Green finance as a tool for achieving sustainable development

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Abstract. The article discusses the need for green finance to achieve several sustainable development goals. The main sources of financing for ensuring the environmental sustainability of cities have been identified, highlighting the potential for a transition to green consumption patterns and the implementation of measures to combat environmental pollution (air, water, and soil) exacerbated by climate change. Rational use of natural resources has been emphasized. Data analysis shows that funding for environmental projects to reduce pollution has increased by 30% in the conflict-affected areas. This will form the basis for the transition to sustainable development, including investments in clean technologies and energy independence. After analyzing the main types of rating, the need for the index method to assess the most rational areas of use of green finance instruments is substantiated to achieve the indicators of the Sustainable Development Goals.

1 Introduction

Russia's full-scale invasion of Ukraine has led to large-scale economic losses, and the loss of overpasses, energy facilities, roads and other infrastructure elements has a negative impact on the welfare of Ukrainians. The hostilities have damaged ecosystems, and there has been contamination of soil and water resources with heavy metals and fuel that has been released into the environment. The destruction of forests, eco-parks, and nature reserves indicates that the environmental situation in Ukraine has become extremely vulnerable.

According to the World Bank, Ukraine's economic losses as a result of the war could amount to hundreds of billions of dollars. This could slow down investments in green technologies that Ukraine needs to implement in order to meet its own renewable energy transition goals. Despite these challenges, Ukraine is actively working on the Ukraine Recovery Plan, including the green infrastructure rebuilding area: Re-build clean and safe environment, Energy independence and Green Deal, Restoration and upgrade of housing and regional infrastructure [1]. The National Council for Post-War Reconstruction is the

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key body coordinating these efforts. Along with cooperation between government agencies and businesses, civil society engagement is essential to ensure transparency in the use of green performance finance instruments in the recovery process.

Green finance is a hot topic in economic, environmental and social research. Many leading foreign scholars have worked on this issue, analyzing various aspects of green finance, its mechanisms and impact on sustainable development. For example, J. Sachs in his work "The Age of Sustainable Development" [2] examines the concept of sustainable development in the context of global challenges faced by humanity. He not only explains why sustainable development is important for the future of our planet, emphasizing economic, social and environmental aspects, but also analyzes in detail major global issues such as poor people, hunger, wealth inequality, global climate change and biodiversity loss. The work describes the Sustainable Development Goals (SDGs) set by the United Nations and new economic models that take into account environmental factors based on sustainable energy and technology. Weber and Saravade in "Green Bonds: Current Development and Their Future" [3] consider green bonds as a tool for financing environmental projects, studying their impact on sustainable development investments.

A series of OECD papers analyzes mechanisms for mobilizing financing for environmental projects, such as environmental bonds and soft loans. In particular, the document "Climate Adaptation Investment Framework, Green Finance and Investment" [4] focuses on the importance of investing in climate change adaptation measures. The work is devoted to the development of a structured approach to investment, analyzing the financing needs for various sectors (agriculture, water supply, infrastructure, etc.) with an assessment of the impact of climate risks on the economy and society. The document emphasizes the importance of monitoring the results of green financing, which is carried out from different levels (governments, the private sector and international organizations) to reduce vulnerability and strengthen resilience to climate change.

The "OECD Review on Aligning Finance with Climate Goals: Assessing Progress to Net Zero and Preventing Greenwashing" [5] examines the key aspects and challenges associated with financing the transition to zero carbon emissions and supporting low-carbon technologies and infrastructure. The paper describes various financing models that can be effectively implemented to meet climate goals and create a favorable environment for long-term investment in sustainable solutions. This work is an important contribution to understanding how the financial system can be effectively configured to support global efforts to combat climate change.

The document prepared by the United Nations Inter-Agency Working Group on Financing for Development, Financing for Sustainable Development Report 2023: Financing Sustainable Transformations [6], covers a number of important topics related to financing sustainable development, especially in the context of the 2030 SDGs, specifically those focused on tackling global challenges like global climate change, poverty and inequality.

The scale of investments needed to achieve the SDGs is determined, with a special emphasis on infrastructure, energy, health, education and other vital sectors. The use of multilateral financing is important. New approaches to financing, such as social bonds, green bonds, and new models of public-private partnerships, are considered.

Baietti, Shlyakhtenko, La Rocca, Patel [7] describe the financing of environmental infrastructure projects, define that green infrastructure covers natural and semi-natural systems that provide environmental services such as air and water purification, water storage and reduction of urban heat island effects, which reduces traditional infrastructure costs, increases the viability of cities and improves the quality of life. The report also describes various sources of financing for green infrastructure projects, including government grants, private investment, green bonds, and socially responsible investments.

In the article by Zheng, Feng, and Chang [8], the authors examine the impact of green finance on the development of renewable energy technologies in 64 countries, considering green finance as investments in projects and technologies that promote sustainable development and mitigate negative environmental impacts. The study emphasizes the need for active implementation of green finance as a key tool to stimulate the development of renewable energy sources, which is critical in the fight against climate change and the transition to a more sustainable economy.

A table comparing the reviewed works (Table 1)

Table 1. Comparing the reviewed works

Study	**Main Topic**	**Key Aspects**	**Impact on Sustainable Development**
J. Sachs, "The Age of Sustainable Development"	Sustainable development concept	Economic, social, and environmental aspects, addressing poverty, inequality, climate change	Describes UN Sustainable Development Goals and economic models for achieving them
O. Weber & V. Saravade, "Green Bonds: Current Development and Their Future"	Green bonds	Financing environmental projects, analyzing the impact of green bonds on investments	Increased investment in sustainable development
OECD, "Climate Adaptation Investment Framework, Green Finance and Investment"	Financing mechanisms for climate adaptation	Analysis of sector financing needs (agriculture, infrastructure, etc.), risk assessment	Strengthening resilience to climate change
OECD, "Aligning Finance with Climate Goals"	Financing net-zero transition	Financing models, preventing "greenwashing"	Supporting low-carbon technology and economy
UN Financing for Sustainable Development (2023)	Financing global UN goals	Investment scale for achieving SDGs, use of social and green bonds	Improving the efficiency of sustainable development financing
A. Baietti et al.	Green infrastructure financing	Financing natural and semi-natural systems for environmental services	Lowering costs of traditional infrastructure, improving quality of life
Zheng M. et al.	Impact of green finance on renewable technologies	Investment in sustainable projects and technologies	Stimulating renewable energy development

Based on the analyzed research, the article focuses on sustainable development and the role of green sector investments, emphasizing the importance of green finance for achieving sustainable development goals.

2 Methodology

The study uses a conceptual approach to defining the essence of the concept of "green finance" depending on the sustainable development goals where this instrument is used, namely: at the macro level - as a set of measures of the State aimed at preventing, minimizing the negative impact on the environment and its restoration after the effects of man-made and natural emergencies and post-war reconstruction, rational use of natural

resources, environmental education, science; at the micro level - as a set of activities aimed at promoting the sustainable development goals. This allows us to differentiate between the priority areas of green financing, promote its effectiveness and achieve sustainable development goals. The index method is used to analyze the practice of the necessary indices in Ukraine in order to comparatively characterize and evaluate the use of green finance instruments to achieve the set goals.

3 Results and Discussion

Ukraine's war-affected environmental sector, which has slowed down and is unable to achieve sustainable development goals, requires significant funding. In the context of post-war reconstruction, it is important that Ukraine creates effective green finance mechanisms and uses the full range of instruments. Green finance is becoming an increasingly important element in the recovery and sustainable development of Ukraine after the war. This financing is provided by instruments aimed at supporting environmental initiatives and projects. Let's define the classification of green finance, i.e., what financial resources are available to support sustainable development goals through the use of green financial instruments. We understand green financial instruments as various types and forms of raising and using capital to implement environmentally sustainable projects and initiatives (Fig. 1).

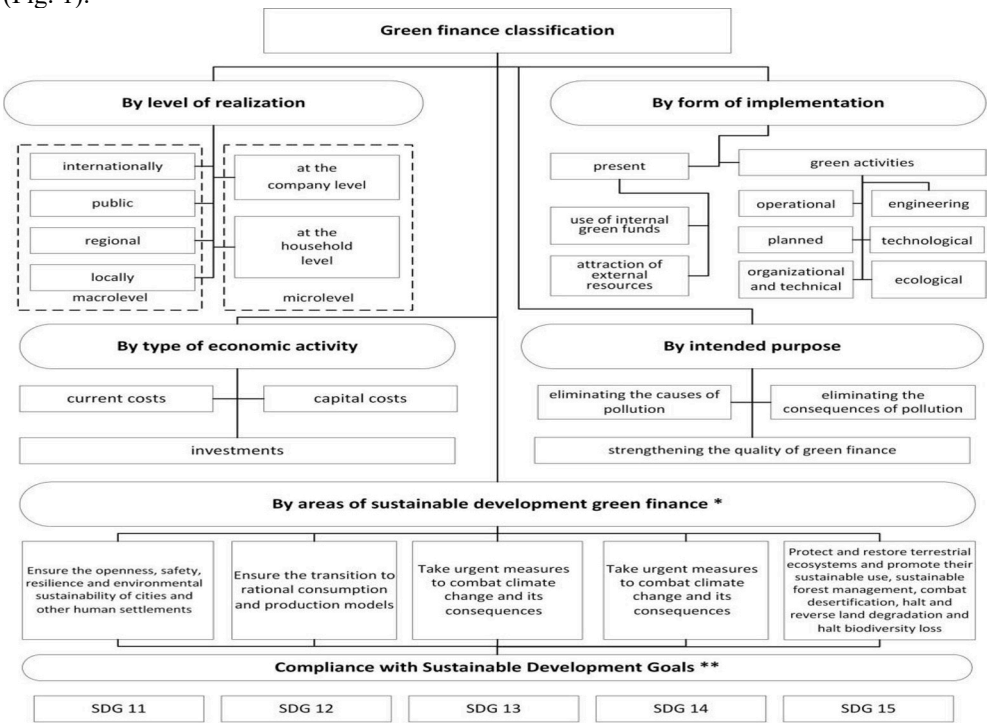


Fig. 1. Classification of green finance [9].

Based on Figure 1, we can identify the main green finance instruments, which include
- Green bonds - debt instruments issued to raise capital to finance environmentally beneficial projects;
- Green funds - specialized investment funds that invest in environmental assets or companies operating in the field of sustainable development.

- Subsidies and grants - types of government support that can be provided for the implementation of green projects;
- Standardization and certification - implementation of standards and certification systems for green projects and financial products.
- Tax incentives (environmental taxation) - fiscal conditions that encourage investors to invest in green projects.
- Environmental taxation is a system of taxes and fees levied for environmental pollution, through the use of natural resources or for emissions of pollutants;
- Environmental expenditures - financial resources aimed at protecting the environment or improving its condition;
- Environmental investments - raising capital for start-ups and companies in the field of green technologies, reducing negative environmental impact and sustainable development;
- Public-private partnership (PPP) - cooperation between public and private participants to implement sustainable development projects, which pools resources and reduces risks for investors.

Green finance instruments are important for raising capital and implementing projects that contribute to the achievement of sustainable development goals and have an impact on environmental aspects. They help to reduce barriers to investment and find sustainable solutions to provide financial support to meet the needs for clean technologies and environmental innovation.

Since 2022, Ukraine has regulated the use of financial instruments such as green bonds. According to Ukrainian legislation [10], green bonds are bonding whose prospectus (or decision on the issue, and for Ukrainian government bonds, the terms of placement) stipulates that the funds raised will be used exclusively to finance the implementation of an environmental project or a distinct stage of it. In this context, an environmental project refers to initiatives in the fields of alternative energy, energy efficiency, waste minimization, utilization and recycling, the introduction of environmentally friendly transport, organic farming, conservation of flora and fauna, water and land resource management, adaptation to climate change, and other projects aimed at protecting the environment, implementing environmental standards, and reducing pollutant emissions into the environment.

For the rational use of green finance, various financing models are available to provide capital for green infrastructure projects. These can include government programs, public-private partnerships (PPPs), or funds specializing in environmental investments. Using all types of green financing, it is possible to attract the necessary financial resources to implement environmental projects. In particular, the public-private partnership (PPP) model is the most promising.

The public-private partnership (PPP) model involves cooperation between public authorities and private companies in the implementation of green finance projects. This includes co-financing, project and risk management, and the use of various sources of financing, such as government grants, private investment, green bonds, and development funds, which provide financial resources for environmental projects [11, 12]. Therefore, the PPP model is one of the key instruments for green financing that can significantly increase the efficiency of resource use, attract investment, and realize environmental goals. The economic benefits associated with linking to sustainable development goals make it possible to mobilize green finance instruments for green projects, including the use of green bonds, green funds, stimulating private investment and expanding access to capital for sustainable development goals.

In order to achieve the Sustainable Development Goals, it is necessary to intensify financing for environmentally friendly projects, which can provide long-term economic

benefits and improve the quality of life. It calls for comprehensive strategies that combine public-private financing.

Therefore, green finance instruments are any financial instrument or financial services activity, as well as insurance, trading in stocks, bonds, commodities and derivatives, analytical or risk management tools that lead to long-term positive changes for the economy, environment and society (sustainable development). The main criterion for a company's or project's "greenness" is its contribution to reducing greenhouse gas emissions [13]. Unfortunately, it is becoming more difficult every day due to significant greenhouse gas emissions, global warming, and the escalation of climate change.

In world practice, the Global Green Finance Index (GGFI) rating is utilized to evaluate the effectiveness of green finance instruments. The GGFI is an initiative funded by the MAVA Foundation and carried out by Finance Watch in collaboration with Z/Yen Group as part of the Long-Term Finance Program [14].

The 14th edition of the Global Green Finance Index (GGFI 14) was released on October 24, 2024. This edition assesses green finance opportunities in 97 key financial centers worldwide (Figure 2). The GGFI is an essential resource for policies and investment decision-makers promoting green finance [15].

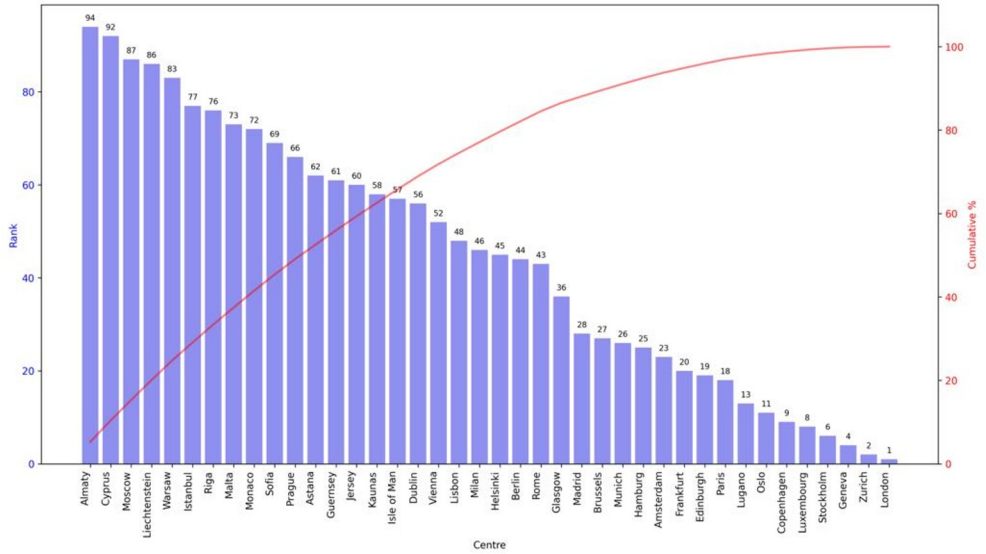


Fig. 2. Ranking of European countries by the Global Green Finance Index (GGFI 14 Rank), 2024 [15].

We have constructed a Pareto chart to better visualize the displayed distribution of data in descending frequency, and on the auxiliary axis, a line of the aggregate value as a percentage of the total.

According to the GGFI developers, 149 instrumental factors are used to calculate the index, which are grouped into the following areas:

– Business environment: economic statistics and information on the legal, tax and political environment;
– Human capital: data on education, employment, crime, corruption, and health;
– Infrastructure: these focus on the physical attributes of centers, such as telecommunications, real estate, and transportation;
– Sustainability: These look at the environmental performance of financial centers, including data on sustainable and green finance.

This data is used in the analytical model according to the following rules:

– Index updates are gathered and reviewed every six months.
– No weighting factors are introduced to the indices.
– Indices are incorporated into the GGFI model as directly as possible, irrespective of whether they represent a rank, derived score, value, distribution around the mean, or distribution to a benchmark.
– If a factor exists at the national level, the score will apply to all centers within that country.
– National factors will be adjusted if specific factors for financial centers (cities) are available.
– When an index presents multiple values for a city or country, the most relevant value will be selected, and the relevance assessment method will be specified.
– If the index includes a regional level, the most relevant score distribution will be assigned to each center, with the relevance assessment method outlined.
– If an index does not provide a value for a particular financial center, a blank space will be recorded for that center, avoiding the use of a mean or average.

In our analysis, we found that the Global Green Finance Index is not calculated for Ukraine due to the lack of data on such instruments:

1. Bank for International Settlements: External Positions of Central Banks as a share of GDP (Ukraine does not report to the BIS).
2. World Federation of Stock Exchanges: Capitalization of Stock Exchanges, Broad Stock Index Levels, Value of Bond Trading, Value of Share Trading and Volume of Share Trading.
3. Mercer: Cost of Living City Rankings.
4. OECD: OECD country risk classification and Personal income tax rates.

The lack of necessary data to calculate the Global Green Finance Index for Ukraine is a serious obstacle to assessing the country's progress in the green economy and attracting investment. This is because it does not allow us to assess the level of development of green financial instruments and projects. Without this data, the country cannot objectively analyze its progress. Also, without accurate data, it is difficult to develop effective strategies and policies to promote the green economy. This can lead to mismanagement of resources and missed opportunities. Investors often rely on such indices to make investment decisions. A lack of data can reduce confidence in the Ukrainian market, making it difficult to attract foreign investment.

A global index allows countries to be compared with each other. Without the data, Ukraine cannot see how it looks in the context of other countries, which makes it difficult to formulate an international strategy. Without such data, there is no clear picture of the benefits and gaps in green economy reform. This can reduce political will and interest in green initiatives. In conclusion, the lack of necessary data is a serious barrier to assessing progress and attracting investment, as without data it is difficult to formulate realistic goals and requirements for financing green projects.

4 Conclusions

Thus, in order to rationally use green finance instruments to achieve sustainable development goals, it is necessary to define project selection criteria in accordance with the best international practices in public green finance management. Since the Global Green Finance Index plays an important role in monitoring progress in sustainable development and provides valuable information for governments, investors, businesses and the public, we suggest the following measures at the global and national levels:

1. Create a national system of data collection and processing:

- Develop a single database that would collect information on all financial instruments related to green investments from all banks, investment funds and other financial institutions;
- Introduce international reporting standards for financial institutions, which will allow comparing data with other countries;
- Actively participate in international studies and projects that assess the state of green investments;
- Cooperate with private companies to develop and implement data collection and analysis tools.

2. Develop a market for green financial instruments:
   - Create favorable conditions for the issuance of green bonds, such as tax incentives and government guarantees;
   - Simplify access to green finance for small and medium-sized enterprises;
   - Create funds to finance innovative projects in the field of green energy, energy efficiency and other sectors.
3. Strengthen the role of the regulator:
   - Develop and implement the National Green Finance Strategy. Set clear, achievable goals and priorities and identify mechanisms for financing environmental projects;
   - Strengthen supervision of the green finance market to prevent manipulation and ensure transparency;
   - Actively participate in international initiatives to develop green finance.
4. Proposals at the global level:
   - Provide technical assistance to Ukraine to develop data collection and analysis systems;
   - Create platforms for the exchange of experience between countries in the field of green finance;
   - Implement joint projects to develop a green economy.

Effective implementation of these measures can significantly increase the volume of green finance in Ukraine, create strong financial centers to support environmental initiatives, and create a financial market that is resistant to non-financial risks. This, in turn, will contribute to the achievement of sustainable development goals and economic growth combined with environmental standards.

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