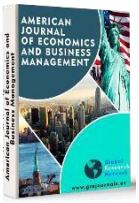

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Article

Analysis of The Global Experience of Increasing The Investment Attractiveness of Energy Enterprises

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Abstract: This article examines the international experience of increasing the investment attractiveness of energy enterprises and the possibility of adapting it to the domestic economy. Special attention is paid to the practice of countries such as China, India and the countries of the Asia-Pacific region. It is emphasized that the formation of an efficient and sustainable energy sector is possible only with the implementation of comprehensive reforms based on the analysis of advanced foreign approaches. This will not only meet the growing energy needs of the population, but also ensure stable economic development of the country in the long term.

Keywords: Investments, Global Investments, Environmentally Friendly Technologies, Investment Attractiveness, Hydrogen Energy, Innovation, Energy Conservation, Energy Security

1. Introduction

Current trends in the development of global energy require an increase in the investment attractiveness of industry enterprises, since it is investments that play a key role in modernizing production facilities, introducing innovative technologies, and transitioning to sustainable energy supply [1]. In the context of increasing demands for environmental safety, energy efficiency and digitalization, it is especially important to study foreign experience, where effective mechanisms for attracting investments in the energy sector have been formed. The analysis of global practices makes it possible to identify successful models of interaction between the state and the private sector, the use of fiscal and financial incentives, as well as the creation of a favorable institutional environment [2]. This knowledge is of significant value for adaptation and application in domestic realities, where the development of the energy industry remains a strategic priority. In this context, the study of international experience and its transformation, taking into account national conditions, is a prerequisite for the formation of a sustainable and competitive energy infrastructure [3], [4], [5].

Global practice demonstrates that increasing the investment attractiveness of energy sector enterprises is possible only if comprehensive and thoughtful reforms are carried out. Leading countries such as the European Union, the United States, China, and others have successfully implemented public-private partnership models, developed green financing tools, and applied economic mechanisms to ensure the return of invested funds and stimulate investment activity [6], [7]. These steps contributed not only to attracting capital,

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but also to the active development of the energy sector, increasing its efficiency and the transition to an environmentally sound production model.

2. Materials and Methods

The methodological basis of this study is made up of scientific works by both domestic and foreign authors, which highlight various aspects of stimulating investment activity in the industrial sector. In the course of the work, the current regulatory legal acts, industry regulations and materials of scientific and practical conferences concerning the problems of attracting investments were also analyzed. The study was based on the principles of a systematic approach, which ensured a comprehensive examination of the object. To achieve these goals, methods such as logical, comparative and statistical analysis were used, which allowed for a deeper assessment of patterns and trends in the field under consideration.

3. Results and Discussion

Depending on the prevailing source of electricity generation, the countries of the world can be roughly divided into several categories. The first group includes States in which the majority of electricity is generated by thermal power plants. These are, first of all, Russia, the USA and Western European countries, where natural gas, fuel oil and coal are actively used as fuel. The second group includes countries such as China, Australia, Mexico, Romania, the Netherlands and Poland, whose energy system is also focused on gas generation, but with a lower proportion of hydrocarbons used in traditional thermal power plants. The third group consists of States that actively use water resources. These include Brazil, Colombia, Kenya, Honduras, New Zealand, Austria, and Paraguay [8], [9]. Their energy balance is formed largely due to the operation of hydroelectric power plants. The fourth category includes countries that rely on nuclear energy, including Japan, France and Belgium. Their electricity production is largely based on the use of nuclear technology.

Today, the world leaders in terms of electricity generation are China, the United States, the Russian Federation and Brazil [10].

In 2024, the volume of global investments in the energy transition reached a record high of 2.1 trillion dollars, which is 11% higher than in the previous year. Mainland China has regained its leading position, accounting for about two-thirds of the global investment growth in this sector. Significant growth was also observed in the clean energy segment: investments in the development of global supply chains in this area amounted to about $ 140 billion. The total amount of financial resources, including both borrowed and own funds, aimed at implementing initiatives in the field of climate sustainability and energy transition, amounted to $1.06 trillion in 2024. Special attention is being paid to energy storage — this year the volume of investments in this sector increased by 36%, reaching 53.9 billion dollars [11], [12]. The clean transportation sector also showed significant growth: the volume of investments in the purchase of zero-emission vessels increased fourfold compared to the previous year, amounting to 452 million. dollars, despite the fact that the share of such shipments remains insignificant.

In 2024, the opposite results were observed in other sectors.:

a. Investments in nuclear energy have not changed and amounted to $ 34.2 billion.
b. Electricity production fell by 5.2% to $77 billion.
c. The costs of CCS and the environmentally friendly industry have halved, to 6.1 billion and 27.8 billion dollars, respectively, see Figure 1. Investments in hydrogen energy decreased by 42% to 8.4 billion.

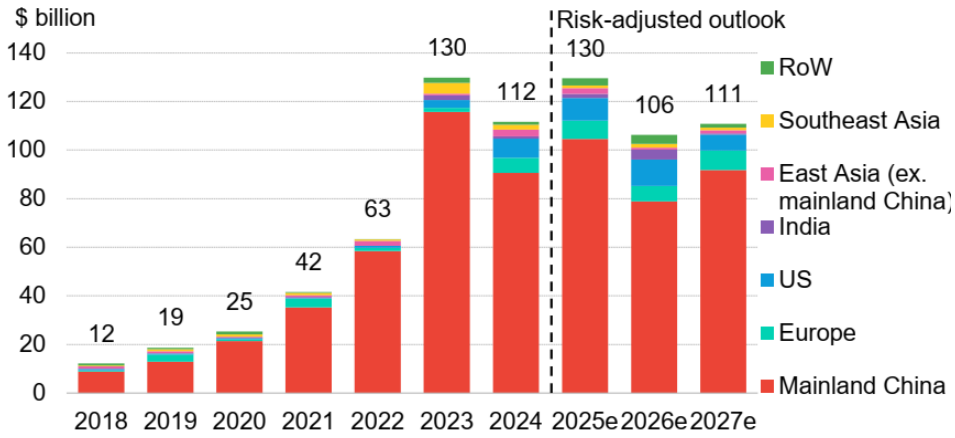

Figure 1. Global investments in the production of environmentally friendly technologies by geography.

Today, China remains the largest investor in the energy transition sector. The volume of investments from China in 2024 reached $ 818 billion, which is 20% higher than the level of the previous year. At the same time, the increase in investment recorded in China accounted for about two-thirds of the total global increase in investment in this area. [13]

According to the National Energy Administration of China (NEA), by the end of April 2023, the installed capacity of all power plants in the country reached 2.65 TW, which is 9.7% more than in the same period last year. Solar power plants made the largest contribution to the growth structure, with a total installed capacity of 440 GW, an increase of 36.6%. The capacity of wind power plants reached 380 GW, showing an increase of 12.2%. In the first four months of 2023 alone, solar power plants with a combined capacity of more than 48 GW were commissioned in China. In total, the country grew by more than 125 GW of new solar and wind capacity during the year, bringing their total installed capacity to 758 GW. This is equivalent to about 29.5% of the total Chinese energy system. In accordance with the adopted roadmap for the development of the renewable energy sector, by the end of 2023, over 160 GW of new renewable energy capacity was commissioned in the country, of which about 97 GW is accounted for by solar and 65 GW by wind installations.

According to the forecast of the Chinese Photovoltaic Industry Association (EPIA), over the next ten years, the net increase in capacity in China's solar photovoltaic industry may exceed 1.7 TWh, which confirms the steady dynamics of this segment. The International Energy Agency (IEA) notes that by the end of 2023, China's investments in renewable energy reached $271 billion, almost equaling the total investments of the Organization for Economic Cooperation and Development (OECD) countries, where investments totaled $277 billion. At the same time, China plans to increase its investments in green energy by another 13% in the coming years.

Forecasts show that in 2023, China's share in the global structure of investments in renewable energy amounted to 41%, and the OECD countries — 42%. In addition, the IEA points out that China occupies a leading position in the field of new capacity construction: the country accounts for 31% of wind power facilities under construction and 52% in solar generation.

One of the key factors of China's success in the field of renewable energy is the presence of a developed raw material and production base. The country is one of the three world leaders in the production of polysilicon, silver and copper, materials necessary for the production of solar panels. At all stages of the solar energy production chain, China's share ranges from 85% to 97% of global capacity.

It is also worth noting that about 90% of China's co_2 emissions are related to fossil fuel-based energy, which makes the task of reducing the carbon footprint particularly relevant for the country. In 2023, China's share in global investments in green energy was 37%, while the United States invested 13%, European countries 22%, and Japan 5%. Chinese companies also dominate the global equipment market: 6 of the 10 largest wind power plant manufacturers and 7 of the 10 leading solar panel manufacturers are Chinese firms. In particular, they provide about 70% of the global production of photovoltaic panels, and more than 90% of wind power plants operated domestically are produced by Chinese enterprises. [14]

The United States remains the world leader in terms of foreign direct investment. In 2021, their figure was $4.97 trillion. High investment attractiveness is ensured by political and economic stability, a transparent regulatory environment, well-developed infrastructure, access to financial markets and a wide range of investment areas. At the same time, high tax rates and inflationary pressures may reduce investor interest. [15]

In 2024, companies working in the field of climate technology raised $50.7 billion from private and public sources, which is 40% less than in the same period last year. This is the third year in a row that the volume of such investments has been declining. Enterprises related to clean energy and eco—friendly transport received the bulk of the financing - they managed to raise $ 31.8 billion.

Previously, the venture capital market of climate technologies demonstrated resilience to the tightening of financial conditions in comparison with the rest of the economy. However, the situation changed in 2024: the volume of venture capital investments in this area decreased by 40%, despite an increase in total venture financing. This is partly due to a shift in investor interest towards startups working with artificial intelligence technologies.

Financing through an initial public offering (IPO) has also declined: in 2024, this figure amounted to $6.2 billion, which is 85% less than in 2021. At the same time, existing climate companies continued to successfully raise funds — the volume of secondary placements increased by 7% compared to the previous year.

Investments in the United States remained roughly at the level of last year, amounting to $ 338 billion. The United States is the world's second largest producer and consumer of energy (after China).

The largest volume of capital raising in 2024 was in the United States, where the volume of new issues amounted to 17.9 billion dollars. Mainland China took the second position with a result of $ 9 billion. India recorded an annual increase of 20%, which allowed it to attract 5.3 billion dollars, mainly due to the listing of companies operating in the field of clean technologies. In turn, European Union companies have raised a total of about 5.6 billion dollars.

In the context of the unfavorable financial situation in the state markets, which has been observed over the past two years, mergers and acquisitions have intensified. In 2024, 200 deals totaling $68.8 billion were concluded. Although this is 7% less than a year earlier, the volume increased by 28% compared to 2022. The most active participants in the transactions were financial and energy companies.

Today, the United States and China remain key markets focused on the transition to low-carbon energy. In 2024, there was an increase in sales of debt securities in these markets. At the same time, the volume of bond issuance in Europe decreased by 7%, due to the slowdown in economic growth in Germany, Italy and Spain. In the markets of Africa and the Middle East, the decrease was 35%.

Investments in India increased by 13%. India is steadily strengthening its position as one of the world's leading energy powers and is moving towards achieving energy independence. Ranked third in the world in terms of electricity production and second in

terms of electricity consumption, the country has significant potential both in the field of traditional energy and in the use of alternative sources, according to the Central Electricity Authority of India (CEA).

На сегодняшний день Индия занимает четвёртое место в мире по объему производства ветровой энергии и пятое — по солнечной генерации. В период с 2010 по 2022 год совокупные энергетические мощности, включая ВИЭ, увеличились на 85%. Особенно примечателен рост доли электроэнергии, производимой без использования ископаемого топлива — она выросла с 21% в 2021 году до 42% в 2022 году.

India's energy strategy for the coming decades sets ambitious goals: to increase non-renewable energy capacity to 500 GW by 2030, meet 50% of the country's needs through renewable energy sources, and reduce CO_2 emissions by 1 billion tons. In addition, by 2030, it is expected to reduce the carbon intensity of the economy below 45%, and by 2070, to achieve zero net emissions. By 2047, India intends to fully ensure energy self-sufficiency.

In 2024, India plans to significantly increase investments in renewable energy by more than 83%, bringing it to 16.5 billion US dollars. These measures are aimed at reducing carbon dioxide emissions and accelerating the transition to environmentally friendly energy sources. As part of this course, it is planned to expand renewable energy capacity by 25 GW this year, which will require appropriate financial investments. In the long term, India intends to achieve significant results. By 2030, the country plans to have up to 65% of installed generation from non-fossil fuel sources. This significantly exceeds the previously stated goal of 50%. In addition to solar and wind generation, special attention is being paid to the development of the green hydrogen sector, which is seen as a strategic direction in ensuring energy security and reducing the carbon footprint.

India is actively attracting private investment in the nuclear energy sector — the volume of estimated investments is estimated at about 26 billion US dollars. The authorities are negotiating with at least five private companies, each of which can invest about 5.3 billion dollars, including large corporations such as Reliance Industries, Tata Power, Adani Power and Vedanta Ltd.

According to the baseline scenarios for the development of energy in the Asia-Pacific region, taking into account current and planned government policy measures, annual investments in this sector are expected to grow to 1.5–1.6 trillion US dollars by 2030. However, in order to achieve Goal 7 in the field of sustainable development, as well as meeting climate commitments to zero emissions, it will be necessary to increase investments to 2.2–2.4 trillion dollars per year, and up to 90% of them should be directed to clean energy, depending on the chosen strategy and the level of ambitions.

According to the International Energy Agency (IEA) assessment for 2021, additional funds are needed under the sustainable development scenario.: $10 billion for universal access to electricity, $2 billion for clean cooking technologies, $242 billion for the development of renewable energy sources and $180 billion for energy efficiency measures. In general, according to the IEA forecasts, by 2030 the annual volume of investments in the energy sector of the region's countries may reach $ 1.2 trillion, of which about 85% will be directed to environmentally friendly solutions.

According to estimates by the International Energy Agency (IEA), if the scenario of achieving zero emissions by 2050 is implemented, the annual global energy investment deficit could reach $1.7 trillion by 2030. At the same time, capital expenditures will be more than 50% higher than in the current policy implementation scenario, and up to 90% of all investments in the industry will be directed to clean energy.

According to calculations by the International Renewable Energy Agency (IRENA), in an effort to keep the global temperature rise below 1.5 °C, the annual shortfall in investments until 2050 is also estimated at $1.7 trillion, which is almost half the amount of

financing provided for in the baseline energy scenario. In its accelerated scenario for achieving climate goals, the Asian Development Bank predicts that developing Asian countries will need to allocate about $700 billion per year from 2020 to 2050 for the development of environmentally friendly electricity supply. This is a third more than in the implementation of current policies, and 50% higher than the level of 2021.

To achieve the goals of universal access to electricity by 2030, about 41 billion US dollars will be needed annually, and at least 4.5 billion dollars a year will be needed to ensure access to environmentally friendly cooking methods.

In 2022, investments in renewable energy sources in the Asia-Pacific region showed steady growth and exceeded 335 billion US dollars, which accounted for about 55% of the global volume. However, excluding China and India, the rest of the region accounts for less than 20% of global investments in the renewable energy sector.

At the same time, there was a decrease in investment activity in the European Union and the United Kingdom: the total volume of investments amounted to 381 billion dollars and 65.3 billion dollars, respectively. According to experts, the EU energy system needs a large-scale reform. According to a report by EuropeanRoundTable (ERT), amid rising costs and deterioration of network infrastructure, the shortfall in investment in Europe's energy grid could reach 800 billion euros by 2030.

One of the key problems is the lack of network capacity to connect new facilities, such as solar and wind turbines. At the same time, the cost of operating existing networks in the EU remains high: for example, in Germany, the cost of using the energy grid exceeds 20% of the cost of electricity, and this share will increase taking into account the need to modernize the infrastructure.

The European Commission estimates that at least 584 billion euros will be needed to modernize and expand energy networks by 2030. In turn, BCG analysts predict a demand of 800 billion euros by 2030 and up to 2.5 trillion euros by 2050. To date, annual investments in the EU's energy grid infrastructure amount to about 32 billion euros, which, at current rates, could lead to a shortage of grid capacity of up to 60% by 2050.

According to BCG, annual investments in the energy grid should more than double to 70-84 billion euros. Of this amount, 60% is planned to be used for distribution networks, 25% for transmission lines, and the rest for cross—border connections and energy storage systems. In recent years, the EU and its member states have begun to implement initiatives to transition industry to a carbon-neutral path. However, unresolved issues remain, including a shortage of low-carbon energy supplies at competitive international prices.

In recent years, the energy system of the Republic of Uzbekistan has been undergoing a stage of active transformation related to the reform of state regulation and improving the efficiency of industry management. Modernization and liberalization of the electric power sector are conditioned by both internal economic challenges and the need to comply with international standards. In this regard, it is particularly important to analyze the experience of other countries, such as China, Great Britain and Russia, which have successfully implemented similar reforms. Studying their practices allows us to take into account both positive results and mistakes, which is especially valuable for the sustainable transformation of Uzbekistan's energy sector.

Improving conditions for investors remains one of the key priorities in Uzbekistan, as attracting foreign capital plays an important role in the development of the national economy. An effective investment policy of a country should take into account its specifics and provide incentives, legal guarantees and clear regulatory mechanisms for foreign partners.

According to the UNCTAD World Investment Report for 2020, Uzbekistan ranked fifth among countries with economies in transition in terms of attracted foreign direct investment, which confirms the growing interest of investors in the region.

International experience in attracting investments in the energy sector demonstrates how much this area can contribute to economic growth. There is a wide potential in Uzbekistan's energy sector that can attract foreign investors, from traditional sources to renewable energy projects.

4. Conclusion

Uzbekistan is actively striving to improve the environmental situation and increase the energy efficiency of the economy by reducing dependence on traditional energy sources and gradually introducing alternative solutions. As part of this course, major projects involving the world's leading energy companies for the construction of solar and wind power plants are being implemented in the country. In 2023, capacities of over 2,000 megawatts have already been commissioned, and projects for another 8,000 megawatts are planned to be launched this year. The development of the "green" economy contributes to the emergence of new industrial areas, which opens up investment opportunities worth about $ 8 billion.

One of the promising areas is osmotic energy technology, which is already being developed and tested in Norway, the Netherlands, Japan and the USA. Such stations are considered environmentally safe because they use natural processes of interaction between fresh and salt water to generate electricity. In Uzbekistan, osmotic power plants can become a sustainable and clean source of energy that attracts the interest of investors.

Despite the high capital costs of construction due to the use of specialized membranes and equipment, such installations have low operating costs, as they do not require conventional fuel. Due to this, the costs can be offset by long-term savings and resilience to market fluctuations in energy prices.

An innovative approach is the installation of solar steam turbine stations on balloons, which makes it possible to integrate renewable energy sources into the energy system and maintain the level of electricity production at 15-20%, which is comparable to the efficiency of photovoltaic panels in solar power plants (USA). Balloon-powered power plants located on the ground are most efficient in regions with more than 300 sunny days per year.

Innovative approaches in the energy sector are being actively introduced in the international arena, one of which is the trigeneration technology, which has become widespread in Japan. Trigeneration is the simultaneous production of electricity, heat and cold, which significantly improves the overall efficiency of energy consumption. The average payback period for investments in such complexes is 3-4 years, and they demonstrate the greatest efficiency in regions with severe seasonal temperature fluctuations. In this context, Uzbekistan's continental climate makes the country particularly promising for the implementation of trigeneration solutions.

Global investments in the fuel and energy sector have consistently exceeded 1.5 trillion US dollars per year over the past five years, and by 2035 total investments could reach 48 trillion dollars.

Given these trends, it becomes obvious that the Republic of Uzbekistan needs to continue reforming the energy sector, focusing on international experience, including China, India and the countries of the Asia-Pacific region. The analysis shows that solving urgent problems requires an integrated approach, including the revision of the tariff and regulatory framework, the introduction of modern management mechanisms and active attraction of investments. Only with systemic transformations based on the best international practices is it possible to build an efficient and sustainable energy system capable of meeting the growing needs of society and ensuring economic growth in the long term.

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