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Green finance as a tool for sustainable development and post-war recovery in Ukraine

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Abstract. The ongoing war in Ukraine poses significant challenges to the country's economy and environmental sustainability, and the use of green finance can be a key tool for post-war economic recovery and sustainable development by attracting resources for environmentally friendly and innovative projects. The purpose of the article was to study the potential of green finance and analyse the possibilities of implementing this tool to support the country's economic and environmental sustainability in the post-war period. The study used empirical, analytical, and systematic methods to assess the impact of green finance on economic growth, reducing environmental impacts, and improving the quality of life of citizens. Overall, the study results demonstrated the high potential of green finance for Ukraine's future development. The article analysed the policy framework and international commitments that could serve as a basis for green finance policy in Ukraine. The study examined the dynamics of green finance in the world over the past 16 years, which showed a steady increase in interest in environmentally sustainable investments. Recommendations for the development of green finance were proposed, including the introduction of mechanisms to attract investment in sustainable environmental projects, support sustainable growth, and modernise sectors of the economy that are critical to the country's post-war recovery. The main conclusion is the need to integrate environmentally friendly and innovative projects into infrastructure reconstruction, which will help ensure sustainable economic development and reduce environmental risks. International financial instruments and commitments that help attract investment in green projects play an important role in this process. The scientific results obtained in the course of this study can contribute to solving the current problems of integrating green finance into Ukraine's sustainable development and recovery strategies, and can be used by government agencies to develop effective mechanisms for financing environmentally sustainable initiatives in the post-war period

Keywords: green finance; green investments; climate change; green bonds; environment; sustainable development goals; post-war reconstruction

INTRODUCTION

In a globally competitive environment, economic growth has led to significant environmental risks, which are of particular relevance for Ukraine due to the consequences of the war and its devastating impact on the environment. The

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climate crisis and the need to address it have become global issues that require quick and effective solutions. One of the main ways to overcome these challenges is through a decarbonisation strategy, which involves reducing greenhouse gas emissions. At the same time, the transition to a 'decarbonised' economy requires significant financing, which will be quite a challenge for Ukraine in the context of post-war recovery. In this context, green finance can become an important tool for attracting the financial resources necessary for the country's environmentally sustainable development and restoration of its ecosystem. The relevance of the study is driven by the need to develop effective mechanisms for using green finance to achieve sustainable development in Ukraine, especially during the post-war recovery period, when it is important to balance economic recovery with environmental sustainability. Therefore, studying the opportunities and obstacles to attracting green finance to the post-war recovery is critical to ensuring the sustainability of the country's economy and ecosystem in the future.

As of 2024, there was no single generally accepted definition of green finance; the concept is multifaceted and encompasses both environmental and economic aspects. In economics, the term is seen as the accumulation of financial resources to address climate and environmental issues, on the one hand, and to improve the management of financial risks related to climate and the environment, on the other (Solodovnik, 2023). Due to the multifaceted nature of the concept of green finance, there are different approaches to the interpretation of this term among scholars. M. Karlin & O. Ivashko (2020) understand green finance as financial relations, entities and financial measures that ensure the conditions for sustainable development and are an important element of financial and economic regulation of environmental management at all levels. A. Dubko (2022) believes that green finance is a set of economic relations for the accumulation and use of funds for the implementation of environmental projects and other programmes aimed at reducing harmful environmental impact and minimising negative environmental consequences. Scientists B. Lutsiv *et al.* (2023) explain the essence of green finance in a narrow sense as the implementation of environmentally friendly investments and low-carbon technologies, projects, and industries based on appropriate tools and products that take into account environmental factors in making decisions on loans and risk management. Ukraine's economy is particularly vulnerable to environmental and economic risks, given the effects of the war and the decline in natural resources. This calls for the effective implementation of green finance mechanisms that can support the country's post-war recovery, contributing to both environmental sustainability and economic growth.

A green financial strategy is important for maintaining financial sustainability and sustainable development, particularly in the context of post-war infrastructure and industrial recovery. O. Cheberyako *et al.* (2021) analysed the key aspects of green finance development in Ukraine as a tool for social and environmental security. Among the main tasks in this area, the authors identify strengthening cooperation with foreign companies and international financial institutions to attract financial resources for sustainable development. In addition, important steps include consultations with banking institutions, institutional investors, and national regulators to develop effective mechanisms to support environmental initiatives and investments in green projects. The authors emphasise that the implementation of these strategies will not only strengthen environmental security at the national level, but also ensure the stability of the social and economic situation in Ukraine in the face of global challenges.

According to research by N. Reznikova (2021), the successful implementation of environmental projects aimed at sustainable development in Ukraine requires close cooperation between public authorities and private entities. This is important given the amount of investment required to implement environmentally friendly technologies and projects. Cooperation between national governments and the private sector can provide the necessary funding and contribute to the development of infrastructure that meets sustainable development standards.

According to N. Ivanova & S. Kononenko (2023), Ukraine has significant potential for a green energy transition, especially in the context of adaptation to new climate conditions and climate policy change. The key to unlocking this potential is the development of renewable energy sources, in particular solar and wind power, as well as improved energy efficiency in the industrial and residential sectors. Thanks to its natural resources and technological progress, Ukraine has the opportunity not only to reduce its dependence on fossil fuels, but also to become a regional leader in green energy.

The strategy of economic recovery based on the principles of sustainable development will allow Ukraine not only to integrate into new industrial processes of the European Union, but also to increase its competitiveness in the global market. The implementation of this strategy envisages the introduction of an "industrial visa-free regime", which opens up new opportunities for Ukrainian industries by facilitating access to EU public procurement, as well as receiving financial and technical support from the European Union in the area of climate change adaptation. However, in order to successfully implement recovery strategies and transition to green initiatives, it is necessary to take into account the obstacles faced by companies and projects. L. Donchak & D. Shkvarchuk (2024) find that the high costs of implementing green technologies can be a serious financial obstacle for many Ukrainian enterprises. This makes it difficult to attract the necessary financing, as many enterprises are not ready for large upfront costs. Another major challenge is the unstable political and legal environment in Ukraine. Changes in legislation and policy can significantly affect the effectiveness of green financial instruments, creating additional uncertainty for investors and borrowers, which reduces their level of trust and encouragement to invest in green projects.

The purpose of the article was to explore the potential impact of green finance on the post-war economic recovery of Ukraine, in particular through the implementation of initiatives in the field of ecology, energy efficiency, and sustainable development. To achieve this goal, this paper set out the following objectives: to highlight the theoretical foundations of green finance as a tool for sustainable development, to consider the prerequisites and international initiatives that contributed to their emergence, to analyse the current state of green finance in Ukraine, and to formulate the prospects for green finance in Ukraine as a tool for post-war recovery.

MATERIALS AND METHODS

To achieve the goal of considering green finance as a tool for the post-war recovery of Ukraine, general scientific and special scientific methods and approaches were used. The prerequisites for the emergence of green finance, which became the basis for the development of the green finance concept, were studied using the chronological method. In particular, the development of the green finance concept from 1972 to 2019 was analysed in dynamics. A critical review of scientific literature sources made it possible to determine the economic essence of the term 'green finance'.

The historical method was used to clarify the essence of the concept of "green finance". The grouping method was used to classify green finance by economic sectors, and the tabular method allowed to present key international events and initiatives that became the basis for the formation of the green finance concept. The tabular method was also used to systematise information on the main programmes of international organisations that support the development of green finance in Ukraine, their areas of activity and financial instruments that can be used in the post-war recovery process.

The graphical method made it possible to build a graph of the dynamics of green finance in the world over a sixteen-year period, as well as to analyse the rates of its growth and increase, which made it possible to assess global trends in the development of this area of financing. To study the main trends in green finance, the article used the systemic and structural methods, and to analyse strategies for their implementation in different countries, the method of statistical comparisons was used. The structural-functional approach has provided for the disclosure of the impact of green finance on sustainable development. It was used to model their potential contribution to the post-war reconstruction of Ukraine, taking into account the principles of sustainable development, with a special emphasis on the implementation of green initiatives. The observational method was used to analyse the environmental consequences of military operations, which significantly affect the implementation of the sustainable development model in Ukraine. Empirical methods were used to identify the strategic goals of green financing in the context of the country's post-war recovery.

The information base of the study was based on scientific articles by scholars from the UK, the US and Ukraine, as well as publications and reports by international organisations for the period from 2009 to 2024. Key sources include documents from the European Union, the World Bank, the Organisation for Economic Co-operation and Development (OECD), the United Nations (UN), and the World Commission on Environment and Development (WCED). In addition, materials from research institutions and non-governmental environmental organisations, such as the Centre for Climate and Energy Solutions (C2ES), were used. The study also analysed programmes of international organisations operating in Ukraine, including the EaP GREEN programme implemented by the United Nations Economic Commission for Europe, OECD, UNEP and UNIDO; the EU-funded EU4Environment initiative; the EBRD Green Cities programme; and the Norway-Ukraine energy efficiency programme.

RESULTS

Amid global change, sustainable and responsible investment in the economy has become an integral part of development. Green finance, which aims to finance environmentally sustainable projects, is one of the key tools for achieving sustainable development and combating climate change. They contribute not only to environmental protection but also stimulate innovation in energy, transport and other critical sectors of the economy. Therefore, it is important to continuously analyse the state of green finance, its potential, challenges and opportunities to ensure a sustainable future.

Green finance is aimed at achieving economic growth while reducing environmental pollution in general, improving waste management and the use of natural resources (OECD iLibrary, n.d.). It can contribute to sustainable development by improving countries' regulatory frameworks, aligning government financial incentives, increasing investment in green projects across sectors, integrating environmental principles into decision-making on financing government programmes in line with the Sustainable Development Goals, financing sustainable use of natural resources and the climate-oriented blue economy, and increasing the use of green bonds. The goals of green finance can be defined as specific areas or achievements that society seeks to achieve: adaptation to climate change, conservation of natural resources, support for the transition to renewable energy, reduction of greenhouse gas emissions, creation of new green financial instruments, raising awareness and attracting investors, support for green innovations and technologies, etc.

The preconditions for the emergence of green finance reflect key international events and initiatives that have become the basis for the development of the green finance concept. Starting with the Club of Rome, which in 1972 first drew attention to the limits of economic growth in the face of limited natural resources, to modern initiatives such as the European Green Deal, presented in 2019. The following developments have formed the basis for the implementation of environmentally sustainable financial practices at

the global level (Table 1). They have become the basis for a taxonomy of green finance that plays a key role not only in global policies but also in national strategies, including for Ukraine in its post-war recovery.

Table 1. Prerequisites for the emergence of green finance

Prerequisite	Event	Year	Description
The "Limits to Growth"	Report Presented by the Club of Rome at an international meeting, New York	1972	Awareness of the planet's limited resources and the need to preserve the environment has prompted investors and financial institutions to look for new, more sustainable investment models.
"Brundtland" report	42nd session of the UN General Assembly, New York "Our Common Future"	1987	The report became the basis for the formulation of global sustainable development strategies.
Agenda for the 21st century	UN Conference on Environment and Development (Earth Summit), Rio de Janeiro	1992	It reflected a comprehensive approach to achieving sustainable development, combining economic, social and environmental aspects.
Kyoto Protocol	3rd Conference on Climate Change (COP3 – UNFCCC), Kyoto	1997	It has become the basis for the development of financing for green projects and initiatives related to emissions reduction and climate change.
Millennium Development Goals (MDGs)	55th session of the UN General Assembly / Millennium Summit, New York	2000/2001	It set 8 global goals to be achieved by 2015 aimed at combating poverty, hunger, disease, illiteracy, environmental degradation and discrimination against women.
Copenhagen climate conference	15th UN Climate Change Conference (COP15 – UNFCCC), Copenhagen	2009	The conference highlighted the importance of global efforts to combat climate change.
Sustainable development goals (SDGs)	69th session of the UN General Assembly / UN Summit on Sustainable Development, New York	2015	The SDGs encourage the integration of environmental and social aspects into financial strategies.
Paris climate agreement	21st UN Climate Change Conference (COP21 – UNFCCC), Paris	2015	Presentation of the European Commission's strategy for the development of the European continent, European Parliament.
EU action plan for financing sustainable growth	Presentation of the European Commission's action plan on financing sustainable growth, European Parliament	2018	The plan aims to mobilise finance for sustainable economic growth by promoting environmentally responsible investments.
European Green Deal	Presentation of the European Commission's strategy for the development of the European continent, European Parliament	2019	The EU strategy aimed at achieving climate neutrality by 2050, which includes incentives for financing green initiatives.

Source: developed by the authors based on data from The Limits to Growth (1972), Report of the World Commission… (1987), United Nations Conference… (1992), Kyoto Protocol (1997), C2ES (2009), United Nations (n.d.), The Paris Agreement (2015)

According to the events and documents presented, it can be concluded that green finance has developed in parallel with the awareness of global environmental problems and the need for sustainable development. Thus, the preconditions for the development of green finance have been evolving over several decades, and have eventually resulted in specific initiatives and policies aimed at achieving global sustainable development goals. They clearly reflect the growing influence of environmental factors on economic decisions, which has largely driven the development of sustainable growth finance.

Addressing climate change and environmental protection requires significant investment, and experts estimate that between USD 125 trillion and USD 275 trillion will be needed to achieve net zero greenhouse gas emissions by 2050 (Krishnan *et al.,* 2022). In this regard, international governments and investors are actively looking for new ways to raise capital through green finance, which should become the main mechanism for addressing global environmental issues and achieving climate goals. Table 2 and Figure 1 show the volume of green finance in the world over the past 16 years, as well as its growth and growth rates, which allows us to assess the dynamics of green finance development at the global level.

The graph clearly demonstrates the rapid growth of green finance in the world from 2009 to 2024, which indicates a significant interest of investors in environmentally friendly projects and a general trend towards more sustainable development models. This fact is confirmed by the activities of companies such as Apple, General Motors, Meta, and Google, which are actively investing in renewable energy sources. For example, as of February 2023, Amazon became the largest buyer of renewable energy (24.8 GW), and Microsoft signed a USD 10 billion agreement to purchase 10.5 GW of renewable energy for the period from 2026 to 2030 (Microsoft signs largest-ever corporate..., 2024). These large investments highlight the importance of green finance as a key tool for achieving sustainable development. More

than 50 countries are actively using green finance in their national economies. Given the steady involvement of green finance in the world, it is also important to analyse how it is distributed across different sectors of the economy (Fig. 2).

Table 2. Analysis of the volume of green finance in the world in 2009-2024, trillion US dollars

Year	Volume	Absolute growth		Growth rate, %		Growth rate, %	
		Basic	Chain	Basic	Chain	Basic	Chain
2009	1.4	-	-	-	-	-	-
2010	1.6	0.2	0.2	1.1	1.1	0.1	0.1
2011	1.4	0.0	-0.2	1.0	0.9	0.0	-0.1
2012	1.7	0.3	0.3	1.2	1.2	0.2	0.2
2013	2.0	0.6	0.3	1.4	1.2	0.4	0.2
2014	2.1	0.7	0.1	1.5	1.1	0.5	0.1
2015	2.2	0.8	0.1	1.6	1.0	0.6	0.0
2016	2.5	1.1	0.3	1.8	1.1	0.8	0.1
2017	3.3	1.9	0.8	2.4	1.3	1.4	0.3
2018	3.0	1.6	-0.3	2.1	0.9	1.1	-0.1
2019	4.1	2.7	1.1	2.9	1.4	1.9	0.4
2020	5.8	4.4	1.7	4.1	1.4	3.1	0.4
2021	7.2	5.8	1.4	5.1	1.2	4.1	0.2
2022	5.4	4.0	-1.8	3.9	0.8	2.9	-0.3
2023	6.8	5.4	1.4	4.9	1.3	3.9	0.3
2024	7.2	5.8	0.4	5.1	1.1	4.1	0.1

Source: developed by the authors on the basis of L. Clements *et al.* (2024)

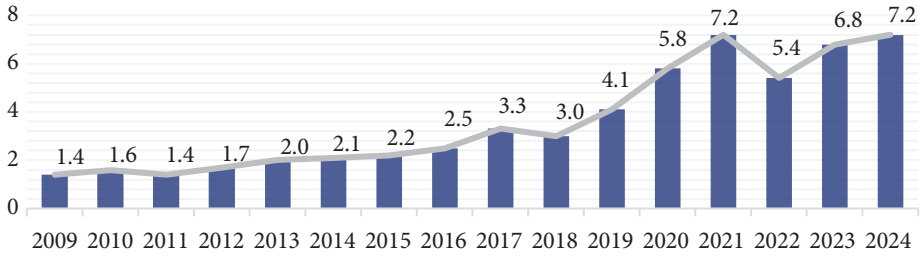

Figure 1. Dynamics of the volume of green finance in the world in 2009-2024, trillion US dollars

Source: developed by the authors on the basis of L. Clements *et al.* (2024)

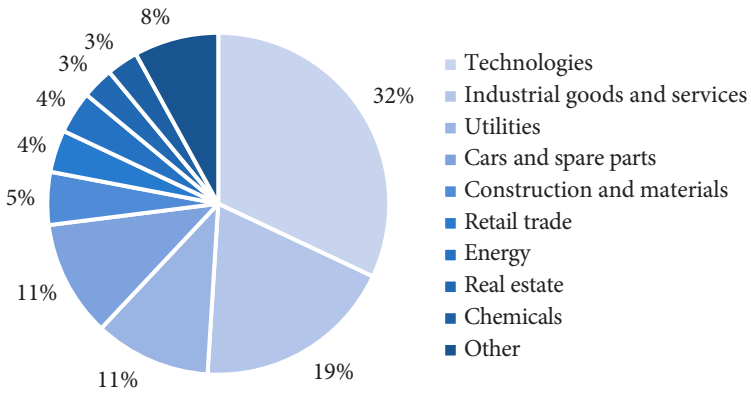

Figure 2. Breakdown of green finance by sector in 2024, %

Source: developed by the authors on the basis of L. Clements *et al.* (2022; 2024)

A breakdown of green finance by sector in 2024 showed that the largest share of investments is in technology (32%), reflecting the high demand for innovative and environmentally friendly technologies that contribute to sustainable development. A significant percentage (19%) is accounted for by industrial goods and services, which underlines the importance of transitioning to sustainable production processes and minimising their environmental impact. Utilities, automobiles and spare parts (11% each) also receive significant funding, indicating the importance

of infrastructure development and green mobility. At the same time, the construction, energy and real estate sectors receive a smaller share, reflecting the gradual, albeit important, transition of these industries to environmentally sustainable models. Other sectors, such as chemicals and retail, have a smaller share of investments, indicating that further efforts are needed to adapt them to environmental requirements. The current state of green finance in Ukraine is an important step towards the country's integration into global economic and environmental processes. To date, Ukraine has ratified 42 international agreements and conventions related to the protection of the environment, nature, flora and fauna (Cheberyako & Miedviedkova, 2021).

Ukraine's tax system contains taxes that can be a fiscal instrument for green finance: environmental tax, excise tax on fuel and electricity, rent for the use of natural resources, etc. In order to achieve the decarbonisation goals in Ukraine, UAH 759 million was allocated for 2024, which was significantly less than the UAH 1,953 million allocated in 2023. Since 2022, the number of taxpayers for air emissions from stationary sources has decreased by 20% due to the consequences of Russia's full-scale invasion (SAF Ukraine, 2024). At the same time, the State Tax Service forecasts that due to a decrease in production volumes, the amount of this tax will decrease by 10% annually starting in 2024.

The basis of green finance in the world is the use of a carbon tax (i.e. the price of emissions of each tonne of carbon dioxide). According to the Tax Code, in 2024, Ukraine will have a carbon tax of EUR 0.77 per tonne of CO_2eq (UAH 32/t CO_2eq), which is one of the lowest carbon prices in the world (SAF Ukraine, 2024). For example, in the EU, the market price for 1 tonne of carbon dioxide equivalent is about €6. Therefore, to meet global green finance standards, Ukraine should not only increase the carbon tax rate but also create appropriate financial instruments that would help attract investment in environmentally friendly projects. This includes the development of green bonds, support for renewable energy sources, and increased financial incentives for businesses that switch to cleaner and more energy-efficient technologies.

European countries together currently lead the green bond market in terms of volume (trading almost half of the world's bonds) (Shevchenko, 2024). The first green bond issues by Ukrainian issuers took place in 2019-2021. In 2019, DTEK issued bonds on the Irish Stock Exchange with a maturity of 5 years and an annual interest rate of 8.5%. The proceeds from these bonds were used to finance renewable energy projects, including the construction of the Tiligul wind farm. In November 2021, state-owned Ukrenergo placed green bonds worth USD 825 million on the London Stock Exchange. USD 825 million on the London Stock Exchange with a five-year maturity and an annual interest rate of 6.875%. However, no green government bonds were issued, due to the martial law in Ukraine and the issuance of domestic government bonds and government bonds. Nevertheless, the potential for financing environmental projects with green financial instruments remains relevant, although it is complicated by political and financial controversies. According to IMF estimates, the total volume of green bonds issued in Ukraine between 2012 and 2022 was USD 1.2 billion (Emerging market green bonds, 2023). It is expected that by 2030 Ukraine is expected to raise USD 36 billion through the issuance of green bonds (Lutsiv *et al.,* 2023).

Given the growing importance of sustainable development and the fight against climate change, international organisations such as the International Energy Agency (IEA), the World Bank, the OECD and the World Economic Forum are actively supporting various initiatives and programmes aimed at financing green projects. These programmes provide governments and businesses with access to finance and expertise to implement environmentally friendly, energy efficient and socially responsible projects. They contribute to infrastructure development, reduce greenhouse gas emissions, improve energy efficiency, and support green investments, which in turn helps Ukraine make the transition to sustainable development and climate change adaptation. Table 3 below summarises the main programmes of international organisations active in Ukraine that support the development of green finance in various sectors of the economy. These programmes help Ukraine to achieve its strategic goals in the field of green finance, support energy-efficient and environmentally friendly projects, create conditions for attracting international investment and climate change adaptation, and promote the integration of environmental standards into the national economy.

Table 3. Green finance support programmes in Ukraine

№	Programme	Essence
1	Programme "EaP GREEN"	The programme, implemented by the United Nations Economic Commission for Europe (UNECE), OECD, UNEP and the United Nations Industrial Development Organization (UNIDO), aims to assist the EU's Eastern Partnership countries (including Ukraine) in the transition to a greener development and business model. It supports the decoupling of economic growth from environmental degradation and promotes the integration of sustainable development principles into national strategies.
2	EU4Environment	The programme supports partner countries in identifying green investment needs and opportunities, as well as sources of public and private finance. The programme also initiated a project to issue green bonds, support subsidy reform and promote greener public spending. The programme, initiated within the framework of Euro Clusters, aims to facilitate the transition of small and medium-sized enterprises (SMEs) to sustainable green production.
3	GEMSTONE	Through the development of specialised services and financial instruments, the programme provides SMEs with access to green finance and supports them in implementing innovative environmental solutions to increase their sustainability and competitiveness.

Table 3. Continued

№	Programme	Essence
4	Programme EBRD "Green cities"	The programme not only promotes the sustainable development of urban infrastructure, but also actively supports green finance as the main tool for implementing environmentally friendly and sustainable projects. The aim of the programme is to help cities implement a green development strategy that includes improving the environment and the quality of life of residents by integrating sustainable solutions into urban infrastructure and natural resource management.
5	Norway-Ukraine Energy Efficiency Programme	The main objective of the programme is to promote the use of local and external financing to improve the energy efficiency of public buildings. The programme also supports the development of local governance and sustainable procurement. Mixed financing is offered for project implementation, including loans, grants, technical assistance and other support.

Source: developed by the authors on the basis of data taken from the websites EU4Environment (n.d.), Norway-Ukraine Energy Efficiency Initiative (n.d.), EBRD Green Cities (n.d.) та OECD iLibrary (n.d.)

Since 24 February 2022, Ukraine has been going through a difficult time of war, which has caused significant damage in many areas, including the economy, infrastructure and social life of the population. Russia's full-scale invasion has not only caused a humanitarian catastrophe, but also made it difficult to implement sustainable development in Ukraine. The war has exacerbated existing environmental problems and created new ones that are much more difficult to solve. The war has caused serious environmental consequences that have a significant impact on Ukraine's sustainable development model. The main ones are:

- mining of large areas, which restricts access to natural resources and negatively affects the conservation of flora and fauna;
- soil contamination, in particular through the use of explosives and the destruction of environmentally hazardous industrial facilities (destruction of a chemical plant in Sievierodonetsk, destruction of the Donetsk Azot plant, repeated rocket attacks on the Artem plant, etc.);
- deterioration of the quality of drinking water contaminated by explosions and aerial bombing (water pollution due to the destruction of sewage systems in Kharkiv, rocket attacks on the Kyiv reservoir, etc.);
- emissions of chemicals into the air due to fires, shelling and other hostilities;
- destruction of such important facilities as the Kakhovka and Dnipro hydroelectric power plants, which led to the loss of part of the green energy potential and the need to use less environmentally friendly energy sources;
- inability to conduct environmental audits in the affected areas, which complicates the assessment and restoration of ecosystems;
- complications in the implementation of measures to reduce the negative impact of toxic and chemical pollution, which further worsens the state of the environment.

Despite the ongoing hostilities, large-scale consequences and the occupation of certain territories, representatives of state and municipal authorities of Ukraine, as well as international experts, are actively discussing the needs and opportunities for post-war reconstruction of the country. One of the most important areas of such discussions is the topic of reconstruction based on the principles of sustainable development, with a focus on green initiatives. Increasing funding for nature should not be based on limiting spending on inclusive development priorities in post-war reconstruction (Naumenkova *et al.*, 2023). Grants from donors and loans on concessional terms for Ukraine cannot be permanent and cover the growing needs for nature financing in full (Naumenkova & Mishchenko, 2024). Thus, in January 2023, the European Commission discussed the possibility of integrating Ukraine's green recovery into the European Green Deal, which was an important step in defining strategic guidelines for the country's post-war recovery. In this context, programmes and initiatives involving the use of green finance should become the basis for sustainable recovery and modernisation of the national economy. Table 4 shows the main areas of recovery, financial instruments and programmes that can be used to achieve these goals in the post-war period.

Table 4. Strategic goals of green finance in the context of post-war reconstruction of Ukraine

Objective	Examples of financial instruments and programmes	Description
Ecosystem restoration and nature conservation	Ecodia; EU Emissions Trading System (EU ETS); Waste Management Support Programme (EU); ISO 14001	Remediation of contaminated or mined areas, biodiversity protection, conservation of natural resources
Energy recovery (green energy)	Green Deal (EU), Commercial Energy Efficiency Programme in Ukraine (UKEEP); green bonds, international loans and grants	Transition to renewable energy sources (solar, wind, bioenergy), restoration of energy infrastructure
Industrial eco-modernisation	EU Industrial Energy Efficiency Programme; Horizon 2020 Programme; Eco-innovation Programme; green bonds	Modernisation of enterprises, transition to energy efficient and environmentally friendly technologies, reduction of CO_2 and other pollutant emissions
Sustainable agribusiness development	CAP – Common Agricultural Policy; Green Agriculture Initiative; support for organic farming through subsidies and grants	Support for sustainable production methods in the agricultural sector, introduction of environmentally friendly methods of soil cultivation and water conservation

Table 4. Continued

Objective	Examples of financial instruments and programmes	Description
Sustainable infrastructure projects	IQ Energy; Green Infrastructure (EU); Urban Sustainable Infrastructure Programme; Climate City Programme	Rebuilding and modernising infrastructure in line with the principles of sustainable development, energy efficiency, and low pollution
Financing through green bonds and loans	Climate Bonds Initiative; green bonds; green loans	Raising funds to finance green projects, both at the national and local levels
International cooperation	United Nations Development Programme (UNDP); EU4Environment; EaP GREEN; Green Economy Financing Facility (GEFF)	Attracting foreign investment, international technical assistance and support for the implementation of sustainable development projects and green initiatives

Source: developed by the authors on the basis of data taken from the websites Emerging market green bonds (2023), EU4Environment (n.d.), OECD iLibrary. (n.d.), UNDP, GEFF (n.d.), Ecodia (n.d.) та ISO (n.d.)

Given the current challenges, including the effects of the war, the green financial sector can be an important tool for achieving environmentally friendly and sustainable development. Thus, despite the challenges posed by the consequences of the war, these factors also open up new opportunities for the introduction of green finance. The need for environmental restoration after the destruction and modernisation of infrastructure can be an impetus for attracting significant investments in sustainable development. Restoring the environmental situation in Ukraine and implementing green finance programmes will be an important step towards building a more sustainable economy that meets the requirements of the current environmental agenda.

In light of the growing attention to the serious environmental challenges facing the planet, green finance is becoming increasingly important as a key element of the modern economy. It goes beyond traditional investment and becomes an important area that links the financial sector to the principles of sustainable development. Major environmental challenges such as climate change, pollution and the depletion of natural resources require immediate attention and action. As noted by D. Shkvarchuk (2024), green finance is an innovative and critical tool for achieving sustainable development and preserving the planet's ecosystems.

The war has caused significant losses for the economy, environment and citizens of Ukraine, which requires the development of an appropriate mechanism to compensate for these losses. An important element of this mechanism should be the development of a system of measures for green financing the reconstruction of the Ukrainian state. It is important to strengthen not only state financial control over the implementation of green projects with foreign investment, but also public control, as the level of corruption in state environmental services is quite high. This is primarily important to prevent so-called 'environmentally toxic' foreign investments from entering Ukraine during the reconstruction period. Such investments may include, among other things, support for coal and oil energy projects, inefficient waste management methods, or other practices that harm biodiversity or contribute to climate change (Karlin & Prots, 2022).

There are a number of factors that hinder the spread of green investments. First and foremost, it is the imbalance of economic indicators, high inflation and high interest rates that reduce the country's investment attractiveness. Another important obstacle is that the technologies used in Ukraine are lagging behind those of developed countries. Low levels of technological innovation and poor infrastructure also reduce the country's investment attractiveness. In addition, corruption processes in Ukraine significantly complicate the implementation of sustainable projects and hinder the development of green finance (Nazarova & Havryk, 2023).

Ensuring sustainable development in the context of post-war recovery in Ukraine requires a more thorough definition of the legal framework for green finance, establishing cooperation with foreign investment companies, international financial organisations and donor funds to attract green finance to Ukraine, although in such circumstances it is difficult to predict its further development. The main areas of green finance development include public-private partnerships, climate risk insurance, sustainability bonds, Islamic finance, government support, and investment in education (Cheberyako *et al.*, 2021). In addition, Ukraine's energy strategy requires ambitious changes in the post-war period of Ukraine's recovery, which should ensure energy independence and energy security of the state and contribute to the welfare of citizens, and RES should not be one of the options for diversifying energy resources, but the basis for rebuilding Ukraine's energy system (Metelenko *et al.*, 2022).

S. Naumenkova & S. Mishchenko (2024) note that excessive debt burden limits the financing of programmes to restore damaged ecosystems and create a green and safe environment. They see green debt swaps as a tool for raising capital in low-income countries to address environmental issues. The debt swap (or conversion) is based on the cancellation of a portion of a country's external debt in exchange for a commitment by its government to mobilise domestic resources (local currency or other assets) to finance the achievement of agreed environmental goals on terms agreed with the creditor.

Thus, the formation of green finance is a modern trend of ensuring sustainable development of the state in the context of globalisation in order to reduce poverty, control the

use of natural resources and increase the number of jobs. And improving the environmental situation is not only a matter of state budget expenditures, but the essence of the new economic system – new economic conditions for doing business, which involve attracting investments in the development of new 'green' industries.

CONCLUSIONS

As a result of the study of theoretical and practical aspects of implementing green finance as a tool for sustainable development and post-war recovery in Ukraine, the following conclusions have been drawn. Green finance includes three areas: infrastructure financing, economic support for industries and enterprises, and financial market development. The concept of green finance has evolved over time in line with the aspirations of economies. With each new international initiative and agreement, the integration of environmental aspects into financial strategies has increased, ensuring the formation of stable financial mechanisms to support climate and environmental goals. Given the need to adapt the economy to climate change and invest in environmentally friendly technologies, the introduction of green finance is an important step towards achieving long-term economic and environmental sustainability.

Between 2009 and 2024, there was a growing demand for environmentally friendly projects and a general shift towards more sustainable economic models. More than 50 countries are actively using green finance mechanisms in their economic strategies. This trend is driven by the introduction of carbon taxes. European countries are leading the way in the green bond market, controlling about half of the world's issuance of these securities. International organisations, such as the International Energy Agency (IEA), the World Bank, the OECD, and the World Economic Forum, actively support various initiatives and programmes aimed at financing green projects, providing governments and businesses with access to financing and expert assistance for the implementation of environmentally friendly, energy efficient, and socially responsible projects. The hostilities have caused serious environmental consequences that have a significant impact on Ukraine's sustainable development model. In the context of Ukraine's post-war reconstruction, the green transformation of the economy can be an important factor not only for recovery but also for increasing the country's competitiveness in the international arena. The introduction of sustainable energy solutions and environmental technologies creates the preconditions for integration into European economic processes and the use of EU financial mechanisms.

Thus, it is important to focus on the principles of sustainable development for Ukraine's successful recovery. International investors are interested in projects that contribute to economic recovery, conservation of natural resources, and energy efficiency. Therefore, projects that meet these requirements will attract investment and contribute to the development of Ukrainian cities, creating conditions for the introduction of environmentally friendly technologies and the restoration of infrastructure to modern standards. This is the basis for effective post-war reconstruction that takes into account the needs of the environment, sustainable development, and improving the quality of life of citizens. Important areas for further research include the development of methods for biodiversity conservation, the introduction of sustainable urbanism models, and the study of effective strategies for managing Ukraine's water and energy resources in the context of post-conflict recovery. It is also important to explore opportunities for the development of smart cities that integrate innovative technologies to reduce the negative impact on the environment.

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Зелені фінанси як інструмент сталого розвитку та повоєнного відновлення в Україні

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Анотація. Тривала війна в Україні створює значні виклики для економіки та екологічної стабільності країни, а залучення «зелених фінансів» може стати ключовим інструментом для повоєнного відновлення економіки та сприяння сталому розвитку, завдяки залученню ресурсів для екологічно чистих та інноваційних проєктів. Метою статті було дослідження потенціалу зелених фінансів, а також аналіз можливостей впровадження цього інструменту для підтримки економічної та екологічної стійкості країни в післявоєнний період. Під час дослідження використовувалися емпіричні, аналітичні та системні методи, що дозволило оцінити вплив зелених фінансів на економічне зростання, зменшення екологічних наслідків та покращення якості життя громадян. Загалом результати дослідження продемонстрували високий потенціал зелених фінансів для відбудови України у майбутньому. У статті було проаналізовано політичні рамки та міжнародні зобов'язання, що можуть стати основою для формування політики зелених фінансів в Україні. В ході дослідження було розглянуто динаміку обсягів зелених фінансів у світі за 16 років, яка засвідчила постійне зростання інтересу до екологічно стійких інвестицій. Було запропоновано рекомендації щодо розвитку зелених фінансів, що включають впровадження механізмів для залучення інвестицій у стійкі екологічні проєкти, підтримку сталого зростання та модернізацію секторів економіки, що є критичними для відновлення країни після війни. Основними висновками є необхідність інтеграції екологічно чистих та інноваційних проєктів у відбудову інфраструктури, що допоможе забезпечити сталий економічний розвиток та зменшити екологічні ризики. Важливу роль у цьому процесі відіграють міжнародні фінансові інструменти та зобов'язання, що сприяють залученню інвестицій у «зелені» проєкти. Отримані в процесі даного дослідження наукові результати можуть сприяти вирішенню актуальних проблем інтеграції зелених фінансів у стратегії сталого розвитку та відновлення України, і можуть бути використані державними органами для формування ефективних механізмів фінансування екологічно стійких ініціатив у повоєнний період

Ключові слова: зелене фінансування; зелені інвестиції; зміна клімату; зелені облігації; навколишнє середовище; цілі сталого розвитку; післявоєнна відбудова