

The green economy in transformation and financial opportunities

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Abstract

The green economy is at the center of the economic and social transformation in the European Union country and Romania is actively integrating into this process. This research explores the evolution of the green economy in the EU, with an emphasis on Romania's specific context. The objective is to analyze the potential and implications of the green economy in the Romanian and European context, highlighting the importance and benefits of the sustainable approach. The study proposes to identify the strategic objectives, the achievements of the implementation of the green economy in the EU, the evaluation of the way in which they are reflected and integrated in the economic policy and practice of Romania. The main aim is to highlight the links between environmental policy, economic development and financial opportunities, to promote sustainable and inclusive growth. The main results of the study include the identification of progress and challenges in the implementation of the green economy in the EU and in Romania, the analysis of financial opportunities available to support environmental initiatives, the assessment of the impact on economic growth and social well-being. The novelty of the article lies in the integrated and comprehensive approach to the green economy in the context of the EU and Romania, with specific aspects. The practical implications of this study include providing information, relevant bases for the development and implementation of economic and environmental policies and strategies that support the transition to a green and sustainable economy in Romania and the EU. The article mentions that success can be ensured by real and functional correlation between European and national programs for the sustainable development of the green economy with financing opportunities, by creating a public and private financing mechanism, intelligent, sustainable, inclusive economic growth can be ensured.

Keywords

Renewable Energy, sustainable development, interdisciplinary, entropic approach, blockchain technology.

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Introduction

Building a green economy in the current context of the complexity of economic structures is a major challenge, but at the same time it offers many opportunities for development and transformation Bran, (2013). Considering the multiple challenges, opportunities, crises we are currently facing, the implementation of strategies and policies, as well as radical transformations in education, in the priorities of public institutions, NGOs, companies, financial-banking institutions are essential for promoting a green economy and durable. This transformation is not only necessary to protect the environment, but also to stimulate innovation, economic growth, resilience (Cretu et al., 2022). In this context, the analysis of the evolution of the green economy, both at the European level and in the Romanian economy, is crucial for understanding the progress made and identifying future development directions (Alpomi et al., 2022). In this article we focused

only on a few main aspects in which we reflected the statistical evolution of the ecological economy in the European Union, according to Eurostat data and the evolution of the green economy in the Romanian economy, with an emphasis on the ecological agriculture sector Radulescu, (2013). Among the works in the field are the studies of the authors Khoshnava et al. (2019) who argue that sustainable economic growth is one of the causes of costly environmental degradation. In supporting the development of the green economy, the circular economy plays a central role, is the opinion of the authors Târziu et al. (2019) which analyzed the European and national framework regarding the transition to the circular economy, identified the main national implications of the measures proposed by the European Commission regarding the circular economy. The author Rădulescu et al. (2022) present some good practices at the European and national level in the application of the circular economy. The authors Fortea et al. (2024) claim that: the transition to a green economy is the main objective of the European Agenda, simultaneously with climate neutrality with the implementation horizon of 2050. We explored financing and investment opportunities in the green economy, with an emphasis on European funds and government programs available in Romania and other financing and investment modalities that can stimulate sustainable development and promote ecological practices (Rădulescu et al., 2023).

1. Review of the scientific literature

The authors Ciula et al. (2024) claim: "Today, Europe's threats are conditioned by both climate change and environmental degradation. The respective approaches are reflected by the European Green Deal, which reflects the major transformations in the new EU economy, with sufficient resources, economically developed and highly competitive, with the objective of zero greenhouse gas emissions". This study aims to carry out research to determine the content of hydrogen sulphide in the landfill gas and the actual efficiency of removing hydrogen sulphide from the gas using activated carbon. The results demonstrated a high carbon content in the tested sample at 92.78%, and the efficiency of removal of hydrogen sulfide from the landfill gas by activated carbon, calculated from the measurements, was 97.05%. The research results are an incentive for cogeneration plant operators to systematically examine the quality of landfill gas and the efficiency of biogas purification devices. The authors Kayakuş et al. (2023) claim that: "The first priority of the agenda for developed and developing economies is climate awareness due to the causes of global warming. The ecological evolution of economic activities, the plans made, all the efforts to adapt to development made by many countries have allowed the development of new perspectives. The most representative document is the Paris Agreement on Climate, from 2015 and the Green Pact, implemented by the European Union (EU) within that Agreement. According to those estimates, developed with the SVR model, it is expected that carbon emissions in Turkey in 2030 will represent 723.97 million metric tons (mt) of carbon dioxide (CO₂). The year 2030, the target year set by the EU. That level is 42% higher than the necessary target to reach, considering the existing data in 2019". The authors Tola, et al. (2023) claim that: "The recovery of materials and components from end-of-life (EoL) ships requires the complete demolition of ships and the implementation of reuse processes to achieve the "circularity" of raw materials, which has potential benefits for economic and environmental sustainability". European Union (EU) legislative policy, as reflected in the Ship Recycling Regulation, has moved towards creating green markets for ship dismantling. The aim is also to introduce a conceptual framework for the efficient recycling of components and raw materials. Scientific publications were collected, reviewed and classified into strategic groups to identify current and future challenges, to establish pathways for potential developments in a circular economy model, for ships, for proposals and future research directions that would support the development and design of the circular economy, ship ecological design system, life cycle management, recycling, etc. Authors Ndue and Pál (2022), argue that green growth, the transition to green growth, is gaining sufficient scientific and public interest at an unparalleled rate across Africa. The ratification of the Paris Agreement by 54 member states, the objectives of the African Union (AU) in Agenda 2063, regarding green economies - is an eloquent proof. The respective activity is in accordance with the aspirations of the European Ecological Agreement (EGD), which proposes to transform Europe into a neutral economy by 2050. The authors Bogoslov et al. (2022) agree that: The European Green Deal (EGD) proposed by the European Commission as a growth strategy, for the transformation of the European Union into a prosperous, resilient society, with a competitive economy, with efficient allocation of resources, with a green environment. The authors of the research highlighted the main criticisms of the European Green Pact, considering the dimensions of entrepreneurial competition in the common market. The authors Firoiu et al. (2022), claim that: "The climate-neutral economy is today a priority issue for all governmental and non-governmental bodies, directly and indirectly involved in the process responsible for society's transition to the green economy. Sustainability is a must." The authors Morelli et al. (2022) claim: "Among the Sustainable Development Goals, the "Green Problems" have attracted important research, regarding the sustainability and ecological transitions within the fourth industrial revolution, it is crucial for the diversification of the spectrum local, sustainable activities to

protect the environment against negative climate changes". The authors Liu and Li (2024) claim that: „China's economy has entered the new stage of high-quality development, in which the balance between quality and quantity in economic development, called (HQED), is monitored, which contributes to sustainable economic and social achievement". The paper analyzes green finance and its impact on the economic development of HQED quality, simultaneously with the mediating role of ecological innovation and the modernization of industrial structures. The authors Yuan et al. (2024) claim: „Bearing in mind China's objectives in terms of neutrality of carbon emissions, or focused on the problem of optimizing carbon efficiency in construction". That study uses a super-Slacks-Based Measure (SBM) model and a Tobit regression model to analyze the heating-related carbon emissions of buildings in China, taking into account urban population density, electricity consumption, building energy and the influencing factors that cause differences in the difference in carbon efficiency. The authors He et al. (2024) claim that: "Since China's economy has passed through a period of favorable economic growth, and has entered the period of high-quality development, having the need to implement innovative ecological practices, which involves innovation in green technology". It is important to note that the capital market environment plays a direct role in influencing the sources and extent of external financing for enterprises, thus affecting their of eco-innovation and the implementation of green technologies. China's Shanghai-Hong Kong Stock Connect (SHSC) mechanism is considered the first official two-way opening of the Chinese capital market. The authors Gao and Li (2024, p. 20-21) argue: "that the role of the components of the digital economy: digital infrastructure, innovation capabilities, degrees of application, economic growth, employment on the Internet reveal the beneficial contributions to reducing emissions and increasing efficiency. But the findings, regarding digital inclusive finance, highlight the impact on green objectives. Efforts to promote social and economic inclusion through digitization also contribute to the environment." The findings indicate that the digital economy helps China achieve its dual carbon targets by reducing carbon emissions by increasing carbon efficiency. The author Vanishvili, M., & Katsadze, I. (2022) analyzed the sustainability of financing the green economy, addressed the problem of determining how and in what to measure the green economy. He addressed Serbia's experience in financing the green economy and the problems it faces. Authors Niyazbekova et al. (2021) they examined the problems of ecology, climate change. In the opinion of the authors, green financing is an instrument that allows the carbon transition to a green economy, providing extra-budgetary sources of financing for projects that ensure that transition. Authors Liu et al. (2020) argue that Green Finance considers social responsibility, the interests of environmental protection, as the core of development, has become a growth point and an engine of promoting the development of the green economy. The author Ünüvar (2019) believes that green finance will support the challenges for banking sector, bond market, institutional investors, decision makers. Systematic support of green finance initiatives, best practices and a collection of recommendations derived from the in-depth discussion. The article Ganbat, Popova and Potravnyy (2016) analyzes the impact investments of project financing., analyzes the sources of financing projects in the field of natural resources, in particular (Equity of companies and members of the consortium, own resources of the company, budget financing, own funds of companies based on the production sharing agreement, borrowed funds; funds from the issue of corporate and municipal bonds). The authors Ilić, Stojanovic and Djukic (2019) analyze the sustainability of financing the green economy, to determine how and to what extent the green economy is financed in the Republic of Serbia, ASEAN countries and what are the economic instruments for achieving green growth. The author Jamie (2018) aimed to clarify the financing role of the Green Economy in achieving sustainable development, in the light of the goals of the UN environment program, represented by economic growth and the impact on the global environmental system. Author Jamie (2018) advocates clarifying the role of financing the Green Economy in supporting sustainable development, according to the goals of the UN Environment Program, which are represented by increasing economic growth and its impact on the global environmental system. Authors Ilić, Stojanovic and Djukic (2019) analyzes the sustainability of green economy financing, to determine how and to what extent the green economy is financed in the Republic of Serbia, ASEAN countries. The focus is on green bonds, modern securities, as well as the impact they have on international renewable energy projects.

2. Research methodology

In the study method, we set ourselves the objective of analyzing the trends and development models of the ecological economy over time, by collecting relevant statistical data on indicators such as the adoption of renewable energy, carbon emissions, investments in green technologies, etc. We set out to use statistical analysis techniques, trend analysis, to identify patterns and relationships, and to understand the evolution of the ecological economy. Approaching the evolution of the green economy in the Romanian economy, aims to investigate the growth and impact of green initiatives in the Romanian economy. Therefore, the research methodology is focused on reviewing the literature on green economy initiatives, policies and projects in Romania. Considering the fact that the study is focused on the issue of funding opportunities for

the green economy, we proposed to study funding opportunities through European Funds and government programs, with the objective of: Examining the role of European funds and government programs in promoting sustainability and ecological initiatives, and the application of the methodology to identify and review the relevant funding programs from the European Union related to environmental sustainability. An important moment is Green Economy Financing and Investment Opportunities, with the objective of: Exploring available financing options and investment opportunities for green projects. The methodology is oriented towards the review of financing mechanisms (green bonds, venture capital funds and public-private partnerships). An important moment for the green economy is the modernization of energy efficiency through the financing of energy efficiency projects, with the objective of evaluating the impact of financing on the modernization of energy efficiency practices in buildings and industries. As a methodology, we aim to identify energy efficiency projects in buildings and industries financed from various sources. Based on the articles studied Mubarik at al. (2021), Polas at al.(2022), we propose to use blockchain technology to support the development of the green economy, it can be applied in: monitoring, sustainability certification; blockchain platforms for financing environmental projects, creating decentralized green energy markets, monitoring and managing supply chains in the green industry, through the transparency of resources used, Tokenization of environmental assets, blockchain to ensure transparency and data verifiability.

2.1. The statistical evolution of the ecological economy

According to Eurostat statistics, we resorted to the statistical analysis of the European Green Pact presented by Eurostat for the European Green Pact, which is one of the major priorities of the European Commission in the period 2019-2024, had the objective of presenting European statistics for the development of the green economy. The respective analysis represents 26 indicators for the EU, member states and EFTA countries, presented in three main topics: Reducing the impact on the climate, protecting the planet and our health, and ensuring a green and fair transition. In the paper we present only a part of these important and relevant indicators both for the European economy and for the Romanian economy.

Table no. 1. Greenhouse gas emissions, Net, Index, 1990=100							
	2009	2012	2015	2018	2020	2021	2022
UE	81.7	79.8	76.4	73.9	66.1	69.9	69.0
RO	43.9	39.5	29, 8	29.8	27.0	29,1	29, 0

Table no. 2. GHG emissions by sector Energy/ % of total gross GHG							
	2009	2012	2015	2018	2019	2021	2022
UE	76.9	76.6	75.6	74.8	74.2	75.2	74.7
RO	70.3	71.0	67.5	67.2	66.5	66.5	68.3

Source: <https://ec.europa.eu/eurostat/cache/egd-statistics/> Statistic for the European Green Deal

Table no. 3. Climate related economic losses, euro/per capita						
	2010	2012	2015	2018	2021	2022
UE	49 euro	9 euro	26 euro	51 euro	133 euro	117 euro
RO	66 euro	1 Euro	166	7 euro	2 euro	54 euro

Source <https://ec.europa.eu/eurostat/cache/egd-statistics/> Statistic for the European Green Deal

Table no. 4. Forest and other wooded land total \ % of land area				
	2009	2012	2015	2018
UE	39.3%	40.7%	41.9%	42.3%
RO	N/A	32.5%	34.1%	35.5%

Source <https://ec.europa.eu/eurostat/cache/egd-statistics/> Statistic for the European Green Deal

Table no. 5. Raw material consumption, Total/tonnes per capita						
	2009	2012	2015	2018	2021	2022
UE	16.4	14.4	13.9	14.9	14.8	14.9
RO	18.3	17.9	22.3	23.3	31.01	30.0

Source <https://ec.europa.eu/eurostat/cache/egd-statistics/> Statistic for the European Green Deal

Table no. 6. Research and development expenditure, total / % of GDP

	2010	2013	2016	2019	2021	2022
EU	1,97	2,10	2,12	2,22	2,27	2,24
RO	0,45	0,39	0,49	0,48	0,47	0,46

Source <https://ec.europa.eu/eurostat/cache/egd-statistics/> Statistic for the European Green Deal

Table no. 7. Renewable energy, total/% of gross final energy consumption

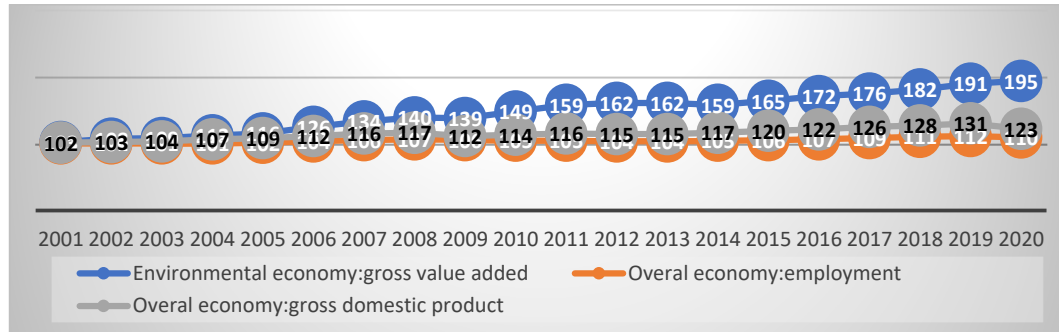
	2010	2012	2014	2016	2018	2020	2021	2022
UE	14,4	16,0	17,4	18,0	19,1	22,0	21,9	23,0
RO	22,8	22,8	24,8	25,0	23,9	24,9	23,9	24,1

Source <https://ec.europa.eu/eurostat/cache/egd-statistics/> Statistic for the European Green Deal

According to the "Table no.7" Renewable energy, total % of gross final consumption energy consumption in 2022, approximately 24,1% in Romania is from renewable sources, above the EU average of 23,0 %, of gross electricity consumption in the EU, in up from 18,0 % in 2016, and in Romania 25,0 % in 2016.

2.2. The evolution of the green economy in the Romanian economy

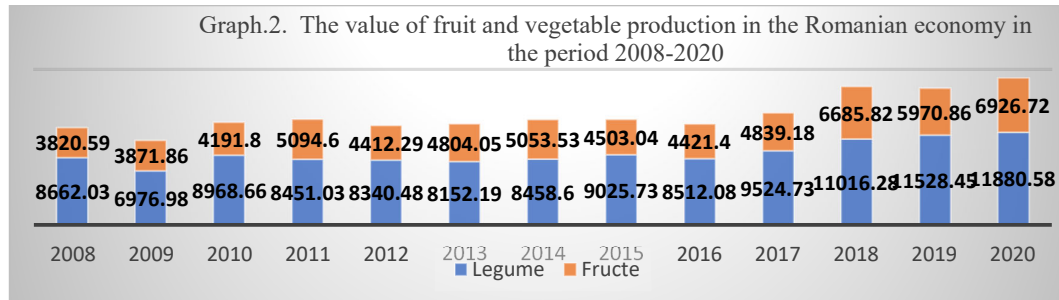
The evolution of the environmental economy, GDP and employment in Romania, % growth compared to the previous year Graph. 1.



Source: www.insse.ro/

2.2.1 The evolution of ecological agriculture in the Romanian economy

According to the methodology of the National Institute of Statistics, the value of fruit and vegetable production is represented by the value expression of the volume of fruit and vegetable products, without losses and including consumption, which were obtained in the calendar year, in "Graph 2".



Source: <http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table>

Table no. 8. The value of fruit and vegetable production in the Romanian economy, period 2008-2021

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1	1,2	1,4	1,7	2,2	2,3	2,21	1,8	1,7	2	2,6	3,2	3,8	4,6

Source: INSSE, www.insse.ro/ TBT0261 - Target 6 - Environment - THE SHARE OF ECOLOGICAL AGRICULTURAL PRODUCTION IN TOTAL AGRICULTURAL PRODUCTION

According to the INS methodology, the agricultural area used ecologically cultivated, represents the agricultural area used ecologically cultivated, on which ecological production methods are applied according to the rules of the European Union and Romania. The agricultural area used is the total area made

up of arable land, including greenhouses and solariums, pastures and permanent hay, permanent crops, family gardens used by holdings, regardless of the way of ownership.

Table no. 9. Agricultural area used organically cultivated

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
140132	168288	182706	229946	288261	301148	289252	245924	226309	258471	326260	395228	468887	578718

Source: INSSE, www.insse.ro/ TBU0262

Sustaining and developing sustainable agriculture is a strategic priority in ensuring food security, promoting environmental management, and achieving long-term agricultural resilience. Let's highlight some main considerations for the development of sustainable agriculture. (1) Soil conservation and health and the application of sustainable agricultural practices that prioritize soil conservation and health. Those activities involve the implementation of crop rotation, cover crop and reduced tillage techniques to minimize soil erosion, to increase soil fertility and promote carbon sequestration. Precision agricultural technologies can optimize the use of fertilizers, pesticides, and contribute to reducing the impact on the environment. (2) Water management in sustainable agriculture aims to focus on efficient water management to minimize water use and reduce the impact on water resources. (3) Biodiversity conservation, protecting and enhancing biodiversity, is a priority aspect of sustainable agriculture. The implementation of agroforestry practices, integrated pest management (IPM), conservation of natural habitats on farms, support the promotion of biodiversity and provide ecosystem services, for example pollination and natural pest control. Development of agroecology and ecological agriculture by prioritizing ecological processes and natural inputs to reduce dependence on synthetic fertilizers and pesticides. Respective practices promote soil health, biodiversity and the use of renewable resources. It is important to emphasize the diversification of crops, the integration of animals, by creating resilient and sustainable agricultural systems. Adaptation to climate change, of sustainable agriculture, must include strategies, policies and managerial activities to adapt, implement, mitigate the impact of climate change. These activities include the use of climate-resilient crop varieties, the implementation of carbon sequestration systems, the adoption of climate-smart practices, the use of climate forecasting technologies to optimize agricultural operations.

Sustainable animal management. Livestock production contributes significantly to greenhouse gas emissions and resource consumption. But sustainable agriculture promotes responsible animal management practices such as rotational grazing, feed efficiency and waste management systems.

2.3. Financial support mechanisms for the development of the green economy

The development of the green economy cannot take place without the essential support of green financing and the adoption of financing methods and techniques. We tried to reflect some ways in which the green economy can be supported and financed in Romania, along with a series of investment opportunities:

European Funds and government programs. One of the most rewarding ways today is represented by European Funds and government programs that support various fields of activity for many years. Accessing European funds intended for environmental and renewable energy projects through Operational Programs (POR, POC, POIM, etc.). Participation in government programs for financing renewable energy or other ecological initiatives, such as the Casa Verde Program or the Rabla Program. Attracting private investment in renewable energy projects, energy efficiency, waste management, etc. Impact investment funds or venture capital funds that focus on the environmental and sustainability sectors. Obtaining bank loans or leasing for investments in green technologies and equipment, such as solar panels, wind turbines, energy efficiency equipment.

Financing and investment opportunities in the green economy. Financing and investment opportunities in the green economy today include a wide spectrum of activities, considering the increased demand related to renewable energies, climate change, environmental protection, etc. offers a wide range of services for large companies, institutional investors who are looking for financial profits, business development, sustainable development. An important point is the power purchase agreements, which are contracts between the developers of renewable energy projects, the buyers of electricity. PPAs, i.e. Power Purchase Agreements, provide certainty of long-term revenues for the project, spanning the long term (10-20 years). When investing in a renewable energy project, evaluating the terms, existing/or potential stability is crucial to assessing the financial viability of the project.

Modernizing the field of energy efficiency by financing energy efficiency projects in buildings and industries. Financial support of energy efficiency projects of buildings (public and private, homes, offices, industrial spaces). We aim to review some financing options available for improving energy efficiency: Let's start with energy performance contracts, which are agreements between energy service companies (ESCOs)

and building or business owners. The ESCO organization performs energy audits, identifies all energy saving opportunities, implements upgrades, guarantees the level of energy saving.

3. Results and discussion

European Funds and government programs. Companies or public entities can issue green bonds to attract financing for specific environmental and sustainability projects. Using crowdfunding or crowdfunding platforms to attract funding from the public for green projects, such as installing solar panels on public buildings or developing urban gardens. The implementation of fiscal policies that provide incentives to support investments in the green economy, through tax exemptions, tax exemptions for companies that implement environmental projects, invest in ecological technologies. The opportune portfolio of green investments in Romania is diversified, it includes: (1) Renewable energy, development of solar parks, wind farms, small hydroelectric power plants, etc. (2) Energy efficiency, modernizing buildings to reduce energy consumption, implementing smart lighting solutions or efficient heating systems. (3) Waste management, investment in recycling infrastructure, selective collection and recovery of waste. (4) Sustainable transport: developing green public transport networks, electric vehicle infrastructure and other sustainable mobility solutions. (5) *Sustainable agriculture and forestry:* implementation of environmentally friendly agricultural and forestry practices, including organic farming and sustainable forest management.

Financing and investment opportunities in the green economy. Promotion of government policies and incentives are priority in the development of the field of renewable energies. Tariffs, tax credits, grants, renewable portfolio standards, all these instruments can provide financial support and give a certain stability to the development of projects. Another important moment is the project development stage. Renewable energy projects go through different stages in the evolution of development, from early development, construction or management and operational activity. Another important question is risk assessment. We would like to mention that carrying out detailed checks is important before any investment decisions are made. This assessment includes technical feasibility assessment, resource assessments, financial analyses, environmental impact assessment, liabilities. Important point is assessing the project's impact on the natural environment and social systems is important for investors. This can help capitalize on sustainability goals, help investors make decisions and align investment portfolios. In the activity of portfolio management, portfolio diversification is very important, considering the multiple risks and economic activities with low results.

Modernizing the field of energy efficiency by financing energy efficiency projects in buildings and industries. Development of bill financing programs that allow owners (of buildings or businesses) to financially support energy efficiency performance by paying utilities. Therefore, the utility company provides the initial capital for the project. The building owner repays the loan through the energy savings achieved over time. As a result, the approach eliminates the need for separate loan payments, spreads the costs over the entire repayment period. Development of Property Assessed Clean Energy financing programs, which allow property owners to finance energy efficiency improvements through property tax assessments. Development of Green Bank or Energy Efficiency Fund models. The establishment of green banks, or funds dedicated to energy efficiency, offer low-interest loans, grants, other financial incentives for energy efficiency projects. Promotion of equipment leasing and financing. Leasing companies, financial institutions, offer leasing options and financing of special equipment (industrial and agricultural installations).

Conclusions

The development of the green economy is a priority for solving the problems of climate change, environmental degradation, resource security. It is vital that we move towards an economic model that emphasizes resource efficiency, sustainability, social and environmental responsibility.

In the current conditions of development, the green economy has created new opportunities for development in agriculture, construction, industry, created new jobs, however, the potential remains untapped and requires the development of new programs, new projects that will be found in the field of renewable energies, of green-sustainable transport, in energy efficiency, will create new jobs if the Green Strategies, correlate with the European and national financing programs, the services and offers of the financial markets.

Supporting the development to the green economy, the mobilization of adequate financial resources is essential. European funds, government programs, private investments, impact investment funds and other financial instruments can play a crucial role in facilitating investments in green projects and initiatives. Incentives and public policies: Implementing appropriate fiscal policies and regulations can stimulate investment in the green economy by offering tax breaks, subsidies, preferential tariffs or other benefits to

companies and projects that adopt sustainable practices. Development of the partnerships between government, the private sector, non-governmental organizations and other stakeholders are essential to accelerate the transition to a green economy. Public awareness and education about the benefits and importance of a green economy are vital to drive demand and support for sustainable products and services. Implementation of appropriate fiscal policies and regulations can stimulate investment in the green economy by the provision by the Government of tax exemptions, subsidies, preferential rates, and other benefits for companies under certain conditions.

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