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## Article

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## MANAGEMENT OF GREEN INVESTMENT OF COUNTRIES IN TERMS OF THEIR TECHNOLOGICAL DEVELOPMENT

*In the conditions of technological development and informatization of social relations, the formation of effective organizational support for the processes of investing in green technologies is becoming more and more actualized. The object of the research is the management processes of green investment of the countries of the world by various stakeholders in the conditions of increasing movement and development of productive forces towards Industries 4.0 and 5.0. Among the problems that need to be solved, the following should be noted:*

- low level of management decision-making and implementation of green investment in countries with transition economies and developing countries;
- high level of divergence in technological development among the countries of the world in the system of technological structures.

*Effective organizational and economic support for green investment at the level of the state, investor, manufacturer, and client should be included among the tools for solving these problems. A comparative analysis of green investment of the countries of the world was carried out. The factors of positive and negative impact on the green investment management process in countries with different levels of economy and technological development were formed. Modern trends in the development of green investment were investigated. The effects of the implementation of green technologies by companies of the world were noted. The benchmarking approach has been improved, with regard to the selection of constituent countries-leaders, which can be used in the management of green investments. The criterion indicators of the SWOT analysis of the green investment management system were formed on the example of the innovative project of the university. The necessary conclusions have been drawn based on the research results.*

*The obtained results are explained by the possibility of their application in the system of implementation of projects and programs regarding investment in green technologies (solar stations, wind stations, sewage treatment system, landscaping and greening of territories, geothermal energy). Practical implementation is possible in various countries of the world under the conditions of sustainable technological development from Industry 3.0 to Industry 5.0.*

**Keywords:** green investment management, countries, technological development, benchmarking approach, criterion indicator.

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### 1. Introduction

Among the main prerequisites that highlight the relevance of research on the topic of managing green investments of countries in the conditions of their technological development, the following should be noted:

- the growth of the greenhouse effect due to anthropogenic impact on the environment;
- accelerating the technological lag of countries with transition economies and developing countries from countries with developed economies;
- the search for more cheaper sources of energy, as a result of increasing the level of competition between producers on world markets;

- trendiness of green technologies;
- formation of a new perception of the world in the conditions of modern technological development through the introduction of environmentally friendly products and services.

All these prerequisites necessitate the practical implementation of investment support, as there is a real need for investment resources for the implementation of green technology projects. There is also a need for effective management of green investments by various stakeholders, which makes it possible to effectively spend investor funds at various levels of implementation of investment programs related to the implementation of green technologies in countries. It should also be noted that in practice, there is also the

importance of managing green investments of countries, as it makes it possible to effectively use investment resources at the level of state and private companies, which in turn significantly reduces the risk of misuse of investment funds for green technology projects and reduces the level corruption component in these projects.

Among the academic papers dealing with green investment, the following should be highlighted. In scientific work [1] it is conducted research on globalization processes of energy-saving production in the context of the economic development of countries, which makes it possible to note the importance of globalization processes in the formation of management mechanisms of green investments.

The study of technological development and innovation is a necessary element in managing the choice of green investment directions in the technological development of the countries of the world. In a scientific study [2] it is analyzed the impact of green innovations on sustainable development in the economy, politics and ecology of countries.

Automation of green investment management processes is important in today's information society. In the paper [3] it is studied the issue of key factors of financial technologies in the field of development of informatization and digitization of countries as positive prerequisites for the development of green investments.

It is also important to study the implementation of information and communication technologies in the process of investing foreign direct investments in the context of environmental quality. This makes it possible to speed up management decision-making, including in green investment, on the basis of automated processing of input information regarding investment provision of green technologies. In scientific work [4] it is analyzed processes in the technological development of African countries.

In the conditions of sustainable technological development, it is also necessary to research innovations in the environment, which focuses on investment projects of energy saving and energy saving, which aims to preserve the environment and implement environmental protection measures. In scientific description [5] it is reviewed the experience of the countries of the European Union in the field of green innovations and their investment.

An important aspect of green investing is the attraction of investment funds to those projects that require attention in terms of technological and scientific intensity, which makes it possible to increase the investment attractiveness of those industries that produce products and services with a high level of added value. In a scientific report [6] the focus was on investment processes in China's renewable energy sector.

When managing green investments, there may be barriers to the implementation of projects, these obstacles may include the male factor, the inability to fill the investment portfolio, ineffective government policy on the implementation of green technologies. In scientific consideration [7] it is noted the need to take into account obstacles in the management of green investment of technological solutions in Brazil.

Compliance of green investment and its management with international regulatory documents is also important in order to comply with international norms and rules in the field of financing environmental protection programs. In scientific justification [8] it is considered the implementation of the Paris Climate Agreement by 2050 in West African countries from the standpoint of financial availability and the possibility of green investment.

Modern trends in green technologies dictate the directions for reducing carbon emissions in oil-producing countries such as the UAE, Bahrain, Qatar, Saudi Arabia, Iran, and Egypt. The green investment management of these countries will be an effective position for revising the policy of oil production in the direction of its reduction due to the formation of ecologically oriented demand and the rejection of the use of oil products in favor of alternative energy sources on the part of other countries of the world. In scientific consideration [9] it is studied these processes in OECD countries.

It is important in the management of green investment to combine the analysis of the technological capabilities of each country with economic capabilities, involving both borrowed and own investments in the processes of implementing green technology programs. In a scientific conclusion [10] it is compared innovative technical capabilities of countries with green finance, investments of countries.

Managers of environmentally polluting firms should consider redesigning their green strategies, shifting from reactive to proactive environmental decision-making. By utilizing frameworks like in [11], firms can transform their strategies and gain a competitive advantage.

During the study of these scientific works, it was established that among the issues that have not yet been resolved, it is necessary to note the need to form an effective organizational mechanism of green investments, which is aimed at the effective implementation of green technology investment projects in countries with different levels of technological development, as well as the economy as a whole.

*The aim of the research* is the formation of effective organizational and economic support for green investments of countries in the conditions of their technological development. What will make it possible to form effective management mechanisms of green investments at the level of state administration in the country (legislative and executive authorities), as well as at the level of stakeholders in the countries (investors, suppliers, manufacturers, customers of green technologies).

## 2. Materials and Methods

*The object* of the research is the process of managing green investments of the countries of the world.

A number of methods were used during the research, namely:

- *methods of theoretical generalization* – when researching the theoretical provisions of green investment of countries in the conditions of their technological development;
- *method of comparative analysis* – when evaluating the green investment of the countries of the world, by forming conclusions based on the analysis of the dynamics of investment indicators;
- *factor analysis* – formation of factors of positive and negative effect on the process of green investment management in countries with different levels of economy and technological development;
- *system analysis* – in the study of modern trends and effects in the development of green investment in order to establish the main targets of green investment in the further technological development of countries;
- *benchmarking method* – when selecting components of leading countries that can be used in the management of green investments;

– *criterion method* – when forming criterion indicators of the SWOT analysis of the green investment management system on the example of the innovative project of the university.

*The technology for establishing a SWOT analysis of the green investment management system on the example of a university innovation project is as follows:*

- establishing the criteria indicators of the SWOT analysis;
- formation of point assessment and weights of criterion indicators of SWOT analysis by expert groups (teachers, employees of the enterprise of the project customer);
- forming an integral assessment of each section (strength, weakness, opportunity and threats) by multiplying the points and weights of the criterion indicators of the SWOT analysis;
- choosing a green investment management strategy for the project.

*The research materials* should include input information from the statistical authorities on the country's investment activities, reports by international organizations (UN, OECD) on investment processes in the world, the results of scientific research in international scientific journals, and expert evaluation information.

### 3. Results and Discussion

It's important to note that green investing has always been part of a larger investment framework. Therefore, it wouldn't be reasonable to only analyze investments labelled «green» in a strict sense. For the sake of simplicity in this paper, let's consider «green» as a subset of various investment approaches like ESG (Environmental, Social, and Governance), SRI (Socially Responsible Investing), responsible investing, sustainable investing, or other similar terms that are often used interchangeably [12].

Seeing as there is a substantial gap between the essence of definitions, it might be more productive for purpose of this research to not take a position on a specific existing definition, but rather to explore what traits are unifying the theory, its commonalities, and inconsistencies.

To achieve this, the main fundamental values of the Green Investment can be considered as next:

1. *Existence of the emission gap.* The first statement recognizes the existence of an emission gap, which refers to the disparity between the current level of greenhouse gas emissions and the emission reduction targets necessary to mitigate climate change effectively. Scientific evidence demonstrates that the current trajectory of global emissions is not aligned with the goal of limiting global warming to well below 2 degrees Celsius, as outlined in the Paris Agreement [13].

2. *The need for global transition to a low-carbon economy.* The second statement emphasizes the imperative for a global transition to a low-carbon economy. This transition entails replacing a significant portion of existing infrastructure and adopting low-carbon technologies and practices across various sectors, including energy, transportation, industry, and agriculture. It recognizes that a fundamental shift in the way society produces and consumes energy is essential to achieve greenhouse gas emissions reductions and mitigate the environmental impacts of economic activities [14].

3. *The need for investments to bridge the investment gap.* The third statement highlights the critical role of investments in bridging the gap between current emission levels

and the required emission reductions. The investment gap refers to the shortfall between the funding needed to support the necessary emission reduction measures and the available financial resources. Closing this gap necessitates mobilizing private and public investments at a scale that matches the ambition of climate and sustainability goals [15].

These conceptual elements of green investment can be triggers for the fulfillment of the main goals of sustainable development and influence the improvement of the level of environmental protection by countries. Let's conduct a comparative analysis of investments of the countries of the world, including those aimed at investments in green technologies, and let's investigate modern trends in the development of green investments.

Regarding the capital inflows CGI sector exhibited significant growth in several key countries. In North America, the United States remained the top destination country, attracting a remarkable 158.1 billion USD in inbound capital investment, representing a substantial 73 % increase from 2021 and a noteworthy 59 % increase from 2019. This impressive surge indicates a robust recovery from the lows experienced during the pandemic. Across the Atlantic, the United Kingdom emerged as the leading destination country in Europe, attracting an estimated 101.2 billion USD through 1119 announced FDI projects. Notably, the renewable energy sector accounted for a significant portion of this investment, amounting to 72.5 billion USD. Furthermore, India witnessed a remarkable surge in capital expenditure, with investment rising from 16.1 billion USD in 2021 to an impressive 75.8 billion USD in 2022. This accounted for 27 % of the total recorded investment in the Asia-Pacific region. Major projects, such as Hon Hai Precision Industry's semiconductor and display complex in Gujarat (19.5 billion USD) and Petronas's renewable hydrogen energy plant in Mangalore 3.8 billion USD), contributed to India's growing appeal as a CGI investment destination.

At a regional level, 2022 witnessed a significant influx of FDI projects in Western Europe, with an impressive total of 5250 projects. In terms of capital investment, both Western Europe and the Asia-Pacific region proved to be highly attractive, each receiving approximately 279 billion USD. Remarkably, Asia-Pacific claimed the top spot by a narrow margin of just 229.9 million USD. For a comprehensive breakdown of FDI distribution by country and regions, please refer to Table 1. These figures highlight the robust investment climate in both regions and underscore the global appeal and competitiveness of their respective economies. As for top companies that contributed to CGI past year, Switzerland-based office provider International Workplace Group (IWG) emerged as the most active foreign investor in terms of corporate green investments. The company experienced significant growth, recording a total of 160 foreign direct investment (FDI) projects, which represented a 36 % increase compared to the previous year. IWG invested an estimated 324 million USD in green initiatives during 2022.

From the analysis of Table 1, one can see very significant differences between the countries that are the leaders of direct foreign investment and the countries that are outsiders.

It should be noted that the leading countries are distinguished by a fairly significant volume of projects aimed at implementing green technologies, which makes it possible in the long term to save significant budget funds of these countries during the implementation of green technology projects (energy conservation, reducing the

level of extraction of exhaustible natural resources). This in turn, it can be used in the effective management of green investments by state authorities, while increasing the synergistic effect of the implementation of green investment projects. These aspects can be effective in the implementation of benchmarking approaches, where at the expense of the developed «road maps» of countries with developed economies, recommendations will be formed specifically for the management of green investments of countries with developing or transition economies.

Let's form factors of positive and negative impact on the process of green investment management in countries with different levels of economy and technological development.

Positive factors include:

- coordination of countries with developed economies regarding the green investment management mechanism due to the high level of standardization of processes and compliance with legislative norms in the field of environmental protection;
- the possibility of assignment to international green investment programs of countries with transition and developing economies;
- quite a large volume of the investment portfolio due to the assignment to the green investment programs of international donors, such as the IMF, EBRD, international financial institutions.

The negative factors include:

- the lack of financial resources in countries with developing and transition economies for green technology projects and the direction of the economies of such countries purely in the economic plane (increasing the income of industries at the expense of environmental damage);
- insufficient labor resources within countries with developing economies due to labor migration and, as a result, the impossibility of implementing green investment programs on the ground.

Let's note the effects of the implementation of green technologies by companies of the countries of the world. Corporate Green Investment plays a significant role in shaping the economic and environmental landscape of recipient countries. It goes without saying that green FDI can have positive effects on the environment, energy, and social aspects, but it is also important to consider both the opportunities and challenges it presents. One of the most significant benefits of FDI is the transfer of technologies critical to environmental management and mitigation, enabling the recipient country to transition from a less efficient and highly polluting phase of development to a «clean» and resource-efficient one. This technology transfer can enhance the recipient country's capacity for environmental sustainability and help promote best practices [16].

Let's examine this investment project for the introduction of

green technologies of Sumy State University, which was developed for the First Innovative Company of Ukraine in 2019. The business project is to commercialize the development of «Mobile installation for the purification of contaminated dielectric fluid» and to bring it to the market with the further prospect of mass production.

Let's form the criterion indicators of the SWOT analysis of the green investment management system on the example of the innovative project of the university; the necessary conclusions were drawn based on the research results (Table 2).

Obtaining the results is explained by the need to form effective organizational and economic support for green investments of countries in the conditions of their technological development. The results differ from the rejections in the literature in that they make it possible to improve the economic support of green investment management, through the formed criterion indicators of the implementation of green technology projects, which contain improved elements of strategic analysis of green investment.

The practical significance of the obtained results determines the possibility of their application in the system of implementation of projects and programs for investing in green technologies (solar stations, wind stations, wastewater treatment systems, landscaping and greening of territories, geothermal energy).

There are certain limitations of the research, such as the subjectivity of approaches to the analysis of green investment projects, as expert groups are involved in this assessment. Also, force majeure circumstances (man-made disasters, natural disasters, and military operations) in countries where green technology projects are implemented, which may make their management impossible, can also be attributed to certain restrictions.

Prospects for further research are determined by focusing attention on the effectiveness of green investment management in countries with developing economies, because the environmental component in the economy of these countries is not a priority and requires additional attention from state management bodies, which are entrusted with the protection of the natural environment.

**Table 1**

FDI by region and country, project numbers and Capital in 2022

Region	Country	Projects	Capital, billion USD
Asia-Pacific	India	994	75.80
Asia-Pacific	Australia	420	68.66
Asia-Pacific	South Korea	98	13.01
Europe	UK	1119	101.21
Europe	Germany	820	21.67
Europe	Ireland	305	25.18
North America	USA, California	197	8.51
North America	USA, Texas	229	15.96
North America	USA, Georgia	63	16.26
Middle East and Africa	UAE	879	10.45
Middle East and Africa	Saudi Arabia	216	13.05
Middle East and Africa	Oman	35	9.79
Latin America and Caribbean	Mexico	433	35.57
Latin America and Caribbean	Brazil	231	17.84
Latin America and Caribbean	Dominican Republic	29	3.54

**Note:** built based on data [14]



**Table 2**

SWOT analysis of the project «Automatic system for object recognition (shells, mines, etc.) of ground and underground occurrence»  
Mobile installation for cleaning process liquids» (excerpt)

Criterion indicators (Strengths/Weak sides/Opportunities/Threats)	Balls	Probability	Weighted assessment
1. Equipment mobility of the installation and its involvement in different territories	9	0.7	6.3
2. High technical characteristics of the equipment (high reliability of the equipment, long service life, high degree of cleaning, low costs for repair and maintenance)	7	0.7	4.9
The sum of weighted estimates (Strengths)	–	–	19.5
1. Low level of optimization of technological parameters according to the results of laboratory tests	3	0.2	0.6
2. Increased wear of the working parts of the hydrocyclone and feed pump	5	0.5	2.5
The sum of weighted estimates (Weak sides)	–	–	12.1
1. Creation of installations for cleaning of liquid of combined type	8	0.4	3.2
2. Short term of entry (1 year) due to patent protection	6	0.7	4.2
The sum of weighted estimates (Opportunities)	–	–	12.2
1. Risk of uncompetitive pricing and falling product sales on the market	5	0.4	2.0
2. Narrowly specialized implementation of technology, limited use of it for the customer	3	0.4	1.2
The sum of weighted estimates (Threats)	–	–	18.7
Difference in weighted estimates S–W	–	–	+7.4
Difference in weighted estimates O–T	–	–	–6.5
As a result of weighted estimates of the difference between strengths and weaknesses (+7.4) and opportunities and threats (–6.5), it choose a competitive strategy taking into account the existing competitive advantages of the products and the market demand for these products			

**Note:** developed by the authors

## 4. Conclusions

A comparative analysis of green investment of the countries of the world was conducted, which makes it possible to form factors of positive and negative impact on the process of green investment management in countries with different levels of economic and technological development, and to investigate modern trends in the development of green investment. The effects of the implementation of green technologies by companies of the world's countries were noted on the basis of the analysis of the leading countries and outsider countries, on the basis of which the benchmarking approach was improved in order to select the components of the leading countries that can be used in the management of green investments. Criterion indicators of the SWOT analysis of the green investment management system were formed on the example of the innovative project of the university. The use of these results can develop the theoretical and practical provisions of the investment policy of countries of the world with different types of economy in the field of implementation of green technologies, which makes it possible to develop modern trends in green technologies and popularize them in the world. As for the qualitative evaluation of the results, it is the improvement of the quality of green investment management of the countries of the world by adding new management approaches and methods. Regarding the quantitative evaluations of the results, it is necessary to note the obtained quantitative evaluations during the conducted methods of strategic analysis of the green technologies project.

## Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

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