https://doi.org/10.33271/nvngu/2024-3/181

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FINANCIAL DETERMINANTS OF THE POST-WAR RECONSTRUCTION OF THE NATIONAL ECONOMY ON THE PRINCIPLES OF THE EUROPEAN GREEN DEAL

Purpose. To substantiate the role of Green Finance and its separate segments for the greening of the national economy in the context of global trends and world practices regarding the transformation of the capital market and compliance with the principles of the European Green Deal; to determine the most effective mechanisms and tools for stimulating the launch and development of the green bond market in Ukraine. To improve methodical approaches to assessing the economic efficiency of investment projects and optimizing the enterprise's investment program, taking into account the environmental impact factor.

Methodology. The theoretical and methodological basis of the research is the theoretical position of scientists in the field of financial support for the development of the green economy; a complex of general scientific and specific methods: system analysis and mathematical statistics; economic and mathematical modeling and logical generalization.

Findings. The peculiarities of the transformation of global green bond financing are established. The growth of its role in the diversification of existing sources of financing of the green economy and dominance in the world issue of debt obligations is proven. A green bond model based on the Green Bonds Principles is proposed; a mechanism for stimulating the launch and development of the green bond market in Ukraine, which will be an important step on the way to the implementation of European standards for the development of green energy and environmental protection. It has been proven that the formation of an optimal portfolio of green investment projects must be carried out taking into account environmental impact factors.

Originality. In the process of research, it was established that in the conditions of an unstable environment and military operations, the role of new financial instruments, primarily green bonds, in financing environmental projects, providing access to global capital markets and international financial aid programs, is increasing. A green bond model based on the Green Bonds Principles and a mechanism for stimulating the launch and development of the green bond market in Ukraine is proposed. Methodical approaches to evaluating the efficiency of investment processes and optimizing the portfolio of green investment projects have been improved, which, unlike the existing ones, take into account the project's ecological impact on the environment.

Practical value. It consists in the development of proposals to stimulate the development of the green bond market in Ukraine; determination of the optimal investment development program of the enterprise based on the economic-mathematical model of optimization of the net profit of the enterprise, which takes into account the growing influence of environmental factors on investment efficiency indicators.

Keywords: *green bond model, global bond financing; environmental impact factor*

Introduction. Environmental threats associated with global climate change and environmental degradation are one of the most threatening risks to world development. The existence of many communities and biological life support systems on Earth is under threat. Therefore, the green economy on a global scale should become the basis for the implementation of the concept of sustainable development of each country.

Ukraine faced all environmental problems as well, but they escalated catastrophically on February 24, 2022, due to the full-scale aggression of the Russian Federation. The war in Ukraine is still ongoing, and the fighting is causing the worst destruction in Europe since World War II. Therefore, the future of the environment and the recovery of Ukraine's economy directly depend on how Ukrainians rebuild their country after the war. Of decisive importance for the post-war recovery of Ukraine is the preservation of the European Green Deal, which should become a key reference point in the process of rebuilding the country and a response to modern environmental and climate challenges. The EU's new growth strategy for the transition to a climate-neutral Europe by 2050 is based on creating a resource-efficient and competitive economy, stimulating the development of a circular economy, transforming climate and environmental issues in all sectors, and EU policy opportunities to ensure a fair and inclusive "green" transition. Sharing the principles of the European Green Deal, Ukraine was one of the first countries in Europe to ratify the Paris Climate Agreement (2016), according to which by 2030 it is to reduce greenhouse gas emissions by 65 %, and by 2060 it is planned to achieve climate neutrality.

It is extremely important that Ukraine now perceives the European Green Deal not as a threat, but as a set of opportunities for the development of new industries, technologies, and experience, finding new niches and forming business partnerships on the European market in the post-war recovery and laying the foundations for future "green" growth. Therefore, the vision of the post-war recovery of Ukraine is presented only in the plane of the green economy.

Ukraine, together with its international partners, is actively forming a strategy and medium- and short-term plans for post-war recovery, considering the scale of the destruction of the national economy and the enormity of measures for its recovery in accordance with the concept of sustainable development.

The agreement on the exemption from industrial visas opens a window of opportunity for the integration of Ukrainian industry into international industrial processes, in particular the development of organic production; cooperation in hydrogen energy, considering the EU-recognized role of Ukraine as the main partner in the European Hydrogen Strategy. In the financial sphere, Ukraine joins the European market of public procurement and EU investment, financial and technical support instruments. It is extremely important to include nature conservation areas of Ukraine in the NATURA-2000 network with the involvement of financial support from the EU and special financial instruments. Adhering to the principles and norms of the European Green Agreement in the field of green transformation of Ukrainian cities, impor-

tant strategic areas of investments will be the restoration and modernization of the housing stock and infrastructure, new construction with zero energy consumption, ensuring energy supply and heat supply in cities with low CO_2 emissions – up to 10 % per year.

However, it should be noted that it is necessary to consider not only the definitely positive aspects of cooperation with the EU within the framework of the EC, but also to comprehensively investigate the negative factors accompanying such integration processes. First of all, attention should be paid to the key threat: non-tariff barriers to trade and restrictions on the access of Ukrainian goods to EU markets, in particular due to a significant share in the structure of Ukrainian exports of energy- and resource-intensive goods. There are also problems with the export of Ukrainian agricultural products and food products to the EU market due to non-compliance with environmental standards during their production.

The successful implementation of strategic and current programs of the post-war economic revival of Ukraine requires the involvement of investments from the European Bank for Reconstruction and Development, credit institutions and, above all, the development of the domestic financial market with the possibility of launching new modern financial instruments for the formation of sustainable financial flows.

Literature review. Numerous domestic and foreign scientists and experts are investigating the financial determinants of green (or sustainable) post-war recovery of Ukraine in the context of generalizing the experience of ecological modernization of the national economies of the European Union, global trends in the transformation of the capital market and the use of green bonds in financing ecological modernization: Rudenko V. [1], Shuba O. A. [2]; modern trends in the functioning of the corporate bond market in Ukraine: Bilous I. V. [3], Kuzhelev M. O. [4]. Domestic scientists Voynarenko M. P., Yepifanov I. Yu. made a significant scientific and theoretical contribution and practical experience in the development of methods for assessing the economic efficiency of investments [5], Savchuk L. M., Cherep A. V. [6], Yastremska O. M. [7], and others.

Unsolved aspects of the problem. Implementation of the tasks defined by the European Green Agreement requires large-scale investments and largely depends on the effectiveness of green financing, that is, the process of attracting financial resources for the implementation of environmental investment programs. Deficits of state and local budgets, the lack of opportunities for self-financing of domestic enterprises, the presence of problematic bank loans for financing environmental projects, prompts both the state and individual economic entities to look for opportunities to attract new sources of green financing for the reconstruction of the national economy based on the principles of environmental protection.

As a significant contribution to the creation of public and private investment funds and in order to ensure adequate access to financial resources, we consider it expedient to carry out a systematic redistribution of investment flows with their subsequent redirection from resource-intensive and polluting production to environmentally friendly business models and ecological technologies, in particular clean production energy sources, energy saving measures, development of low-carbon infrastructure.

Currently, the issue of modeling financial support for environmental investment projects in Ukraine is quite relevant, the mechanism for launching and functioning of green bonds on the financial market, the selection of optimal options for green financing and financial instruments in conditions of a shortage of financial resources need to be improved. Considering the problems of investment support for the development of the green economy, methodical approaches to assessing the economic efficiency of investment projects, taking into account the environmental impact, need to be improved.

Theoretical basis. Green finance is used to finance activities related to climate change mitigation, adaptation to climate change and other environmental protection objectives such as water management, biodiversity, landscape protection, etc. Climate finance is an important component of green finance, which is used to finance projects and actions aimed at mitigating the effects of climate change. The history of the concept of green finance relates to program documents, strategies and directives of global organizations and the European Union [8, 9].

Currently, Ukraine has already made a lot of achievements regarding the implementation of EHC programs. This is especially noticeable in the field of renewable energy, which brings additional investments to the Ukrainian economy and opens new horizons of economic development. In the last 3 years alone, about 700 million euros were involved in Ukrainian green projects, more than 400 million euros was invested in the introduction of 1,670 MW of new thermal capacities with alternative energy sources, 300 million euros was directed by businesses to the installation of numerous renewable energy facilities power industry. Such powerful investment programs were implemented thanks to the improvement of the regulatory and legislative framework in the field of renewable energy and consistent systematic actions of the Government regarding the global energy transition to clean energy sources. Considering the significant potential for the development of clean energy in Ukraine, it is expected that the share of green energy in the total primary supply will reach 25 % in 2035.

It is estimated that achieving the current climate and energy targets by 2030 will require €260 billion of additional annual investment, which is approximately 1.5 % of Ukraine's GDP in 2018. Such a large-scale investment flow requires systematic support for a long time [10]. In total, within the framework of the European Green Course, the EU plans to attract 1 trillion Euro investments for sustainable projects and political activities. The scale of investment problems requires the mobilization of both the public and private sectors. It is expected that half of the investment resources (€503 billion) will be generated from the EU budget, within the framework of the Multiannual Financing Program for 2021–2027, €114 billion will come from national governments through co-financing, the rest will be generated through private capital from EU guarantees within the framework of the InvestEU program [11].

One of the ways of financing Ukraine's post-war transition to a green course may be joining the EU investment program InvestEU. As this program supports one of the four policy areas, namely Sustainable Infrastructure, at least 30 % of the InvestEU programme, in line with the objectives of the European Green Deal, will support the financing of investments that contribute to the achievement of climate goals. In addition, 60 % of the investments supported under the "Sustainable Infrastructure Window" of the InvestEU Fund will contribute to the achievement of climate and environmental goals [11].

At the "Ukraine – European Union" summit (2020), the agreement on "Climate package for a stable economy in Ukraine" was signed, which provides for the financing of numerous investment programs in the field of green economy in the amount of 10 million euros, the implementation of which will bring Ukraine closer to a gradual transition to a clean and climate-friendly neutral economy. The expected systemic financial support from the EU countries will make it possible to implement the climate goals of Ukraine, which will positively affect not only the state of the environment but will also contribute to the sustainable development of all sectors of the national economy based on the introduction of innovative green technologies and means of production [8]. Important financial instruments for meeting the investment needs of EU countries at the state level are: InvestEU, Just Transition Mechanism, Horizon Europe, Next Generation EU, Modernization Fund, Cohesion Fund [10].

The main ways Ukraine receives financial support from the EU are the allocation of limited financial resources directly from the EU budget and international aid programs. Involvement of the Ukrainian government in available direct fi-

nancing takes place mainly within the framework of the "Horizon Europe" program with the use of international development instruments: the European Neighborhood Instrument, the instruments of partnership and cooperation in development, the European Fund for Sustainable Development Plus.

The governments of the EU member states and its private business in the field of B2B lending can become important financial instruments of green financing for Ukrainian business, which will receive support and financing from their governments under the ECK program. Currently, enough funds have been created in the EU (European Fund for Regional Development, Common Agricultural Policy – SAR, Innovation Fund and others) for financial and technical support of investment programs in Ukraine in priority areas: clean energy, circular economy, technologies, biodiversity, etc. The "LIFE" Program will be important for financing the processes of restoring nature in accordance with the circular economy without emissions and the development of such areas as: "Clean, affordable and safe energy supply", "Energy-efficient and resource-saving buildings", "Preservation and restoration of ecosystems and biodiversity".

Having joined the Horizon Europe Research and Innovation Framework Program (2021–2027), the Research and Training Program of the European Atomic Energy Community (2021–2025), Ukraine will receive from the EU part of the project funding for scientific research in the field of nuclear safety and protection, which will contribute to scientific development and strengthening of scientific potential in the field of atomic energy [12].

Financial flows from the EU are possible due to investments in Ukrainian enterprises and export of goods or services to the EU by state and private institutions, since it is the Ukrainian industry that will be able to help the EU in decarbonization and the fulfillment of climate goals.

It should be noted that green finance, as a significant source of funding for green economy projects, covers many different financial instruments, such as: green bonds, shares, green loans, mortgages, derivative financial instruments; green venture capital, government subsidies such as grants, loans, compensation, guarantees, feed-in tariffs, taxes, pollution permits, tax credits, green public procurement, etc. Therefore, it is not surprising that researchers focus on one or several financial instruments, focusing on specific issues related to their introduction and functioning on domestic and global financial markets. An encouraging characteristic of the green financing market was the significant growth of green debt instruments, primarily green bonds. The global energy crisis has stimulated clean energy policies in the world's largest economies. As governments around the world continue to expand their climate ambitions, more and more capital is being allocated to increasing renewable energy capacity and new technologies such as green hydrogen.

According to the Climate Bonds Green Bonds database, the market for green finance has reached its most significant milestone: since its inception in 2007, the total issuance of bonds amounted to $1.002 trillion. USA. This milestone was passed at the beginning of December 2022. In recent years, the demand for green bonds has significantly exceeded the supply. This trend continues to this day. Many countries have allocated a significant part of their budget expenditures to accelerate the transition to a low-carbon economy. Green bonds continue to dominate global debt issuance, accounting for 56 % of GSSS issuance at the end of 2022, increasing the combined cumulative total of this market segment to USD 2.2 trillion at the end of 2022 (Table 1). In June 2023, the global cumulative issuance of GSSS bonds (green, social bonds, sustainable development bonds and bonds related to sustainable development) reached USD $ 4.4 trillion. Green bonds accounted for 64 % of the total, while emerging market issues accounted for 16 % of the total.

The public sector, including sovereign states, government agencies, public development banks, regional authorities, municipalities, and local governments, accounted for 31 % ($1.37 trillion) of total bonds issued to date. Green Bonds, which account for 60 % of the amount issued, are still the most popular instrument for public sector issuers.

Sovereign issuers remain the largest segment (31 %) among public sector issuers, followed by state institutions (25 %) and state development banks (19 %). In the second quarter of 2023, the public sector issued USD 116 billion of T-bills, up to 11 % from the first quarter of 2023 and up to 38.3 % from the first quarter of 2022, mainly driven by sovereign and regional authorities. 48 sovereign states entered the OVDP bond market by June 2023. In the 2nd quarter of 2023, Turkey and Cyprus debuted on the market. The cumulative volume of issuance by sovereign issuers reached USD 429 billion (10 % of the total volume of GSSS bonds ever issued). Green bonds remain the most popular instrument for sovereign issuers, with USD 345 million in bonds issued through this instrument [14]. Unlike developed market sovereigns, which still show a significant preference for green bonds (97 % of total bond issuance), emerging market sovereigns are issuing more bonds that finance a mix of green and social projects, i.e. sustainable bonds development (46 % of the total volume of issued bonds), and not only green projects.

In the last ten years, the issue of green bonds has gained considerable popularity in many countries of the world, growing exponentially in the global financial market, even though green bonds are a relatively new financial instrument (Fig. 1). The priority of the world in green financing is revealed in the fact that today, according to the data of the Climate Bonds Initiative, the market of green bonds is more than USD $2 trillion [13].

Consequently, green bonds are becoming a core product and a vital contribution to climate finance and achieving the goals of the Paris Agreement. Adhering to the principles of sustainable development, a community of socially responsible investors is actively forming in economically developed countries, which redirect their investment flows into green projects to solve national and global challenges.

All green bond deals have been vetted for their green credentials in accordance with the GBDB Climate Bonds Methodology. The largest share of the global green bond market belongs to the European Union with a total volume of 6.5 bil-

Table 1

System of indicators of the global debt market at the end of 2022 (compound by data [13])

	Debt obligations by types of instruments			
	Green bonds	Social bonds	Bonds of sustainable development (sustainable technologies)	Bonds related to sustainable development
Total market size (cumulative)	USD 2.2 trillion	USD 653.6 billion	USD 682.0 billion	USD 204.2 billion
Number of issuers	2,457	772	507	336
Number of countries	85	49	57	50
Number of currencies	49	42	41	21

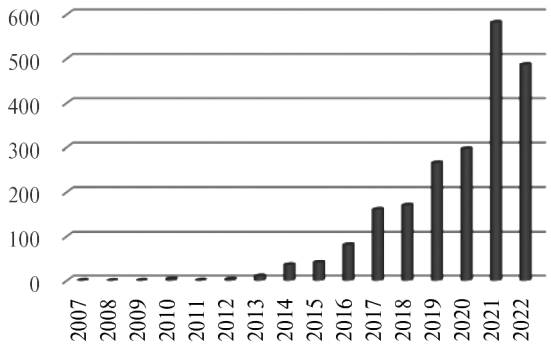

Fig. 1. Global annual volume of green bond issuance for the period 2007–2022, billion USD (*compound by data* [13, 14])

lion USD, the proceeds from the issue of which were directed to the implementation of relevant target programs: research and innovation activities to support the transition to a green economy; digital technologies to support the green transition, energy efficiency; clean energy and networks; adaptation to climate change; water resources and waste management; clean transport and infrastructure; nature conservation, restoration and biodiversity.

The member countries of the European Union continue to increase the issuance of green bonds, and the most consistent country in this matter is France, which has successfully increased the issuance of "green" bonds for the sixth year in a row. Austria, Canada, Denmark, New Zealand, Singapore and Switzerland have become newcomers to the Club of Sovereign Green Bonds.

Two thirds (67 %) of the volume of green bonds in 2022 come from developed markets, 23 % from emerging markets and 9 % from supranational issuers. The volume of green bond issuance in 2022 decreased in all regions of the world compared to last year, except for the supranational sector, which amounted to $45.1 billion, which is 43 % more compared to the previous year. The main part of its growth was due to the large-scale EU Green Bond Program, under which since its debut in October 2021, bonds for a total amount of 39.9 billion dollars have been issued. USA within the framework of four agreements. It is part of the European Commission's efforts to finance up to 30 % of its NextGenerationEU recovery plan through the issuance of special green bonds, aimed at delivering multiple benefits for the EU, capital markets and sustainable finance. The growth in Asia Pacific, the second largest region, can be explained by the increase in the market weight of financial corporate issuers, which accounted for 51.8 billion USD, or 39 % of the total volume of issuance in 2022 (2021: 39.7 billion US dollars). The three most prolific countries in the Asia-Pacific region are China ($85.4 billion and 332 deals), Japan ($12.6 billion and 69 deals) and South Korea ($7.9 billion and 30 deals).

In 2022, hard currencies were the source of 79 % of green bond issuance. For the fifth year in a row, preference is given to the euro. In 2022, 357 agreements denominated in euros were concluded from 170 issuers, increasing the cumulative volume of this currency to 922.1 billion dollars USA. Europe is the source of the most advanced policy measures and the largest number of targeted investment mandates in the field of investment, which is why the region dominates the issuance of green bonds. Issuers raising euro-denominated debt can minimize risks and maximize investor diversification. The market share of the Asia-Pacific region grew at the expense of Chinese issuers, which was reflected in a 21 % increase in the volume of issuance denominated in Chinese yuan to $73.3 billion in 2022.

Therefore, global world trends, international practice and green economy financing trends in Ukraine indicate radical changes in the structure of the capital market and diversification of existing sources of green economy financing, increasing the role of new financial instruments, primarily green bonds, in financing environmental projects thanks to access to global capital markets and the reduction of the cost of financial resources, particularly the cost of debt obligations. The emergence of a new debt financial instrument, which meets the principles and requirements of the global capital market, will allow the financial sector to be mobilized to achieve the goals of EZ and sustainable development, directing domestic and international capital flows to environmental projects for the development of a green economy. This will contribute to the fulfillment of national strategic goals and international obligations within the framework of the European Green Deal. Given that this type of investment attraction is new for Ukraine, it is necessary to research and generalize, transforming to Ukrainian realities, the specifics of the launch of the green bond market in countries that are currently leaders in the transition to a green economy.

As can be seen from Table 2, in most of the countries of the world, especially in the EU countries, relevant legal acts have been developed, new international investment standards have been established, effective mechanisms for the introduction and development of the green bond market are involved, the instruments of influence of which cover numerous sectors of the national economy: the financial market , industry, energy, agro-industrial complex and land use, transport, water and housing and communal management, preservation and reproduction of ecosystems, etc.

Currently, Ukraine is actively developing and developing a regulatory framework for the green bond market, based on which a well-founded national policy and sustainable green bond market is being formed, considering the recommendations of the EU and global market leaders (ICMA, World Bank Group, etc.) (Table 3).

To effectively use green bonds on the domestic and global capital markets, to create an effective green bond market, a model of green bonds has been proposed in accordance with the Green Bonds Principles, which contains key provisions regarding the content, features, and principles of their application on the financial market of Ukraine in accordance with international standards (Fig. 2). An important component of the model is the development of a system of financial, socio-economic, and environmental indicators, which will allow systematic monitoring of the current state and development trends of the GB market, timely neutralization of the impact of negative factors on the volume of issuance, the number of issuers, liquidity, and profitability of green bonds.

Table 2

Features of the launch of the green bond market in different countries of the world

Country	Features of the launch of the green bond market
France	Financing of government targeted green projects of national importance through the issuance of sovereign green bonds
Poland	Provision of cheap loans by the country's banking system for the issuance of sovereign green bonds
Great Britain	Stimulation of GB market development by a special state investment bank – issuer (GIB). It engages a reputable independent party (Center for International Climate Research, CICERO) to evaluate projects selected for green bonds
Germany	Stimulating investors to finance green projects through the provision of cheap green loans by banks – issuers with state capital
China	Comparative analysis of green projects that are implemented in a certain territory in the absence of an assessment of their compliance with uniform selection standards

Table 3

Development of the regulatory framework for the green bond market

International practice		Ukraine	
2007–2008	The first issues of European Green Bonds were carried out. Investment Bank (EIB) and the World Bank	2020	Law of Ukraine of June 19, 2020, No. 738-IX "On Amendments to Certain Legislative Acts of Ukraine on Simplifying Investment Attraction and Introducing New Financial Instruments" [18]
2014	The first edition of the Green Bond Principles (GPB) with the support of the International Capital Market Association (ICMA) and the Consortium of Banks	2021	Law of Ukraine "On Capital Markets and Organized Commodity Markets" [19]
2019	Approved and published Green Bond Principles. Attention is focused on directing financial capital to green investments (ICMA)	2022	Law of Ukraine "On the ratification of the Agreement between Ukraine, on the one hand, and the European Union and the European Atomic Energy Community, on the other hand, on the participation of Ukraine in the Framework Program for research and innovation "Horizon Europe" [12]
2020	The Green Bond Standard (EU Green Bond Standard – GBS) the European Green Deal Investment Plan was introduced	2022	The concept of the introduction and development of the green bond market in Ukraine. APPROVED by the order of the Cabinet of Ministers of Ukraine dated February 23, 2022, No. 175-p [20]. Recovery Plan of Ukraine, National Recovery Council, July 2022 [21]
2021	Updated and supplemented the edition of GPB with recommendations on mandatory external control (verification); reporting on the distribution of emission funds, on the impact on the environment [15]		
2022	Communiqué COM 233 "Ukraine Relief and Reconstruction" dated May 18, 2022 [16]. Analytical note "Relief, Recovery and Resilient Reconstruction: Supporting Ukraine's Immediate and Medium-Term Economic Needs" [17]		

It should be noted that even a substantial legal framework is not a guarantee of effective use by all categories of issuers of such a modern financial instrument as green bonds. In accordance with the accepted model of green bonds, an effective mechanism for the effective functioning of the green bond market in Ukraine is proposed, which provides for the accumulation of influence tools and a system of measures in two directions:

I. *Creation of legislative and technical prerequisites for the formation of the green bond market*:

- improvement of the regulatory and legislative framework, in particular budget legislation, regarding the creation of opportunities for the growth of green bond issuance based on their diversification (issuance of various types: income, project, securitized, the issuance of which is currently blocked due to the imperfection of domestic legislation);

- formation and development of the institutional infrastructure of the GB market with the involvement of state institutions (the National Bank, the Antimonopoly Committee, the National Committee for Securities and the Stock Market, the ministries of finance, energy, infrastructure, environmental protection and natural resources, economic development, trade and agriculture); municipalities; non-governmental organizations and private stakeholders;

- the active involvement of international organizations, primarily financial, in helping for the launch of the green bond market, particularly the Green Climate Fund for financing the issue, the World Bank – technical assistance in issuing sovereign GBs, the International Capital Market Association – ICMA and the International Finance Corporation (IFC) – development of methodological recommendations on market procedures;

- carrying out information and advertising campaigns regarding the target purpose, the role of green bonds in the financing of environmental projects and procedures of the GB market.

II. *Formation of instruments of influence on the development of the GB market and their involvement in green financing on the investment market*:

- for the successful practical implementation of all procedures of the GB market in accordance with the current regulatory framework, to develop structural and logical schemes for the issuance of green bonds by various categories of issuers (the state in the domestic and foreign markets, municipalities, enterprises, banking and international financial institutions), taking into account the peculiarities of the implementation of these procedures by each category;

- to create an association of independent local and external verifiers on a permanent basis;

- to form and constantly update a portfolio of nationally significant and pilot "green" investment projects for the issuance of sovereign and standard green bonds;

- to develop the GB stock market segment and define the green bond stock market index;

- in order to ensure and maintain high liquidity of green bonds on the stock markets, taking into account the fact that one of the key criteria for the attractiveness of financial debt instruments is liquidity, it is proposed to restructure the stock market by issuing bonds of a new type, which are planned to be divided into two components: an ordinary bond and a green component in the form of a green certificate, which precisely provides for the allocation of income from an ordinary bond to finance green projects. This will facilitate the procedure for attracting green investments, stimulate growth in the volume of bond issuance, reduce transaction costs and the cost of debt, provide investors with better transparency in the use of funds and investment decisions;

- to stimulate the involvement of domestic and international institutional investors in the financing of green projects through the GB market using financial and economic incentives (high liquidity of sovereign GBs, a reasonable level of interest rates and risk premiums) and socio-political levers of influence on socially responsible investors.

Currently, the situation regarding the martial law on the territory of Ukraine, starting from 2022, does not contribute to the improvement of green investment financing. There is a clear trend towards a further decrease in the investment resources of enterprises and the state as a result of the destruction of assets,

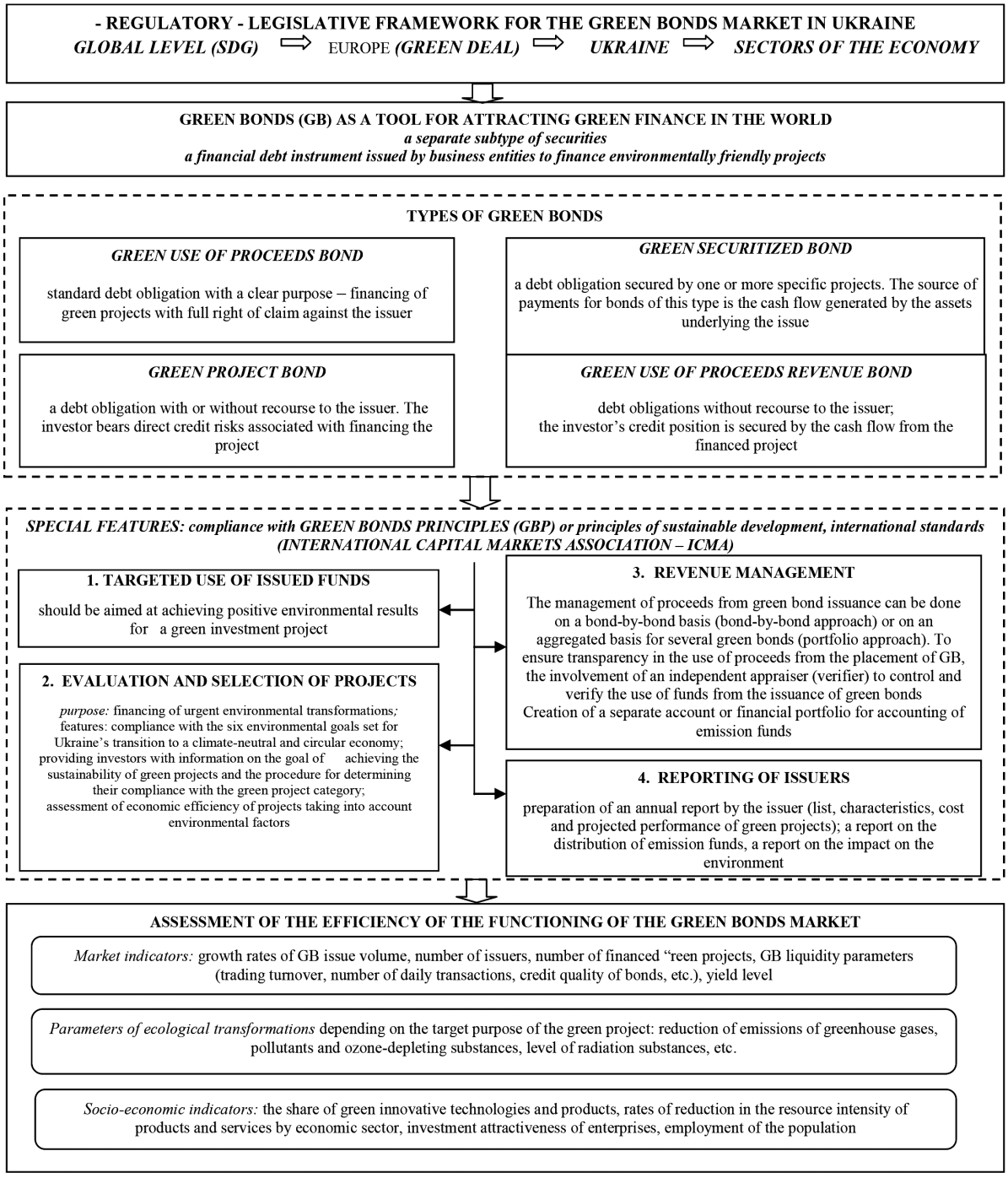

Fig. 2. The model of green bonds on the financial market of Ukraine (*developed by the authors based on* [15, 18])

stoppage or deterioration of the financial results of a significant number of enterprises. Negative trends in investment financing also occur in the banking sector due to the high cost of credit investments. Thus, during the heyday of pre-war green energy, banks actively provided loans for the development of this industry. In the gross loan portfolio of banks, according to the NBU, the share of green energy loans was approximately 4 %. However, green energy constantly has to solve problems that have existed for many years and deepened during the war.

As of the beginning of May 2023, the accumulated debt for purchased green electricity amounted to UAH 18.6 billion. During the conflict, some renewable energy producers were only able to pay interest on the green tariff due to limited financial receipts. Therefore, only the diversification of existing sources of funding for the green economy with the involvement of new financial instruments, first of all green bonds, will allow the financing of environmental projects and Ukraine's fulfillment of international obligations within the framework of the European Green Agreement, taking into account the transformation of global capital markets and the reorientation of international capital flows in sustainable development projects, in particular green investment projects.

According to the Recovery Plan of Ukraine, aimed at accelerating sustainable economic growth, the total need for financing all sectors of the economy is 750 billion dollars. USA, including priority financing in the amount of more than 500 billion dollars. The USA needs projects aimed at eliminating the consequences of military actions: the restoration of damaged assets, a clean and safe environment, the restoration and modernization of housing and regional infrastructure, energy independence and the Green Deal [20].

The implementation of green investment programs for the post-war reconstruction of Ukraine is impossible without the help of Partners: support on the way to EU integration and

opening access to global financial markets, financial support, in particular, promotion of private investments through the green bond market.

Currently, the development of the system of measures presented in the Concept of the development of the green bond market in Ukraine ensures the creation of an institutional basis for the launch of an effective mechanism for its functioning on the financial market. According to the International Finance Corporation (IFC), the potential of the Ukrainian services market from the development of clean energy alone by 2030 is 73 billion dollars USA. By mobilizing the financial sector to invest in green business, it is forecasted to attract more than $36 billion to Ukraine through the issuance of green bonds by 2030 [21].

As noted in the diagram (Fig. 2), an important component of the presented model of green bonds and the process of launching the "green" bond market according to Green Bonds Principles is the assessment and selection of effective investment projects, the procedure for which needs to be improved in terms of assessing the degree of environmental impact of implemented projects on the environment.

In our opinion, the structural and logical presentation of the optimization process of the enterprise's investment program, considering environmental factors, should include the following stages:

- financial diagnostics of the effectiveness of the use of production and financial resources of the enterprise and urgent environmental problems of the enterprise, industry, country;
- determination of strategic goals and long-term prospects for the investment development of the enterprise and its financial support in compliance with the principles of EEC;
- development of a mechanism for the formation and implementation of the enterprise's investment program with optimal parameters: tools for interaction with the state on the policy regarding EZC and green bonds, development of green financing; a pool of tools for interaction with the financial market and the market environment regarding the implementation of green business models; tools for internal regulation of the processes of optimization of investment development directions of the enterprise and formation of an optimal portfolio of green projects (internal regulations and standards for financing and evaluation of investment projects taking into account environmental factors, methods of system analysis and economic-mathematical modeling, financial instruments: green bonds and loans, etc.);
- assessment of the implementation of the optimal investment program of the enterprise and its impact on the change in the ecological parameters of the environment.

When forming a portfolio of green investment projects, we will foresee the division of investments into:

- investments of economic growth, the evaluation of the effectiveness of which is carried out considering the influence of environmental factors;
- ecologically oriented investments aimed at reducing and eliminating the negative man-made impact on the environment.

Ecological investment involves the implementation of the following goals:

- preventive goals: prevention of environmental pollution;
- goals of impact limitation: elimination of the consequences of environmental pollution; limitation of environmental pollution (reduction of industrial emissions into water bodies, soil, atmosphere); compensation for the shortage of natural resources due to secondary processing;
- restoration goals: restoration of the natural environment [22].

Formation of the optimal portfolio of green investment projects must be carried out considering the environmental impact factor (Fig. 3).

When determining the economic efficiency of projects, it is proposed to consider the coefficient of environmental impact, thus changing the "subordination of ecological projects to economic feasibility" [23, 24]. The coefficient of environmental impact (*KEI*) characterizes the ratio of economic damage to the environment after (ED_a) and before the implementation of projects (ED_b)

$$KEI = 1 - \frac{ED_a}{ED_b}.$$

Economic damage to the environment in each case is determined by comparing actual indicators with normative and indicators of the past period.

If $KEI < 0$, it means that the implementation of this project leads to the deterioration of the environment and therefore, when determining the economic efficiency of the project, it is necessary to add the increase in economic damage to the environment to the costs of implementing the project, thus reducing the component of economic growth.

That is, considering this coefficient is necessary when determining initial investments, because in the future it will be necessary to introduce measures to improve the state of the environment at least to the level that was before the implementation of the investment project. The implementation of these measures also requires additional investments.

$$NPV = \sum_{j=1}^{m} PV_j - I_{init} \cdot (1 + KEI);$$

$$Ipr = \frac{\sum_{j=1}^{m} PV_j}{I_{init} \cdot (1 + KEI)}.$$

If $KEI > 0$, it means that the implementation of this project leads to an improvement in the state of the environment, and therefore, when determining the economic efficiency of the project, it is necessary to add the reduction of economic damage to the environment to the cash receipts from the implementation of the project, thus increasing the component of economic growth.

That is, taking into account this coefficient is necessary when determining the amount of discounted cash flows (PV) for the project.

$$NPV = \sum_{j=1}^{m} PV_j \cdot (1 + KEI) - I_{init};$$

$$Ipr = \frac{\sum_{j=1}^{m} PV_j \cdot (1 + KEI)}{I_{init}},$$

where I_{init} is initial investments for the i^{th} investment project, UAH.

To form the optimal investment program for the development of the enterprise in accordance with the green course of development, we will use the economic-mathematical model of optimization of the undistributed part of the net profit, which considers the growing influence of environmental factors on investment efficiency indicators.

The objective function of the economic-mathematical model has the form

$$\sum_{j=1}^{m} \sum_{k=1}^{n} \frac{NP_{kj}}{(1+i)^n} \cdot Y_{kj} \to \max,$$

where NP_{kj} is the net profit that remained at the disposal of the enterprise after paying all taxes and payments during the implementation of the j^{th} event in the k^{th} year, UAH; Y_{kj} – Boolean variable; i – discount rate; j – the investment project number ($1 \le j \le m$); n – the term of validity of the investment program.

Achieving the goal with the help of the economic-mathematical model is carried out under the following restrictions:

- the amount of financial resources, both own and borrowed, which can be allocated for investment development of the enterprise

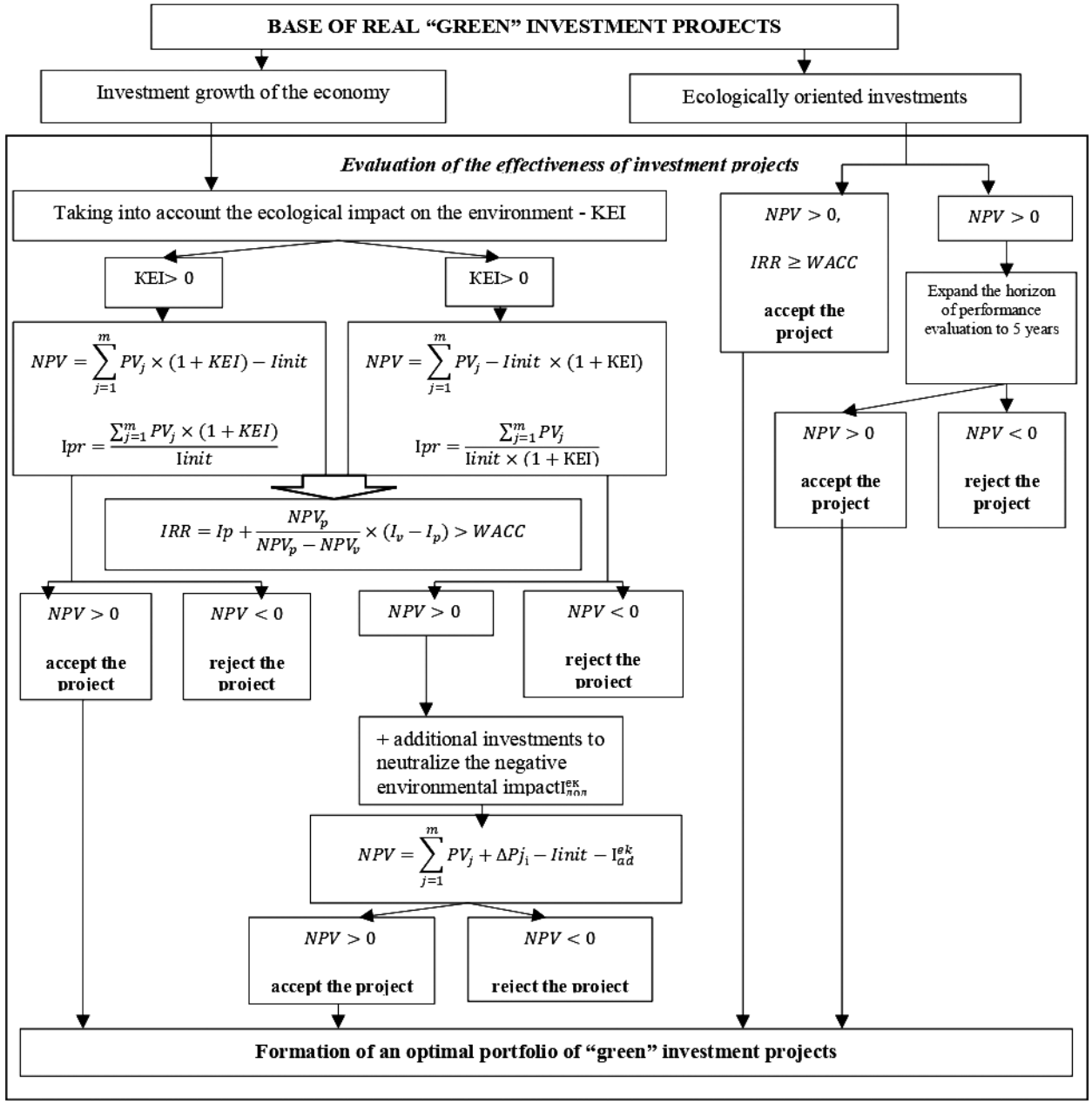

Fig. 3. Scheme of formation of an optimal portfolio of green investment projects

$$\sum_{i=1}^{n} K_j \cdot Y_j \leq OC + GF^2,$$

where K_j is capital resources of the enterprise, necessary for financing the i^{th} event, UAH; OC – the company's own capital; GFI – financial instruments for stimulating the development of the green economy;

- provided that the financial stability of the enterprise is ensured

$$\frac{OC + GF^2}{BC} > 0.7,$$

where BC is Balance Sheet;

- if the internal rate of return of each investment project exceeds the weighted average cost of investment resources

$$(WACC)IRRR_i > WACC,$$

where IRR_i is the internal rate of return calculated for the j^{th} measure, %;

- the limit of a certain type of resources for the implementation of measures of the development investment program

$$\sum_{j=1}^{m} R_{gj} \cdot Y_j \leq R_e - R_{cur},$$

where R_{cur} is the volume of q-type resources required for the normal current activity of the enterprise, UAH; R_{gi} – resources of the q^{th} type, which will be used during the implementation of the j^{th} investment project; R_e – the total amount of resources owned by the enterprise; Y_j – Boolean variable;

- the non-negativity of the environmental impact coefficient

$$KEI = 1 - \frac{ED_a}{ED_b} \geq 0;$$

- provided that the investment project is included in the optimal investment development program of the enterprise

$$\begin{cases} 1 - & \text{if the } j^{th} \text{ investment project is included in the} \\ & \text{optimal enterprise development program} \\ Y_j = 0 - & \text{if the } j^{th} \text{ investment project is not included in the} \\ & \text{optimal enterprise development program.} \end{cases}$$

Conclusions and recommendations for further research. Summarizing the results of the study, we note that the problem of green financing in the post-war reconstruction of Ukraine is extremely urgent. The war in Ukraine leads to extremely large destruction of assets, infrastructure, and a drop in the country's economic potential. But at the same time, with the support of European and other global partners, a window of opportunity is opening for the restoration of the national economy based on the principles of the European Green Course: involvement in joint scientific research with the invitation of world experts in various fields, access to various business models for the development of new industries and technologies, to new sources green financing and modern financial instruments on international capital markets, establishing new partnerships to develop approaches and solutions for carrying out the necessary transformations and achieving the environmental goals of the transition to a climate-neutral economy.

For the successful post-war recovery of Ukraine's economy based on the principles of the European Green Course, it is necessary to create an effective state policy to stimulate the development of processes of greening the economy, search for new and diversify existing sources of green financing. For this purpose, a model of green bonds based on the Green Bonds Principles and domestic legislation, a mechanism for the functioning of green bonds in Ukraine, is proposed. We emphasize that the introduction of the green bond market will be an important stage for Ukraine on the way to the implementation of the European standards of sustainable development, the expansion of green business financing opportunities with the help of green bonds. The world experience regarding the introduction of the green bond market shows that their effective functioning on the financial market is possible only in the case of the development and implementation of a single integrated state policy, which, being coordinated with international legislation, will take into account the leading global practices and the peculiarities of national conditions: the possibilities, needs, and priorities of specific countries. Formation of the economy in the conditions of social and ecological foundations requires a review of previously established priorities. The selection of effective investment projects must be carried out taking into account the ecological impact on the environment, especially in the conditions of the post-war reconstruction of Ukraine.

Taking into account the peculiarities of the functioning of the financial market of Ukraine, in further scientific research, it is advisable to focus the special attention of scientists and practitioners on the search for additional sources of green financing and innovative ways of their involvement in investment processes under the EZC program; on improving the mechanism for the introduction of green bonds as a new financial instrument that meets the principles and requirements of the global capital market, which will allow directing and accumulating domestic and international financial flows to the development and financing of domestic environmental projects that will ensure the effective post-war recovery of Ukraine.

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Фінансова детермінанта повоєнної відбудови національної економіки на принципах європейського «зеленого» курсу

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Мета. Обгрунтувати роль «зелених» фінансів і їх окремих сегментів для екологізації національної економіки в контексті глобальних тенденцій та світових практик щодо трансформації ринку капіталу й дотримання принципів Європейського «зеленого» курсу; визначити найбільш ефективні механізми та інструменти стимулювання запуску й розвитку ринку «зелених» облігацій в Україні. Удосконалити методичні підходи до оцінки економічної ефективності інвестиційних проєктів і оптимізації інвестиційної програми підприємства з урахуванням коефіцієнта екологічного впливу.

Методика. Теоретико-методологічною основою дослідження є теоретичні положення вчених у галузі фінансового забезпечення розвитку «зеленої» економіки; комплекс загальнонаукових і специфічних методів: системного аналізу й математичної статистики; економіко-математичного моделювання й логічного узагальнення.

Результати. Встановлені особливості трансформації глобального «зеленого» облігаційного фінансування. Доведено зростання його ролі в диверсифікації існуючих джерел фінансування «зеленої» економіки та домінування в світовому випуску боргових зобов›язань. Запропонована модель «зелених» облігацій на фінансовому ринку України, заснована на міжнародних стандартах, та механізм функціонування ринку «зелених» облігацій, що сприятиме імплементації Європейських стандартів розвитку «зеленої» економіки й доступу до світових фінансових ринків. Доведено, що формування оптимального портфеля «зелених» інвестиційних проєктів необхідно здійснювати з урахуванням чинників екологічного впливу.

Наукова новизна. У процесі дослідження встановлено, що в умовах воєнних дій і критичного економічного стану в Україні відбувається підвищення ролі нових фінансових інструментів, насамперед «зелених» облігацій, у фінансуванні проєктів екологічного спрямування, забезпечуючи доступ до світових ринків капіталу та програм міжнародної фінансової допомоги. Запропонована модель «зелених» облігацій, заснована на Green Bonds Principles і вітчизняному законодавстві, механізм функціонування «зелених» облігацій на фінансовому ринку України. Удосконалені методичні підходи до оцінювання ефективності інвестиційних процесів і оптимізації портфеля «зелених» інвестиційних проєктів, що, на відміну від існуючих, ураховують екологічний вплив проєктів на навколишнє середовище.

Практична значимість. Полягає в розробці пропозицій щодо застосування «зелених» облігацій в Україні як нового фінансового інструмента для формування інвестиційних ресурсів екологічного спрямування; визначенні оптимальної програми інвестиційного розвитку підприємства на основі економіко-математичної моделі оптимізації чистого прибутку підприємства, що враховує зростаючий вплив екологічних факторів на показники ефективності інвестицій.

Ключові слова: *модель «зелених» облігацій, глобальне облігаційне фінансування; коефіцієнт екологічного впливу*

The manuscript was submitted 18.12.23.