

Features of bank financing innovative projects renewable energy in today's conditions

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Abstract. Financing innovative renewable energy projects in today's conditions is an extremely relevant topic, given the global challenges of climate change, the energy crisis caused by geopolitical conflicts (in particular in Ukraine) or the reorientation of world economies towards sustainable development.

Financing innovative solutions in the field of RES is a determining factor for the implementation of the "green" transition, but it is accompanied by a number of barriers: regulatory instability, limited access to investments, high risks of introducing the latest technologies. In this context, it is relevant to study effective financing models, opportunities for international support, as well as a comparative analysis of the experience of Ukraine and Hungary in order to identify best practices and establish cross-border cooperation in the field of sustainable energy. The article examines modern approaches to financing innovative projects in the field of renewable energy in the face of global challenges, in particular the energy crisis, climate change and martial law in Ukraine. The main sources of financing, including international aid, banking instruments, green bonds and private investments, are considered. Particular attention is paid to the role of state support and development of innovative technologies, such as microgrid systems, energy-saving technologies.

Key barriers and prospects for the development of innovative RES in the context of sustainable development and European integration have been identified.

Keywords: innovation, bank, financial transaction, economic relations, business, foreign experience, cooperation, enterprise.

Особливості банківського фінансування інноваційних проектів відновлювальної енергетики в умовах сьогодення

Анотація. У сучасних умовах глобальних кліматичних змін, зростання енергетичної нестабільності та необхідності зменшення залежності від викопного палива питання розвитку відновлювальної енергетики (ВДЕ) набуває особливої важливості.

Для країн Центральної та Східної Європи, зокрема України та Угорщини, цей напрям є не лише складовою екологічної трансформації, але й стратегічним

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інструментом забезпечення енергетичної безпеки. В умовах повномасштабної війни в Україні значно зросла потреба у децентралізованих, автономних і сталих джерелах енергії. Угорщина, зі свого боку, прагне модернізувати енергетичну систему, розширюючи участь у європейських фінансових інструментах та кліматичних ініціативах.

Фінансування інноваційних рішень у сфері ВДЕ є визначальним чинником для реалізації "зеленого" переходу, однак супроводжується низкою бар'єрів: регуляторною нестабільністю, обмеженим доступом до інвестицій, високими ризиками впровадження новітніх технологій. У цьому контексті актуальним є дослідження ефективних моделей фінансування, можливостей міжнародної підтримки, а також порівняльного аналізу досвіду України та Угорщини з метою виявлення кращих практик та налагодження транскордонного співробітництва у сфері сталої енергетики.

У статті проаналізовано сучасні механізми та виклики фінансування інноваційних проєктів у сфері відновлювальної енергетики в Україні та Угорщині. Обидві країни, перебуваючи в різних економічних та геополітичних умовах, активно долучаються до процесів енергетичної трансформації в рамках реалізації європейської кліматичної політики та переходу до сталої енергетики. Висвітлено особливості фінансування ВДЕ-проєктів у кожній із країн: в Україні — на тлі воєнного конфлікту, руйнування енергетичної інфраструктури та потреби у децентралізованих системах живлення; в Угорщині — в контексті інтеграції до європейських механізмів фінансування та прагнення зменшити залежність від імпортованих енергоносіїв. Розглянуто основні джерела фінансування: міжнародні програми допомоги (зокрема для України), інструменти ЄС, банківські кредити, «зелені» облігації, публічно-приватне партнерство. Звернено увагу на інноваційні рішення у сфері ВДЕ, які впроваджуються або мають потенціал впровадження в обох країнах, включно з розвитком Smart Grid, акумуляюючих систем, біоенергетики та водневої енергетики. Зроблено порівняльний аналіз законодавчої та фінансової підтримки інновацій у сфері ВДЕ, визначено сильні та слабкі сторони фінансово-інституційного середовища. У підсумку наголошено на необхідності посилення регіонального співробітництва між Україною та Угорщиною у сфері інноваційної «зеленої» енергетики та адаптації фінансових механізмів до сучасних викликів.

Ключові слова: інновація, банк, фінансова операція, економічні відносини, бізнес, зарубіжний досвід, співробітництво, підприємство.

Introduction

The problem statement is due to the need to intensify innovation activity in Ukraine to increase the competitiveness of the national economy and at the same time, ensure its sustainable development. Taking into account the current conditions of globalization and rapid technological changes, it is renewable energy enterprises that have flexibility and ability to quickly adapt and play an important role in the implementation of innovative projects. However, among the key constraints on the innovative development of these enterprises is the limitation of financial resources, in particular bank financing. Particular attention should be paid to the study of international experience, in particular Hungary, in supporting the innovative activities of such enterprises through effective bank financing mechanisms, which have achieved significant success. Hungary has valuable experience in building a system of financial support for the innovative development of renewable energy enterprises, which may be relevant for Ukraine.

The study was carried out in accordance with the research work of the Department of Management and International Entrepreneurship of Lviv Polytechnic National University on the topic "Resource and information support of models of development of national economies and their subjects in the global economic system", State registration number: 0121U108836.

A lot of works are devoted to investment opportunities in the energy sector of Ukraine. Akymenko O., Kostyuchenko I. (2020) focus on the prospects for the introduction of alternative energy sources. [1]. Kubatko, O. (2024) and Kalinichenko, L., Treus, A., Lin, D. & Mishchenko, J. consider the directions of improving the energy system of the national economy on the basis of the contribution of alternative energy to the system of energy sustainability of the country [2]. They note that alternative energy will contribute to the creation of new jobs and the development of new sectors of the economy related to the production, development and operation of alternative energy sources. S. Yarmus (2025) identifies a number of factors influencing the development of alternative energy in modern conditions [6]. But having analyzed many works of both domestic and foreign scientists, we can say that the issue of bank financing of innovative renewable energy projects in modern conditions remains little studied.

The purpose of this article is to study the experience of Hungary in the field of bank financing of innovative projects of renewable energy enterprises and to develop recommendations on the possibilities of its application in Ukraine, in particular in the activities of the country's leading banks.

To achieve this goal, it is necessary to solve the following tasks:

- to reveal the essence and features of bank financing of innovative renewable energy projects;
- to analyze theoretical approaches to financing innovation activities of relevant enterprises and the role of banks in this process;
- to investigate Hungary's experience in the field of state support and mechanisms of bank financing of innovative alternative energy projects;
- to carry out a microeconomic analysis of banks' activities in the field of enterprise financing and to study the possibilities of applying the Hungarian experience;
- to develop practical recommendations for banking institutions and government agencies to intensify bank financing of innovative renewable energy projects in Ukraine, taking into account the experience of Hungary.

In the process of research, the following research methods were used: comparative analysis, statistical analysis, system approach, generalizations and expert assessments.

The practical significance of the results obtained lies in the possibility of using the developed recommendations by banking institutions of Ukraine to improve the mechanisms for financing innovative renewable energy projects, as well as by state bodies in the formation of a policy to support innovative projects.

Results

In the context of the transformation of energy systems and the implementation of global sustainable development goals, financing innovative projects in the field of renewable energy (RSE) becomes strategically important. A special role in this process is played by banking institutions, which ensure the accumulation, transformation and effective allocation of financial resources in appropriate investment initiatives.

The economic essence of bank financing of innovative RES projects is the organizational and financial support of the process of introducing the latest technologies through the provision of credit resources, preferential financing, participation in public-private partnership projects and attraction of foreign capital.

Banks not only act as creditors, but also actively interact with international financial institutions, form partnership programs to support energy initiatives, participate in the issuance of green bonds and specialized investment funds.

In Fig.1, we will depict the main aspects of the economic essence of bank financing of innovative renewable energy projects.

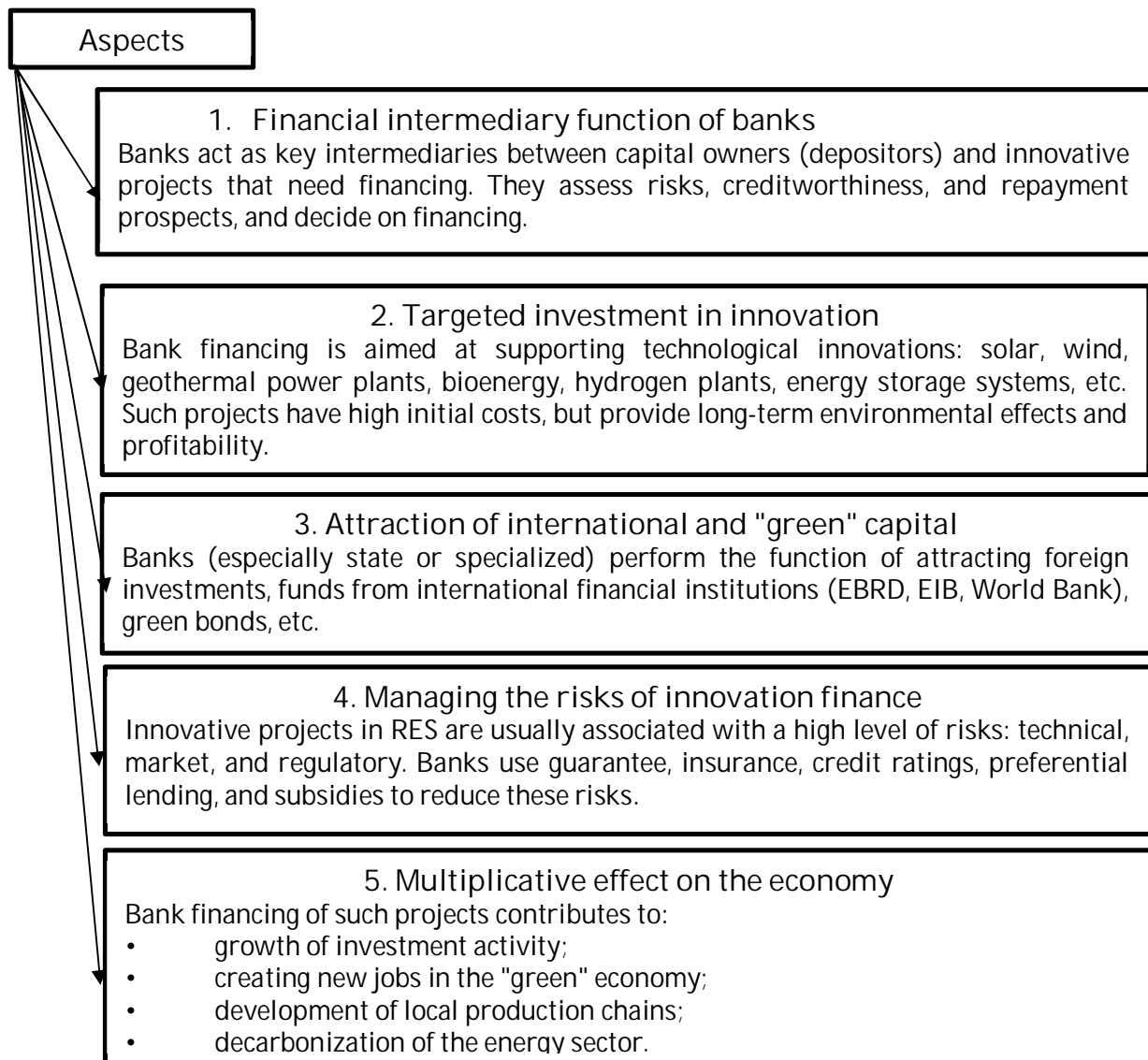


Fig.1. Main aspects of the economic essence of bank financing of innovative renewable energy projects

Notes: grouped by authors by [2; 3-6]

Innovative projects in the field of RES, in particular those related to the use of solar, wind, geothermal, hydro and bioenergy, are characterized by a significant amount of initial investments, a long implementation period and a high risk profile. Therefore, banks also perform the functions of expert assessment of the financial viability of projects, forecasting profitability, minimizing risks, and structuring financing taking into account the specifics of the industry.

At the same time, the development of bank financing in the field of RES is an important condition for strengthening the energy independence of countries, improving energy efficiency, stimulating economic growth and fulfilling international decarbonization obligations.

The participation of banks in the financing of innovative energy projects provides a multiplier effect:

- promotes the development of related industries;
- contributes to the creation of new jobs;
- contributes to the formation of the national market of "green" energy.

As you can see, bank financing is a key element of institutional support for energy transformation. Its economic essence lies not only in providing financial resources, but also in

the formation of new financial mechanisms that meet the challenges of greening and digitalization of the modern economy.

First of all, we aimed to research, analyze and invite Ukraine to pay attention to the Hungarian experience of bank financing. Financing of innovative projects in the field of renewable energy largely depends on a combination of macro- and microeconomic factors, the regulatory environment, the availability of financial resources, as well as the institutional capacity of the banking system. The analysis of the situation in Ukraine and Hungary makes it possible to identify common and different elements of the impact on bank lending of RES projects. In Table 1, we will group the factors influencing bank financing of innovative renewable energy projects in Ukraine and Hungary.

Table 1

Factors influencing bank financing of innovative renewable energy projects in Ukraine and Hungary

Influencing factors	Ukraine	Hungary
Regulatory Regulation and Public Policy	It is characterized by the instability of the regulatory field (changes in the feed-in tariff system, delays in payment to RES producers), which reduces the confidence of banks and investors. At the same time, the adoption of the National Energy Efficiency Action Plan and Energy Strategy until 2035 sets strategic guidelines.	It has a stable regulatory environment with effective support from state financial institutions (e.g. Hungarian Development Bank), the introduction of green subsidies and a transparent permitting procedure.
Availability of banking resources	Limited access to long-term lending, high cost of capital, lack of sufficient internal guarantees and insurance reduce banks' activity in lending to RES.	It has favorable terms of cooperation with the European Investment Bank, the EBRD and other EU funds, which increases the liquidity of the banking sector and simplifies lending in the field of green technologies.
The level of development of the banking system and experience in RES financing	Banks have limited experience in structured financing of innovative projects. The lack of standardized risk assessment models for RES projects complicates decision-making.	Banks are actively implementing ESG criteria in lending policy, have experience in working with project financing, and specialized product lines to support RES.
Political and macroeconomic risks	Military conflict, macroeconomic instability and inflation risks negatively affect the investment attractiveness and creditworthiness of enterprises.	Despite some political tensions over the EU's environmental policy, the country remains economically stable with relatively low risks for investors.
International integration and donor support	Active participation in international initiatives (REPowerEU, IRENA, UKEF), but the implementation of donor projects requires transparency and effective monitoring mechanisms.	It has a clearly integrated policy within the framework of the European Green Deal, with a high level of coordination with EU financial instruments.

Notes: formed by the authors according to [4; 6-7]

The development of renewable energy as a component of the energy transition to a carbon-neutral economy requires effective financial support, primarily through banking institutions. Therefore, it is necessary to pay attention to the conditions of bank financing of innovative renewable energy projects both in Ukraine and in Hungary (Table 2).

The terms of bank financing of such projects largely determine the pace of implementation of the latest energy technologies, as well as the investment attractiveness of the industry. The study of the situation in Ukraine and Hungary allows us to identify key differences and opportunities for optimizing the financial environment.

Table 2.

Conditions for bank financing of innovative renewable energy projects in Ukraine and Hungary

Conditions		
1. Lending structure and financial instruments:		
<i>Ukraine:</i> Short- and medium-term loans with high interest rates (usually 18-25% per annum) dominate, limited access to project financing. The main source remains commercial banks, often with the involvement of donor guarantees.	<i>Hungary:</i> Long-term project financing with fixed rates of 2-6% per annum, supported by government programs (e.g. "Green Program" from the MFB) and EU structural funds, is widely used.	
2. Loan terms		
Showman	<i>Ukraine</i>	<i>Hungary</i>
Interest rate	18–25% per annum	2–6% per annum
Loan term	3–5 years (mostly)	7–15 years old
Початковий внесок (equity)	20–40%	10–20%
Warranties/Assurances	Strict requirements: real estate, equipment	Flexible conditions, the possibility of state guarantees
Vacation Opportunity	Surveyed	Vacations for 1-3 years are provided
Financing currency	Hryvnia, sometimes dollar/euro	Mostly euros
3. State participation and incentives		
<i>Ukraine:</i> Lack of permanent government programs to offset interest rates or provide preferential loans for RES innovations. International technical assistance programs are partially functioning.	<i>Hungary:</i> There are interest rate subsidy programs, partial compensation for investments, preferential lending through state-owned development banks (MFB, OTP Green Finance).	
4. Conditions for access to international funding		
<i>Ukraine:</i> There is access to funding from the EBRD, IFC, NEFCO, but complex bureaucratic procedures and high reporting requirements. Funding is often limited to pilot projects or large businesses.	<i>Hungary:</i> Direct integration with EU financial mechanisms, simplified system of grants and sub-lending, extensive participation in Horizon Europe, LIFE, etc.	

Notes: grouped by [1; 4; 7]

Fig. 2-4. Let's illustrate a comparison of the key conditions of bank financing of innovative renewable energy projects in Ukraine and Hungary according to three indicators:

- ❖ average interest rate (Fig. 2);
- ❖ loan term (Fig. 3);
- ❖ down payment (Fig. 4).

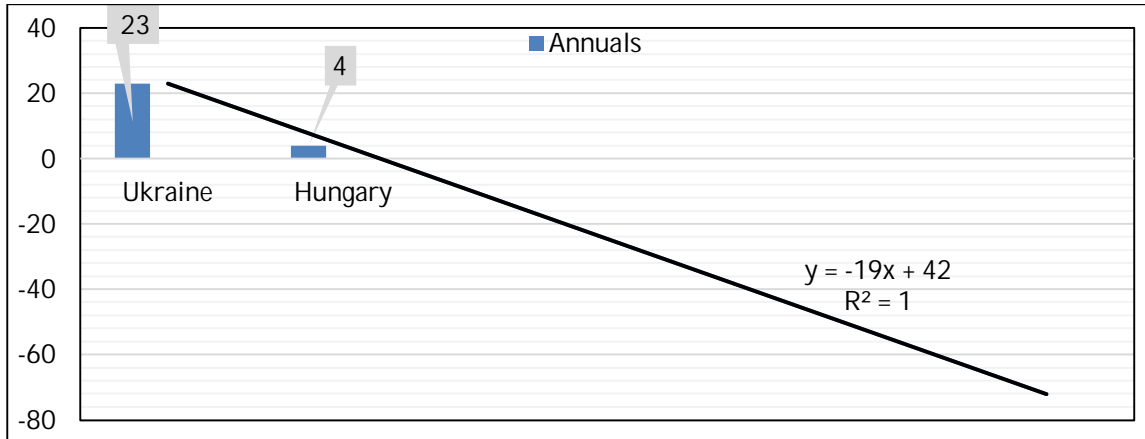


Fig. 2. Comparison of key terms of bank financing of innovative renewable energy projects in Ukraine and Hungary at the average interest rate

Notes: Generated by [7]

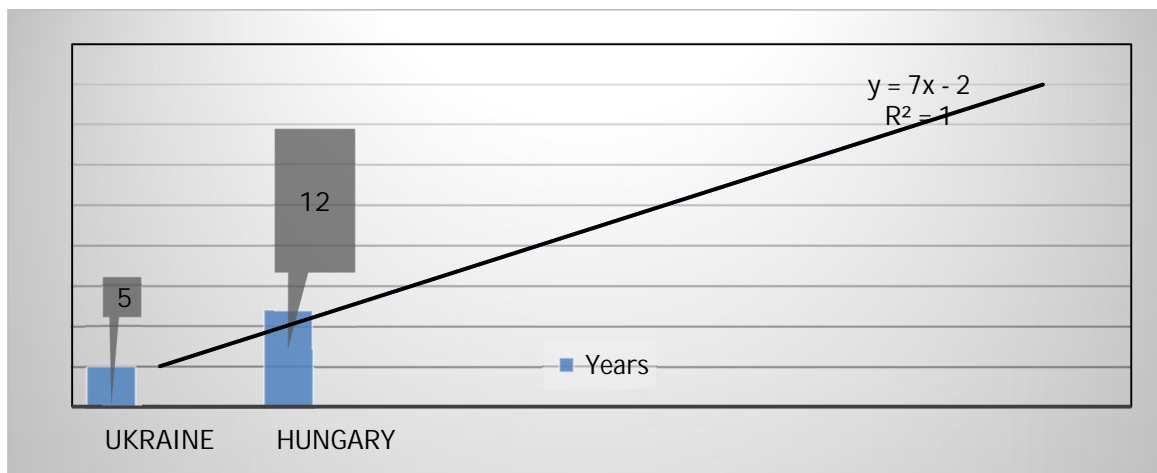


Fig. 3. Comparison of key terms of bank financing of innovative renewable energy projects in Ukraine and Hungary by loan term

Notes: Generated by [7]

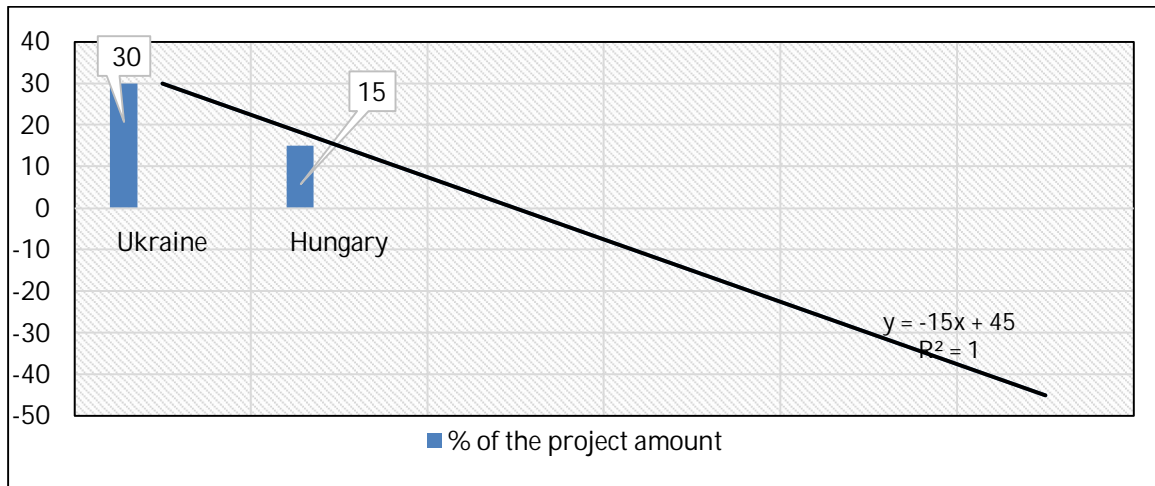


Fig. 4. Comparison of key conditions for bank financing of innovative renewable energy projects in Ukraine and Hungary by down payment

Notes: Generated by [7]

Let us also pay attention to the financed successful innovative projects of renewable energy in western Ukraine (Table 3).

Table 3

Main funded RES projects in western Ukraine

№	Name of the company / project	Energy Type	Region	Power (MW)	Source of funding
1	Crystal Solar	Solar	Lviv	6.5	Ukrgasbank + EBRD
2	Solar energy of Ternopil	Solar	Ternopil	4.0	Oschadbank
3	Solar Carpathian	Solar	Ivano-Frankivsk	5.5	Kredobank
4	Carpathian wind	Wind	Lviv	10.0	Ukreximbank + EU
5	Wind technology	Wind	Ivano-Frankivsk	2.0	GIZ
6	Danosha	Bioenergetics	Ivano-Frankivsk	1.2	ProCredit Bank + NEFCO
7	Gals Agro Energy	Bioenergetics	Ternopil	3.5	Raiffeisen Bank + EBRD
8	Chervonograd (municipal project)	Geothermal	Lviv	-	Deutsche Bank + GIZ
9	ESCO projects Lutsk / Rivne	Geothermal	Volyn / Rivne	-	NEFCO + Ukrgasbank

Notes: grouped by authors by [7-8]

Bank financing of innovative projects in the field of renewable energy in the west of Ukraine was mainly focused on the following areas:

1. Solar energy (SPP): Regions: Lviv, Ternopil, Zakarpattia regions. (Industrial ground-based solar power plants with a capacity of 1-10 MW; Households and small enterprises (within the framework of the support of the "green tariff") In particular, the solar power plant "Ternopil

region SOLAR" (Ternopil region) — partially financed by a bank loan in cooperation with local investors Banks: Ukrgasbank (green financing), Oschadbank, Kredobank.

2. Wind energy: Regions: Ivano-Frankivsk and Lviv regions, foothills of the Carpathians. (Pilot wind farms with a capacity of up to 10 MW; study and testing of wind potential in the Carpathian region.

3. Bioenergetics. Regions: Volyn, Lviv, Rivne regions. (Biogas plants based on agro-industrial waste (pig farming, corn, breweries; integrated utilization of biomass and wood waste; pilot projects with the support of the EBRD and the USELF (Ukraine Sustainable Energy Lending Facility) program.

4. Geothermal systems and heat pumps. (communal buildings, schools, hospitals (within the framework of energy efficiency projects).

The development of renewable energy in Ukraine is strategically important for achieving energy independence, fulfilling commitments under the Paris Climate Agreement and implementing the Sustainable Development Goals. At the same time, bank financing of innovative projects in this area faces a number of systemic problems that slow down the processes of energy transformation.

Therefore, summarizing the above material, we can in Table. 4 outline the problems of bank financing of innovative renewable energy projects and present ways to solve them in Ukraine.

Table 4

Problems and Ways to Solve Bank Financing of Innovative Renewable Energy Projects in Ukraine

Problems	Solutions
High cost of credit resources: Loan rates for enterprises remain at the level of 18-25% per annum, which makes the implementation of capital-intensive RES projects economically unprofitable without additional sources of financing or subsidies.	Creation of a state program for preferential lending to innovative RES projects: It provides for compensation of part of the interest rate or the provision of state guarantees to reduce the cost of banking resources.
Instability of regulatory policy in the field of RES: Frequent changes in the terms of the "green" tariff, restrictions on guarantees for the purchase of electricity, debts to producers reduce the investment attractiveness of the industry and restrain bank lending.	Implementation of green insurance and risk guarantee mechanisms: Through the creation of specialized state or semi-autonomous agencies that would provide insurance for the risks of implementing innovative projects (analogues of KfW, UKEF, MIGA).
High risks and lack of mechanisms for their compensation: Most banks do not have specialized risk assessment models for innovative energy projects. In addition, Ukraine has a poorly developed market for green insurance and guarantees.	Development of project financing with the support of international partners: It is necessary to intensify cooperation with the EBRD, IFC, NEFCO and other donors to implement co-financing models with banks under the terms of joint risk sharing.
Insufficient experience of banks in RES project financing: Most Ukrainian banks limit themselves to classic lending with a requirement of liquidity collateral, which does not correspond to the specifics of innovative energy projects.	Introduction of a national register and rating of RES projects: This will increase market transparency, standardize approaches to project evaluation, and make it easier for banks to make credit decisions.
Weak interaction between banks, the state and international institutions: The	Modernization of the regulatory framework with a focus on stability and

lack of coordinated financing policies, in particular public-private partnerships, reduces the effectiveness of the use of potential sources of international financial assistance.	predictability: It is necessary to ensure long-term predictability of the terms of tariff and tax regulation, create legislative incentives for banks investing in the green economy
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Notes: formed by the authors at [4; 7-8]

Conclusions

Bank financing of innovative renewable energy projects is a strategic tool for stimulating environmentally sustainable economic development, modernization of energy infrastructure and integration into the European energy space. Effective interaction of banks with the state, investors, and technology startups makes it possible to turn innovations in RES into a driver of economic growth.

The factors that affect bank financing of RES projects in Ukraine and Hungary have both common features (the role of the state, the importance of international financing) and specific features. For Ukraine, the key barriers remain the instability of the regulatory environment, high risks and limited resources of banks. Instead, Hungary has created a favorable institutional and financial framework for the active involvement of banks in financing innovative energy.

The conditions for bank financing of innovative projects in the field of renewable energy in Hungary are much more favorable compared to Ukraine due to a stable macroeconomic environment, the availability of effective state support instruments, access to cheap EU financial resources, and high financial literacy of market participants. In Ukraine, the main barriers remain the high cost of credit resources, short financing terms, unstable RES policy, and limited state support.

Improving financing conditions in Ukraine requires systematic interaction between the banking sector, the state and international partners, the introduction of targeted programs to support innovations, the development of the green bond market and project financing.

To stimulate bank financing of innovative projects in the field of renewable energy in Ukraine, a combination of institutional reforms, state support and active participation of international financial structures is needed. The introduction of a systematic approach will intensify the lending activities of banks, reduce risks and accelerate the energy transformation of the Ukrainian economy.

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