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INVESTMENT ACTIVITY IN RENEWABLE ENERGY AS A COMPONENT OF ECONOMIC SECURITY

Investment in renewable energy strengthens economic security by diversifying energy sources, reducing dependence on imports, and fostering sustainable development. The transition to renewable energy sources (RES) is a priority for many countries, ensuring energy independence and mitigating environmental harm. Green investments have gained importance amid global energy instability, climate change, and economic risks. Developing RES requires substantial financial resources, making an attractive investment climate and effective financial mechanisms essential. Global challenges such as the energy crisis, geopolitical tensions, and resource depletion accelerate the search for alternatives. Governments, financial institutions, and private investors play a key role in expanding the sector, but investment levels depend on regulatory policies, tax incentives, and technological advancements that improve efficiency and cost-effectiveness. This article examines investment trends in renewable energy and their impact on economic security. It analyzes global and national investment dynamics, highlighting key drivers and obstacles. The main sources of financing—state subsidies, private capital, international grants, and public-private partnerships—are explored. Special attention is given to investment stimulation mechanisms, such as preferential loans, green bonds, and carbon credit systems. Key factors influencing investment growth, including government policies, tax incentives, and technological innovation, are identified. State support, such as feed-in tariffs and investment guarantees, significantly impacts investor decisions. Advancements in energy storage, smart grids, and

hydrogen energy enhance RES attractiveness. The role of financial institutions in sustainable investment, including green funds and ESG criteria, is also discussed. The article examines debt financing in the energy sector and sustainable financial structures. The growing share of green bonds and climate-related financial instruments reflects increasing commitments to renewable energy. The risks and benefits of financing models, such as project financing and venture capital, are assessed. Investing in renewable energy reduces environmental impact while enhancing social security and economic stability. This sector fosters social entrepreneurship, creating jobs and supporting sustainable development through innovation and international cooperation. The findings support strategies to attract investment and strengthen Ukraine's energy security. Expanding RES and adapting international best practices are crucial for a resilient and sustainable energy system.

Keywords: *renewable energy, investment activity, economic security, sources of financing, sustainable development, social protection, social entrepreneurship, instability.*

Statement of the problem. Investment activity is a key driver of renewable energy development and sustainable economic growth. In the current context of global climate change and energy challenges, the role of investment in this area is growing. Renewable energy is becoming a strategic direction of economic policy in many countries, including Ukraine, which requires the development of an effective investment model [1]. Despite the growth in renewable energy investments, Ukraine faces challenges in attracting long-term capital due to macroeconomic risks and regulatory barriers. In the context of post-war recovery, the country needs mechanisms to stimulate investment activity that would facilitate integration into the European energy market and increase energy security [2].

Analysis of recent publications. Different aspects of renewable energy development and investment activity have been studied by domestic and foreign scientists. In particular, the issues of investment attractiveness of the energy sector were considered by Pidlisna O.A., Chepizhko L. M. [3], Slavkova A., Kolisnyk D. [4]. The theoretical foundations for the formation of mechanisms for attracting investment in renewable energy were studied by Palasevych M., Luchakivskyi A. [5], Melnikov I. [6]. The impact of investment processes on the energy sector was analysed by Sheverdin O. [7], Zhuravel M. [8] and others.

Unsolved parts of the problem. Despite the significant scientific achievements in the field of renewable energy investment, the development of effective investment policy strategies in the context of Ukraine's post-war recovery remains insufficiently studied. In particular, the issues of adapting international financial mechanisms, introducing public-private partnership instruments, and integrating Ukraine into global energy markets require further analysis.

The purpose of the article is to improve the scientific and methodological foundations for stimulating investment activity in the field of renewable energy as a key factor of sustainable economic development and security. The object of the study is the investment environment in the renewable energy sector, which plays a crucial role in ensuring Ukraine's energy security and post-war economic recovery.

To achieve this goal, the study addresses the following objectives:

- analyse global trends in investment activity in the renewable energy sector;
- developing recommendations on financial instruments to stimulate long-term investment in renewable energy.

Research methodology. The methodology for studying investment activity in renewable energy as a component of economic security is based on an integrated approach that combines

theoretical, empirical and analytical methods. The study is based on a systematic analysis that allows us to consider the relationship between investment and sustainable economic development and energy security, which makes it possible to comprehensively assess the processes that determine the development of renewable energy and formulate sound recommendations to ensure its effective functioning in the context of economic security.

Research findings. Investment activity in renewable energy plays an important role in ensuring sustainable economic development and energy security. Increased investment in renewable energy sources helps to reduce dependence on fossil fuels, reduce greenhouse gas emissions and create new jobs. Recent decades have seen a rapid increase in financing for clean energy projects, driven by both government incentives and growing interest from private investors.

The global energy sector is undergoing an active transformation, driven by the growing demand for clean energy and policy initiatives aimed at reducing dependence on fossil fuels. Investment flows in renewable energy are showing steady growth, outpacing traditional energy sources. Figure 1. shows a comparison of clean energy and fossil fuel investments for the period 2018-2024, which will allow us to assess the scale of changes in the global energy sector financing structure.

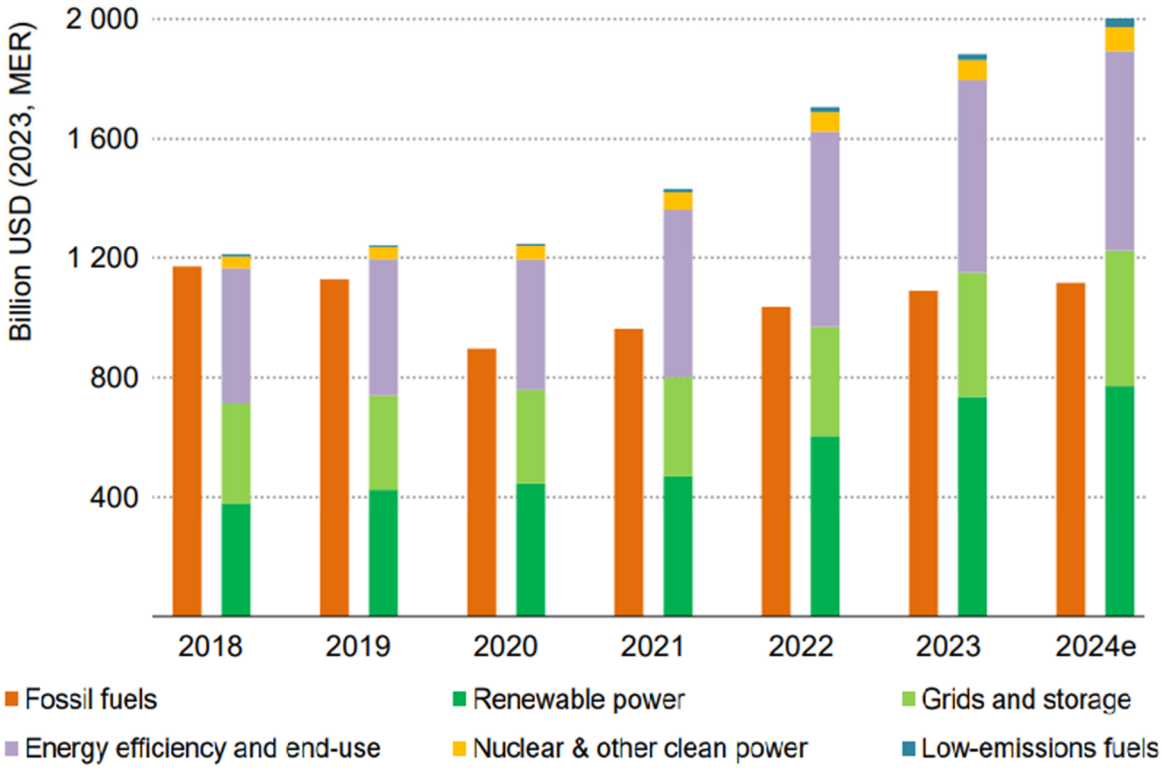

Figure 1. Global investment in clean energy and fossil fuels, 2018-2024e*

Source: Compiled by the authors based on [9].

Overall, global investment in renewable energy showed a steady upward trend during the period under review. Investment in clean energy has accelerated since 2020, and spending on renewable energy, networks and storage now exceeds the total spending on oil, gas and coal.

This trend can be explained by several key factors. In particular, it is worth noting the easing of supply chain pressures and falling prices. The cost of solar panels has fallen by 30% over the past two years, and the prices of minerals and metals crucial to the energy transition have also

plummeted, especially for metals needed for batteries. Experts estimate that investments in clean energy will approach USD 320 billion by 2024, which is more than 50% more than in 2020 [9]. Growth in renewable energy investments accounts for almost half of all investments in the energy sector in developed economies. Progress in India, Brazil, some parts of Southeast Asia and Africa is linked to government policy, public procurement and improved grid infrastructure. Africa's clean energy investments in 2024 amounted to more than USD 40 billion, almost double the amount in 2020.

Investment flows are mainly directed towards solar and wind energy, with solar accounting for the largest share. Investments in solar PV systems currently exceed investments in all other technologies combined, and this upward trend is continuing, as shown in Figure 2.

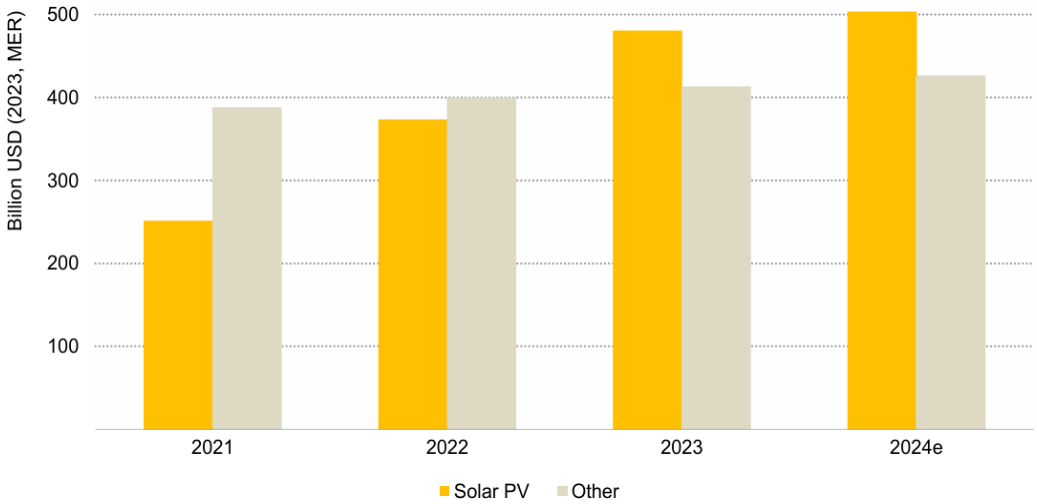

Figure 2 Global annual investment in solar PV and other generation technologies, 2021-2024e*

Source: Compiled by the authors based on [9].

*2024e = estimated values for 2024

This growth can be attributed to several important factors. The steady decline in the cost of solar PV technologies has made them more cost-effective and attractive for investment. Lower prices for solar panels, inverters, and other key components have significantly reduced the overall cost of projects, which has increased their profitability. Growing global awareness of environmental issues and the need to address climate change have led governments and businesses to actively support clean and renewable energy sources. Solar energy, as an affordable and clean source of energy, has received widespread support through policies such as feed-in tariffs, tax breaks and subsidies, which has further stimulated investment in solar PV.

An analysis of the sources of financing for the energy sector will allow us to assess the sustainability of investment flows and identify the main players providing financing for renewable energy projects (Figure 3).

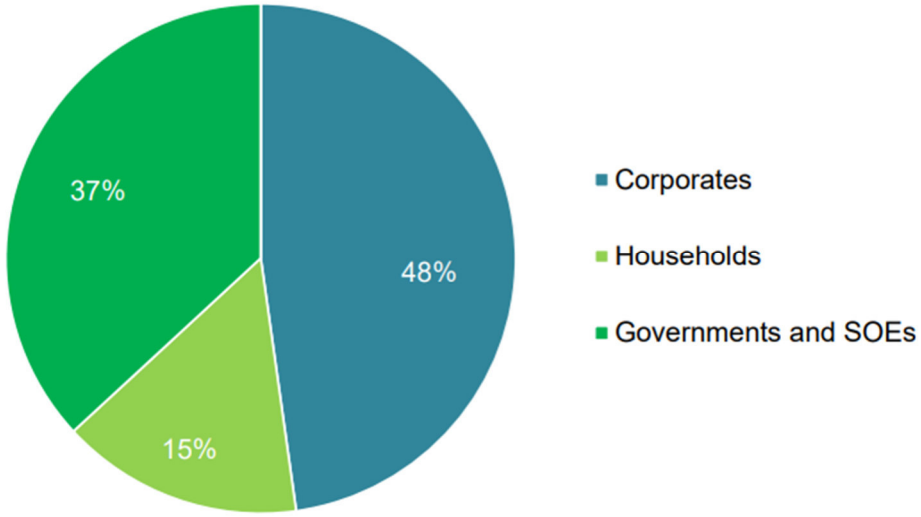

Figure 3 Sources of investment in the energy sector, average 2018-2023
Source: Compiled by the authors based on [9].

As shown in Figure 3, the main sources of investment in the energy sector are corporate funds (48%), but a significant share of funds also comes from households and the public sector. This financing structure indicates the need to diversify financial instruments to attract additional capital to the clean energy sector.

Sources of financing for the energy sector are also important for assessing the risks and opportunities for renewable energy development (Figure 4).

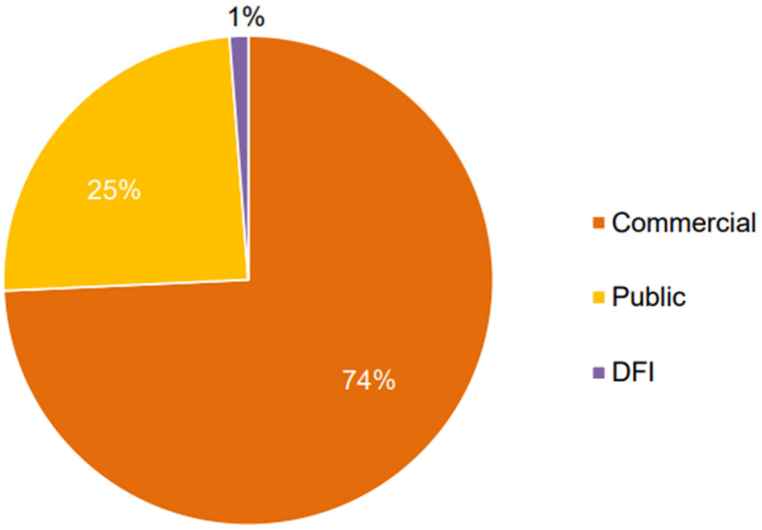

Figure 4 Sources of finance in the energy sector, average 2018-2023
Source: Compiled by the authors based on [9].

It is important to note that over 70% of funding comes from the private sector, which confirms the high level of business interest in clean energy projects. At the same time, the public sector continues to play a significant role in stimulating investment through direct subsidies and creating favourable conditions for the development of new technologies. Thus, investment strategies and the ability of public authorities to attract private capital are central to a safe and affordable transition to renewable energy.

Assessing the level of debt financing in different segments of the energy sector will help determine the level of risks and financial obligations associated with project implementation (Figure 5).

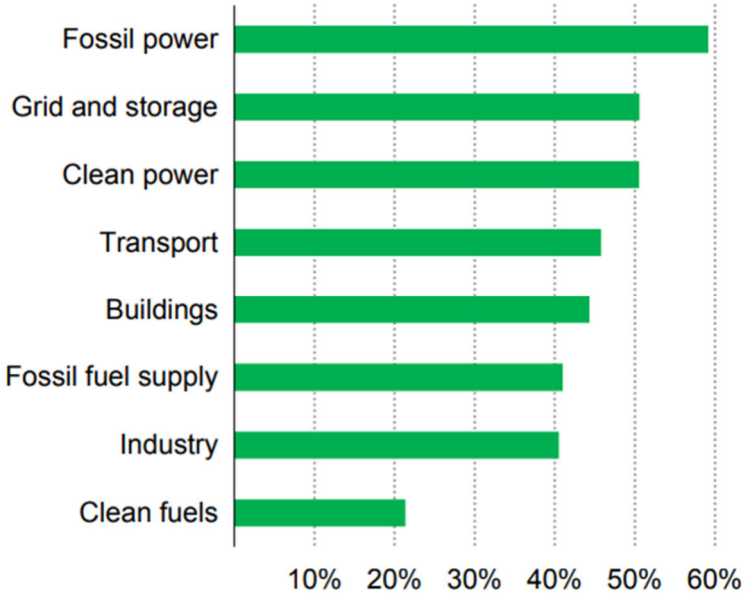

Figure 5 Debt share by energy assets, 2018-2023
Source: Compiled by the authors based on [9].

The largest share of debt is associated with conventional fossil fuel energy (Fossil power), exceeding 50%, indicating significant financial commitments in this sector (Figure 5). Grids and storage, as well as clean energy, also account for a significant portion of the debt, reflecting the importance of investments in infrastructure modernisation and the transition to renewable energy sources. Debt in the transport, buildings and industry sectors is in the middle, reflecting the need to finance projects to decarbonise these sectors. Clean fuels account for a relatively smaller share of debt, which may indicate a lower level of investment in the development of alternative fuels compared to other energy sectors. Overall, the chart highlights the significant financial commitments related to both conventional energy, which indicates an increased focus on sustainable development projects.

The sustainable development of the energy sector also depends to a large extent on the use of modern financial instruments (Figure 6).

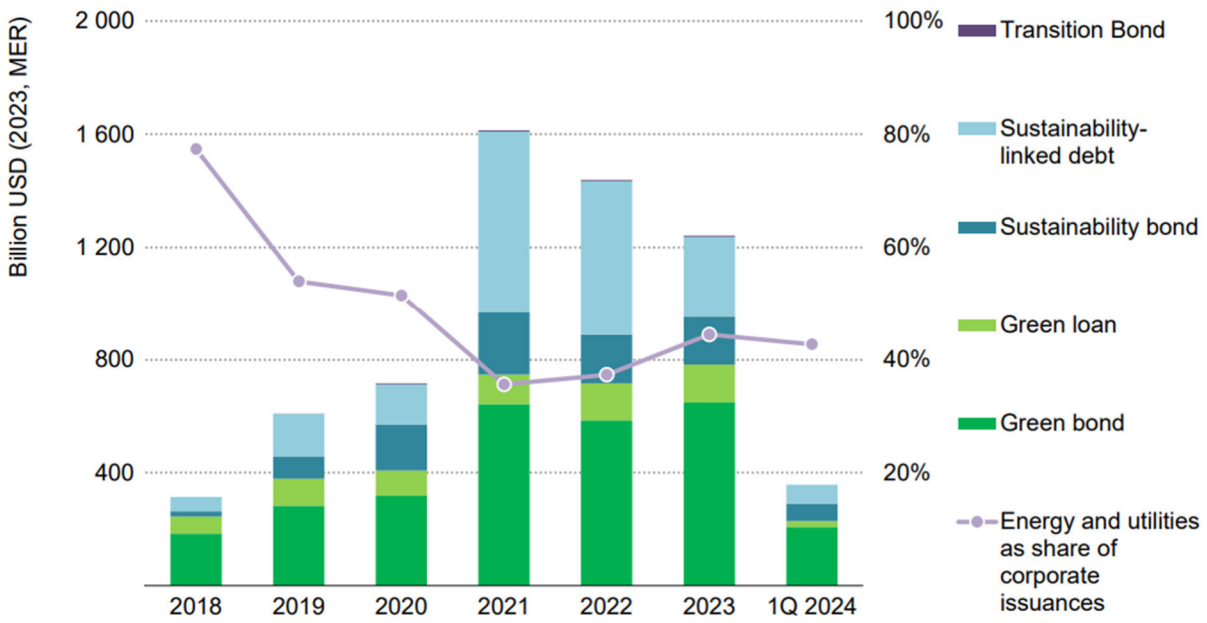

Figure 6 Sustainable debt issuances by type, 2018-2024
Source: Compiled by the authors based on [9].

The total volume of green bonds, loans, and other sustainable finance instruments issued has been increasing markedly since 2018, peaking in 2021 and then declining (Figure 1.6). Green bonds make up the bulk of the structure, but their share varies by year. Sustainability bonds and sustainability-linked debt instruments make a significant contribution, reflecting the growing interest in sustainable finance. The purple line shows the share of the energy and utilities sector in total corporate bond issuance, showing a decline from 2018 to 2021 and then stabilising at around 40%. In 2024, a relatively low volume of issuance was recorded compared to previous years, which may be due to macroeconomic factors or a change in investment priorities.

The dynamics of global investment in the energy sector will help identify key trends in the industry (Figure 7).

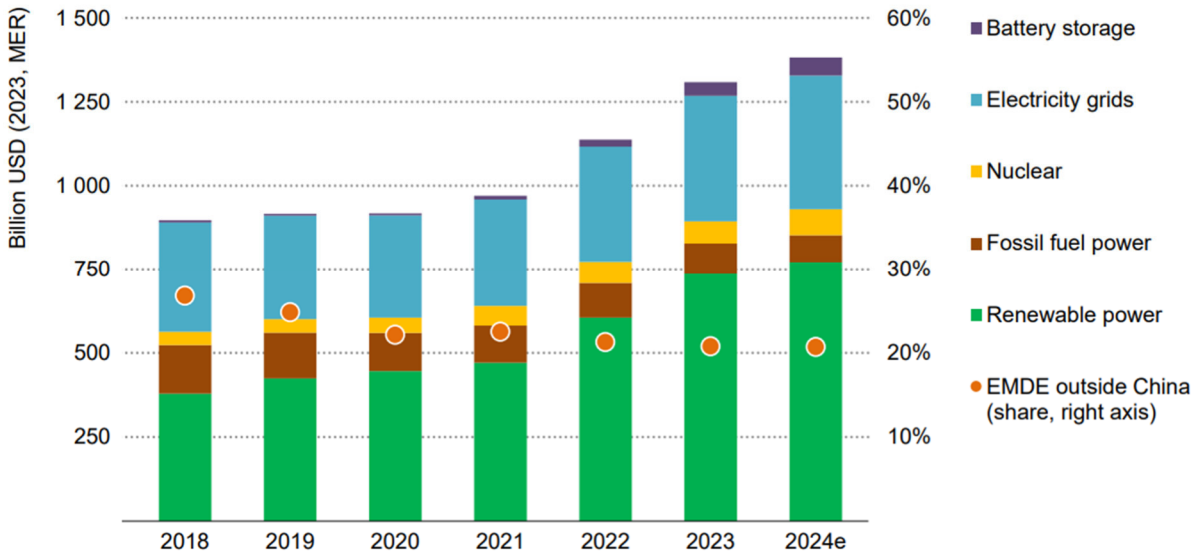

Figure 7 Sustainable debt issuances by type, 2018-2024

Source: Compiled by the authors based on [9].

Figure 7 shows the dynamics of global energy investment from 2018 to 2024. The total volume of investments shows a steady growth, especially noticeable after 2021. The largest share is accounted for by investments in renewable energy, reflecting the global trend towards the transition to clean energy sources. Significant investments are being made in the development of electricity grids due to the need to modernise infrastructure to integrate renewable energy sources. Investments in fossil fuels remain relatively stable, but their share is gradually declining. In recent years, there has been an increase in investment in nuclear power and energy storage systems, reflecting the desire to ensure a sustainable energy supply. The orange dots in the graph indicate the share of investment in emerging economies (excluding China), which has remained stable with little fluctuation. Overall, these trends are evidence of a global shift towards sustainable energy sources.

In addition, improvements in energy storage and smart grid technologies have increased the stability and reliability of renewable energy supply, making it even more attractive to investors. Going forward, amid growing global efforts to combat climate change and ongoing technological advances in renewable energy, international investment in the sector is likely to continue to grow, playing an even more important role in accelerating the global energy transition and sustainable development.

Thus, a high level of investment activity will contribute to strengthening economic security, which will allow diversifying energy sources, reducing dependence on imported energy and stimulating technological development.

In turn, government policy should also be aimed at stimulating investment. A clear renewable energy development strategy, effective regulation and transparent procedures for attracting investors will help to increase confidence in the sector. In addition, modernisation of energy infrastructure, support for research, and promotion of local equipment manufacturing will help create a sustainable economic model focused on innovation and environmental safety.

One of the key mechanisms for attracting investors is the introduction of tax incentives, which may include tax cuts, tax holidays and reduced customs duties on renewable energy equipment. At the same time, it is important to develop economic support mechanisms, such as:

Fiscal incentives: significant upfront investment subsidies should be provided to investors in renewable energy to overcome high start-up costs. Tax incentives, such as reduced or exempt income tax and value added tax for renewable energy companies, can significantly increase the profitability of investments. In addition, governments should provide reliable guarantees for green bonds, reducing issuance costs and facilitating the growth of the sector.

Political support: energy suppliers should be obliged to include a minimum share of renewable energy in their supply portfolios to stimulate production. Simplification of the approval process by reducing bureaucracy and shortening project implementation time will help to further develop renewable energy. Long-term power purchase agreements between governments, large energy consumers and producers can provide stable revenue streams, encouraging investment. Governments should also implement short- and long-term policies, evaluate their effectiveness, and strengthen financial support, regulatory frameworks, and technological innovation.

Technology research and development (R&D): public funding for R&D in the renewable energy sector is crucial to improve efficiency and reduce costs. Establishing technology transfer platforms can facilitate the adoption of advanced technologies in enterprises and regions.

Increased investment in R&D and the development of effective platforms can improve technical capabilities and expand the use of renewable energy technologies.

Financial innovations: the creation of investment funds in the renewable energy sector attracts social capital and supports various projects. Crowdfunding and impact investing models can engage the public and diversify funding sources, contributing to sustainable development.

Education and training: comprehensive training on renewable energy markets, technologies and investment strategies is vital for investors and practitioners. The inclusion of renewable energy topics in school curricula helps to raise environmental awareness and prepare future investors. Establishing specialised research institutes can foster innovation, and cooperation with international organisations can facilitate the exchange of best practices and global collaboration.

Public outreach and information: media campaigns should highlight the benefits and investment opportunities of renewable energy to raise public awareness and perceptions. Organising seminars and forums can facilitate communication and cooperation with investors. Dedicated renewable energy investment platforms can provide information on projects, policy updates and technological advances, facilitating connections between investors and developers.

Improving infrastructure: modernising the power grid is essential for the efficient transmission and distribution of renewable energy, reducing losses and costs. Investments in advanced energy storage technologies, such as solid-state and flow batteries, can improve stability and availability. Collaborative efforts between governments, industry and academia are vital to drive innovation and accelerate deployment.

Conclusions. The global world is facing numerous environmental and economic challenges that require changes in approaches to energy production and consumption. Renewable energy has become one of the key drivers of sustainable development, and investment activity in this area is becoming increasingly important. Investments in renewable energy sources not only help reduce greenhouse gas emissions, but also create new jobs, stimulate economic growth and ensure energy security.

Stimulating investment activity in the renewable energy sector not only contributes to reducing environmental impact but also strengthens social security and economic stability. Investments in this sector support social entrepreneurship, creating new jobs and contributing to sustainable development at both global and local levels. A comprehensive approach to supporting innovation, international cooperation, and public policy fosters the creation of a favourable investment environment, ensuring the stable development of the energy sector and social stability.

In order to achieve effective results, it is necessary to create a favourable investment environment, develop international cooperation and stimulate technological innovation.

In summary, stimulating investment activity in the renewable energy sector is a necessary step to strengthen economic security, and a comprehensive approach, including tax incentives, financial support, effective government policy and international cooperation, will create a stable investment environment and ensure the sustainable development of the energy sector.

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ІНВЕСТИЦІЙНА АКТИВНІСТЬ У ВІДНОВЛЮВАНІЙ ЕНЕРГЕТИЦІ ЯК СКЛАДОВА ЕКОНОМІЧНОЇ БЕЗПЕКИ

Інвестиційна активність у відновлюваній енергетиці відіграє ключову роль у зміцненні економічної безпеки держав, оскільки сприяє диверсифікації енергетичних джерел, зниженню залежності від імпортних енергоносіїв та створенню стійких економічних моделей розвитку. Сучасні глобальні виклики, пов'язані з енергетичною кризою, екологічною нестабільністю та економічними ризиками, вимагають підвищеної уваги до формування сприятливого інвестиційного середовища у секторі "зеленої" енергетики. У статті досліджено тенденції інвестиційної активності у сфері відновлюваної енергетики та її вплив на економічну безпеку держави. Проаналізовано основні джерела фінансування та механізми стимулювання інвестицій у чисту енергетику. Визначено ключові чинники, що сприяють зростанню інвестицій у відновлювані джерела енергії, зокрема державні політики, податкові стимули та розвиток технологій. Окрему увагу приділено аналізу боргового фінансування енергетичного сектору та структурі сталого фінансування. Отримані результати можуть бути використані для розробки ефективних стратегій залучення інвестицій та покращення політики енергетичної безпеки України.

Ключові слова: *відновлювана енергетика, інвестиційна активність, економічна безпека, джерела фінансування, сталий розвиток, соціальний захист, соціальне підприємництво, нестабільність.*