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PRIORITIES OF IMPACT INVESTING IN ENVIRONMENTAL PROTECTION PROJECTS: THE CASE OF THE FUTURE POST-WAR RECONSTRUCTION OF UKRAINE

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Abstract. The purpose of this article is to identify environmental protection projects for priority impact investing on the example of the future post-war reconstruction of Ukraine. To evaluate priorities, it is proposed to use the results of a survey of ten independent experts in the field of environmental projects and ecology, belonging to the public, private and non-profit sectors of Ukraine. The survey includes an assessment of environmental protection projects based on the importance and effectiveness of their impact, the characteristics of stakeholders, the duration and risks of the projects, their contribution to the environment and sustainable development. The obtained scores are ranked based on the criteria of Laplace, Wald, Hurwitz, Savage, and Bord and Condorcet rules. In accordance with this, the most priority projects for impact investing are environmental protection projects aimed at land reclamation, conservation and protection, forest restoration, implementation of the national system of trading quotas for greenhouse gas emissions, and eco-modernization of industrial and infrastructural enterprises. This indicates the need for a comprehensive multi-vector approach to the selection of priority areas for impact investing. The lessons learned will be useful for the effective direction or selection of investment projects, their forecasting and analysis.

Keywords: impact investment, environmental protection projects, prioritization, post-war reconstruction, Ukraine, decision-making theory.

JEL Classification: F64, G11, O16.

Introduction

Russia's full-scale military invasion of Ukraine caused not only the death of tens of thousands of people, the destruction of entire settlements, including large cities, a critical worsening of the socio-economic situation, but also catastrophic environmental changes. Destruction of industrial and infrastructural facilities throughout the country, active hostilities in most border regions, in the East and South, and mining of territories cause significant damage to water and land resources, atmospheric air, and therefore entire ecosystems, including the natural reserve fund. All this can really lead to a global man-made catastrophe, threatens nuclear and radiation safety, and devalues the achievement of global goals to oppose climate changes around the world.

Russia's war in Ukraine threatens to widen the already deep gap in funding needed to achieve Sustainable Development Goals (SDGs) around the world. This effect is especially devastating in developing countries. According to UNCTAD estimates, in the pre-war period the average annual amount of necessary financial resources was USD 3.6 trillion.

According to the Ministry of Environmental Protection and Natural Resources of Ukraine, more than 2,000 incidents of environmental damage with losses amounting to over UAH 395 billion were recorded in Ukraine during the six months of the war (Ministry of Environmental Protection and Natural Resources of Ukraine, n.d.). In May 2022, more than 260 environmental crimes-ecocides have been documented, most of which were recorded in

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Kyiv Oblast, Donetsk Oblast, and Dnipropetrovsk Oblast (State Environmental Inspectorate of Ukraine, n.d.). However, with each new day of the war, their number and impact only increase. The National Council for the Recovery of Ukraine from the Consequences of the War reports that more than 20% of all nature conservation area of Ukraine is at risk, and 160,000 sq. km of territories of Ukraine are contaminated with explosive items (National Recovery Council, 2021).

Post-war overcoming of the consequences of recorded ecocrimes and environmental damage in Ukraine will require the accumulation of significant and diversified amounts of financial resources, including impact investments. In such conditions, the question arises of developing an effective mechanism for selecting and setting priorities of numerous environmental protection projects for impact investing, which is the purpose of the study.

1. Literature review

Impact investing is a universally recognized concept that has become widely spread in the world due to its principles and guidelines, which are reflected in scientific works. In the previous publications of the authors of this article (Vorontsova et al., 2021), the bibliometric analysis of the responsible investment categories was investigated in complex, which allows us to reveal the interdisciplinary nature of its use and connection with the sustainable development, and environmental management and climate actions. At the same time, the issue of state regulation and the established regulatory framework of environmental, social and governance investment, necessary for financing sustainable development and effective transfer of environmental innovations in the "enterprise-region-state" system, is still at the stage of formation and development (Plastun et al., 2019; Shkarupa et al., 2019).

Impact investing refers to the stock market and accordingly operates according to its basic rules and laws. The latest studies are aimed at identifying the directions of the impact of the COVID-19 pandemic and digitalization on the behavior of investors (Zulfikar, 2022; Melnyk et al., 2021), which have undergone significant changes. Another worthwhile scientific research is devoted to the factors influencing investment decisions, which, in addition to traditional ones (risk and income – Shivaprasad et al., 2022), began to include behavioral aspects (Quaicoe & Eleke-Aboagye, 2021), as well as external environment factors. Slepecký et al. (2022) investigated how traditional and ESG stock market indices affect a country's net international investment position.

Applying impact investing for environmental projects is undoubtedly the best option, but currently there is no single approach to the selection or prioritization of the projects. Rohov et al. (2021) noted that national environmental efficiency is formed depending on numerous political factors (for example, the level of corruption, the state of the judicial system and antitrust policy) and economic factors (the level of credit development, the availability of business incentives, the level of innovation, etc.).

Issues and problems of implementing the basic rules to the impact investing in environmental projects on the financial market are studied by L. Dziawgo and E. Dziawgo (2016) on the example of Poland, and by Steiauf and Schäfer (2014) on the example of Germany. At the same time, the potential of investments in environmental protection projects, particularly in relation to renewable energy, was empirically confirmed by Čeryová et al. (2020).

Riyazahmed (2021) notes that it is important to consider investment motives, particularly the nature of investments, future financial needs, personal characteristics of the investor, security and stability of investments, etc.

Stojcetovic et al. (2016) suggested using SWOT and Analytical Hierarchy Process (AHP) methods to select the most optimal renewable energy projects (using the example of Serbia), which allowed analyzing the strengths and weaknesses of each project, opportunities and threats, evaluated according to the relevant criteria. Chou et al. (2017) applied the decision making trial and evaluation laboratory (DEMATEL) and the analytical network process (ANP) methods to assess green projects for the most optimal management. Process, organization and environment construct criteria are taken as a basis. The scientific team of Ikram et al. (2021) analyze the ways of selecting environmental projects based on the Fuzzy Delphi method and the Fuzzy Analytical Hierarchy Process (FAHP). The main criteria are the quality of the environment, the utilization of resources and energy, environmental safety, the development of agro-industry and forestry, etc. As a result, the indicators for supply chains and food security, energy processing and eco-farming received the highest scores, making it possible to establish these areas as the highest priority for investment. In addition, numerous works use different decision-making methods for selecting the highest priority environmental projects for investment, such as DEMATEL, MOORA, MCDM (Tsai et al., 2009), etc.

Despite such a variety of methods and models, there is a need to select the most relevant and effective investment projects for use in the specific conditions of the post-war reconstruction of Ukraine, which is the subject of this article.

Attracting impact investments is one of the most acceptable and effective ways of post-war reconstruction of Ukraine, including the terms of its ecological development. This becomes particularly relevant, since, despite the continuation of the war on the territory of Ukraine, strategic guidelines for the post-war reconstruction of the state are beginning to be formed and discussed now. This was the aspect of the creation of the Rebuild Ukraine platform and the formation of the National Recovery Council of Ukraine from the consequences of the war (National Recovery Council, 2022), whose activities should be aimed at a new course – the development of the country on the basis of sustainable development

and the transition to a "Green" economy and Digital transformation.

The Recovery Council, based on the work of 24 groups, consisting of numerous experts and partners from both the governmental and non-governmental sectors, Ukrainian and foreign representatives, drew up the Ukraine Recovery Plan presented at the International Conference on the Recovery of Ukraine in Lugano, Switzerland in 2022. This plan is evaluated as one of the most expensive projects in Europe of modern time (more than 750 billion dollars) and provides not only compensation for damages, but also the complete modernization of Ukraine. Its main vectors are integration into the European Union and access to the EU and G7 markets, as well as the country's national security (energy independence, developed sectors of defense capability and military industry, environmental security). This is possible only if the following favorable conditions are met: macro-financial stability of the country; a beneficial environment for business, which involves the transformation of priority sectors of the economy, the formation of strong human capital and efficient infrastructure (National Recovery Council, 2021).

The ecological component is the fundamental component, without which it is impossible to imagine the post-war reconstruction of Ukraine. At the same time, it is necessary to continue the previously defined strategic and current guidelines within the framework of The European Green Deal aimed at accelerating the European integration of Ukraine. Shevchenko et al. (2021) empirically confirmed that the pre-war Ukraine was ready for the relevant changes, which was an indicator of its capacity to implement the SDG in accordance with the provisions of the European Green Deal. At the same time, the country was the least prepared for SDG 13 "Climate action", which should be given more attention.

According to the Recovery Plan's financial estimate, about USD 20 billion is needed to restore the environment. This ammount should include partnership grants and loans, private investments, etc. (National Recovery Council, 2021). In this aspect, it is necessary to emphasize the impact investing, which is an effective mechanism for attracting financial resources for a positive social and environmental impact, and not just for obtaining financial profit.

According to the findings of the Ecological Safety working group, the proposed Recovery Plan identifies the following five key areas and the approximate needs for their financial support (Table 1).

The most urgent tasks for the nearest period of time should be the large-scale demining of liberated territories (according to experts' estimates, approximately 5% of the country's territory) and the disposal of military waste. Despite this, each strategic direction consists of many subsections, goals and objectives that must be implemented within the specified time frame during the next 10 years (2022–2032). There are also various sources of funding: funds from international financial organizations and specialized funds, the state budget of Ukraine and the Recovery Fund, international technical

Table 1. Strategic ways of the post-war reconstruction of a clean and safe environment in Ukraine (National Recovery Council, 2022)

Strategic direction	Sections	Estimated need for financing, EUR million	Estimated number of proposed projects
1. Climate policy: prevention and adaptation to climate changes	–	23,45	8
2. Environmental safety and effective waste management	2.1. Increasing environmental security, including chemical, nuclear and radiation security 2.2. Waste management 2.3. Industrial pollution: reduction and prevention of atmospheric air, water and land pollution	17721,446	11
3. Balanced use of natural resources in conditions of increased demand and limited supply	3.1. Land resources 3.2. Forest resources 3.3. Aquatic resources 3.4. Mineral resources	6383,44	16
4. Preservation of natural ecosystems and biological diversity, restoration and development of nature conservation areas and objects	–	665,89	5
5. Effective state management in the field of environmental protection and nature management	5.1. Reform of public administration in the field of environmental protection and natural resources 5.2. Improvement of tools for implementation of state environmental policy 5.3. Environmental control and legal responsibility 5.4. Environmental monitoring, public access to environmental information and participation in decision-making	507,86	11

assistance, EU loans and donors' aid, private investments, etc. In particular, within the framework of this plan, more than 50 environmental protection projects were suggested (Appendix A). It should be emphasized that the specific SDGs and their targets were not directly taken into account either when developing the Recovery Plan or when forming the main directions and projects in the ecological block. These strategically important documents just mention the transition to a new economic model based on sustainable development, green technologies, and the like.

2. Methodology

In this paper, it is proposed to use the theory of decision making, which offers its own approaches to the most optimal behavior under conditions of uncertainty. In particular, the methods of choosing the best decision alternative according to the criteria of Laplace, Wald, Hurwitz and Savage, and methods of collective decision-making according to Bord's and Condorcet rules (formulae 1–7) are applied. Their generalization and mathematical representation is given in Table 2.

Table 2. Characteristics of management decision-making criteria (source: Nitzan & Baharad, 2003; Ulansky & Raza, 2021)

Criteria	Brief description	Mathematical representation
Laplace criterion	Selection of the best option with the same probability of all quality criteria	$D = \max\left(\frac{1}{n}\sum_{j=1}^{n} V_{ij}\right)$ (1)
Wald criterion	It is based on the principle of maximum caution, that is, the best of the worst options is chosen	$D = \max_i \min_j \{V_{ij}\}$ (2) $D = \min_i \max_j \{V_{ij}\}$ (3)
Savage criterion	It is based on minimizing losses and assuming reasonable risks to win	$D = \max_i \min_j \begin{cases} \max\{V_{ij}\} - V_{ij} \\ V_{ij} - \min\{V_{ij}\} \end{cases}$ (4)
Hurwitz criterion	Characterizes the averaged version between extreme pessimism and optimism	$D = \max_i \{\min_i V_{ij} + (1-)\max_i V_{ij}\}$ (5) $D = \min_i \{\max_i V_{ij} + (1-)\min_i V_{ij}\}$ (6)
Bord rule	Provides a ranking of possible alternatives (*r_ij*)	$D = \sum_{j=1}^{n} r_{ij}$ (7)
Condorcet's rule	Consists in a pairwise comparison of alternatives according to the majority rule	X

From a mathematical point of view, the case can be described as follows. Suppose that under conditions of uncertainty there is a certain set of potential management decisions R_i, their total number is n. For each decision, certain states are recorded – quality criteria S_i (where I = 1... m, m is the total number of such states). Based on this, a matrix can be formed, the rows of which are represented by management solutions, and the columns are represented by their states. At their intersection, we have a certain estimate value – V_{ij}.

To analyze the qualitative characteristics of the selected projects, the approach suggested by the international organization Impact Frontiers (Impact Frontiers, n.d.) was applied. It was adapted to this study, which involves determining not only the features of impact in investing (importance and effectiveness, duration, riskiness, etc.), but also takes into account the presence of indicators of achieving the SDGs. In addition, this approach was used to develop a questionnaire with a scale for evaluating the weight of answers from –1 to 3 (Table 3). Unfortunately, to date, these environmental protection projects do not specify which SDG targets they will be aimed at, which reduces the effectiveness of their evaluation and implementation.

The evaluation took place in the form of a questionnaire based on the approach described above, by a team of ten independent experts in the field of environmental protection projects and ecology, belonging to the state sphere, the public sector and business in Ukraine. Based on this, it can be concluded that the sample is not representative, since it involves taking into account the opinions of individual experts in this field. However, it corresponds with the purpose of this study – to offer an effective mechanism for the justified identification of environmental projects for priority impact investing. Experts evaluated these environmental protection projects according to the above six dimensions and assigned the corresponding points. The total number of points received for each project was analyzed according to the described criteria for making management decisions.

3. Results

Here are the results of the expert assessment for 8 projects of the strategic direction No. 1. Climate policy: prevention and adaptation to climate change according to the proposed approach to assessing the impact of the studied environmental protection projects, is presented in Table 4.

The obtained sum of values, together with other expert assessments, constitutes data base for criteria calculations within the framework of decision-making theory. The results of their calculations are given in Appendices B and C (Tables B1, C1).

Table 3. Approach to assessing the investment impact of the environmental protection projects under research (source: developed on the basis of Impact Frontiers, n.d.)

Indicators	Rating scale				
	–1	0	1	2	3
DIMENSION 1 – WHAT					
1. The importance and effectiveness of the project's impact	A negative result	No result	A weak improvement	A noticeable improvement	A significant improvement
2. Progress in the targets of the SDG	SDG targets regress	No impact on SDG	Determines progress within 1 SDG	Determines progress within 2-3 SDGs	Leads to progress in more than 3 SDGs
DIMENSION 2 – WHO					
3. Characteristics of affected stakeholders	Does not apply to any stakeholder	Individual stakeholders (separate enterprise)	Regional level (local communities)	National level (individual authorities, the Ministry of Environmental Protection, society)	Cross-border level (improving the image of Ukraine as an ecologically clean country for its neighbors)
DIMENSION 3 – HOW MUCH					
4. The duration of the results obtained from the implementation of the project	Negative changes	No changes	Short-term positive changes	Medium-term positive changes	Long-term positive changes
DIMENSION 4 – CONTRIBUTION					
5. Environmental contribution of the enterprise in the form of a contractual result	The result is worse	The result is at the same level	Weak improvement of the result	The result is noticeably better	The result is much better
DIMENSION 5 – RISK					
6. Features of risk management	Risks are not taken into account	Risks are listed, but there are no measures to eliminate them	Individual risk management measures for individual risks	System of measures	Complex consideration of risks and integration into project management

Table 4. Intermediate result of expert evaluation of the projects of strategic direction No. 1. Climate policy: prevention and adaptation to climate change

Project number	Survey No. 1		Survey No. 2	Survey No. 3	Survey No. 4	Survey No. 5	Total
	1	2	3	4	5	6	
1	1	1	3	3	1	2	11
2	1	1	2	3	0	2	9
3	2	1	3	3	2	2	13
4	3	1	3	3	3	2	15
5	1	1	2	3	2	2	11
6	2	1	2	3	2	2	12
7	0	1	0	3	1	0	5
8	1	1	1	3	2	1	9

Figure 1 shows the results of the evaluation of the selected decision-making criteria for the most priority environmental protection projects. According to most of them (criterion of Laplace, Wald, Hurwitz, Borda), the same results were obtained. This indicates that the most optimal solution was obtained.

The top 6 most promising environmental protection projects for the impact investment are shown in Table 5.

According to the Savage criterion, the results are slightly different, which is due to its specificity in minimizing losses: its top projects include No. 22, No. 21 and No. 10, similar to the previous results, and

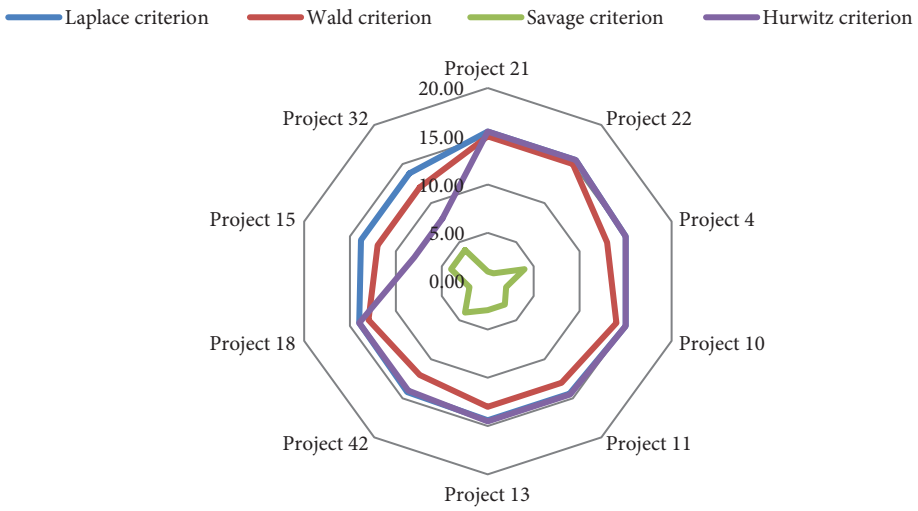

Figure 1. Visualization of the highest priority environmental protection projects according to the criteria of Laplace, Wald, Savage and Hurwitz

Table 5. Top 6 most promising environmental protection projects for the impact investment

Project number	Project name	Strategic direction
Project No. 21	Implementation of land reclamation, conservation and protection measures in the pilot territories, including those affected by the military aggression of the russian federation	No. 3
Project No. 22	Reforestation and balanced development of forestry	No. 3
Project No. 4	Implementation of the national system of trading quotas for greenhouse gas emissions and improvement of the system of monitoring, reporting and verification of greenhouse gas emissions	No. 1
Project No. 10	Eco-modernization of large combustion plants, which play the role of critical infrastructure for the heat supply of cities	No. 2
Project No. 11	Eco-modernization of industrial factories	No. 2
Project No. 13	Restoration of damaged and destroyed waste management facilities, as well as development of the infrastructure of waste management facilities to increase the level of waste processing and environmentally safe disposal of waste	No. 2

project No. 18 "Restoration of the RAW management infrastructure and its further development" and project No. 6 "Creation of a system of recuperation, regeneration, recycling and utilization of ODSs and HFCs".

To apply the Condorcet rule, it is necessary to compare the pairwise results of the proposed alternatives, which is quite difficult for a large data base. That is why the top 5 projects were analyzed in this work, which allowed forming our own distribution of positions. To make a decision, a matrix with intermediate results of such a pairwise comparison was formed based on the analysis of the results of the experts' evaluation (Table 6).

Table 6. Matrix of pairwise comparison of the benefits of nature conservation projects according to Condorcet's rule

Project number	21	22	4	10	11
21	x	4	6	8	8
22	6	x	8	8	10
4	4	2	x	6	9
10	2	2	4	x	7
11	2	0	1	3	x

According to this rule, project No. 22 is the best alternative, followed by project No. 21, which confirms the previously obtained results.

Conclusions and discussion

This study was aimed at developing an effective mechanism for sufficient identification of environmental protection projects for prioritized impact investing on the example of the future post-war reconstruction of Ukraine. Its relevance is due to the fact that in Ukraine today there is an aggravation of environmental problems, caused primarily by Russian aggression and military actions on the territory of the country. Corresponding consequences threaten not only Ukraine locally, but also globally in terms of achieving progress in the Sustainable Development Goals, in particular SDG 13. Covering such damages from climate change and other environmental threats and ecocrimes requires the involvement of a wide range of financial resources, among which investment

resources should occupy an important, even leading place.

The information basis was adopted from the work of the Ecological Safety group as part of the current Recovery Plan of Ukraine, which includes more than 50 projects related to such strategic directions as climate policy, environmental safety and effective waste management, balanced use of natural resources in conditions of increased demand and limited supply, preservation of natural ecosystems and biological diversity, restoration and development of nature conservation territories and objects, effective state management in the field of environmental protection and nature use (Table A1).

The project prioritization mechanism was carried out based on the use of Laplace, Wald, Hurwitz and Savage criteria, Bord and Condorcet rules and questionnaires of experts in the field of environmental protection projects and ecology, belonging to both the state sphere and the public sector of business in Ukraine. The analysis showed that the highest priority for the impact investing should have the projects aimed at the reclamation, conservation and protection of lands in pilot territories, including those affected by the military aggression of the russian federation, restoration of forests, implementation of the national system of trading emission quotas for greenhouse gases and eco-modernization of industrial and infrastructure enterprises. Thus, the identified projects provide not only the environmental safety and effective waste management, but also the balanced use of natural resources in conditions of increased demand and limited supply, climate policy and prevention of climate change. This indicates the need for a complex multi-vector approach to selecting high priority directions for impact investing.

It should be noted that the main limitations of this work is the analysis of a certain number of projects within the framework of the Recovery Plan of Ukraine. Despite this, the proposed approach can be applied to other data sets to obtain the necessary results for ranking and prioritizing investment projects. Another limitation is the time period, which is the next ten years. The availability of such data in retrospect would make it possible to empirically substantiate the suggested methodology and its effectiveness. However, it can be the basis for further research.

The lessons learned will be useful not only for the scientific community in the framework of the development of the conceptual foundations of responsible investment and its practical implementation, but also at the level of business and the state for the effective direction or selection of investment projects to combat climate change, project forecasting and analysis, in particular at the level of the Ministry of Environmental Protection and Natural Resources of Ukraine, as well as for international organizations such as the CDP and The Financial Stability Board in the context of disclosure to investors, creditors and insurers, etc. to manage their impact on the environment and assess the risks associated with climate change.

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Author contributions

Oleksandra Rieznyk and Alla Treus conceived the study and were responsible for the design and development of the data analysis. Oleksandra Rieznyk and Alla Treus were responsible for data collection and analysis. Oleksandra Rieznyk were responsible for data interpretation and wrote the first draft of the article. Serhiy Kozmenko is responsible for data curation, reviewing and final editing.

Disclosure statement

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APPENDIX A

Table A1. List of environmental protection projects in accordance with the Recovery Plan of Ukraine, materials of the Ecological Safety working group (National Recovery Council, 2022)

No.	Project description	Estimated need and proposed funding sources	Implementation period
1. Climate policy: prevention and adaptation to climate change			
1	Creation of the National Climate Fund as a separate body	1.8 million euros Funds from international financial organizations, international technical assistance, private investments, the Fund for Economic Recovery and Transformation	2023–2032
2	Creation of the Innovative Technology Center for Climate Change Prevention and Adaptation	4 million euros International technical assistance	2023–2025
3	Building institutional and technical capacity to ensure Ukraine's participation in global efforts to combat climate change	0.8 million euros International technical assistance, Economic Recovery and Transformation Fund	2022–2032
4	Implementation of the national system of trading quotas for greenhouse gas emissions and improvement of the system of monitoring, reporting and verification of greenhouse gas emissions	9 million euros International technical assistance, Economic Recovery and Transformation Fund	2022–2032
5	Development of an automated system for collecting, storing and recording data about the operators of controlled substances, persons who have received qualification documents (certificates) in accordance with Article 11 of the Law "On Regulation of Economic Activities with Ozone Depleting Substances and Fluorinated Greenhouse Gases"	0.32 million euros International technical assistance	2023–2025
6	Creation of a system of recuperation, regeneration, recycling and utilization of ODSs and HFCs	6.5 million euros Rebuild Ukraine Facility, UNEP, international technical assistance, Economic Recovery and Transformation Fund	2024–2032
7	Creation of a system of professional development for the personnel of companies conducting operations with ozone-depleting substances and fluorinated greenhouse gases	0.03 million euros Fund for recovery and transformation of the economy, international technical assistance, funds of enterprises (operators of controlled substances	2023–2025
8	Planning and subsequent rehabilitation of community infrastructure adapted to the effects of climate change as determined by the climate change vulnerability assessment	1 million euros Fund for economic recovery and transformation, international technical assistance	2023–2032
2. Environmental safety and effective waste management			
9	Translation and approval of the Best Available Techniques (BAT) for updating industrial production capacities (joint project)	0.13 million euros International technical assistance	2022–2026
10	Eco-modernization of large combustion plants that play the role of critical infrastructure for the heat supply of cities	26 million euros International technical assistance, export credits, private investments	2023–2032
11	Eco-modernization of industrial factories	10,000 million euros International loans and EU donor aid	2023–2032
12	Creation of a network of pneumatic tire processing factories	0.016 million euros International loans and EU donor aid	2023–2025
13	Restoration of damaged and destroyed waste management facilities, as well as development of the infrastructure of waste management facilities to improve the level of waste processing and environmentally safe disposal of waste	7,370 million euros Specialized funds. International financial organizations. International technical assistance. Private investments	2023–2032
14	Taking fire safety measures in the exclusion zone	22 million euros International financial organizations. International technical assistance	2022–2025

Continued Table A1

No.	Project description	Estimated need and proposed funding sources	Implementation period
15	Modernization of the radiological monitoring and dosimetry system in the exclusion zone	9 million euros International financial organizations. International technical assistance, State budget	2023–2028
16	Restoration of scientific and research infrastructure within the Chernobyl Scientific Hub	58 million euros International financial organizations. International technical assistance	2025–2032
17	Decommissioning of the Chernobyl nuclear power plant, handling of spent nuclear fuel and transformation of the Shelter facility into an environmentally safe system	60 million euros State budget, International financial organizations. International technical assistance	2022–2032
18	Restoration of radioactive waste management infrastructure and its further development	60 million euros State budget, International financial organizations. International technical assistance	2022–2025
19	Ecological restoration of the territory of the Radykal plant	52 million euros State budget, International financial organizations. International technical assistance	2023–2025
20	Ecological restoration of the Solotvyno salt mines	64.3 million euros State budget, International financial organizations. International technical assistance	2026–2032
3. Balanced use of natural resources in conditions of increased demand and limited supply			
21	Implementation of land reclamation, conservation and protection measures in the pilot territories, including those affected by the military aggression of the russian federation (joint project)	100 million hryvnia National Reconstruction Fund, State budget, local budgets, funds of owners and users of land plots, funds of donors	2022–2032
22	Forest restorations and balanced development of forestry	23.8 million euros Fund for the restoration of the country, funds of international technical assistance	2022–2032
23	Full restoration of the work of the Ukrainian state forest management industrial association UKRDERZHLISPROEKT, carrying out forest management in all forests damaged by the war or growing in territories that were temporarily out of control of Ukraine	16.01 million euros Fund for the restoration of the country, funds of international technical assistance	2022–2032
24	Improvement of the existing forest fire protection system	20.8 million euros Fund for the restoration of the country, International financial organizations, state enterprises funds, International technical assistance	2022–2032
25	Forest infrastructure development	59.6 million euros Fund for the restoration of the country, International financial organizations, state enterprises funds, International technical assistance	2022–2032
26	National improvement, arrangement and recreation in forestry	3.85 million euros Fund for the restoration of the country, International financial organizations, state enterprises funds, International technical assistance	2022–2032
27	Transition to a mechanized way of harvesting timber using harvesters and forwarders	303 million euros Fund for the restoration of the country, International financial organizations, state enterprises funds, International technical assistance	2022–2032
28	Restoration of forest on the protected areas on the examples of Chernihiv Oblast and Lviv Oblast	0.04 million Fund for the restoration of the country, funds of international technical assistance	2022–2026

Continued Table A1

No.	Project description	Estimated need and proposed funding sources	Implementation period
29	Protection and restoration of small rivers of Ukraine, ensuring compliance with the regimes of coastal protection areas and water protection zones (joint project)	0.63 million euros State budget, local budgets, funds of agricultural producers involved in the campaign	2024–2025
30	Expansion of the mineral base of Ukraine and improvement of its management model (joint project)	145.3 million euros The state budget, the Fund for the recovery and transformation of the economy, international technical assistance	2022–2032
31	Deregulation and simplification of access to the mineral resources (while preserving environmental procedures and public participation in decision-making)	0.05 million euros The state budget, the Fund for the recovery and transformation of the economy, international technical assistance	2022–2032
32	Restoration of hydrotechnical objects, structures and equipment damaged as a result of military operations, used to meet the needs of the population and the economy sectors of water resources, as well as for anti-flooding purposes and opposing to the harmful effects of water	Based on the results of the audit and inventory of war-damaged buildings National Recovery Fund	2026–2032
33	Pilot implementation of positive global experience in the conservation of wetlands in the Pripyat river basin	0.2 million euros Funds of international technical assistance. Other sources of funding which are not prohibited by law	2025–2026
34	Involvement in the development of man-made deposits	1 million euros National budget	2023–2032
35	Preparation, development of approaches to implementatimg integrated management of water resources according to the basin principle and marine environmental protection policy, taking into account the need to eliminate the consequences of military actions (joint project)	5,950 million euros National Recovery Fund. State budget, local budgets, budgets of local self-government bodies, funds of economic entities, funds of international financial aid, other financial sources not prohibited by law	2024–2031
36	Control of reclamation measures to reduce the negative impact on the environment after the cessation of mining	4.7 million euros National budget	2022–2026
4. Preservation of natural ecosystems and biological diversity, restoration and development of nature conservation areas and objects			
37	WAW-nature: National Parks for People	576 million euros State budget, international donors, EU, private business	2022–2025
38	Renaturalization of natural areas damaged during the military actions and restoration of wild nature of Ukraine (joint project)	24.46 million euros State budget, international donors, EU	2022–2032
39	Establishing a network of regional centers for the rehabilitation and rescue of wild animals in Ukraine	1.3 million euros International donors, EU, private business, state budget	2026–2032
40	Creation of a network of ecoducs (biocrossings) in Ukraine	64 million euros Recovery fund, international donors, EU, private business	2023–2032
41	Landscape program for Ukraine establishment	0.13 million euros State budget, international technical assistance	2022–2032
5. Effective state management in the field of environmental protection and nature management			
42	Assessment of damage and losses to the environment and needs for environmental restoration as a result of russian armed aggression	1,3 million euros Recovery Fund, international technical assistance	2022–2026
43	Reforming the environmental control system	12,5 million euros State Budget, international technical assistance	2022–2025

End of Table A1

No.	Project description	Estimated need and proposed funding sources	Implementation period
44	Improving Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) procedures (joint project)	1,1 million euros State Budget within existing finance allocations, international technical assistance, Recovery Fund	2022–2032
45	Transformation of the structure of the domestic system of environmental taxation in order to strengthen the incentive function of the eco-tax and harmonize with the tax system	0,16 million euros State Budget, international technical assistance	2023–2032
46	Increasing the possibility of integrating environmental policy into sustainable spatial and regional development (joint project)	0,17 million euros State Budget, international technical assistance in the field of sustainable territorial planning and development	2022–2032
47	Creating the Interdepartmental Program Environmental Education and Awareness for the Sustainable Development of Ukraine for 2022–2032 for each region of Ukraine	11 million euros State Budget, regional funds of environmental protection; budget of cities, districts, amalgamated territorial communities; other funding sources consistent with the law; international technical assistance	2023–2032
48	Audit and restoration of the infrastructure of the state system for monitoring the environment affected by military operations; its modernization, development and digitalization	180 million euros Recovery Fund, LIFE Program, State Environmental Protection Fund, international technical assistance	2022–2032
49	Recovery and modernization of the National Hydrometeorological Service of Ukraine	289 million euros Recovery Fund, international technical assistance, loan against the state guarantees of the Export–Import Bank of the United State (EXIM BANK)	2023–2032
51	Implementation of a unified ecological platform EcoSystem of a nationwide ecological automated information and analytical system for providing access to environmental information and its network	1 million euros LIFE Programme, State Environment Protection Fund, international technical assistance	2022–2025
52	Creation of an IT system to provide an electronic service for issuing a permit for emissions of pollutants into the atmosphere	0,12 million euros International technical assistance	2023–2025
53	Implementation of accounting and economic valuation of ecosystem services in state environmental management and sectoral development (joint project)	4,11 million euros International technical assistance, Recovery Fund	2022–2032

APPENDIX B

Table B1. Results of the evaluation and ranking of the best environmental protection projects according to the criteria of Laplace, Wald, Savage and Hurwitz

Project number	Laplace criterion	Wald criterion	Savage criterion	Hurwitz criterion
22	15.50	15.00	1.00	15.50
21	15.50	15.00	1.00	15.50
10	15.00	14.00	2.00	15.00
18	14.00	13.00	2.00	14.00
6	11.70	11.00	2.00	12.00
49	11.00	10.00	2.00	11.00
36	9.20	8.00	2.00	9.00
13	14.40	13.00	3.00	14.50
11	14.40	13.00	3.00	14.50
14	13.70	12.00	3.00	13.50
17	13.40	12.00	3.00	13.50
45	13.40	12.00	3.00	13.50

End of Table B1

Project number	Laplace criterion	Wald criterion	Savage criterion	Hurwitz criterion
38	13.30	12.00	3.00	13.50
16	12.70	12.00	3.00	13.50
26	12.70	11.00	3.00	12.50
33	12.60	11.00	3.00	12.50
48	11.60	10.00	3.00	11.50
46	11.50	10.00	3.00	11.50
9	11.10	10.00	3.00	11.50
5	10.80	9.00	3.00	10.50
35	10.70	9.00	3.00	10.50
39	10.40	9.00	3.00	10.50
27	10.20	9.00	3.00	10.50
47	10.10	9.00	3.00	10.50
52	9.90	9.00	3.00	10.50
40	9.70	9.00	3.00	10.50
2	9.30	8.00	3.00	9.50
53	9.20	8.00	3.00	9.50
30	9.00	8.00	3.00	9.50
4	15.00	13.00	4.00	15.00
42	14.20	12.00	4.00	14.00
32	13.80	12.00	4.00	14.00
15	13.80	12.00	4.00	14.00
20	13.00	11.00	4.00	13.00
19	13.00	11.00	4.00	13.00
3	12.70	11.00	4.00	13.00
12	12.50	11.00	4.00	13.00
1	11.00	9.00	4.00	11.00
25	10.80	9.00	4.00	11.00
24	10.70	9.00	4.00	11.00
28	10.50	9.00	4.00	11.00
8	10.30	9.00	4.00	11.00
43	10.00	8.00	4.00	10.00
44	9.60	8.00	4.00	10.00
51	9.20	8.00	4.00	10.00
29	9.20	8.00	4.00	10.00
23	6.80	5.00	4.00	7.00
7	6.60	5.00	4.00	7.00
41	11.50	9.00	5.00	11.50
34	10.90	9.00	5.00	11.50
37	9.90	8.00	5.00	10.50
31	7.20	5.00	5.00	7.50

APPENDIX C

Table C1. Results of the evaluation and ranking of the best environmental protection projects according to Bord's rule

Project number	Ranking of experts										Total number of points
	1	2	3	4	5	6	7	8	9	10	
21	50	51	49	47	50	49	51	51	50	51	499
22	51	50	48	50	51	50	47	50	49	50	496
10	48	49	51	51	48	43	49	48	43	47	477
4	47	45	39	48	46	51	48	44	48	49	465
13	45	43	45	49	47	48	41	41	39	46	444
42	49	46	46	38	49	44	45	34	47	43	441
11	44	48	47	46	39	38	39	40	51	48	440
18	46	44	38	36	40	41	44	47	42	45	423
14	40	42	42	45	45	40	37	32	46	42	411
32	39	47	50	43	38	37	36	31	45	41	407
15	38	35	37	30	33	47	50	49	44	40	403
17	41	36	31	44	44	42	31	45	41	36	391
45	32	40	44	42	29	33	42	42	40	35	379
19	43	37	32	26	21	45	46	43	37	39	369
38	31	39	43	41	43	29	28	36	35	44	369
20	33	30	20	39	37	36	43	46	38	34	356
3	42	33	23	40	42	39	30	37	27	37	350
16	30	34	36	29	27	46	40	33	34	33	342
26	34	31	21	33	35	35	35	39	36	38	337
33	35	41	41	31	34	34	34	25	24	28	327
12	25	38	40	37	41	20	21	29	33	32	316
48	37	32	22	34	32	15	17	28	25	29	271
6	36	21	19	32	28	26	22	30	26	30	270
46	26	28	35	28	23	32	29	19	17	20	257
41	10	11	26	35	36	28	33	20	18	27	244
49	23	26	18	19	18	24	20	23	31	25	227
9	20	25	34	27	22	13	16	15	29	23	224
1	27	29	13	12	15	30	24	17	30	24	221
25	22	18	9	4	25	25	32	38	21	18	212
35	24	27	30	20	10	11	15	27	19	21	204
5	28	19	10	14	16	17	10	26	32	31	203
34	9	10	25	24	20	31	38	21	14	9	201
24	21	17	8	21	26	18	18	35	20	17	201
39	29	20	17	5	6	22	26	18	22	19	184
28	12	12	27	25	31	19	19	16	13	8	182
8	11	6	15	17	30	27	23	8	9	14	160
27	13	7	16	18	17	23	27	9	10	15	155
47	15	14	29	6	11	8	13	6	28	22	152
52	16	24	12	15	14	12	9	13	12	16	143
43	5	8	24	23	2	4	25	24	23	3	141
37	3	22	33	3	24	14	5	4	7	13	128
40	14	13	28	13	9	7	12	5	16	10	127
44	6	23	11	22	19	9	4	10	3	5	112
2	18	16	7	11	8	16	6	11	4	6	103
51	17	15	6	2	5	5	8	3	15	26	102
53	19	4	14	16	1	3	11	14	5	11	98
30	7	3	3	8	13	6	3	22	6	12	83
36	8	9	5	10	7	10	14	7	8	2	80
29	4	5	4	9	0	21	7	12	11	7	80
31	1	2	2	7	12	2	0	1	1	1	29
23	2	1	1	1	4	1	2	2	0	0	14
7	0	0	0	0	3	0	1	0	2	4	10