

## DIGITAL GREEN FINANCE ARCHITECTURE IN THE CONTEXT OF GREEN DEAL IMPLEMENTATION: MODERN FINTECH TOOLS AND SOLUTIONS UNDER THE SUSTAINABLE DEVELOPMENT CONCEPT

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### ABSTRACT

**Objective:** The purpose of the article is to develop a scientific and applied toolkit, which is a set of a logically informationally and algorithmically interconnected means of the information-analytical support of green financing within the Green Deal under the sustainable development concept.

**Theoretical Framework:** The study is based on the Paris Climate Agreement, the European Green Agreement, and the concept of sustainable development.

**Method:** To achieve the defined goal and solve the set tasks, a system of general scientific and special research methods was used.

**Results and Discussion:** The author's vision of the ecosystem model of the green financing is presented. The main trends of the global green bond market are identified; the parameters of the digital financing markets are estimated. The management decisions on accelerating the capital attraction and activation of green financing, ensuring the balance of the regional financing opportunities in the face of the global challenges are systematized.

**Research Implications:** The important role of the state impact on the creation of the favourable conditions for the climate finance expansion by reducing the political, regulatory, control, macroeconomic and business risks has been established. It was established that the political stability, the consistent and clear regulatory framework, the agreed green financing policy and the openness to the international investors create the attractive conditions for the climate finance conditions.

**Originality/Value:** Applying the author's developments will create a basis for making the substantiated managerial decisions to the accelerated involvement of the capital in the green financing under the sustainable development concept.

**Keywords:** green Fintech ecosystem, financial services market, digital economy, insurtech, financial security, green digital technologies, financial instruments of sustainable development, sustainable development goals (SDGs).

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## 1 INTRODUCTION

Ensuring the sustainable economic development, preservation of the global market competitive positions, coverage of new spheres and branches of the economic activity, investment boom, social stability -- these and other objectives were determined as the priorities in the management policies of every country a few years ago. Today, in reality, the problematic issues of ensuring the resistance to the climatic influences, which are critically important factors in the global ecological and economic development of the world community, are brought to the fore.

The fundamental inequalities in the access to financing the “green” programs and projects, vulnerability of the countries to the physical impacts of the climate change, growing economic imbalances, domestic debt and the COVID-19 pandemic that have exacerbated the already existing stresses, call for the global action. In this regard, to ensure the safe and sustainable future for the world, the main development priorities should be the acceleration and deployment of financing for the global climate solutions in the next decade. The synergetic cooperation of the governments of the world’s leading countries, assets owners, financial institutions, international organizations, energy companies and developers of the effective market approach to strengthening the financial and information investment initiatives in the climate and environmental solutions should be implemented through the functioning the FinTech companies and digital platforms.

## 2 LITERATURE REVIEW

Normative regulation of the environmental problems and attempts to find the guidelines for their solution were reflected in the Paris Climate Agreement (2015), the European Green Deal (2020), and other regulatory acts.



Along with this, the undeniable fact of overcoming the climate investment trap in the world is the deployment of the serious scientific and practical research in the field of the climate financial problems, in particular: the mismatch between the capital needs and investments, bias, differences in the risk perception by the countries and industries, as well as the limited institutional capacity to provide the guarantees.

The concept of the climate actions financing is the object of research by many scientists. Studying the works of Merk, O., Saussier, S., Staropoli, C., Slack, E., Kim, J-H (2012), Marke, A and Sylvester, B (2018), the following scientific interpretations of the definitions were established. For example, the authors of the scientific study (Climate Change, 2022) identify the financing of the climate actions and climate financing.

Within the framework of the investigated issues, we share the considerations (Mobilising Green Investment, 2023) regarding the need to assess the climatic financial flows from the safe, private, or alternative mixed sources to support the measures on the green financing. We fully agree with the opinion of authors (Ali S. *et al.*, 2022) that the financing mechanism can support the climate investing through the private-private partnerships, international finance, the national investment mechanisms, pricing, monetary regulation (Zybareva O. *et al.*, 2022), international standards, debt financing (Polishchuk Ye. *et al.*, 2020), and fiscal decentralization increased use of computer technologies (Dubyna M. *et al.*, 2022). We believe that these mechanisms have the potential to mobilize the private finance (Nikiforov P. *et al.*, 2024) to achieve the climate goals.

Signing the European Green Deal (2020), the finance ministers and heads of the central banks of the world's leading countries, the European Commission, the World's Bank and the International Finance Corporation, the European Investment Bank, the European Bank of Reconstruction and Development, the Organization of Economic Cooperation and Development, etc. began to pay special attention to the formation of the international and green financing markets. Most of the world's countries, including those with the transition economies, have developed or are actively working on the road maps and strategies aimed at forming the "green" financing market.

Taking into account the financial architecture, the efficiency of the activity results and possible involvement in the business processes, we believe that the next development of the green financing must be connected with the activities of the Fintech companies and their instruments. They are the ones that encompass the advanced “new technologies”, which ruin the traditional financial services, including the mobile payments, money transactions, loans, fundraising, and assets management (Dubyna M. *et al.*, 2021; Viknianska A. *et al.*, 2021; Finance outlook, 2023; Scislak J., 2022). We are convinced that Fintech creates new possibilities for achieving the sustainable development goals, and in future, will create the perspectives of the formation of the absolutely new branches, markets and economic models for further green financing (Zhavoronok A. *et al.*, 2022; Clere A., 2023).

The presented scientific arguments aroused interest and led to the choice of the research topic.

The purpose of the article is to develop a scientific and applied toolkit, which is a set of a logically informationally and algorithmically interconnected means of the information-analytical support of green financing within the Green Deal, and that is presented in the developed author’s architecture of the Green FINTECH ecosystem. Applying the development will create a basis for making the substantiated managerial decisions to the accelerated involvement of the capital in the green financing based on the specific financial instruments (green bonds) and investment financial technologies on the way to ensure the sustainable financing, achieving the goals of the environmental and economic policy in the face of the global challenges.

### 3 METHODOLOGY

To achieve the defined goal and solve the set tasks, a system of general scientific and special research methods will be used, namely: methods of theoretical generalization, induction, comparison - to clarify problematic aspects of sustainable economic development, increase resistance to climate impacts, systematization of existing green financing tools; systematic approach, methods of analysis and synthesis - to substantiate general patterns



and identify trends of indicators reflecting the amount of green financing; graphical and tabular methods - for visual illustration of the researched architecture of the green FinTech ecosystem model; an abstract method for summarizing research results and determining priority areas and tools for further application of green financing solutions proposed in the work of FinTech.

#### 4 RESULTS AND DISCUSSIONS

For all countries of the world today, the focus is on the problems related to the negative impact of the climate change on the economic situation. Along with the ambitious global coordination of the climate policy and organizational measures to solve the climate problems, the transformative role of the finance as a means of achieving the climate results is gaining particular importance. As a result, there is a need to align the financial flows with the long-term global goals in line with the Green Deal.

The full-scale invasion of Russia on the territory of Ukraine exacerbates the impact of the social and environmental risks on the financial security of not only of Ukraine, but also the European countries in the near future. This exacerbates the aggravation of the geopolitical situation, causes the intense financial stress, worsens the refugees' crisis, exacerbates the food insecurity, increases inflationary pressures, and weakens the long-term drivers of the growth. The aggravation of the humanitarian and environmental crisis requires the concentrated and coordinated efforts of the world community, including to reduce the increased volatility of the financial market.

The actual size of the industrial and regional climate finance gaps is the only one component of the challenge scale of the financial and economic viability, the access to the capital markets, investment requirements for the adaptation, loss and damage reduction, challenge of the financial and economic viability, access to the capital markets, investment requirements for the adaptation, loss and damage reduction, the adequate climate-responsive social protection, and the regulatory framework and institutional capacity to attract and facilitate investment and provide guarantees are critical to scaling up the



green finance.

The green financing represents the intention to increase the level of the financial flows (from banking services, microcredit, insurance and investment) from the public, private and non-profit sectors to the priorities of the sustainable development, in particular, the effective management of the environmental and social risks, the use of the opportunities that bring both a decent rate of return and environmental benefits, and provide a greater accountability level.

The green financing as a process of a set of the economic-political, organizational and social relations that forms a specific green architecture, determines the composition of the participants, regulatory and legal support, nature of the information and financial flows, which collectively gives grounds to substantiate the functioning model of the green financing ecosystem. The study of the green financing nature made it possible to present the author's vision of the global architecture of the green financing - the GREEN FINTECH ecosystem (Fig. 1).

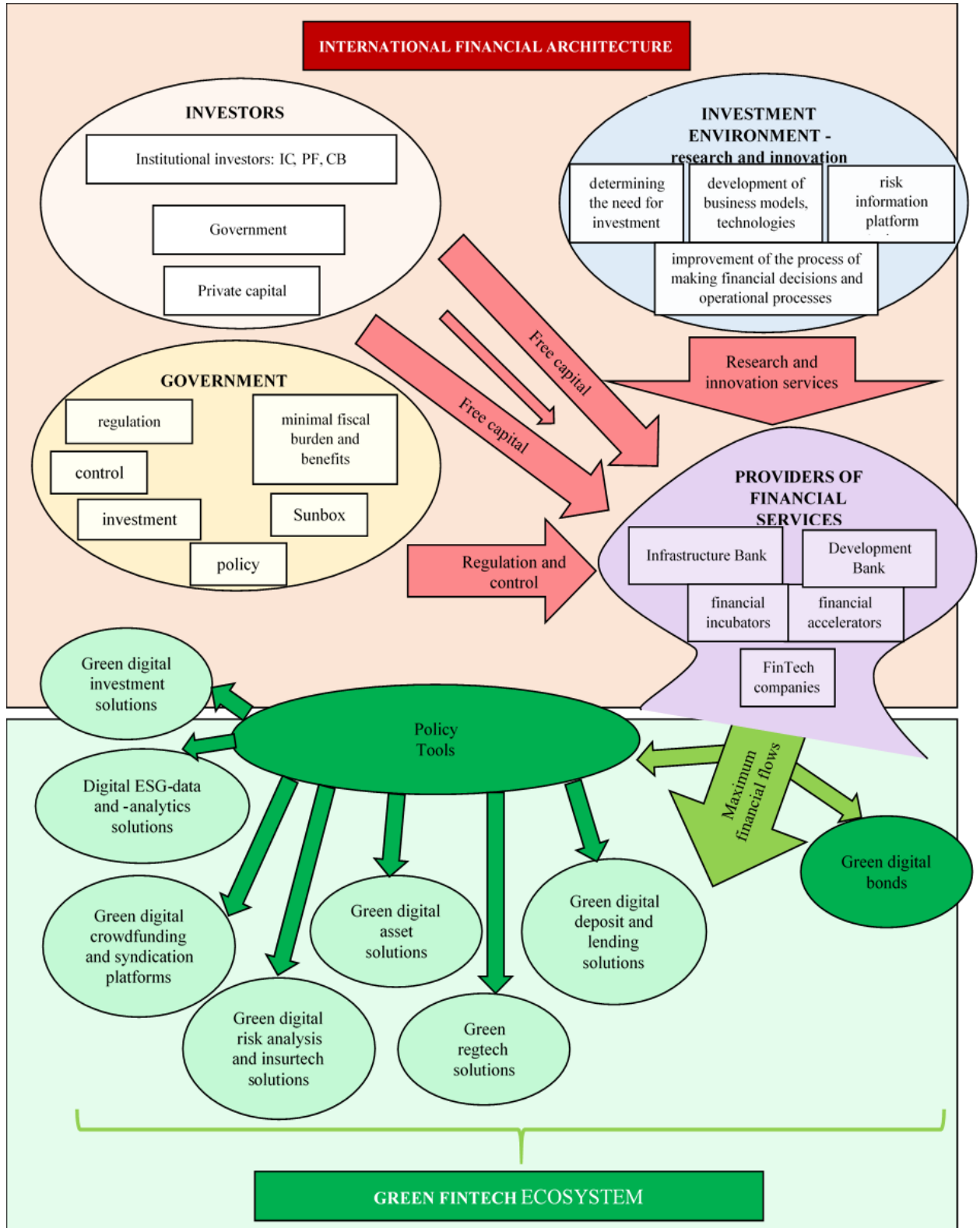
An important aspect of the research topic is establishing the role of the investors, whose financial activity forms the investment microclimate that in the complex will ensure the effective implementation of the climate policy. For the investor today, it is important not only to achieve the certain values of the financial indicators, but also to take into consideration the environmental and social consequences of the green financing, which is especially relevant within the framework of the European Green Deal implementation.

The transition to the ecologically clean economy requires the significant changes in the activities of all participants in the economic life, including the entities of the financial market and the regulators in the context of the execution of the Green Deal principles. The current investment level is not enough to make the world more sustainable and to develop in a more socially, environmentally climate sustainable way. The investment deficit is assessed by various experts for hundreds of billions of dollars for a year during next 20-30 years (Nariyanur S.S. *et al.*, 2023). Therefore, the state funds alone are not enough. Achieving the climate goals and commitments cannot happen without further regulatory, supervisory intervention and innovation in the financial

sector and the mobilization of the private capital.

**Figure 1**

*Global architecture of the green financing - the GREEN FINTECH ecosystem*

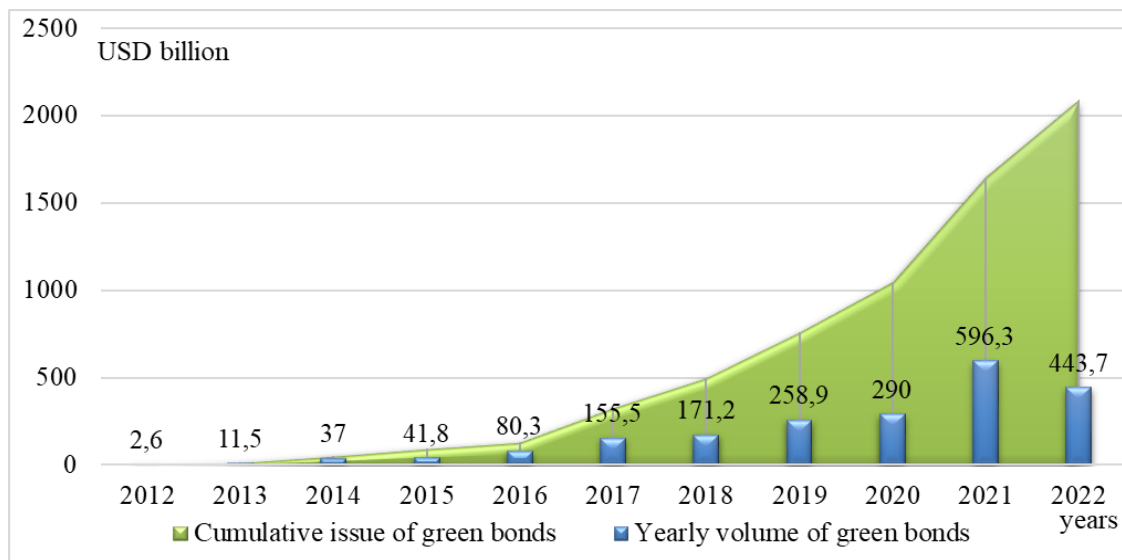


Source: developed by the authors

One of the solutions that have been actively implemented recently are green bonds, which are perceived as a natural element of the transformation of the world economy into the financing or refinancing of the renewable energy sources, improving the energy efficiency, attracting the financing for the projects or programs related to the climate change or the adaptation to such changes. The thematic labelling enables the investors interested in the thematic area to focus their investments in that sphere. More importantly, they are a debt instrument that provides the benefits in the policy sphere, namely: using the innovative regulatory mechanisms, tax policy and risk sharing. The first green bond was issued by the European Investment Bank (EIB) (2006). In 10 years, the market has reached almost USD 81 billion (Fig. 2), which is equivalent to USD 9.2 billion, which are hourly collected. Since the launch of the World Bank’s program “Green bonds” in 2007 and the Climate Awareness Bonds program by the European Investment Bank (EIB) in 2008, the investors are interested in increasing the profitability of the investments in the green bonds of the capital to struggle with the climate change.

**Figure 2**

*Dynamic of the increase of the green bonds issue*



Source: Climate Bonds, 2017; Climate Bonds, 2019; Climate Bonds, 2022; Climate Bonds, 2023; Worldbank, 2022.





As can be seen from Fig. 2, the green bond market was increasing capacity in 2014, and in 2015, seven countries demonstrated a considerable increase of the green bonds market: USA - USD 10.5 billion, Germany - USD 5.6 billion, Netherlands - USD 4.1 billion, China - USD 1.0 billion, Norway - USD 0.9 billion, Great Britain - USD 0.7 billion, Japan - USD 0.5 billion. 7 new countries joined the green bonds market in 2015, namely: Brazil (the green bond emission made USD 0.6 billion), Denmark (USD 0.6 billion), Estonia (USD 0,06 billion), Hong Kong (USD 0.3 billion), India (USD 1.1 billion), Latvia (USD 0.08 billion) and Mexico (USD 0.5 billion). Commonly they added USD 3.2 billion worth of green bonds to the market.

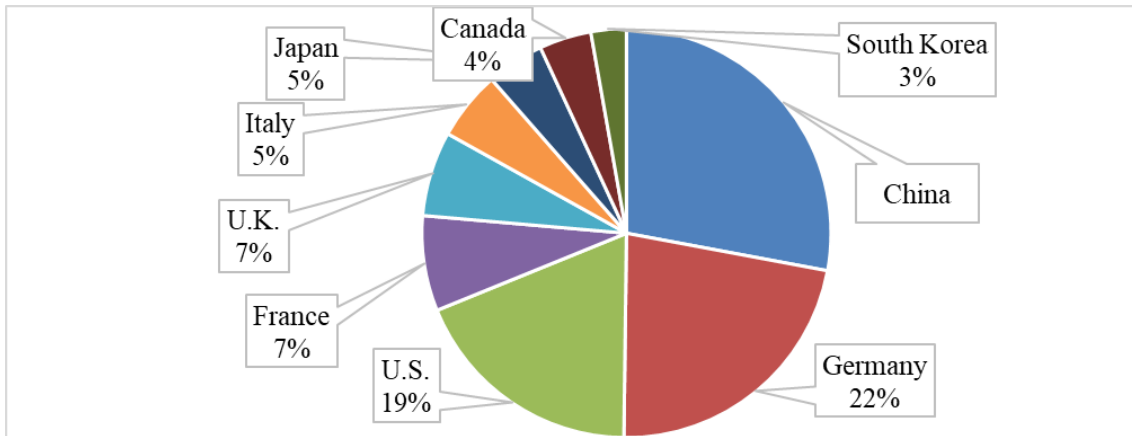
According to the Climate Bonds Initiative (Climate Bonds Initiative, 2023), a British environmental debt tracking company, the issuers sold USD 443.72 billion worth of green bonds worldwide in 2022, down from USD 596,30 billion in 2021. The issuance of the government bonds fell by 38.1% compared to the same period of the last year, while the supply from non-financial companies fell by 35.8%.

The green bonds issuance in the fourth quarter of 2022 made USD 83.64 billion, down 15.9% from the previous quarter and the lowest level since the second quarter of 2020. This happened due to the market instability, inflation, rising interest rates and geopolitical uncertainty caused by the Russia's military aggression against Ukraine, reduced borrowing costs and cooling investor appetite in the global bond market.

In Europe, the supply of green bonds in 2022 fell by 32.5% to USD 219.03 billion, while in North America, the issuance fell for 43.2% to USD 60.22 billion. The issuance of the Asian-Pacific region was more stable, falling for 2.5% in 2022. It was the second largest issuer in the region, issuing USD 120.83 billion for the whole year, helped by the China's efforts to bring its stable debt in line with the international standards and growing volume, and the demand on the part of the world investors. The issuance of the "green" bonds in China in 2022 reached USD 76.25 billion, followed by Germany - USD 60.77 billion and the USA - USD 49.00 billion (Fig. 3).

**Figure 3**

*Issuance volume of the green bonds by the biggest economies in the world in 2022*



Source: Climate Bonds Initiative, 2023; Worldbank, 2022.

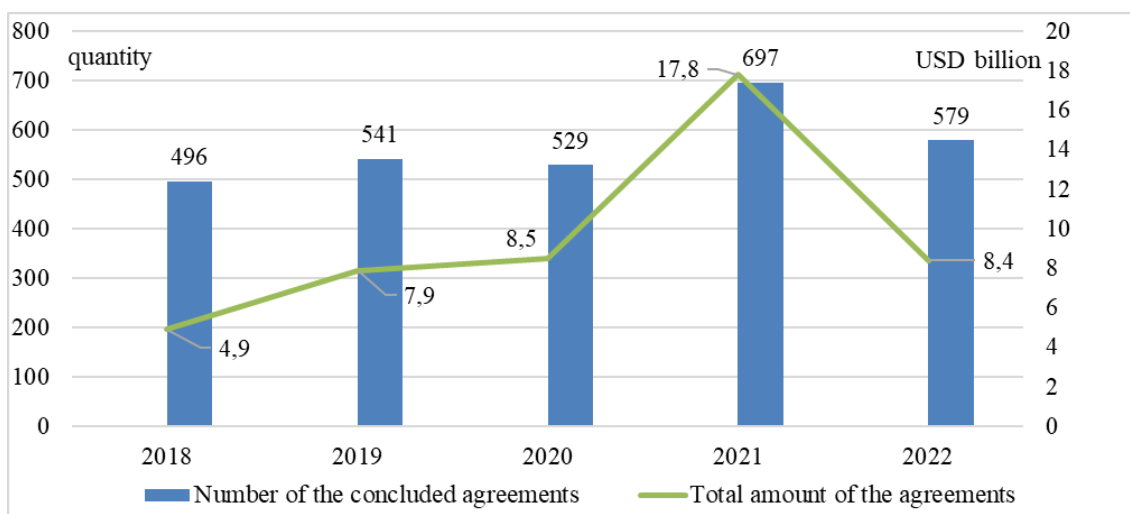
The climate FinTech start-ups, also often called the “Green FinTech”, operate in several segments: carbon accounting software, carbon management platforms, ESG reporting (environmental, social, governance), management of climate risks and insurance, crypto currency for the climate, sustainable banking, sustainable retirement and much more.

The insurance industry is one of the economy sectors that feels the direct and significant impact on its business of the consequences of the climate change. Due to the changing nature of the climate risks, today, the insurance companies are working on the development of the more accurate risk models and insurance products to protect their own assets and those of their customers. To that end, the insurers are cooperating with the InsurTech to work on a new set of innovations. Reinsurers, insurers and the InsurTechs cooperate in order to create the innovation insurance decisions to manage the risks of the climate change.

In recent years, the insurance companies have paid special attention to the demonstration of the ESG-accounts. The leaders of the insurance market that use the ESG practice as a means of the environment protection and involvement of the new investors are as follows: an insurance company Zurich, Aviva, an insurance broker Willis Tower Watson and a reinsurer Swiss Re. In an effort to increase the share of the ESG bonds till 2050, the companies plan to increase the investments and the renewal and social infrastructures (Fig. 4).

**Figure 4**

*Dynamics of the indicators of the Global Insurtech financing*



Source: Pulse of Fintech H2'22, 2023

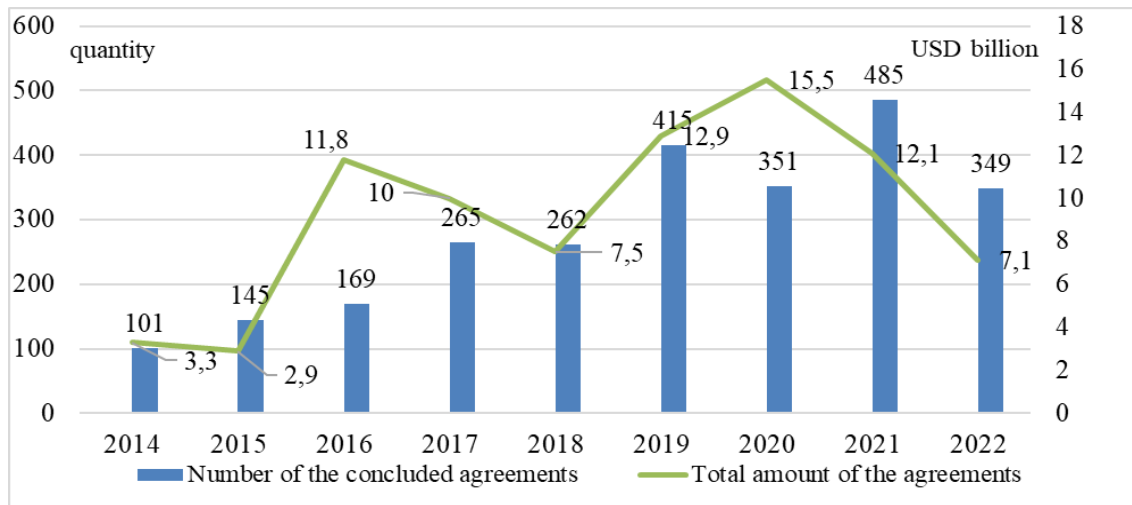
Regarding the financial strength of the InsurTech market, according to the Grand View Research, the size of the global insurance technology market was estimated USD 3.85 billion in 2021, and is expected to grow at a compound annual growth rate (CAGR) makes 51.7% in the period of from 2022 to 2030. In 2022, the global insurance technology funding fell by more than 50% to USD 8.4 billion after the record financing in 2021 for the sun of USD 17.8 billion.

According to the CB Insights, the InsurTech companies under the estimates of 2020 have attracted the record USD 15.5 billion, at the same time, 351 agreements were concluded, and already in 2021, their quantity made 485. The biggest part of the investment activity was connected with the real estate and accident insurance, which accounted for 73% of the agreements in the insurance technologies sphere for the third quarter of 2021 (Fig.5).

Over the next five years, the new and innovative InsurTech start-ups are expected to focus on helping the insurance companies insure against the risks of the climate change using the technologies of the new century, such as: Big Data, Internet of Things, blockchain and artificial intelligence (Veru N., 2023).

**Figure 5**

*Dynamics of the indicators of the Global Insurtech financing*



Source: Pulse of Fintech H2'22, 2023

The proposed author's architecture of the GREEN FINTECH ecosystem was supplemented with the following instruments (Fig.1):

- green digital payments and solutions for the accounts;
- solutions for the green digital investments and ecological digital assets;
- solutions for the green digital ESG data and analytics;
- digital solutions on the green deposits;
- green digital platforms of the crowdfunding and other propositions of the FinTech products.

Thus, the green finance is a synthesis of the digital technologies and innovations in the financial sector, which is used for submitting, expanding and distribution of the financial services by the technological companies through the FinTech platforms directed for decreasing the climate risks.

The creation and strengthening of the regulatory environment, institutional capacity, financing needs, and R&D and venture capital to develop the new technologies and business models are often neglected despite their critical role in facilitating the deployment of the climate change - green financing.

The goals achievement of the global ecological and economic development in the world, in particular the activation of the green financing, can be achieved through:

- 1) updating the legal framework of the countries and harmonizing the state



- financial initiatives;
- 2) supporting the private sector in creating the favourable investment environment;
  - 3) promoting the activation mechanisms of the public-private partnership of the green financing (green bonds), growth of the green financing of the various sectors of the global economy;
  - 4) formation and strengthening of the green financing infrastructure on account of the international, national and financial-credit institutions, local, regional and national banks of development and the private capital market;
  - 5) coordination of the decision-making regarding the public sector financing with the environmental dimension of the Green Deal,
  - 6) increasing both the volume and quality of the investments in the green programs and projects;
  - 7) financing of the sustainable green economy based on the natural resources, and climate-smart economy;
  - 8) growing use of the green bonds;
  - 9) expansion of the green financing mechanism at the expense of the market instruments (pricing, standardization, regulation), debt financing and fiscal decentralization;
  - 10) wide introduction of the InsurTech achievements to solve the problems of the climate change by building a new risk assessment system, developing the innovative new green insurance products (parametric insurance);
  - 11) reducing the risks of the cross-border investments and the market development of the local green bonds;
  - 12) reduction of the investment costs, including the transaction costs, as well as the risks elimination through the funds and distribution mechanisms;
  - 13) using of the FinTech platforms (green digital deposits/green loans/green insurance);
  - 14) supporting the investment decisions using the ESF data collection and measurement systems.

Therefore, green finance solutions must be such that they provide the necessary scale of climate investment in those markets that have the greatest need to use the global capital surplus. It is also necessary to focus on reliable and effective financial strategies and products that provide substantial support to the real economy, and achieving these goals is possible based on the cooperation of countries, financial regulators and financial sectors to direct financial flows to the implementation of the Green Deal goals.

## 5 CONCLUSION

The ambitious global cooperation, joint implementation of the climate policies, and the enhanced climate financing through the viable FinTech ecosystem and combined sources of investing can help address the world's macroeconomic uncertainties by the direct capital markets to invest in the climate mitigation, and the cost-effective environmental restoration processes.

The important role of the state impact on the creation of the favourable conditions for the climate finance expansion by reducing the political, regulatory, control, macroeconomic and business risks has been established. It was established that the political stability, the consistent and clear regulatory framework, the agreed green financing policy (available programs to stimulate the green investments in the world's leading countries) and the openness to the international investors create the attractive conditions for the climate finance conditions.

The authors' team is convinced that the use of the FinTech green tools will have the important long-term benefits for the participants, in particular: increase in both the volume and composition of the financial-innovation, information-investment support and expansion of the partnership, strengthening the role of the international and national financial institutions, including the central banks, decreasing the risks of the trans-border investments, development of the green bonds market and coordinating the Green Deal climate policy with the main goals and directions of the national policy in general according to the sustainable development goals, decreasing the financing costs and improving the procedures of the data collection, as well



the implementation of the green financial products using the digital technologies. We realize that the difficulties and barriers will not disappear on the path of the green financing, but we believe that the green digital technologies will bring the long-term climate effect.

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