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ENERGY TRANSITION, ENERGY STRATEGIES, GLOBAL ENERGY SECURITY AND POTENTIAL RISKS

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Abstract: For a long time, the energy transition has been a central topic in global policy discussions across the world's various energy systems. The energy transition refers to the shift from traditional energy sources (such as oil, coal, and gas) to renewable sources (like solar, wind, and hydropower). This process is further supported by existing international agreements. Many countries are developing their own strategies and plans to meet energy-related objectives. However, the differing approaches to energy policy often lead to global disagreements, as countries have varying interests regarding resources, energy security, and climate obligations. Global energy security is emerging as a significant challenge in the international context. Rising energy demand, geopolitical tensions, market volatility, and the vulnerability of energy systems are putting immense pressure on global stability. Potential risks associated with the energy transition include an unequal distribution of resources and technologies between developed and developing nations, which could exacerbate global social and economic inequalities. Furthermore, a rapid transition to renewable energy without adequate infrastructure may lead to energy supply instability, higher prices, and potential social unrest. In addition, the security of emerging technologies-such as smart grids and the digitalization of energy systems-raises new concerns about data protection and cybersecurity. While the energy transition is essential for achieving global sustainability goals, it presents significant challenges that require careful management and international collaboration. Developed energy strategies must strike a balance between energy security, environmental objectives, and economic interests, while also minimizing the risks that come with transitioning to new energy sources. This balance forms the foundation for the analysis of the issues addressed in this paper.

Keywords: Energy transition, energy strategies, energy security, mining, global risks.

1. INTRODUCTION

The energy transition, global energy security, and the associated risks are critical issues in tackling the challenges of the 21st century. These topics are closely linked to sustainable development, climate change, technological innovation, and geopolitics, all of which shape the future of the global energy system. The energy transition refers to the shift from fossil fuels,

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such as coal, to sustainable sources like solar, wind, hydro, and biomass, while also improving energy efficiency. This process presents technological, political, economic, and social challenges, requiring coordination across global initiatives, local actions, and consumer behaviors. National, regional, and global energy strategies are essential for guiding the transition to a sustainable energy future. These strategies, often backed by policies, subsidies, and innovations, aim to reduce carbon emissions, enhance efficiency, and ensure energy security, while encouraging investments in renewables and new technologies, (Dablander et al., 2025). Global energy security is becoming increasingly important, as disruptions in energy supply can destabilize the global economy and political relations. Many nations' dependence on fossil fuels from geopolitically unstable regions poses significant risks to energy stability. While the shift to renewable energy brings benefits, such as reduced emissions and job creation, it also presents challenges, including potential energy instability during periods of low renewable output, high infrastructure investment costs, and economic uncertainty for countries reliant on traditional industries. Energy security has also become a key factor in international relations, with the dominance of certain countries in energy production affecting both infrastructure and economic ties. Instability in oil- and gas-rich regions, combined with the impacts of global climate change, highlights the need for careful management of energy transitions. The risks associated with this shift-including supply insecurity, economic costs, social inequalities, and geopolitical tensions-could have far-reaching effects on the global economy and society, (Kuzemko et al., 2025).

2. SOME OF THE LATEST GLOBAL EXPERIENCES IN THE ENERGY TRANSITION

The energy transition is a process that involves transforming the global energy system from reliance on fossil fuels to sustainable, environmentally friendly energy sources. This process began with the goal of reducing carbon dioxide emissions, combating climate change, conserving natural resources, and creating new economic opportunities. Global experiences with energy transitions offer valuable insights into how different countries are tackling the challenge of reducing emissions and increasing the share of renewable energy in the global energy mix, including the key initiatives and challenges they face.

Europe stands as a global leader in the energy transition, pioneering efforts to reduce carbon dioxide emissions. The European Union has set ambitious goals through the European Green Deal, aiming to make the EU climate-neutral by 2050. Key countries in this transition include: (Gatto et al., 2024).

Germany is one of the trailblazers of the energy transition, with its Energiewende (Energy Revolution) plan recognized as a model for other countries. Germany aims to reduce carbon dioxide emissions by 80-95% compared to 1990 levels by 2050 and to derive 80% of its energy from renewable sources. Key components of the plan include: Nuclear phase-out: Germany decided to shut down all its nuclear power plants by 2022; Coal phase-out: Germany is also committed to reducing its dependence on coal, though it faces significant social and economic challenges, particularly for regions reliant on this sector; Expansion of renewable energy: Germany has become one of the largest producers of energy from wind and solar power, (Sacco et al., 2024).

Denmark is recognized as a global leader in wind energy technology and generates a large portion of its energy from wind farms. Some of Denmark's key steps include: Ambitious 2050 goal; Denmark aims to become entirely independent of fossil fuels by 2050, relying mainly on renewable energy sources, particularly wind power; Decentralized energy systems:

Denmark focuses on decentralized energy systems, enabling citizens and small businesses to invest in energy technologies.

Ireland and Spain have made significant strides in implementing solar and wind energy systems. Both countries share the common goal of increasing the share of renewable energy in their total energy production: Ireland is focusing on reducing emissions in transport and households, investing in electric vehicle infrastructure, and expanding solar capacity. Spain has heavily invested in solar energy and aims to increase its renewable energy capacity to 74% of total energy production by 2030.

The USA, one of the largest producers of CO2 emissions, faces substantial challenges in its energy transition. However, after withdrawing from the Paris Climate Agreement under the previous administration, the current administration of President Joe Biden has refocused policy on reducing emissions and increasing the share of renewable energy. Key initiatives include: Solar and wind energy: China, the largest producer and consumer of solar panels, is also a leader in installing wind energy capacity. The country plans to achieve carbon neutrality by 2060, a highly ambitious goal considering its rapid industrial development. Electric vehicles: China is the largest player in the electric vehicle sector and is introducing further incentives to boost production and sales of EVs. Coal and energy security: Although China is investing in renewables, it remains one of the largest consumers of coal. Balancing energy security and emission reduction, particularly in industrial sectors, is a significant challenge (Amin et al., 2024; Movsessian et al., 2025).

India is still in the developmental phase of its energy systems but is increasingly recognizing the need to transition to sustainable energy sources. Given its large energy needs and rapidly growing population, India faces considerable challenges related to energy efficiency and emissions reduction: Solar energy: India has made notable progress in expanding its solar capacity and plans to increase its renewable energy capacity to over 175 GW by 2030. The country is also focusing on decentralized systems and solar energy in rural areas. Coal and sustainability: While India remains dependent on coal for power generation, there is increasing pressure to reduce its reliance on coal by investing more in clean technologies and renewables, (Barragán-Ocaña et al., 2025).

Africa, with its vast natural resources, holds significant potential for renewable energy but faces numerous challenges related to infrastructure and financial resources. Many African countries, such as Kenya and Ethiopia, have already become pioneers in the use of geothermal and hydropower: Solar energy: Africa has enormous potential for solar energy, with countries like Morocco and South Africa investing in large-scale solar farm projects. Many African nations also use decentralized solar panel systems to supply energy to remote and rural areas. Geothermal energy: Kenya stands out as a leader in geothermal energy, with projects providing a significant portion of the country's energy consumption, (Chandra, 2025).

Global experiences in the energy transition show that while this process is long-term and challenging, it is also essential for the future of our planet. Each country faces its own specific challenges, but global cooperation and investment in technology, renewables, and energy infrastructure can help accelerate the transition. The coming decades are expected to be crucial in advancing the energy transition and achieving global climate goals.

3. ANALYSIS OF MODERN AND LATEST ENERGY STRATEGIES IN THE WORLD: CHANGES AND NEW APPROACHES

World energy strategies have developed significantly over the last decades, positioning above all global challenges such as climate change, depletion of fossil fuels, growing energy consumption and the need for sustainable development. The analysis of past and latest energy

strategies is crucial for understanding global efforts to reduce carbon dioxide emissions, transition to renewable sources and ensure energy security. In previous decades, energy strategies around the world were based predominantly on fossil fuels of oil, coal and natural gas. These were the main components of the global energy system during the 20th century and the first decade of the 21st century, (Hassan & Gong, 2025).

Key features of the current strategies include; Energy security: Energy security was a priority, especially in the context of geopolitics and dependence on energy imports. Many countries have been developing strategies to diversify energy supplies, ensure the stability of energy supplies and reduce dependence on politically unstable regions; Centralized infrastructure: Production and distribution of energy in past decades was centralized in large energy systems. National power grids were overloaded, while energy storage capacities were minimal. The use of technologies to optimize energy distribution and energy efficiency was neglected; Focus on fossil fuels: Energy strategies relied on coal, oil, and natural gas because they were relatively cheap, readily available, and in large quantities. Countries invested in the development of infrastructure for the extraction, processing and distribution of these energy sources, and energy production was centralized, with large thermal power plants dominating the markets; Emissions and environmental impact: Climate change and the negative impact of fossil fuels on the environment were not in focus. Emissions of carbon dioxide (CO2) and other pollutants were high, while regulations in many countries were not strict enough to reduce emissions or prevent degradation of natural resources.

In the last decade, energy strategies have shifted to more sustainable and environmentally friendly models, relying on renewable sources, new technologies and global environmental protection goals.

The main features of the new energy strategies include: Transition to renewable energy sources: The biggest change in the new strategies is the transition from fossil fuels to renewable energy sources-solar, wind, hydro, geothermal, and even energy from biofuels. Solar panels, wind turbines and hydroelectric power plants are becoming the dominant sources, and technologies such as energy storage batteries enable the efficient use of these sources. New strategies include the use of decentralized energy production systems, where households and businesses can produce their own energy.

Sustainable energy policy and emission reduction: Climate change has become a central factor in the formulation of new energy strategies. Global goals like the Paris Agreement have set ambitious plans to reduce carbon dioxide emissions. Many countries, including the EU, China, the US and others, have set targets to reduce CO2 emissions, increase the share of renewable energy sources and achieve "zero emissions" in the medium term. The EU plans to achieve net zero CO2 emissions by 2050, and China by 2060 years.

Energy storage technologies and hydrogen: The development of efficient energy storage technologies, such as lithium batteries and hydrogen-based technologies, has become crucial to the success of new strategies. Energy from renewable sources is often continuous and varies during the day and seasons, and the ability to store energy allows continuity of supply. Hydrogen as an energy carrier is increasingly seen as a potential solution for sectors such as industry and transport.

Smart grids and digitization of energy systems: Infrastructure modernization through the development of smart grids and digital energy management systems has become crucial. Smart grids enable optimization of energy distribution, better integration of renewable sources and reduction of energy losses. Also, advances in artificial intelligence (AI) and the Internet of Things (IoT) enable automatic adjustment of energy consumption in real time.

Energy as a service and energy independence: The new energy strategy also focuses on greater access to energy for wider social groups. The concept of "energy independence" allows

communities to take control of their own energy production and distribution, thereby reducing energy dependency and increasing availability. Also, programs for energy efficiency in industry and everyday life are increasingly applied.

When analyzing the differences between the current and the latest energy strategies in the world, realistically new directions that will be implemented in the near future can be transparently positioned. It should be noted that energy strategies in most of the world's countries are mostly specific, appropriate to their own energy realities and realities with similar and almost at the same time common final goals and outcomes. Countries like the USA and China have the latest energy strategies of their own, and they in a certain way represent new strategic challenges both for them and for the entire world energy sector.

Climate goals: Previous strategies did not have a strong environmental component, while the latest strategies focus on reducing carbon dioxide emissions, reducing global warming, and protecting the environment. Global goals such as the Paris Agreement have set new standards for reducing emissions and transitioning to clean energy sources.

Energy sources: Previous strategies were largely based on fossil fuels, while new strategies recognize the need to switch to renewable sources. This transition is not only justified ecologically, but also becomes economically justified, considering the drastic drop in prices of technologies for the production of solar and wind energy.

Decentralization and c autonomy: Old energy strategies were directed towards centralized energy production and distribution, while new strategies are increasingly based on decentralization. This approach enables a greater degree of energy autonomy and reduces the risks associated with centralized systems.

Technology and innovation: While previous strategies focused on infrastructure projects that relied on existing technologies, new strategies use innovations in energy storage technologies, digitization and smart grid integration. These technologies enable greater efficiency and integration of renewable sources into the energy system.

Environmental aspect and sustainability: Old energy strategies neglected long-term environmental consequences, while new strategies have a clear focus on sustainability and environmental protection. Green plans and international agreements, such as the Paris Agreement, directly influence the shaping of modern energy policies that promote cleaner energy and reduce pollution.

The difference between the old and new energy strategies in the world is not only in technology and energy sources, but also in the philosophy of approach. While the old strategies were based on the economics of mass production and energy consumption, the new strategies are directed towards sustainability, energy efficiency and reducing the impact on the environment. Given the global challenges, such as climate change, the depletion of fossil fuels and energy resources, new approaches lay the foundations for a more secure and sustainable energy future, (Gajdzik et al., 2024).

4. NEW TRENDS IN GLOBAL ENERGY SECURITY

Global energy security has become a key issue in the modern world due to increasing challenges related to energy resources, changes in geopolitics, the development of new technologies and the need for sustainable development. In recent decades, energy security has been developing in the context of new trends that significantly affect global energy dynamics. Some of those trends are listed in the further part of the paper, (Ibekwe et al., 2024).

Decarbonization and transition to renewable energy sources: One of the most important trends is the global effort to reduce dependence on fossil fuels (such as oil, gas and coal) and switch to renewable energy sources (RES), such as solar, wind and hydropower. The goal of

reducing carbon dioxide emissions and achieving sustainable climate goals poses new challenges, but also opportunities for energy security. This trend leads to:

Greater diversification of energy sources: Using different renewable sources reduces dependence on a single source, thus increasing the stability and resilience of the energy system.

New energy storage technologies: The development of high-capacity batteries and other energy storage technologies is becoming crucial for the integration of unstable renewable sources (wind and solar) into the energy system.

Geopolitical dynamics and energy crises Geopolitical uncertainty, such as the war in Ukraine, sanctions against Russia, tensions in the Persian Gulf and trade disputes, significantly affect energy flows. In the last period it became clear that:

Increased need for energy diversification: Countries are looking for alternative energy sources and reducing dependence on one or a few suppliers. For example, European countries are increasingly turning to LNG (liquefied natural gas) from other countries (such as the US, Qatar, etc.) while also investing in renewables and nuclear power.

Energy diplomacy and strategic alliances: Countries are looking for ways to align their energy policies with strategic partners to ensure long-term energy security. Also, interest in energy resources in the Arctic and other geopolitically sensitive areas is increasing.

Energy transition and decentralization of energy production. The transition to clean energy leads to the development of decentralized energy production systems:

Distributed energy systems: Home solar panels, small wind turbines, battery storage systems and smart grids allow consumers to become energy producers as well. This trend reduces the need for large centralized plants, reduces distribution losses and increases resilience to energy supply shocks.

Smart technologies: Smart networks use advanced technology to monitor, control and optimize energy consumption and distribution. They enable more efficient operation of the energy infrastructure and better integration of renewable sources.

Nuclear energy as a viable option. Although the public occasionally opposes nuclear power due to safety concerns, there has been a resurgence of interest in nuclear power in recent years, particularly in the context of energy security and climate change. Nuclear energy offers advantages:

Stability and low carbon dioxide emissions: Nuclear power plants provide stable and emission-free energy that can help balance a system with a large share of renewable sources.

New generations of nuclear reactors: Small modular reactors (SMRs) and advanced technologies can make nuclear power safer and more economical, making it more attractive to many countries.

Increased role of energy efficiency: Energy efficiency becomes an important factor in ensuring energy security. Given the increase in energy consumption and the need to reduce carbon dioxide emissions, energy-saving strategies are becoming crucial for long-term development:

Energy efficiency in industry and transport: Many industrial and transport technologies are being improved to reduce energy consumption.

Green cities and sustainable infrastructure: Urban areas are becoming key foci for the implementation of energy-efficient solutions, such as smart buildings, green transport networks and energy-efficient heating and cooling systems.

New forms of energy cooperation and trade: World energy markets are becoming more and more connected, and international cooperation is becoming crucial for energy strategies. New forms of trade and infrastructure include:

Regional energy blocs: Taking into account technical and economic advantages, many countries are joining regional energy communities that facilitate energy trade and improve security of supply.

Hydrogen trade: This energy source, considered key to the decarbonisation of heavy industry and transport, is becoming an important part of international energy markets. The infrastructure for the production, storage and distribution of hydrogen is rapidly developing.

Digitization and cyber security in the energy sector. As energy systems become increasingly digitized and connected, protection against cyber attacks becomes critical for energy systems. New trends include:

Integration of advanced IT solutions: Digitization of the energy network enables better monitoring of consumption, optimization of resources and more accurate forecasting of consumption.

Infrastructure cyber protection: Protection against cyber/attacks on energy systems becomes crucial, as attacks can cause major disruptions in energy supply and have long-term economic consequences.

Global energy security is increasingly evolving within new trends that include de carbonization, decentralization, geopolitical changes, technological innovation, and changes in energy infrastructure. Countries and international organizations face challenges that require integrated strategies to ensure a stable and sustainable energy supply. Understanding and adapting to these trends will be key to the future of global energy security, (Kim et al., (2025).

5. RISK SYNERGY IN THE GLOBAL ENERGY TRANSITION- STRATEGIC AND SECURITY PERSPECTIVES

Analyzing the synergy of risks in the context of energy transition, energy strategies and energy security in the world is a complex and demanding process, which requires knowledge of various aspects of energy, politics, technology, economy and international relations. In this context, we can identify key points of synergy of risks that may appear in the process of energy transition, as well as their impacts on energy strategies and global energy security. The energy transition represents the transition from traditional sources of energy, such as fossil fuels (coal, oil, gas), to sustainable sources of energy, such as renewable sources (solar, wind, hydro, geothermal energy) and nuclear energy. Although this transition is considered necessary to reduce carbon dioxide emissions and fight climate change, it carries certain risks, (Li et al., 2024). Risks of energy transition: Technical uncertainty: Many new technologies, such as energy storage (batteries), smart grids and infrastructure renewal, are still in the development or deployment phase. Their scalability, efficiency and security remain uncertain. Economic risks: Energy transitions require huge investments. Countries and companies unwilling to invest in new technologies may face significant economic problems, including reduced competitiveness, job losses in fossil fuel-dependent industries, and economic uncertainty during the transition period. Political risks: Changes in energy policies may be viewed unfavorably by interest groups dependent on fossil fuels. Also, international tensions over control of resources and technologies can cause political disagreements and trade wars, (Koval et al., 2025).

Synergy of risks in energy strategies: Developing strategies for the energy transition must take into account the interconnectedness of different types of risks and how they can reinforce or mitigate each other. Risk synergy occurs when the combination of different risks creates greater threats or challenges than if they were acting individually. Risk of energy shortages and economic instability: If energy strategies do not provide stable and affordable energy sources during the transition, energy shortages may occur that cause economic problems, especially in countries that rely on fossil fuels or have weak renewable infrastructure.

Geopolitical instability and energy security: Dependence on certain energy sources, such as oil and natural gas from politically unstable regions, can lead to geopolitical risks. Combined with global pressures to reduce emissions, conflicts over resources and technologies may arise. Risk of job loss and social instability: The energy transition can lead to job cuts in traditional industries such as coal mining and the oil industry. If social policies and workforce training are not effective, it can cause social unrest and undermine political stability in many countries, (Radosavljević et al., 2009; Radosavljević et al., 2013).

In order to minimize the risks associated with the energy transition, governments and international organizations must develop strategies that include the recognition and mitigation of risk synergies. This may include: Policies that promote cooperation and coordination: Given the global character of the energy transition, cooperation between countries and sectors becomes crucial. These include international agreements to reduce emissions, joint investments in research and development of new technologies, as well as the development of joint crisis management strategies. Innovation in energy efficiency technologies: Encouraging research and development in energy efficiency and new forms of energy storage can reduce the risk of supply instability. Approaches that include social justice: Developing policies that help workers and communities affected by the transition can reduce the risk of social unrest and enable a balanced transition to sustainable energy sources, (Radosavljević et al., 2022).

The potential synergy of risks in the context of energy transition, energy strategies and energy security in the world is complex, but can be mitigated through careful planning, global cooperation and the development of flexible, more resilient energy systems. Understanding the interconnectedness of risks and responding to challenges in a timely manner are key to ensuring a sustainable energy future, (Radosavljević et al., 2009).

6. RESULTS AND DISCUSSION

Research shows that the energy transition, although crucial for reducing emissions and sustainability, brings challenges in terms of energy security. Countries that successfully combine renewable sources with stable fossil fuel reserves currently have the highest level of security of supply. Conversely, a rapid and unplanned transition can cause instability, especially in countries dependent on energy imports. Therefore, it becomes crucial to develop balanced energy mixes. Serbia strives to shape its energy mix in the new global conditions and increase its energy sovereignty. Based on the analysis of global experiences and modern energy strategies, several key guidelines have been identified that can contribute to the successful management of the energy transition: Long-term and integrated strategies; International cooperation; Diversification of energy sources; Digitization and modern infrastructure; A just transition; Energy efficiency and innovation and Cyber security and system resilience. These guidelines indicate the need to balance environmental goals, energy security and social sustainability. They are explained in more detail in the previous part of the paper. Their application can significantly contribute to a successful and stable energy transition at the global level. Global energy security depends on international coordination, technological progress and adapted local policies, while geopolitical tensions emphasize the need to diversify sources and strengthen cooperation.

7. CONCLUSION

The energy transition is a complex but necessary process that has long-term consequences for the environment, economy and society as a whole. The transition to sustainable and renewable energy sources, as well as strengthening resistance to energy shocks,

are key goals of modern energy policy. In this context, the development of national and global energy strategies is essential for achieving the goals of the energy transition. These strategies must be comprehensive, long-term and flexible, bearing in mind that the energy sector requires significant capital investments and technically complex changes that cannot be realized in a short period of time. However, the energy transition is not without its challenges. Risks concerning global energy security are becoming more pronounced, especially when it comes to dependence on certain technologies and global supply chains, which can pose a serious threat to the stability of the energy system. These risks include not only the physical availability of energy sources, but also political security in their delivery. The energy transition, along with the development and implementation of smart and adaptive strategies, is the path to a sustainable energy future. Nevertheless, this process carries with it certain risks that must be proactively managed and reduced to acceptable thresholds, in order to ensure the long-term stability and security of the energy system.

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