fuels, primarily oil and gas, were used extensively throughout most of the 20th and early 21st centuries, defining the energy landscape. It had a significant impact on international politics by establishing a power structure based on who possessed more and less energy resources.

Major impacts of this system were seen in international politics, economy, and security. Nations possessing substantial fossil fuel deposits, like Venezuela, Saudi Arabia, and Russia, held considerable political Influence.

The Organization of the Petroleum Exporting Countries' (OPEC) unofficial leader, Saudi Arabia, had significant global influence on oil prices. It benefited greatly from its vast oil reserves and output for many years, which stabilised the world oil market and gave it significant influence in international affairs. In a similar vein, Russia established itself as a key force in the European energy market by utilising its vast natural gas reserves. By maintaining control over energy supply, it safeguarded its political interests through its state-owned gas corporation, Gazprom. The gas dispute between Russia and Ukraine that triggered gas shortages and increased price levels in several European nations, highlighted the dynamic geopolitical implications of energy dependency. The impact of the Russia-Ukraine war and the EU's restriction on Russian gas supplies had a number of macroeconomic consequences, including inflation rates hitting an all-time high at the end of 2022 due to increases in energy prices and product value chains. Global economic growth rates have considerably slowed.

Venezuela strengthened its standing in Latin America and the world by utilising its huge oil reserves. Hugo Chavez was a significant figure in the early 2000s since the government utilised oil revenue to support social projects and regional diplomacy throughout his administration. However, these resource-rich nations were at the mercy of countries that mostly relied on imported energy. The majority of the European Union, Asia, and other energy-importing regions struggled due to supply disruptions and fluctuating energy prices. For example, Japan's reliance on imported energy made it vulnerable to international energy crises like the 1973 oil crisis, which had a detrimental economic impact. Similarly, Europe's long-standing reliance on Russian gas has created security worries and led to searches for other energy supplies.

The conventional energy landscape has resulted in strategic alliances and conflicts. Because of America's need for Saudi oil, the US-Saudi alliance, for example, has managed to persist despite huge ideological differences. Similarly, to counterbalance the losses caused by the OPEC embargo, India, led by Prime Minister Indira Gandhi, reached favourable agreements with Iran and Iraq. In February 1974, India and Iran signed a deal that set the price of crude at $8.50 per barrel, provided India with a $500 million credit to pay some of its oil purchases, and assured supplies for a refinery in Madras that was built with Iranian assistance.

Competition for energy resources has been fuelled by the region's oil and gas potential, leading to issues such as territorial disputes in the South China Sea. In conclusion, the conventional energy scenario, which is based on fossil fuels and has led to the formation of power structures, dependencies, and strategic alliances, has produced the global political order. The advent of renewable energy technology, however, is changing this situation and could lead to a shift in the global power structure. Given these developments, it is critical to comprehend how state-to-state relations, domestic policies, and cross-border investments are changing in order to assess their implications and significance in the global energy transition that has generated a lot of interest.

4. Drivers and Challenges of Renewable Energy Transition

4.1 Policy Change

Efficiency and cost reduction are not the main drivers of the energy transition. The necessity to cut carbon emissions and achieve net zero carbon targets is what is driving this shift. Prior energy transitions relied on competition amongst fossil fuels that proved to be effective energy sources for rapid industrial growth and consequent economic expansion. Today, the goal of energy transition is to prevent or lessen the effects of climate change caused due to atmospheric emissions.

After comprehending the motivation for the energy transition, we have to acknowledge that it can only be accomplished with the support of all parties involved. Consumers must cut back on their use of unabated hydrocarbons, and producers must be urged to decarbonize their output. At the same time, investors won't feel inspired unless they see real-world projects and opportunities for expansion in renewable energy. Achieving the necessary shift will be hampered by a lack of understanding of environmental externalities. Taking into account the externalities and the necessary cross-sector involvement, Policy Regulation will prove to be a catalyst in driving energy transition because of the ability of government policy in coordinating expectations.

In order to decide upon measures to stabilise the expectations of investors, producers and consumers alike, it is suggested that the policymakers ask the following questions: “what type of targets are being set to reduce emissions and meet climate goals and how are they being adjusted over time? In relation to this, what are the implications of specific targets for renewable electricity or other forms of decarbonised energy, both for incumbent and new industry players and consumers? Furthermore, what is the impact and relative cost of different technologies on emissions outcomes and what are the efficient routes to achieving climate targets? (Henderson et al., 2021)”

Answering these critical questions will lay a foundation for strategizing climate policies. "The network of institutions in the public and private sectors whose activities and interactions initiate, import, modify, and diffuse new technologies" is how Chris Freeman defined the National System of Innovations. Freeman emphasized that “the integrated approach to R&D, design, procurement, production, and marketing within large firms; the high level of general education and scientific culture, coupled with extensive practical training and frequent industry updates; and the beneficial role of government, working closely with industry and the scientific base (Freeman, 1995)” to encourage vision, development and marketing of most advanced technologies.

Expectations regarding the continuity or stability of policy frameworks are critical. Policies can only be improved by comprehending the breadth and complexity of innovation processes. Furthermore, understanding stakeholders' roles as 'enablers' in advancing sustainable innovation across the policy-making and implementation process is critical. This method may help to address the environmental policy concerns of locked-in technologies and a lack of representation of innovators in policy making. This would lead to increased public and governmental support for sustainable innovation. All of these points emphasize the need for policy reform in accelerating the transition to renewable energy.

4.1.1 How Does Common but Differentiated Responsibility fit into worldwide policy frameworks to achieve Net Zero Carbon Emissions?

Climate policies and investments in the developed countries alone are not sufficient to solve climate change issues worldwide. Any effective solution will need to engage the developing economies too.

While the efforts of developed countries towards reaching net zero emissions are notable. Climate Inequalities and Vulnerabilities cannot be ignored. The narrative that the Global North has a historical responsibility to reduce their emissions in order to compensate for the delayed industrial growth started in the Global South is criticized. It is believed that this principle excludes high emission countries like China and protects them from changing their development patterns. However, a linear understanding of energy transition ignores the realities of developing countries. Some of the key barriers facing the Developing Countries are:

- ***Affordability of Contemporary Energy Technology***

Solutions feasible and on the verge of implemented in the developed countries such as the Carbon Capture Utilisation and Storage (CCUS) technology, electric vehicles, hydrogen production is inaccessible in developing countries. A major section of the population lacks the resources to access energy services and therefore the aggregate public response in adopting the contemporary energy services is weak. Developing countries struggle in creating infrastructure, finance and necessary regulatory framework to encourage the adoption of renewable energy.

- ***Infrastructural Barriers***

The shift to Renewable Energy is not swift. Without supplementary infrastructure development the transition objectives cannot be met. Supply nodes like power plants, hydrogen hubs and interconnections over large distances are required. For such endeavours land procurement, which gets difficult in many developing countries where land ownership is fragmented, permits system are corrupted and involve multiple stakeholders.

- ***Investment***

Attracting capital and securing favourable financial terms is essential for a transition to sustainable energy sources. Limited access to capital markets, high borrowing costs, and real or perceived investment risks deter domestic and foreign investors. This problem is even more pronounced in today’s high-interest-rate environment. Political instability, Currency volatility and uncertain regulatory environment undermine investor confidence. Mobilising up-front capital independently is difficult for many developing countries.

- ***Climate Inequalities***

Apart from Domestic Barriers, Geopolitical and International Framework related factors also foster climate inequalities. Essentially the effect of geopolitics on Renewable Energy consumption is significantly different depending on the income level. "For comparatively low income countries, the rising geopolitical uncertainty adversely affects the renewable energy sector; however, geopolitics and renewable energy have a positive connection at higher income levels. Richer countries have a greater capacity to develop clean technologies in times of uncertainty; however, the Renewable energy sector in emerging and developing countries seems more vulnerable to geopolitics. (Nidhaleddine Ben Cheikh, 2024)"

- ***Carbon Laws***

It is the need of the hour that a higher rate of decline is achieved for energy emissions compared to the expanding rate of economic output. "However, the increased globalisation of trade creates a policy issue, because emissions are generated throughout a supply chain that is widely geographically dispersed. Moreover, International trade enables the costs of decarbonisation to be shifted outside national borders, creating negative externalities elsewhere." (Henderson, The Energy Transition: Key challenges for Incumbent and new players in global energy systems, 2021) This carbon leakage is facilitated by Offshoring Carbon Intensive Production, waste exportation etc. This concern is relevant to low income countries because of less stringent anti-carbon laws to facilitate production. An important finding is that it is easier for dirty industries to shift to countries with lax or less stringent environmental regulations.

Furthermore, efforts such as the implementation of carbon border adjustment mechanisms (CBAMs), which try to reduce carbon leakage by placing a fee on imported commodities depending on their carbon content, exacerbate the split. With the goal of leveling the playing field for domestic producers who face carbon costs and discouraging companies from shifting production to countries with lower or no carbon pricing, measures like these create competitiveness issues for producers in hard-to-abate sectors by requiring them to pay additional costs to offset the embedded carbon in their goods. This would make their products more expensive than those from countries with lower carbon costs, diminishing their worldwide competitiveness. This can be observed in the case of India and the European Union. The Carbon Border Adjusted Mechanism devised by EU impacts India in the following way:

- Given that coal dominates overall energy consumption the carbon usage in Indian products is higher than that in EU. Moreover, direct and indirect emissions from iron and steel is higher in India due to increased proportions of coal-fired power. This translates into significant carbon tariffs to be paid to EU.
- The mechanism creates the risk of Export Competitiveness. This might expand to sectors such as refined petroleum, pharmaceuticals, textiles, which are among the top 20 goods imported from India by the EU. Moreover, the risk might have discriminating effects. Countries with carbon pricing systems might have to pay less or get exemptions. However, countries like India with no such system will face higher consequences.

Considering the unique vulnerabilities of economies related to decarbonisation, the negative impacts of such frameworks are disproportionate. Poorer countries, which heavily rely on mineral resources will be worse off.

Finally, for a just energy transition acknowledging the responsibility of Global North is important. Developed countries are yet to take substantial actions on their financial and technological commitments to the developing countries. The inability of Financial and technological transfers consolidates these barriers. Even the policies of countries are highly influenced by their energy requirements from developed countries. In such a scenario, expectations of transition from conventional sources of energy to renewable energy is unfair.

Thus, Acknowledging the barriers and differences in realities of The Developed and Developing countries, it becomes quintessential to recognise that while the hazards of climate change are common but the vulnerabilities and exposure are different. Therefore, any policy regulation or technological advancement cannot be imitated or accepted universally.

4.2 Infrastructure

A thorough understanding of the geographical and technical characteristics of renewable energy systems reveal both the infrastructural requirements as well as the barriers posed by geopolitical factors. There are several technical characteristics that need to be evaluated before exploring Renewable energy sources. However, two of the main characteristics influenced by international relations are as follows:

- ***Global Disparities in Resources and Potential***

Renewable energy sources are not scarce or as geographically constrained as fossil fuels. Every country has access to at least some form of renewable energy, however the supply value chains differ substantially. Any country must identify its potential and then judge which energy it is equipped to harness. The potential for renewable energy is not spread equally across the globe. Just like the reserves of fossil fuels, some countries and regions are better endowed than others. In addition, the potential for energy generation is not the same for all renewables. Solar and wind potential is far larger than that of biomass, hydro, or geothermal energy. The renewable energy sector is highly capital intensive. A thorough estimation of the cost of financing structures that would drive the transition along with the estimation of returns raises questions over its viability especially in the case of developing economies.

- ***Commercial viability***

The transition to cleaner technologies require electricity supply and financial instruments that several low income countries lack. For example, African countries suffer from public utility resistance in addition to concerns over energy security and deliberate attention on developing domestic sources of energy. The affordability, ease of availability and technological maturity of oil in some regions have contributed to the slow uptake of investment in renewable energy projects. Therefore, commercially viable endowments of fossil fuels provide a strong incentive for continued investment in these sources.

- ***Concentration of Rare Earth Metals and Infrastructural Gap***

Rare earth metals are critical components in various renewable energy technologies due to their unique chemical properties. The demand for these elements has surged as the world transitions towards cleaner energy sources. The central role that rare earth metals play in the transition cannot be overstated. In the process of decoupling economic growth and greenhouse gas emissions, there is intensive recoupling of economic growth with extraction and mining. China has leveraged its geo- economic rise to power over the last two decades on the back of integrating supply chains of rare earth metals from extraction, processing and export. It's interesting to note that while developing companies highlight their commitments to reduce greenhouse gas emissions, they heavily rely on China for processing rare earth metals that they extract. The Mineral Commodity Summaries of 2024 released by United States Geopolitical Survey revealed that 72% of United States' Rare Earth Imports source from China. This paper later discusses the critical role of China in monetising its control over the processing of rare earth minerals through the Belt and Road Initiative and how it fits into the puzzle of renewable energy transition.

Rare earth metals are abundantly available in the earth's crust, the problem lies in the capacity to process them. The Chinese recognised the potential for profit took leverage over other countries through its processing capabilities. This enables it to continue its lax environmental standards and control the market. The dependency of nations on China raises serious questions like does the shift to renewable energy erase the economic hazards fossil fuels posed?

Won't countries that control the supply chain have the potential to block the world's supply? Finally, how green is the renewable energy transition? More importantly, is the accumulation of environmental damages caused today for acquiring decarbonisation tomorrow worth it?

4.3 Participation of Economies in Renewable Energy Transition

In December 2015, the parties to the United Nations Framework Convention on Climate Change (UNFCCC) reached a joint agreement to combat climate change. With its 195 signatories, the Paris Agreement constituted a truly global consensus to take appropriate measures to keep global warming well below two degrees Celsius. Nationally Determined Contributions (NDC's) ensured that every signatory specifies their greenhouse gas emission reduction target.

The differentiation in mitigation and review related actions set under the Kyoto Protocol between Developed Economies and Developing economies was scrapped in the Paris Agreement. Under their Nationally Determined Contributions, all participants had to set targets to reduce carbon emissions, increase their renewable energy market share and increase energy efficiency. By disintegrating the Common but Differentiated Responsibility principle, the Paris Agreements ignores the varied vulnerabilities of economies. The historical responsibility of the developed world for creating the problem of emissions is erased and the burden of transition moves to the still developing world.

This affects the participation of economies along with any tangible improvement in their efforts. “Article 9 of the Paris Agreement stipulates that developed country Parties shall provide financial resources to assist developing country Parties with respect to both mitigation and adaptation in continuation of their existing obligations under the Convention (The Paris Agreement , 2015).” There is no stringent enforcement apart from periodic reporting. All participants are obliged to submit reports of their actions in the form of national emissions inventories and progress towards achieving their NDCs.
In order to understand the participation of economies as a driver of renewable energy transition, we must understand the direct effects of non-participation in the Paris Agreement to the global carbon emissions and the welfare of the economies. In each economy the goal is to find an optimum point where the economy is indifferent to the climate damages and economic cost of cutting down emissions.

There are finding in consequent to non – participation in the Paris Agreement that “that if all countries fulfil their NDCs, global emissions are lowered by 25.4%. Furthermore, the model took into consideration the welfare effects, and how their national welfare is affected in the full cooperation scenario in which all countries fulfil the pledges made in their NDCs. While almost all countries face some real income losses due to the carbon pricing required to fulfil their NDCs, these losses are mild in most countries and they are typically offset by lower climate damages. Countries experiencing a welfare loss from the global NDC implementation mostly have very high income from selling fossil fuels and in some cases low climate damages, for example oil exporting countries like Saudi Arabia (Larch & Wanner, 2024).”

4.3.1 How do Power Dynamics and Economic Trade-offs influence the Participation of Nations?

Petro States

First let us take the example of Petro States. The states might profit in the transitioning phase but will end up being geopolitical losers, losing their leverage at the end of the transition when oil will cease to exist as a key global commodity. This comes as an encouragement to states mainly dependent on fossil fuel exports to look for alternate energy sources and join the renewable energy transition. Iran, for instance, has joined hands with China and formally became part of the Belt and Road Initiative to stimulate investment in the renewable energy sector.

However, the primary concern for oil-rich countries is the disruption of their energy economic models. They need to understand how to incorporate a low-carbon plan into the current energy grid. In oil-rich countries, the strategic quandaries are fundamental alterations of the existing energy industry and the national economy. New resources' interventions in renewable energy sectors do not generate as much cash as the oil and gas industry. Furthermore, domestic conflicts and proxy warfare in the Middle East raise uncertainty about the transition to renewable energy. Threats to energy security will slow the transition.

Russia

Among states which are rich in Oil resources and indispensable to the renewable energy transition is the Russian Federation. The Russian invasion of Ukraine strangled Europe and caused a global energy crisis. Immediately afterwards it caused a spike in the use of Coal for heating and power ensuing an increase in the greenhouse gas emissions. However, in the medium or long run it has proved to be a catalyst of Europe's green transition. Despite the tensions caused Russia remains essential for the transition to renewables. Russia had a significant leverage in Nuclear power generation, and mineral supply chain critical for decarbonisation. The development of Nuclear Energy depends upon Uranium. Russia has 8% of known deposits. "While Australia and Kazakhstan together have 43%, Russia has 40% of the world's uranium conversion capacity and 46% of global enrichment capacity. In 2021, the U.S. bought 14% of its uranium from Russia and used Russian enrichment services for 28% of its needs. For Europe, 20% of its uranium and 26% of enrichment comes from Russia. Most immediately, countries that are already operating Russian VVER (WATER-WATER POWER REACTOR) nuclear power plants (NPPs), such as Ukraine, have been somewhat stuck because only one company outside Russia makes the necessary fuel. Moreover, 50% of NPPs currently under construction are Russian models going up in Turkey, Bangladesh, and Hungary, among others (Jayanti, 2023)."

Apart from China, Russia is a silicon mining country. It is the third largest nickel exporter, with its Iberian Norilsk Nickel company being the world's largest producer of high grade nickel. Russia's stronghold over critical minerals can be grasped by the case of Ukraine. After the invasion, commodities' prices soared over 50% in 2022. It is the crucial role Russia plays in the supply chain of renewable energy transition that makes its participation necessary.

United States of America

Another nation of importance is The United States of America which is speculated to leave the Paris Agreement again after the re-election of President Donald Trump. In his last term, he made the announcement in 2017. As per the terms of the accord, the US was officially a non-member in 2020. Under the Nationally Determined Contributions, the US was liable to pay $ 3 Billion out of the $100 Billion the Developed Countries are expected to pay to developing countries annually for their transition. In the speech in which the president announced the withdrawal from the Paris Accord, he made claims underlining the impact of continuing to be a part of the accord on the US economy. Citing reports of NERA Economic Consulting, Massachusetts Institute Of Technology, he sought to explain the miniscule decrease in greenhouse gas emissions as opposed to substantial increase in joblessness in the United States.

Not only were these claims misinterpreted but also reflect how politics of convenience is often prioritised over the collaborative effort towards renewable energy transition. It has been analysed that:

1. Trump's undue emphasis on America First ignores the global nature of the human-induced climate-change problem. As Cropper (2018) points out, “If all countries considered only the domestic effects of their greenhouse gas emissions, about 86 percent of climate change impacts on US citizens would be ignored” because no one outside the country would be factoring in the impact of their actions on the United States’ climate.
2. The space and equity for development in developing countries would have been narrowed down and crowded out. Trump openly denied the belief in the principle of Common but differentiated responsibility. He could link environmental and trade issues to make developing countries take on environmental responsibilities and obey environmental standards similar to that of developed countries. He can use environmental articles in trading agreements to impose green barriers to developing countries.
3. Moreover, Donald Trump’s re-election caused a hit in the Renewable Energy stocks, especially the solar power sector. Fears that the Inflation Reduction Act enacted under the Biden regime driving clean energy initiatives on tax incentives have emerged (ZHANG Hai-Bin, 2017).

4.3.2 Conference of Parties 29 (COP-29)

The COP '29 summit followed a massive outrage from the developing countries. The financing is based on vague pledges instead of scientific and equity based targets. All nations have a responsibility to reduce their emissions. However, under the Paris Agreement the pledges made by several developing nations are partially or totally dependent on international finance, technology and capacity building. Implementation of these commitments becomes difficult in a scenario where the financing pledged by the developed nations does not materialise. In the COP’29 summit, developed nations have promised to continue to provide $300 billion annually by 2035. However, part of the funds that have been pledged are in the form of debt creating loans. Developed countries’ suggestion that nations could cover the shortfalls in climate finance by borrowing money from the World Bank and International Monetary Fund reflects their inaction towards their pledge and historical obligation to provide financial help to developing countries for a swift renewable energy transition.

Moreover, without a legal check over these financial pledges, double counting becomes evident. Developed nations reassign humanitarian aid, investment in foreign banks and development banks as climate finance. Double claiming through bilateral relations, market mechanisms can also be facilitated. In other cases, funds are diverted from other developmental activities such as education and healthcare to climate financing. Therefore, the funding that should be new and additional becomes superfluous. An overestimation of mitigation results due to Double Counting hinders tangible achievement of internationally agreed objectives.

Finally the carbon credits scheme approved in the summit is a false solution. The deal paves the way for countries and companies to buy credits removing or reducing greenhouse gas emissions elsewhere in the world and recognise it as their own efforts towards climate actions. This could further lead to Double Counting where the funds generated may be tagged as climate finance. The new rules and standards proposed under this Paris Agreement Trading Mechanism are fraught with problems of Temporary Carbon Removal. Countries and Companies may try to offset their emissions by gaining credits through temporary carbon removal such as carbon storage in soils and forests. However, the fossil fuel emissions that remain in the atmosphere for millennia cannot be offset by these temporary methods.

While the summit represents the hope for multilateral actions against climate change, it has become a war of attrition between the developed and developing countries. There are ambitious commitments made by developed countries which do not turn into tangible actions while the developing nations wait and the political haggling continues. With an assertive declaration of the United States of America to exit the Paris Agreement the difficulties become more prominent. This underlines the fact that politics of convenience remains a major element influencing the pledges of nations, environmental concerns are often an afterthought.
The COP '29 Summit has received a major backlash from developing countries. This consolidates the argument that international climate requires more than just negotiating climate agreements, making promises to decarbonize, and mitigating the national security implications. Nations are making decisions based on the geopolitical concerns that surround them. Crisis such as the Russia-Ukraine War or the conflict in Gaza reflect an important truth - Crisis leads to an increase in Oil Prices due to market expectations of disruption in Supply. Energy sourced from fossil fuels still makes up a major part of economies. Moreover, the transition towards renewable energy depends upon energy derived from fossil fuels. Increase in oil prices will affect the economies of these projects. Moreover, technology that is key to solving technical and logistical problems cannot eliminate competition, power differentials or the incentive countries have to protect their interests and maximise their influence. Failing to identify this reality will lead to discontinuities.

The greatest risk of failing to identify this pitfall is that if national interests and security concerns come into conflict with climate change ambitions, a successful transition might not take place at all. (O'Sullivan, 2021) This necessitates the need to understand the geopolitical dynamics while considering the transition to renewable energy.

The drivers and dynamics of energy transition can be understood better through case studies of two major economies steadily increasing their influence in the renewable energy landscape.

5. Energy Diplomacy

5.1 China: The Transformation of Solar Power, The Belt and Road Initiative, the control over rare earth minerals and Its Impact on Global Energy Politics

China has become a global leader in the production and technology of solar energy, utilising its investments and manufacturing prowess to reduce costs and increase solar capacity globally. The ambitious Solar Silk Road Initiative is the spearhead of China's efforts to promote solar power diplomacy. The Solar Silk Road is a proposed addition to the Belt and Road Initiative that intends to create a network of solar power installations connecting Europe, Asia, and Africa. The collaboration between China and Pakistan on the Quaid-e-Azam Solar Park is one prominent example of the Solar Silk Road Initiative in action. This project, which covers an area of more than 11,000 acres, is a prime example of China's dedication to aiding Pakistan in its energy transition and promoting bilateral cooperation through the development of renewable energy. China's utilisation of solar energy to fulfil Pakistan's increasing energy needs not only strengthens economic relations but also showcases China's ability to promote sustainable development via energy diplomacy.

china, being the largest producer of solar panels and components globally, is crucial in reducing the price of solar energy and increasing the availability of clean electricity. China enhances its standing as a global centre for solar energy innovation and investment by encouraging the manufacture and application of solar technologies domestically.

China will be a major player in determining the direction of international relations and the future of global energy governance as it continues to increase its presence in the solar energy industry.

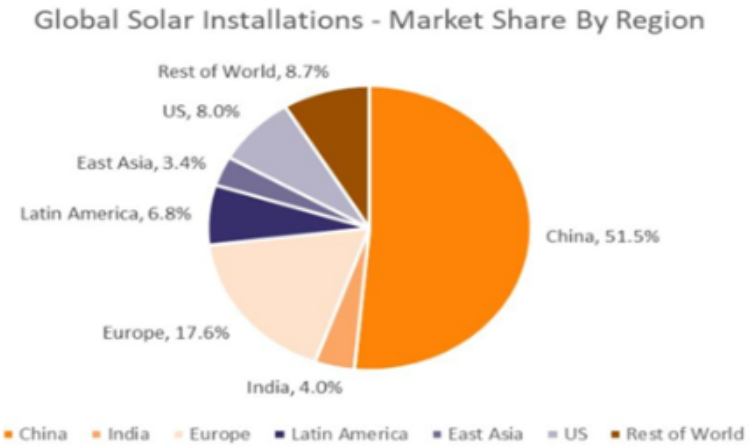

Figure 1: Source: *China leads photovoltaic, wind power, concentrated solar power and electric vehicles*

5.1.1 Control of China over rare earth minerals

In order to achieve "green growth" China recoupled economic growth with intensive mineral extraction. To harness renewable energies like the sun and the wind, China developed solar panels, windmills and batteries. It was feasible as in the case of China as it is gifted with tons of non-renewable rare earth minerals which are essential in developing the technology.

It is very clear by now that countries who tend to maximise energy efficiency tend to dominate geopolitical dynamics. China dominates the processing of Lithium, Cobalt and Nickel. "At present China produces 60 percent of the world's rare earths but processes nearly 90 percent, which means that it is importing rare earths from other countries and processing them. (Baskaran, What China's Ban on Rare Earths Processing Technology Exports Means, 2024)" This has given China a near monopoly over critical minerals. China skilfully leveraged its geo-economic rise to power by integrating supply chains for rare earth from extraction to processing to export. The European Union is 98% dependent on China for rare earths. China through its Belt and Road initiative is trying to get access to more mineral resources.

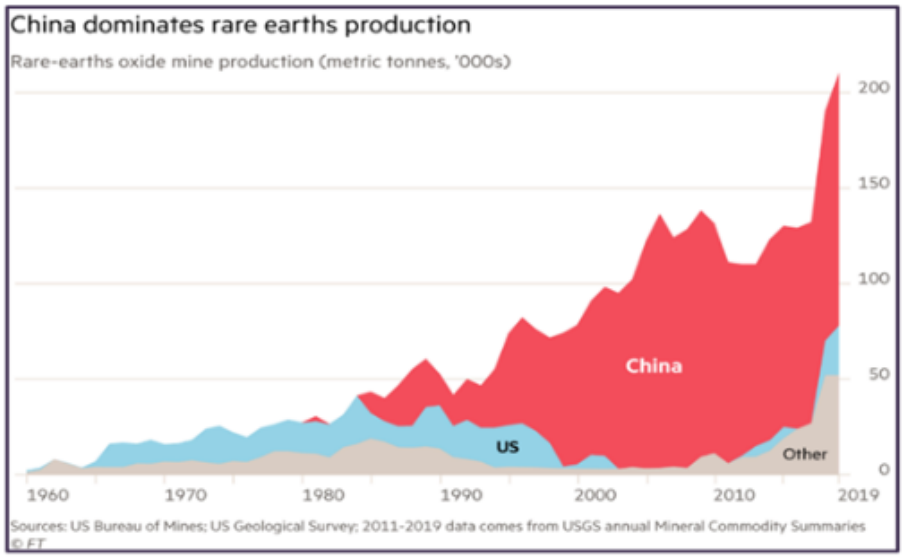

Figure 2: Source: *China's control over rare earth supply chain*

China's stronghold over Rare Earth Metals was grasped first in 2010, when it cut exports to Japan. "China behaved in a way that resembles OPEC, the oil-producers' cartel, cutting exports by 5-10% per year." (The Economist, 2010) When Japan arrested Chinese Fishermen who had entered the disputed territorial waters, Japan claimed that as a response China blocked supplies and suspended shipments entirely. The case was filed in the World Trade Organisation, which ruled against China and stated that "China's policies to restrict exports of several metals, such as bauxite and magnesium, violated its WTO obligations." ("FINDINGS AND CONCLUSIONS IN THE APPELLATE BODY REPORT IN DS431," n.d.)

One reason behind the Chinese dominance in Rare earths could be from heavy investments in the 1980s when China's economy began to open. In 1992 Deng Xiaoping said "the Middle East has oil; China has rare earths". As China's production came on stream in the 1990s, it came to dominate production as it could mine rare earths cheaply even if at great environmental cost, causing international prices to plummet and pushing out competing foreign (e.g., US) producers out of the business through mine closures. "Rare earths executives complain western industry prioritises low-cost products rather than ensuring its supply chain is not dominated by a single company or nation." (Smyth, 2020) In order to establish a non-Chinese supply chain, public funding, international co-operation and collaboration and investment will be required.

5.1.2 Soft power strategy

China's leadership in the field of energy landscape goes beyond technical norms. It encompasses wider geopolitical ambitions. Its efforts are motivated by the desire to portray itself as a responsible global leader and expand its legitimacy globally.

China's strategic goals of strengthening its position in international energy politics and promoting economic cooperation with allies are reflected in the incorporation of solar power diplomacy into the Belt and Road Initiative. China aims to enhance energy relations with participating countries, ease investments in solar projects, and encourage the adoption of solar energy technology through the BRI.

Additionally, their cooperation on solar energy projects with Southeast Asian nations is indicative of their efforts to bolster their influence in the area and offset that of other regional powers. China positions itself as a major player in the energy transition of the region by extending its economic clout and soft power through programs like the Mekong Solar Initiative. China expands its geopolitical influence and strengthens its economic relationships with participating nations by investing in solar infrastructure, creating alliances and dependencies that serve its strategic objectives.

Finally, the continuous expansion of the Belt and Road initiative along with its monopoly over the rare earth metals has enabled China to set up markets around the world, notably in the United States of America too. Re-election of Donald Trump might lead to imposition of tariffs but that wouldn't be different from policies he devised in the last term. Moreover, China has been anticipating this verdict and took measures to stabilise its leadership in the Global South. Additional long term measures have been adopted to arm china against the trade war Trump leadership can reignite. It has the capability to weaponize its dominance over critical minerals such as Lithium crucial to modern technologies. It is this ability China has to influence the world supply chains that makes it a key player in energy transition.

The Belt and Road Initiative's incorporation of China's solar power diplomacy highlights the growing significance of renewable energy in world energy politics. China hopes to further its ecological goals and economic interests, as well as strengthen its influence in strategic regions, by encouraging investments and infrastructure related to solar energy.

5.2 European Union: European energy security study: Offshore Projects and Geopolitical Tensions in the North Sea

Wind power has developed into a vital diplomatic tool that shapes geopolitical relations and fosters international cooperation, in addition to its environmental benefits. Globally, nations are increasingly looking to wind energy as a sustainable and clean substitute for fossil fuels. The move toward renewable energy has spurred a fresh round of diplomatic initiatives centred on wind energy.

Diplomacy around wind energy has also benefited from regional cooperation rather than just bilateral alliances. The goal of the Nordic Wind Energy Alliance is to share best practices in wind energy development and encourage cross-border cooperation. The alliance is an alliance of the Nordic region. Likewise, in an effort to lessen their reliance on fossil fuels and diversify their energy mix, the Gulf Cooperation Council (GCC) nations are looking into joint wind energy project options.

Due to its enormous potential for offshore wind farms and the production of renewable energy, the North Sea has become a hub for the development of wind energy. The North Sea region is now a critical location for energy security issues as European nations rely less on fossil fuels and more on wind power to diversify their energy sources. This case of the European Union aims to analyse the consequences for European energy security and the larger geopolitical environment by examining the junction between wind energy development and geopolitical concerns in the North Sea.

5.2.1 Wind Energy Diplomacy in Europe

As part of its larger green diplomacy mission, the European Union (EU) has been promoting wind energy diplomacy in Europe. The European Union is using wind power to further its climate goals and fortify regional partnerships. Examples of this include boosting offshore wind projects in the North Sea and aiding in the development of wind energy in neighbouring nations.

The North Sea is a prime area for the development of renewable energy because it has good wind conditions and shallow waters that are suitable for offshore wind farm construction. By taking advantage of the region's abundant wind resources and integrating investments in offshore wind projects, European nations like the UK, Germany, Denmark, the Netherlands and Belgium have lowered reliance on imported fossil fuels. By the development of wind energy they set to improve energy independence and resilience while aiming towards decarbonisation in the energy sector (Sanjana S. Kumar, 2024).

These countries are collaborating to integrate offshore wind farms, create interconnected transmission infrastructure, and ease cross-border commerce of renewable electricity through programs like the North Seas Energy Cooperation (European Commission, n.d.). North Sea nations collaborate to optimise wind energy potential while advancing regional energy security and sustainability through the sharing of resources and expertise.

The North Sea Wind Power Hub project, which aims to build man-made islands as centres for offshore wind energy generation and distribution, is a well-known example of regional cooperation. This ambitious endeavour, spearheaded by the Netherlands, Germany, and Denmark, shows that creative solutions may be found to get over technical and legal obstacles to offshore wind growth.

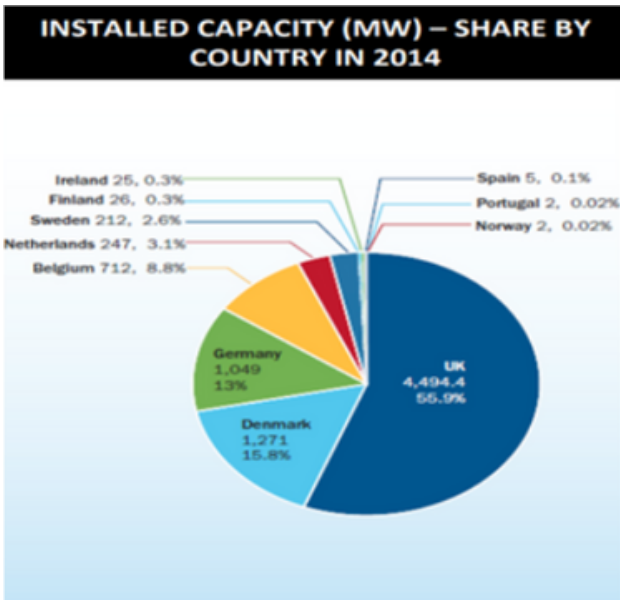

Figure 3: Source- *Offshore Wind Industry Europe Key trend and Statisitcs, 2014*

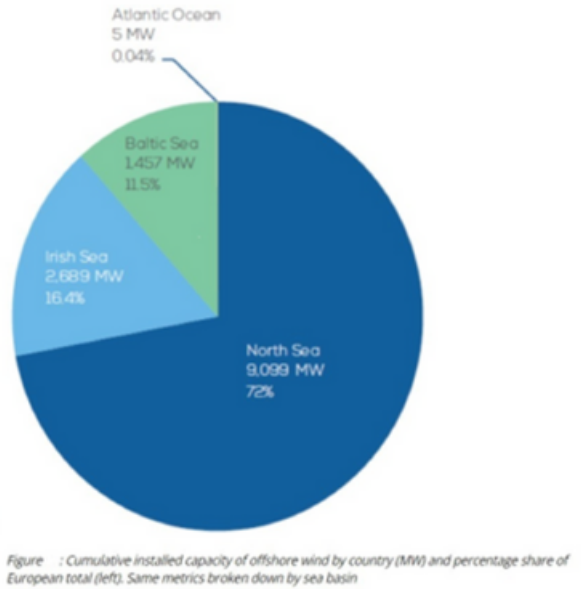

Figure 4: Source- *European percentage share of offshore wind capacity*

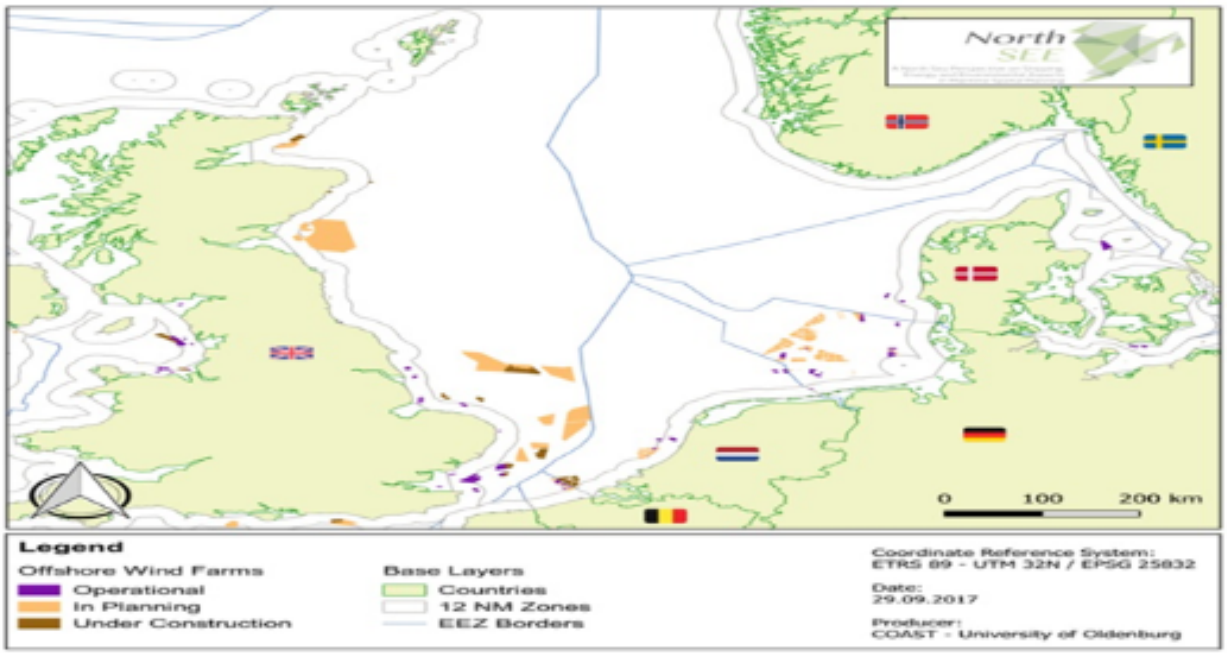

Figure 5: Source- *Map of offshore wind farms in Europe*

5.2.2 Associated Geopolitical Concerns

In the North Sea region, geopolitical conflicts and territorial issues have become major problems despite the potential benefits of wind energy growth. Conflicts between adjacent nations have arisen as a result of competition over marine borders, resource distribution, and access rights, especially in regions with significant wind energy potential. The deployment of offshore wind farms and collaboration on energy security efforts have been complicated by political tensions and legal challenges resulting from overlapping exclusive economic zones (EEZs) and conflicting territory claims.

Furthermore, geopolitical factors impact project finance and investment decisions. Investment plans are shaped by worries about market access, regulatory stability, and security. For example, ambiguity over the legal framework for offshore wind projects in several North Sea nations may discourage investors and impede the expansion of the renewable energy industry.

Nevertheless, despite geopolitical difficulties, North Sea region stakeholders understand the benefits of cooperation and are actively looking for ways to overcome obstacles. Multilateral forums such as the North Seas Energy Cooperation offer a venue for discussion and cooperation on cooperative research and development, grid integration, and regulatory harmonisation. North Sea nations may create enduring alliances and realise the full potential of wind energy diplomacy in the area by promoting trust and openness.

Encouraging sustainable wind energy growth in the North Sea and resolving geopolitical conflicts require international cooperation and multilateral agreements. Proactive steps to address root causes of tension and aid in dispute resolution are required to reduce geopolitical risks and advance stability in the North Sea region. Clear regulatory frameworks for offshore wind development may be established and maritime disputes can be resolved with the use of international arbitration procedures, mediation services, and diplomatic involvement. Furthermore, fostering an atmosphere that is favourable for sustainable energy collaboration and investment in the North Sea can be achieved through encouraging transparency, trust-building, and information sharing among stakeholders.

Finally, in international arena The EU wind ecosystem holds a significant advantage over its competitors, as it is the most active in patent filings (Team, 2024). Countries in the European Patent Organisation hold the most applications, indicating that the region is world-leading in innovation. Denmark and Germany lead the charge in the development of offshore wind turbine towers that are less material-intensive. Denmark also leads in innovations relating to wind turbine blades, accounting for 85% of inventions between 2017 and 2022, with a surge in patents related to recyclability. This demonstrates Europe's upper hand in the technology transfer pertaining to international relations.

6. Geopolitical implications due to the Switch in Renewable Energy

Discussed up till now is how geopolitical dynamics, power alignments and crisis shape the drivers of renewable energy transition. Furthermore, the case studies discussed consolidated the view that relations between countries shape investments, costs and security of transitioning to renewable energy. Furthermore, these geopolitical dynamics might prove to be barriers or by products of the transition to renewable energy. Based on the challenges discussed above, varying expectations can be made for a world where renewables take centre stage.

6.1 New Power Asymmetries and dependencies

Contrary to the wide belief that renewable energy due to its abundance has advantages in terms of international security, the critical minerals fundamental for the development of technology capable of harnessing renewable energy pose a security threat. "Between 2007 and 2018, 8 disputes in the PV sector were brought to WTO, of which 4 were initiated by China as a complainant, and the remaining ones by the US, Japan, India and the Republic of Korea, respectively. The US was the respondent in 5 disputes, while India, Canada and the European Union jointly with Italy and Greece were the respondents in one case each. In all of these cases the direct reason for complaints was the imposition of trade measures related to the renewable energy sector" (Pera, 2020). These trade disputes reiterate the difficulty in striking a balance. Many times in an attempt to reach an optimum point, international relations especially trade ties will get affected.

Table 1. World Trade Organization (WTO) trade disputes over solar energy.

Number of Case	Subject	Complainant	Respondent (Trade Measures)	Third Parties	Initiation Date/ Status	Selected WTO Provisions Referred to
DS437	Countervailing Duty Measures on Certain Products from China	China	United States (countervailing duties)	Australia; Brazil; Canada; European Union; India; Japan; Republic of Korea, Norway; Russian Federation; Turkey; Viet Nam; Saudi Arabia	25 May 2012/ pending	Subsidies and Countervailing Measures: Art. 1.1, 1.1(a) (1), 1.1(b), 2, 10, 11, 11.1, 11.2, 11.3, 12.7, 14(d), 30, 32.1; GATT 1994: Art. VI, XXIII
DS456	Certain Measures Relating to Solar Cells and Solar Modules	United States	India (domestic content requirements)	Brazil; Canada; China; European Union; Japan; Korea, Republic of; Malaysia; Norway; Russian Federation; Turkey; Ecuador; Saudi Arabia, Kingdom of; Chinese Taipei	6 February 2013/ pending	GATT 1994: Art. III:4 Trade-Related Investment Measures (TRIMs): Art. 2.1 Subsidies and Countervailing Measures: Art. 3.1(b), 3.2, 5(c), 6.3(a), 6.3(c), 25
DS412	Certain Measures Affecting the Renewable Energy Generation Sector	Japan	Canada (domestic content requirements, subsidies)	Australia; Brazil; China; El Salvador; European Union; Honduras; India; Saudi Arabia; Republic of Korea; Mexico; Norway; Chinese Taipei; United States	13 September 2010/ implementation notified by respondent	GATT 1994: Art. III: 4, III:5, XXIII:1; Subsidies and Countervailing Measures: Art. 1.1, 3.1(b), 3.2 Trade-Related Investment Measures (TRIMs): Art. 2.1
DS452	Certain Measures Affecting the Renewable Energy Generation Sector	China	European Union; Italy; Greece (domestic content requirements, subsidies)	-	5 November 2012/ resolved by consultations	GATT 1994: Art. I, III:1, III:4, III:5 Subsidies and Countervailing Measures: Art. 1.1, 3.1(b), 3.2 Trade-Related Investment Measures (TRIMs): Art. 2.1, 2.2
DS510	Certain Measures Relating to the Renewable Energy Sector	India	United States (subsidies, domestic content requirements)	Brazil; China; European Union; Indonesia; Japan; Korea, Republic of; Norway; Russian Federation; Saudi Arabia, Kingdom of; Singapore; Chinese Taipei; Turkey	9 September 2016/ pending	GATT 1994: Art. III:4, XVI:1 Subsidies and Countervailing Measures: Art. 3.1(b), 3.2, 5(a), 5(c), 6.3(a), 25 Trade-Related Investment Measures (TRIMs): Art. 2.1
DS545	Safeguard measure on imports of crystalline silicon photovoltaic products	Korea, Republic of	United States (safeguards - increased tariffs)	Brazil; Canada; China; European Union; Egypt; India; Japan; Kazakhstan; Malaysia; Mexico; Norway; Philippines; Russian Federation; Singapore; Chinese Taipei; Thailand; Viet Nam	14 May 2018/ pending	GATT 1994: Art. X:3, XIII, XIX:1 Safeguards: Art. 1, 2.1, 3.1, 3.2, 4.1, 4.1(c), 4.2, 5.1, 5.2, 7.1, 7.4, 8.1, 12.1, 12.2, 12.3
DS562	Safeguard Measure on Imports of Crystalline Silicon Photovoltaic Products	China	United States (safeguards - increased tariffs)	-	14 August 2018/ pending	GATT 1994: Art. X:3, XIII, XIX:1, XIX:2 Safeguards: Art. 2.1, 2.2, 3.1, 3.2, 4.1, 4.1(c), 4.2, 5.1, 7.1, 8.1, 12.1, 12.2, 12.3
DS563	Certain Measures Related to Renewable Energy	China	United States (domestic content requirements)	-	14 August 2018/ pending	GATT 1994: Art. III:4 Trade-Related Investment Measures (TRIMs): Art. 2.1, 2.2 Subsidies and Countervailing Measures: Art. 3.1(b), 3.2

Source: Adapted from WTO [76].

Figure 6: Source- *International Trade Disputes over Renewable Energy*

Moreover, trade disputes would arise due to the dependencies created as a result of China's control over rare earth minerals in the renewable supply chain. These tensions can be sensed already as the world prepares for an intense trade war between Trump and china.

6.2 Power Transition

The emergence of renewable energy is posing a threat to the established power paradigms, which are based on the ownership and distribution of fossil fuels. If they don't make significant investments in renewable energies, nations who have historically been energy superpowers, like Saudi Arabia, Russia, and the United States, may experience a reduction in their worldwide dominance. However, nations that successfully utilise their renewable resources may become politically significant. For example, China's leadership in the production of solar panels raises its profile internationally, and Iceland's effective use of geothermal energy provides a model for other countries.

7. Conclusion

International cooperation, technology transfer, capacity building, and policy assistance are needed to address these issues. Governments must promote collaboration and create plans that strike a balance between geopolitical interests, economic growth, and environmental sustainability. In order to support a more equitable global energy transition, efforts must be taken to guarantee that the advantages of renewable energy are available to all communities and nations. In conclusion, the geopolitical landscape intertwines with the energy transition in all aspects. In such a scenario the goal is to find balance between economic, social and political conflicts that challenge the transition today. The paper discussed the three main drivers of renewable energy - Technology, Policy Change and Participation of countries. All of these drivers face conflicts and disagreements amongst countries.

Nonetheless, the importance of transition to cleaner energy is understood by most major economies if not all. World is heading towards a successful transition even if the pace is not sufficient. What is important to recognise is that, once the post transition period sets in, what will the new world order look like? Perhaps, Geopolitics of the new era will resemble the fossil fuel era of concentrated supply monopolies but the players will be different. Oil and Gas will phase out but materials such as metals and minerals will take over. Power and influence will rest with economies that control these. Countries like China and Russia already have leverage over critical minerals and will continue to have so unless alternate sources are found.

Finally, nations are prioritising energy security and economic security over environmental security. Activities required to fulfil the renewable energy requirements such as mining and extraction of key resources like lithium impact the climate. The Climate clock is ticking and therefore, the way to find a balance between economic growth and climate change becomes more treacherous.

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