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THE GEOPOLITICS OF ENERGY TRANSITION: THE IMPACT OF RENEWABLE ENERGY ON THE GLOBAL BALANCE OF POWER

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Abstract. The energy transition has been identified as a contributing factor to the transformation of the global energy order, leading to a reduction in dependence on traditional hydrocarbon sources and the promotion of decentralization of energy supply. These processes have been shown to enhance the energy security of individual states. However, concurrently, they have also been shown to intensify competition for critical resources, technological leadership, and control over strategic supply chains, thereby creating new vectors of geopolitical tension.

Key aspects discussed in this article include the redistribution of global influence, advanced renewable energy technology pertaining states, and strategic challenges for traditional hydrocarbon exporters. We analyze the mechanisms of adaptation of various countries to these new realities, the new energy dependencies being created, and the possible long-term geopolitical consequences. Still, since the development of RES continues and at any rate is not yet finished or perfect in many aspects of these processes the results are still difficult to predict concretely.

The conclusions emphasize the heterogeneous impact of the energy transition on different states: countries with a technological advantage gain additional leverage over the global energy sector, while hydrocarbon exporters face the need to revise their economic models. In this context, the energy transition is not an unambiguous factor in reducing geopolitical tensions, but rather changes its nature, creating both new challenges and opportunities for international cooperation and adaptive strategies.

The paper will address these questions, therefore, in the context of energy transition, as not always an outright force for lowering the tension level but rather switching its form peculiarly into both general new challenges and opportunities for international cooperation.

Key words: renewable energy, energy transition, geopolitics, energy security, critical resources, technical development, decarbonization, energy independence

Introduction

The subject of renewable energy encompasses such broad aspects as energy security, global climate change and its resulting environmental impacts, and renewable technology innovation devices. However, this paper will mainly concentrate on the geopolitical aspect of converting to renewable energy sources and its effect on the global balance of power.

In order to carry out a comprehensive literature review, it is necessary to define the key concepts of renewable energy and geopolitics. The definition of renewable energy, as set out in its statutes by the International Renewable Energy Agency (IRENA), includes all forms of energy derived from renewable sources: bioenergy, geothermal, hydropower, solar power, marine energy, and wind power. [1]. The term "geopolitics" was first put forward by Swedish political scientist Rudolf Kjellen in 1899 and originally meant the politics of international relations sold in a place where politics are made by territorial expansion and power rivalry. [2].

The term has since evolved over time to imply a broader analysis of how geographical factors affect states' diplomacy and international relations. In the context of this study, geopolitics is examined through the prism of competition among leading powers for control over key territories and access to strategically important natural resources, including critical metals needed to produce renewable energy technologies.

In recent decades, the global energy system has undergone one of the most significant shifts in its history: the transition from fossil to renewable energy sources. This process is driven not only by environmental factors, but also by states' desire for energy independence, geopolitical risk reduction and technological advances.

This transformation has the potential to effect considerable change in the system of international dependencies, with concomitant reform of the global energy market, and stimulation of the formation of new alliances, which may, in turn, lead to geopolitical conflicts. China, the European Union and the United States are becoming new centers of influence, with the result that international cooperation is expanding, and the architecture of global energy security is being shaped. However, in parallel, there is growing competition for access to rare earth metals, which are required to produce renewable energy equipment, creating new points of tension.

Materials and Methods

This study employs comprehensive methodological approaches to identify the theoretical foundations of the geopolitics of the energy transition and its impact on the global balance of power. The main tool employed was a systematic study of scientific publications, analytical reports of international organizations and statistical data. The application of literature selection and systematization methods allowed for the identification of key concepts explaining the transformation of the global energy architecture.

Analysis was used as the main method of logical data processing aimed at identifying geopolitical changes in the energy transition process. System analysis facilitated the identification of interrelationships between the theory of resource dependence, the concept of energy security, the concepts of technological determination and sustainable development, as well as their influence on the formation of new geopolitical alliances.

The method of synthesis enabled the combination of various aspects of the problem under study into a holistic model explaining the interaction of states in the context of energy transition. The study utilized empirical data from reports of the International Energy Agency (IEA), OPEC, the World Bank, and the International Renewable Energy Agency (IRENA), as well as statistical data from Eurostat and national energy agencies.

Results

A review of the current academic literature on the geopolitical strategic implications of changing energy supplies points to two schools of thought. The first argues that as countries switch to renewable sources, international conflicts will not necessarily be reduced, but their form has transformed. The second position, in contrast, assumes that the increased use of renewable energy and the growing energy self-sufficiency of states will reduce conflicts over energy access.

Proponents of the former perspective posit that renewable energy will not wholly eliminate conflict but rather transform its forms [3]. Predominant argument is that while reducing reliance on fossil fuels, novel geopolitical challenges may emerge during the energy transition, including competition for rare earth metals deemed essential to renewable energy technologies, as well as competition for dominance over supply chains and logistics infrastructure [4]. The geopolitics of low-carbon energy is set to be more intricate than that of traditional energy policy, as it is determined not only by resource availability but also by factors such as technological development and cybersecurity. In addition, the growing threat of cyber-attacks on energy infrastructure is becoming a significant challenge, which could undermine the energy security of nations [5].

Conversely, other scholars posit that the energy transition has the potential to markedly diminish the influence of conventional hydrocarbon exporters, such as Russia, Saudi Arabia and Iran, due to a decline in global demand for oil and gas [6]. Consequently, the entrenched interests of the fossil fuel industry in political, economic and social institutions may form a so-called “carbon inertia” that hinders institutional change, leading to resistance from key players dependent on traditional energy resources, thereby creating new conflicts.

In contrast to this view, proponents of the second approach argue that the development of renewable energy leads to a more balanced distribution of resources and reduces geopolitical tensions. The emphasis placed on technological strength and the degree of development of energy infrastructure as key factors in determining energy significance in the future is a notable departure from the conventional view. The geographical concentration of resources characteristic of fossil fuels is reduced by the possibility of local production of renewable energy, which in turn reduces the likelihood of international conflicts caused by uneven distribution of energy resources. Considering the aforementioned statements, the subsequent table has been devised in order to furnish a more illustrative comparison of the attitudes of the two perspectives on the impact of the energy transition on geopolitics:

Table 1. Geopolitical implications of Energy Transition: Competing perspectives

Geopolitical impact	First school of thought	Second school of thought
Nature of conflicts	The energy transition will not lead to full exhaustion of conflicts, but it will result in a transformation of their nature. The ongoing competition over rare resources, energy supply chains, and the prevalence of cyberattacks could act as new catalysts for conflicts.	The use of RES promotes energy independence for nations and reduces conflicts related to access to resources.
Cybersecurity risks	The energy transition involves the digitalization of energy systems, that poses new treats as possibility of potential cyberattacks on energy security.	Technological development increases resilience to cyber threats, reducing risks related to centralized fossil fuel networks.
The role of fossil fuel exporters	Traditional fossil fuel exporters may face carbon inertia, making it difficult to transition to new energy management models.	Lower demand for oil and gas may weaken the role of traditional energy powers, reducing the energy dependence of importing countries.
Energy independence	The increase of energy self-sufficiency will not fully eliminate geopolitical struggles, as competition will shift towards the control of renewable energy technologies and supply networks.	Increasing energy independence through local renewable energy production will decrease international energy-related tensions and encourage cooperation.
Perspectives on global energy architecture	The energy transition will not lead to the elimination of global competition, but it will demand new strategies and approaches to regulation.	A new energy system based on RES can contribute to sustainable development and reduce international conflicts.

Determining an unambiguous perspective is challenging because both positions rely on predictive scenarios, while the actual consequences remain uncertain. In his study, Basilian identifies four possible scenarios for a global energy transition: the "Big Green Deal," "Dirty Nationalism," "Technological Breakthrough," and "Muddling On," each with specific geopolitical implications. The author emphasizes that while predicting the potential outcomes of an energy transition is relatively straightforward, the key challenge lies in the transformation process itself and the selection of the optimal trajectory. His findings suggest that a geopolitical structure based on renewable energy sources will differ significantly from the traditional fossil fuel-centered system, necessitating a rethink of energy management strategies and the development of mechanisms to ensure the stability and sustainability of the global energy architecture [7].

Consequently, the energy transition signifies a profound transformation of the geopolitical landscape, guaranteeing neither a weakening nor an intensification of international conflicts, but rather a change in their nature, resulting in both new challenges and opportunities for international cooperation. The future of energy geopolitics will depend on the ability of states to adapt to new conditions, build sustainable partnerships and form strategies aimed at balancing energy security, technological progress and global stability.

Discussion

The process of energy transition to renewable energy sources remains a complex and multifaceted phenomenon, with increasing attention being directed towards it from policy makers and the scientific community. The diversity of forecasts and scenarios indicates a high degree of uncertainty in the future global energy order, given that today the world is still largely dependent on fossil energy sources.

A primary challenge is the evolving structure of global dependencies. For instance, Russia, a major exporter of fossil fuels, is experiencing changes due to the decline in European demand resulting from the Ukraine crisis and the European Green Deal. The European Union has reduced the share of imported Russian gas from 45% in 2021 to 18% in 2024 [8]. Consequently, Russia has redirected its gas supplies toward China and India. In a similar vein, Saudi Arabia has initiated a program aimed at diversifying its economic portfolio by reducing its excessive reliance on oil. (Vision 2030) [9].

This shift is set to give rise to novel forms of economic and political competition, whilst concurrently, the projected decline in demand for hydrocarbons could exert substantial financial pressure on the economies of countries reliant on their exports, which in turn could engender resistance on their part [10].

As illustrated in Table 2, major hydrocarbon exporters such as the United States, Russia, Saudi Arabia, and Iran are facing a significant decline in their geopolitical influence as the energy transition unfolds. This transformation may act as a catalyst for resistance to the widespread adoption of renewable energy, as these states seek to maintain their economic and strategic positions. Conversely, China is emerging as a key actor in the global renewable energy transition, using

its dominance in clean energy technologies and supply chains to consolidate its geopolitical position.

Table 2. Approximate Comparative Table of the Geopolitical Impact of Energy Transition on Energy Trade Models [11].

Oil and gas					
	Key exporters		**Refining/Midstream**		**Consumption**
Oil	US, Saudi Arabia, Russia		US, China, Russia		US, China, India
Natural gas	US, Russia, Iran		Russia, Qatar, Australia		US, Russia, China
Clean technologies					
	Mining	**Processing**	**Battery material**	**Battery cell/ pack**	**Electric car deployment**
Coper	Chile, Peru	China, Chile	China, South Korea, Japan	China, US, South Korea	China, US, EU
Lithium	Australia, Chile	China, Chile	**Polysilicon**	**Solar panel**	**Photovoltaic panels**
Nickel	Indonesia, Philippines	China, Indonesia	China, Korea, Germany	China, Korea, Canada	China, EU, US
Cobalt	Democratic Republic of Congo	China	**Wind Turbine & Components**		**Wind Installations**
Rare earth	China	China	China, India, US, Spain, Germany		China, EU, US

Notably, China has positioned itself at the forefront of the renewable energy transition through substantial investments in research, infrastructure, and industrial policy [12]. In 2024, China was one of the outstanding countries in terms of technological development and investment in renewable energy, with about 80% of the global investments in renewable energy, surpassing the United States. The total installed capacity of RES exceeds 1.5 billion kilowatts. A substantial portion of the nation's budget, exceeding 40%, was allocated to renewable energy sources (RES), which is approximately double the amount designated for fossil fuels [13]. The successful integration of RES into China's energy system can be attributed to several key factors:

As previously mentioned, China has emerged as a global leader in the production and technological advancement of renewable energy sources, particularly solar panels, wind turbines, and batteries. The significant development of these renewable energy sectors can be attributed, in part, to China's abundant natural resources, particularly silicon, which is a crucial component in the production of solar panels. According to the annual summary on mineral raw materials of the U.S. Geological Survey, in 2024, China accounted for approximately 80% of the global silicon production, which is the primary material in solar panel manufacturing. The United States is the second-largest producer, with 50% of global silicon production [14].

A further important factor is complete control over the critical materials needed to manufacture RE equipment. China is responsible for the extraction of approximately 80% of the global supply of rare earth minerals, with the remainder being processed within its borders. For instance, despite the mining of rare earth resources in other countries, their processing is predominantly conducted in China. A notable illustration of this phenomenon is Lynas Rare Earth, a major Australian mining entity specializing in rare earth elements, which allocates a substantial portion of its production to China for processing [15]. A deposit in the United States, Mountain Pass in California, which is the largest in the country, also supplies the majority of raw materials for processing in China. Another mechanism is expressed in the control over the supply of rare earth raw materials. For instance, in 2023, China imposed export restrictions on germanium and gallium, key elements in the production of various equipment, including microchips, solar panels, car batteries, and semiconductors, in response to sanctions imposed by the EU and the U.S.

The implementation of significant initiatives such as the One Belt One Road project has been instrumental in augmenting China's geopolitical influence, a process that has been facilitated, in part, by the RES. A substantial number of renewable energy projects are being implemented under this initiative, with a focus on developing countries. For instance, China has invested in a number of solar and wind energy projects in Africa (Garissa Solar Plan with a capacity of 55 MW), Pakistan (Quaid-e-Azam Solar Park with a capacity of 1,000 MW), Latin America (Cauchari Solar Plant hydropower project with a capacity of 300 MW), Kazakhstan (Zhanatas Wind Farm with a capacity of 300 MW) and other countries.

While the Chinese authorities do not deny that renewable energy is not yet capable of meeting the entire energy demand of China, the direction for the development and diversification of energy is clearly delineated. This example demonstrates how countries are beginning to re-prioritize the energy sector in order to avoid being left behind as a result of the energy transition. However, the precise consequences of the energy transition are contingent on a multitude of factors, including the rate of technological progress, the adaptation strategies employed by states, and the extent of international cooperation.

In addition, international institutions and norms are growing in importance in regulating the global energy transition. The development of cooperation programs, such as the European Green Deal, and initiatives to reduce carbon footprints are shaping a new energy security architecture [16]. However, the lack of global consensus on key issues is deepening the gap between countries with technological advantages and those dependent on fossil fuels. Consequently, a key EU priority in its transition to renewable energy sources is the complete rejection of coal, a transition that some countries cannot afford. In Poland, for instance, the authorities assert that mines are a cornerstone of the country's energy security [17].

The ultimate vector of the energy transition remains uncertain, but it is clear that its consequences go beyond purely technological or economic

transformations, affecting the entire system of international relations. In these new conditions, states will have to rethink their energy strategies, balancing the need to invest in innovation with the need to maintain traditional industries. The configuration of the future global energy order is thus contingent not solely on technological progress, but also on the international community's capacity to reach compromises, avert conflicts over resources, and establish inclusive mechanisms to oversee the energy transition.

Conclusion

The global transition to renewable energy sources profoundly affects geopolitical relations, reshaping the balance of power between countries and rearranging strategic interests. While reduced reliance on fossil fuels enhances energy security for many countries, it also creates new dependencies, particularly on vital minerals like lithium, cobalt, and rare earths. These minerals, which are critical to renewable energy and energy storage technologies, are concentrated in a limited number of countries, thereby creating new focal points of geopolitical importance.

In reaction to energy transition, the positions of key world players are being reshaped. China has emerged as a leading actor in the renewable energy space, particularly in the production of solar panels and the development of battery supply chains, thus expanding its strategic influence. The European Union is consolidating its leadership by adopting regulation regimes and large green investment projects, while the United States is leveraging its technological advantage to drive energy storage innovation and the upgrading of grid systems. Traditional hydrocarbon producers like Russia and the Gulf states are facing economic pressures and need to change to remain relevant in the changing energy order.

The long-term geopolitical implications of the energy transition depend on the choice of either cooperative approaches or competitive methods. Development scenarios can range from increased international cooperation (e.g., the "Big Green Deal") to increased protectionism and competition for key resources (e.g., "Dirty Nationalism"). A path guided by global cooperation, characterized by diversified supply chains and coordinated energy policies, can potentially create stability and improve sustainable development. In contrast, a path guided by resource nationalism, where countries compete to control vital resources, can potentially lead to new geopolitical tensions and economic fragmentation.

The shift to renewable energy means not just an environmental or technological shift but also signals a profound realignment of global power relations. Nations that invest heavily in renewable energy systems, provide access to critical resources, and promote technological innovation will improve their position in the global arena. Overall, it is evident that the shift in energy systems is more than just an environmental or technological change, symbolizing an important reorganization of global power relations.

Nevertheless, extant research in this area does not permit unambiguous determination of whether the energy transition will lead to the stabilization of

international relations or, in contrast, the creation of new challenges for the global order. It is evident that the transition to renewable energy sources (RES) is accompanied by structural changes in the global economy and politics, which require adaptive strategies from states to balance energy security, technological development, and the sustainability of the global energy architecture.

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ЭНЕРГЕТИКАЛЫҚ ӨТПЕЛІ КЕЗЕҢНІҢ ГЕОСАЯСАТЫ: ЖАҢАРТЫЛАТЫН ЭНЕРГИЯНЫҢ ҒАЛАМДЫҚ КҮШТЕР ТЕПЕ-ТЕҢДІГІНЕ ӘСЕРІ

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Аңдатпа. Энергетикалық көшу жаһандық энергетикалық тәртіптің трансформациялануына ықпал ететін фактор ретінде қарастырылады. Бұл процесс дәстүрлі көмірсутек көздеріне тәуелділіктің төмендеуіне және энергиямен жабдықтау жүйесінің орталықсыздандырылуына әкеледі. Нәтижесінде жекелеген мемлекеттердің энергетикалық қауіпсіздігі нығаяды. Алайда, сонымен қатар, бұл үрдістер маңызды ресурстар, технологиялық көшбасшылық және стратегиялық жеткізу тізбектерін бақылау үшін бәсекелестікті күшейтіп, жаңа геосаяси шиеленіс ошақтарын қалыптастыруда.

Мақалада энергетикалық көшудің негізгі аспектілері, соның ішінде жаһандық ықпалдың қайта бөлінуі, жаңартылатын энергия көздері (ЖЭК) технологиялары дамыған мемлекеттердің рөлінің артуы және дәстүрлі көмірсутек экспорттаушылары үшін туындайтын стратегиялық сын-қатерлер қарастырылады. Әртүрлі елдердің жаңа жағдайларға бейімделу механизмдері, жаңа энергетикалық тәуелділіктердің қалыптасуы және осы процестердің ұзақ мерзімді геосаяси салдары талданады. Сонымен қатар, ЖЭК дамуы жалғасып жатқандықтан, бұл процестердің көптеген аспектілері әлі де белгісіз болып отыр.

Қорытындылар энергетикалық көшудің әртүрлі мемлекеттерге әсерінің біркелкі еместігін көрсетеді: технологиялық артықшылығы бар елдер жаһандық энергетикаға ықпал етудің қосымша тетіктеріне ие болады, ал

көмірсутек экспорттаушылары өздерінің экономикалық модельдерін қайта қарауға мәжбүр. Осы тұрғыдан алғанда, энергетикалық көшу геосаяси шиеленісті азайтудың біржақты факторы емес, керісінше оның сипатын өзгертеді, халықаралық ынтымақтастық пен бейімделу стратегиялары үшін жаңа сын-қатерлер мен мүмкіндіктер туғызады.

Тірек сөздер: жаңартылатын энергия көздері, энергетикалық көшу, геосаясат, энерегетикалық қауіпсіздік, маңызды ресурстар, техникалқ даму, декарбонизация, энергетикалық тәуелсіздік

ГЕОПОЛИТИКА ЭНЕРГЕТИЧЕСКОГО ПЕРЕХОДА: ВЛИЯНИЕ ВОЗОБНОВЛЯЕМОЙ ЭНЕРГИИ НА ГЛОБАЛЬНЫЙ БАЛАНС СИЛ

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Аннотация. Энергетический переход способствует трансформации структуры глобального энергетического порядка, изменяя баланс геополитического влияния. Эти процессы усиливают энергетическую безопасность отдельных государств, однако одновременно обостряют конкуренцию за критически важные ресурсы, технологическое лидерство и контроль над стратегическими цепочками поставок, формируя новые векторы геополитической напряженности.

В статье рассматриваются ключевые геополитические аспекты энергоперехода, включая перераспределение глобального влияния, растущую роль государств, обладающих передовыми технологиями в сфере возобновляемой энергетики, а также стратегические вызовы для традиционных экспортеров углеводородов. Анализируются механизмы адаптации различных стран к новым реалиям, формирование новых энергетических зависимостей и возможные долгосрочные геополитические последствия. При этом, учитывая, что развитие ВИЭ продолжается, многие аспекты этих процессов остаются неопределёнными.

Выводы подчеркивают неоднородность влияния энергоперехода на различные государства: страны с технологическим преимуществом получают дополнительные рычаги воздействия на мировую энергетику, тогда как экспортеры углеводородов сталкиваются с необходимостью пересмотра своих экономических моделей. В этом контексте энергопереход не является однозначным фактором снижения геополитической напряженности, а скорее изменяет её природу, создавая как новые вызовы, так и возможности для международного сотрудничества и формирования адаптивных стратегий.

Ключевые слова: возобновляемые источники энергии, энергетический переход, геополитика, энергетическая безопасность, критические источники, техническое развития, декарбонизация, энергетическая независимость

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