



Green Banking: A New Approach to Support the Transition to a Low-Carbon Economy - Europe as a Model -

Zebar Lamia¹ / Faculty of Economics, Commerce and Management Sciences , LEMAC,
University of Setif 1, Algeria, zebar.lamia@univ-setif.dz

Meheni Douniazad Faculty of Economics, Commerce and Management Sciences , LEMAC,
University of Setif 1, Algeria, douniazad.meheni@univ-setif.dz

Received:24/04/2024

Accepted: 04/12/2025

Published: 29-12-2025

Abstract:

This study aims to explore the role of green banks in enhancing the transition to a low-carbon economy in Europe and examine how financial institutions apply sustainable financing to promote clean and environmentally friendly projects. To achieve this, we adopt a case study approach focusing on leading European banks. Data and information were collected from secondary sources, including industry reports, financial data, and regulatory documents. The results indicate that European banks have successfully integrated green banking practices, focusing on investments in clean energy, sustainable infrastructure, and green bonds to achieve climate goals. As a result, these banks are successful models that other financial institutions can follow to accelerate the transition to a more sustainable and low-carbon economy.

Keywords: Green Banking, low-carbon economy, Green finance, clean energy projects, renewable energy

Jel Classification Codes : G21;G23 ; Q56;Q42 ;

Résumé:

Cette étude vise à explorer le rôle des banques vertes dans la facilitation de la transition vers une économie à faible émission de carbone en Europe et à examiner comment les institutions financières appliquent le financement durable pour promouvoir des projets propres et respectueux de l'environnement. Pour ce faire, nous adoptons une approche par étude de cas en nous concentrant sur les principales banques européennes. Les données et informations ont été collectées à partir de sources secondaires, y compris des rapports sectoriels, des données financières et des documents réglementaires. Les résultats indiquent que les banques européennes ont intégré avec succès des pratiques de banque verte, en se concentrant sur les investissements dans les énergies renouvelables, les infrastructures durables et les obligations vertes pour atteindre les objectifs climatiques. En conséquence, ces banques sont des modèles réussis que d'autres institutions financières peuvent suivre pour accélérer la transition vers une économie plus durable et à faible émission de carbone.

Mots clés: Banque verte, économie à faible émission de carbone, finance verte, projets d'énergie propre, énergie renouvelable

Jel Classification Codes : G21;G23 ; Q56;Q42 ;

^{1.} Corresponding author: Zebar Lamia , e-mail address: zebar.lamia@univ-setif.dz

I. Introduction;

In light of ongoing environmental challenges and increasing concerns about climate change, a low-carbon economy has become more urgent than ever, aiming to reduce energy consumption, greenhouse gas emissions, and the impacts of global warming. (Mahyar Kamali saraji&Dalia Streikiene, 2023). One of the leading and successful strategies to aid in this transformation is green banks, which allocate funds to environmentally friendly initiatives that help the world become carbon neutral. Europe is at the forefront of green finance, where European banks allocate funds for clean technologies, sustainable transportation, and renewable energy. This helps achieve its climate goals, which include reducing emissions by 55% by 2030 and achieving carbon neutrality by 2050. In the context of sustainable development) climate.ec.europa.eu(2024). Through several innovative tools, green banks play a vital role in providing financing for projects that promote environmental sustainability. This European model has become a benchmark for many other countries seeking to implement sustainable financing practices and achieve a green economy. This study reviews the role of green banks in Europe as a key tool for achieving the transition to a low-carbon economy, highlighting their current status and achievements in reducing carbon emissions. From this perspective, the following problem can be posed. ***How can green banking support the transition to a low-carbon economy in Europe?***

1.1 Study Hypotheses: the following hypotheses can be suggested:

- H1:** Green banking practices positively influence the transition to a low-carbon economy.
- **H2:** European climate policies, provide a strong regulatory framework that can enhance the role of green banks in supporting low-carbon economy projects.
- **H3:** The European model of green banking, including its regulatory frameworks, green finance tools, and market acceptance, can be effectively adapted and implemented in other regions to accelerate the global transition to a low-carbon economy.

1.2 Importance of the Study: this study is manifested in providing an analytical framework to understand the role of green banking in supporting the transition to a low-carbon economy, and offering practical recommendations to enhance the role of European banks in financing green projects and achieving sustainable environmental goals.

1.3 Literature Review: There are many studies that have dealt with this topic in various aspects:

- A study by Hyoungkun Park and Jong Dae Kim entitled: ***“Transition towards green banking: role of financial regulators and financial institutions”***,2020. The paper discusses the role of green banks in achieving

competitive advantage and managing climate risks, highlighting the approaches from developed and developing countries, central bank initiatives, and financial regulatory initiatives. It uses the theory of change framework to identify barriers and recommends improved measurement standards and sustainability integration in banking operations.

- A study by Irene Monasterolo and others entitled: *“The role of green financial sector initiatives in low-carbon transition”*,2022. This study analyzes how green financial initiatives, such as financial and regulatory policies and financial instruments, can play an important role in the transition to a low-carbon economy by supporting countries in implementing economic policies aimed at decarbonizing their economies. The study highlights the importance of understanding the conditions that can enable the expansion of green investments and the achievement of climate change mitigation goals in the transition to a low-carbon economy.

- A Study by (Maria J.Nleto and Chryssa Papathanassiou) entitled: *“Financing the orderly transition to a low carbon economy in the EU: the regulatory framework for the banking channel”*,2023. explores the EU's regulatory framework for financing the transition to a low carbon economy, focusing on the role of banks in achieving sustainable goals. It discusses the EU's ambitious climate goals and the regulatory approaches to manage financial risks. The study emphasizes the importance of international cooperation and standards in channeling investments and the need for interoperability of regional taxonomies to mitigate financial risks.

- A study by C.M Орлов and others entitled *"discusses the impact of green bonds on welfare and climate change mitigation in Europe, focusing on the extended DICE model analysis"*,2024. It provides an advanced analysis of the role of green bonds in accelerating the transition to a low-carbon economy in Europe, focussing on the impact of interest rates on the effectiveness of these bonds in mitigating the effects of climate change. By using the DCIE model, which is a dynamic integrated model that combines economic and climatic factors. The study showed that the use of green bonds can accelerate the transition to a low-carbon economy, especially when interest rates are low. It also indicated the need for additional compensation mechanisms.

Our study differs from previous studies by focusing on the role of green banks as a key tool in supporting the transition to a low-carbon economy in Europe, while most previous studies have focused on specific financial instruments such as green bonds. Additionally, it is characterized by the interaction between European policies such as the European Green Deal and the European taxonomy with the role of green banks in implementing these policies. It also provides a

comprehensive analysis of the impact of green banks on the European economy, adding a new dimension to the literature on green finance.

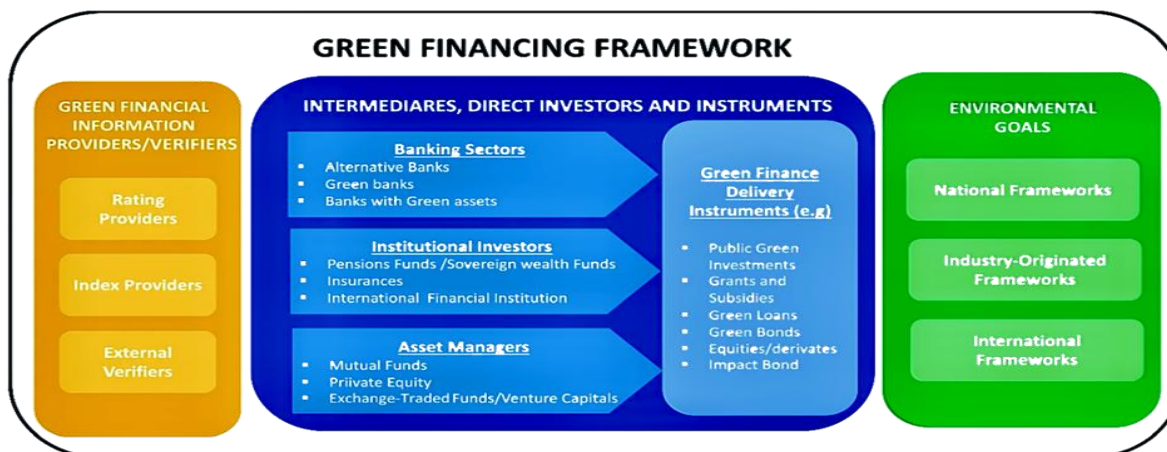
II. Theoretical Background

II.1 Green banking within the concepts of green finance;

- 1- Green finance is one of the key tools in tackling climate change and reducing carbon emissions. (Jingyan Fu& Artie W Ng, 2020, p. 6). is based on the idea of greening the financial system through the effective management of environmental risks.
- 2- green finance refers to financial operations that focus on projects and activities with an environmental component, like clean and renewable energy projects. This includes policies, regulations, investments, products, and financial services like lending, insurance, and financial technologies. (Linderberry, 2014, p. 2).

It is also related to mitigation and adaptation financing specifically for climate-related activities, as well as activities that contribute to reducing or avoiding emissions.

Figure (01): Green Financing Framework



Source: (IFC(International Finance Corporation) , 2024)

The previous figure illustrates the general framework of green finance. This can be summarized in the following elements:

- **Control agencies:** which focus on achieving social justice, evaluating, and monitoring the work of financial institutions within a sustainable framework.
- **Public policies:** Through the availability of the legislative and legal framework that outlines environmental and economic goals, based on government and international policies regulating industries and investments with an environmental dimension.
- **Financial system institutions and intermediaries,** such as green banks and the Green Climate Fund, are innovative in implementing green investments,

while also establishing legal, economic, and institutional frameworks for their interactions.

II.2 Concept of Green banking and its practices;

The term "green banking" first appeared at the Dutch Triodos Bank in 1980, which incorporated the concept of sustainable banking into its operations by launching the "Green Fund" to finance clean projects. The Paris Agreement and the Rio+20 Conference played a major role in enhancing the importance of green banking.

1 -The (IDRBT) Institute for Development and Research in Banking Technology defines green banking: "Sustainable banking practices aim to optimize banking operations, technologies, and infrastructure, minimizing environmental impact, while ensuring efficient use of resources and minimal environmental impact." (PrathimaB .J& Gowri Hebbar, 2017)

2- The term "**green banking**" includes the measures and policies adopted by banks, financial institutions, and financing companies to support sustainable development goals. This trend among banks has become a model for developing practices to reduce the carbon footprint (Vikas Natha et al, 2014, p. 46).

green banking generally consists of practices adopted by banks and financial institutions to reduce the negative impacts of climate change and carbon. It focuses on directing investments and transactions towards clean environmental activities, with authorities playing a crucial role in designing and implementing interventions. (Taslina Julia&Salina kassim, 2020, pp. 3-4). Accordingly, the activities of green banks vary to include the following areas:

- Projects related to alternative energy;
- Environmental protection projects;
- Supporting food security projects;
- Supporting poverty and unemployment alleviation programs;

II.3 Green banking products and services

Banks have started to modify their financial operations to satisfy sustainability and green transition requirements, as well as aligning their policies to integrate higher environmental standards when making loan and investment choices. They also consist of instruments for financial technology. Among the most important of these products and services are the following:

Table (01) : Green banking products and services

Service	Description
Green Mortgages and Loans	they allows customers to benefit from 15% of the value of their homes in the form of sustainable improvement loans to reduce energy consumption. This includes loans for smart buildings, smart and electric cars, loans for small, medium, and large businesses to invest in renewable energy projects, smart agriculture, energy transactions, and green infrastructure loans...;



Green Deposits	Deposits made through digital financial instruments, in addition to offering higher interest rates on fixed deposits and savings, and allowing customers to manage their accounts online, providing fee waivers and an incentive system to increase customer uptake.
Green leasing	It is mostly used in real estate by including clauses to improve environmental performance in commercial properties to enhance energy efficiency and conserve resources, such as those related to certificates of BREEAM or LEED.
Green certificate of Deposits	By issuing green deposit certificates, which are considered a short-term financial instrument to promote energy-saving green businesses
Green insurance	Insurance includes transactions free from CO2 emissions, focusing on electricity and hydrogen sources, and alternatives to vehicle fuels such as insurance for electric scooters, coverage and discounts for smart buildings, insurance against risks, and reducing losses from the impacts of climate change.
Green Bonds	They are debt securities issued by banks to finance clean projects according to strict issuance standards, aiming to direct funding towards these projects. The types of these bonds vary between: use of proceeds bonds, revenue use of proceeds bonds, project bonds, and secured bonds. This tool is considered one of the most important green financing instruments, with a global trading volume exceeding 600 billion dollars in 2024.
Equity Investment and green fund	Investment in startups and ventures in environmental and climate-smart fields and green technologies, investment in carbon credits.
Carbon credit business	It specializes in providing cash deposit services and carbon credits for clean projects. Banks can finance it and offer consulting for the registration and marketing of these projects.
Green sukuk	In order to encourage governments and banks to support the development of Sharia-compliant financial products for investing in climate change solutions, the Clean Energy Business Council, the Climate Bonds Initiative, and the Gulf Bond and Sukuk Association created green sukuk. One of the first experiences in this area has been reported to be Malaysia's utilisation of green sukuk.
Green Crowdfunding	Platforms like Kickstarter and GoFundMe for funding environmental and sustainable projects
Green Robo-Advisors	Platforms using (AI) to manage environmental investments according to ESG standards

Source: Prepared by the researchers based on:

- (Manajo sangisetti and Pechetty Venkata Purna Kumari, 2023, p. 383),
- (Anu Sahi and Anurag Pahuja, 2017, p. 49),
- (Lukas Stricker and al , 2022, p. 7),
- (Giuseppe Cortellin and Ida Claudia Panetta , 2021, p. 2),
- (Hyounghun Park and Jong Dae Kim, 2022, p. 18)

II.4 The role of green banking in supporting the transition to a low-carbon economy;

Through finance sustainable initiatives, green banks have played a crucial role in improving energy efficiency and reducing emissions.

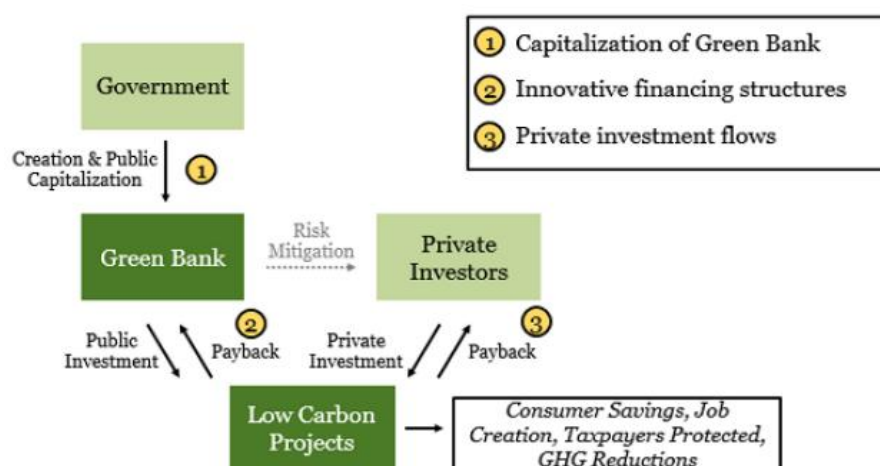


Figure (02): The structure of green banks' operations

Source: (Fanny Septina, 2017, p. 164)

The illustration shows the cycle of green banks with the shift to a low-carbon economy through the following stages:

1-Capitalising the green bank with the help of central banks, monetary policies, and governments. In order to lower financial risks and entice private investors to enter this market,

2-Innovative finance structures: the green bank uses creative financing methods, such as credit guarantees, green bonds, and low-interest loans. (OECD, 2016, p. 34). This contributes to mobilizing private investment flows towards it, thereby implementing sustainable energy projects capable of reducing dependence on fossil fuels and achieving a reduction in greenhouse gas emissions(GHG) .

3- Private investment flows: Clean projects contribute to creating green jobs and reducing energy costs for consumers through more efficient and less expensive energy solutions, in addition to protecting taxpayers from the financial pressures caused by the impacts of climate change. A sustainable financing cycle is created by recovering returns from these initiatives, where funds are returned to the green bank and private investors through the profits of completed projects."Payback" (UN, 2019, p. 14).

Green banks also support the stability and effectiveness of carbon pricing systems by enhancing investor confidence in low-carbon markets and enabling the technologies needed to reduce emissions. (bank, 2023, p. 32) . Sustainable investment funds are another low-carbon digital financial tool that green banks priorities. (Wiebe Draijer&Bouke de Vries, 2021, p. 21). Through the integration of public and private financing, as well as financial innovation and sustainable projects, the Green Bank model contributes to achieving low-carbon economy.

II.5 Requirements for enhancing the role of green banking in supporting the transition to a low-carbon economy ;

Leading the move to a low-carbon economy through a series of interconnected mechanisms that boost investments in clean projects, and assist in removing financial obstacles is the foundation of green banks.

1. **Strengthening political and organizational frameworks:** Green banks are considered useful executive tools for carbon emission reduction initiatives. (OECD, 2016, p. 34) as it's supported by international rules and regulations. In addition to the Paris Agreement, which sets the international legal framework and binding goals to reduce greenhouse gas emissions and promote the environmental transition. (UNFCCC, 2015, p. 12)
2. **Support from central banks and governments:** Central banks use monetary policy tools to encourage green financing and stimulate climate-related financial disclosures (TCFD), such as purchasing green bonds within quantitative easing programs, or providing credit facilities to financial institutions that support low-carbon projects(NGFS) (NGFS, 2020, p. 4). Central banks also play a regulatory role by requiring financial institutions to assess climate risks as part of credit risk management, also it's supporting the Public-private partnerships in this sector.
3. **Financial tools, innovations, and digital technologies:** Financial innovations are transforming green banking practices by expanding sustainable financial markets, such as pollution rights, carbon markets, and green stocks and bonds. These innovations include tradable permits, green bonds, climate bonds, and environmental performance bonds. The digital revolution has changed the banking sector's models, through blockchain technology, crowdfunding platforms, decentralized finance, smart contracts, and the trend towards creating a green digital currency
4. **Capacity Building:** Training and empowering bank employees to understand and prioritize low-carbon initiatives is crucial. This includes fostering an "active mindset" that sees a low-carbon future as necessary; (cambridge, 2020, p. 13)

III. The European strategy in green banking to support the transition to a low-carbon economy through clean projects;

Europe has developed a comprehensive strategy for green banks as one of the main drivers of the transition to a low-carbon economy . This strategy is based not only on legislation and regulations, but also represents an integrated system of pushing for climate neutrality by 2050.

1. Strengthening the legislative framework;

One of the most important sections of these strategies:

1-1 Issuing regulations and laws: In 2007, the EU Emissions Trading System (**EU ETS**) was launched as the first and largest global carbon pricing system, helping to create an environment conducive to green finance. Additionally, the **European Sustainability Financial Disclosure Regulation (SFDR)** has mandated that banks provide detailed disclosures on how they integrate sustainability risks into their investment decisions. (European C. , 2019, p. 7) .In 2019 The European Union launched the "**European Green Deal**", which aims to make Europe the first carbon-neutral continent by 2050. In this context, the **EU Taxonomy Regulation** was established **European Green classification regulation** , providing banks with a clear roadmap to identify projects eligible as green investments. This regulatory tool helps financial institutions ensure that their investments align with European climate goals and enhances transparency in the green finance market. (commission, 2020, p. 15) .In July and December 2021, the committee published the 'Fit for 55' package (referring to the goal of reducing emissions by 55% by 2030). The legislative proposals included the revision of several energy-related legislations to align them with the new climate goals

- With the launch of the European Green Deal in December 2019, Europe became more ambitious in integrating green finance into the core of its economic growth strategy. Key achievements:

- ✓ **2021:** Launch of the **NextGenerationEU** program with 30% of its budget (around 250 billion €) allocated to financing green projects. (European c. , 2023, p. 5)
- ✓ **2023:** Update of **EU Taxonomy regulations** to include more precise criteria on clean energy.
- ✓ **2024:** The European Central Bank (ECB) commits to integrating climate into monetary policy and directing bond purchases towards green assets only.
- ✓ In the UK it was released **climate transition plan for 2023**, the Bank of England's Climate Transition Plan is a strategic plan that outlines the bank's goals to reduce greenhouse gas emissions by 2040. The bank aimed to reduce greenhouse gas emissions from its operations by 90% compared to the baseline year of 2015/2016. (Bank of England, 2023)

2. Benchmarks Regulation (Low Carbon Benchmarks Regulation) in 2019. Developing low-carbon benchmark indicators, helping investors and financial institutions choose green financial products. Supporting transparency in the climate performance of investment portfolios. (European c. , 2019, p. 8)

3. CSRD (Directive on Corporate Sustainability Reporting) 2023 This law aims to expand the scope of sustainability disclosure to include all large and

medium-sized companies in Europe. requiring companies to submit detailed reports on their environmental, social, and governance (ESG) impacts, supporting banks in assessing environmental risks and opportunities in their portfolios. (European c. , 2022, p. 4)

3-1 Alternative Fuels Infrastructure Regulation 2023 : Aims to enhance the infrastructure for alternative fuels (electric vehicle and hydrogen charging stations). Financing green transport networks through loans and bank guarantees.

3-2 Energy Efficiency Directive 2023: Raising the energy efficiency rate in the European Union to 39.5% by 2030 (energy.ec.europa.eu, 2025)

3-3 European Market Infrastructure Regulation (EMIR Refit) 2024: It aims to improve transparency and reduce systemic risks in financial markets by Requiring full transparency for energy and carbon derivatives to avoid unsustainable speculation.

3-4 Subsidy and financial incentive programs: the most important program: Horizon Europe (2021–2027) With a budget 95,5 milliard€. InvestEU (2021–2027) with a budget 372 milliard €. EU Innovation Fund with investements 10 milliard € until 2030. (horizon-europe.gouv.fr, 2025)

4. Stimulating financial markets through sovereign green bonds and innovative instruments: In 2023, the European Commission launched the "European Sovereign Green Bond Program" worth 250 billion € to finance clean energy projects, sustainable transport, and smart infrastructure, making it the largest program of its kind globally. (European c. , Next Generation EUgreen bond, 2023, p. 5) Major banks such as BNP Paribas and Crédit Agricole launched innovative financing tools in 2023, including "**Sustainability-Linked Loans**", which tie the interest rate to the environmental performance of the project. (Intiative, 2023, p. 18)

4-1 Sustainable Digital Bonds : In 2021, the European Investment Bank (EIB) issued the first digital green bonds using blockchain to finance renewable energy projects in the European Union. Digital bonds worth €100 million have been issued, targeting the financing of renewable energy and clean technology projects. Green banks participate in issuing digital green bonds and environmental tokens through partnerships with fintech companies. (eib.org, 2025)

5. The role of European Investment Bank (EIB) in 2023 was that it allocated 50% of its total funding to climate projects, with total climate and environmental financing reaching 45 billion € in just one year, making the bank the largest multilateral "**green bank**" in the world (EIB, 2023, p. 9). Moreover, the bank has committed to supporting the implementation of the "**REPowerEU**" plan,

which aims to reduce Europe's dependence on Russian fossil fuels by 60% by 2027.

- **The role of European central bank “ECB”**

The European Central Bank (ECB) supports green projects through monetary facilities and refinancing sustainable projects. In addition Integration of sustainability standards in the central bank's investment portfolio In 2020-2021, the asset purchase program was expanded to include green bonds within the financial stimulus program, helping banks purchase green bonds issued to support renewable energy projects and sustainable infrastructure. also launched new **climate stress tests** in 2023 on major European banks to measure their ability to withstand shocks from the transition to a low-carbon economy. (ECB, 2023, p. 11)

6. Regional and community partnerships: The **EU Platform on Sustainable Finance** 2023 has launched an initiative to develop unified Environmental Impact Standards with the aim of standardizing green finance criteria among member states and facilitating project comparisons. (finance, 2023, p. 15)

7. Carbon capture, utilization, and storage (CCUS) in Europe 2024: technologies that capture carbon dioxide (CO₂) from industrial sources or directly from the air. And the use of carbon dioxide in new industrial processes (such as the production of synthetic fuels or bioplastics). In addition to storing CO₂ in deep geological formations to prevent its emission into the atmosphere. (IEA, 2023, p. 4)

8. Non-financial reporting guidelines: Current non-financial reporting obligations must be taken into account, in addition to the federal disaster relief fund and classification regulations. Financial institutions focused on the capital market have been required to disclose specific non-financial elements in their operations since 2017. To improve corporate transparency regarding sustainability issues.. (intereconomics.eu, 2025)

- **Green tax policies:** Carbon tax The European Union Emissions Trading System (EU ETS) imposes carbon prices on companies that release carbon dioxide into the atmosphere. "**Carbon permits**" are sold, imposing a cost on their carbon emissions. Green banks are encouraged to support green projects that reduce carbon emissions. In this context, European banks have focused on the necessity of adhering to legal decisions and regulations within their lending activities. Several sustainable green banks have emerged, including:)vegclubmagazine.com(2025 ,

- **Triodos Bank:** Based in the Netherlands, Triodos Bank is a pioneer in sustainable banking

- **Nykredit:** A Danish bank committed to ESG principles, focusing on financing sustainable projects and reducing support for fossil fuel industries.
- **ProCredit Holding:** Operating across several European countries, this bank emphasizes environmental sustainability in its lending practices.
- **Nordea:** Based in Sweden, Nordea is a leader in sustainable finance, integrating ESG principles into its operations and investments.
- **Rabobank:** A Dutch cooperative bank, Rabobank focuses on sustainability, particularly in agriculture and rural development.
- **Standard Charter(UK):** which seek to strike a balance between financial success and beneficial social and environmental effect, are something that Standard Chartered is dedicated to.
- **The German development banks,** which are known for their focus on sustainable financing, fund and support many initiatives that promote sustainable development in Germany.
- **BNP Paribas:** Headquartered in France, this multinational bank is known for its commitment to sustainability and social responsibility

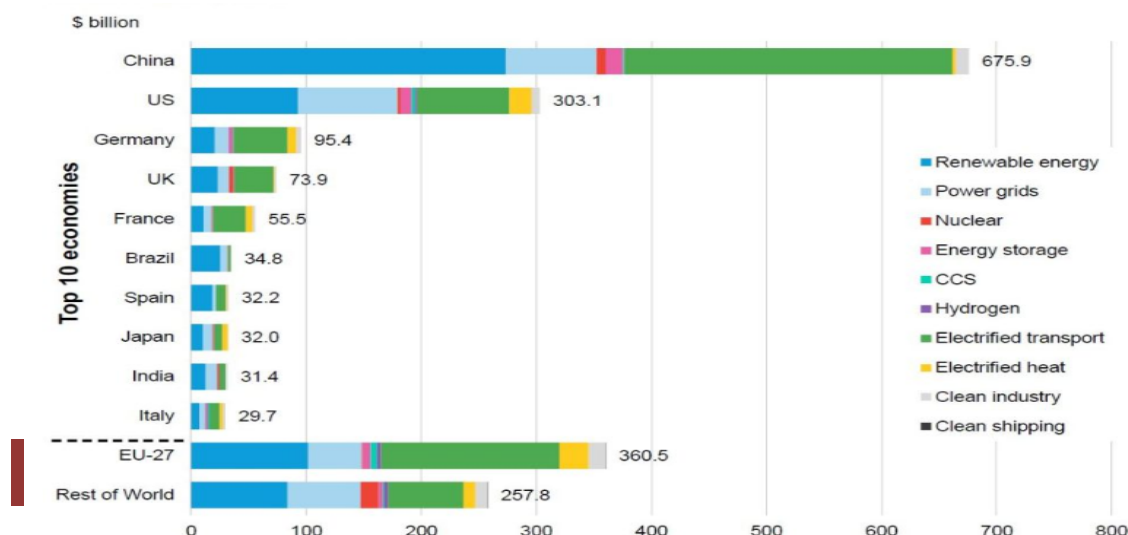
IV. The role of green banking in carbon neutrality in Europe;

Green banks play a vital role in achieving carbon neutrality in Europe by promoting investments in renewable energy and clean technologies.

IV.1 European countries in the global renewable energy investment market ;

European countries are considered among the economies that aspire to carbon neutrality within the framework of sustainable development goals by the beginning of 2050. This is evident through the developments in investment and growth indicators within the energy sector and its technologies. Which reflects Europe's commitment to improving its energy fabric. Clean energy contributed an average record of 9% to the European economy within the EU countries and Britain in 2024, with an average share of 12% in Germany

Figure(3) : The global investment volume in clean energies from 10 top countries around the world in 2023.
Unit: billion dollars



Source: (Bloomberg NEF, 2024)

The figure shows the global investment in clean energies by Top 10 the leading countries in this sector during 2023 Global investment in the energy sector reached a record high of \$1.8 trillion., China leads in the volume of investment in renewable and clean energies, with an increase of 40% in total investment compared to 2022, reaching a total of 675.9 billion \$ in 2023.Followed by the 27 European Union member countries with a total of more than 360 billion \$, an increase of 60% from 2022, focusing on investment in renewable energies with more than 90 billion \$ moreover invest . Next is Germany, a leader in reducing carbon emissions with a total clean investment of 95 billion\$. And France, which is currently focusing on reducing carbon through its projects related to hydropower and green hydrogen, where its total investments reached 55.5 billion\$. United Kingdom is also one of the key countries emphasizing the reduction of the carbon footprint, especially within its Net Zero Strategy program, through the tightening of financial institutions and the government on energy sustainability and efficiency, with an investment of 73.9 billion\$. Especially since it is considered one of the most experienced countries in the field of utilizing clean technology, supported by the transportation and green construction sectors, which involve infrastructure and supply networks for clean energies.

IV.2 The development of renewable energy production in Europe between 2022-2023

Green banking actively enhances this development by financing clean energy projects and providing the necessary investments for renewable energy technologies to achieve the energy transition in European countries.

Table (2): The production of Renewable energy in Europe in 2022-2023
unit:Gwh

Energy	Solar energy	Solar-photovoltaic	Bioenergy	Wind-energy	Solid biofuels and renewable waste	Geothermal energy	Hydropower	pumped storage	Marine energy	Nuclear heat
2022	233906	231585	42458	496134	26687	1637	620085	28676	509	155 481,428
2023	288644	286323	42835	522443	26930	1640	526653	28871	525	157 950,621

Source: Prepared by the researchers based on: (IRENA, 2024, pp. 2-80)

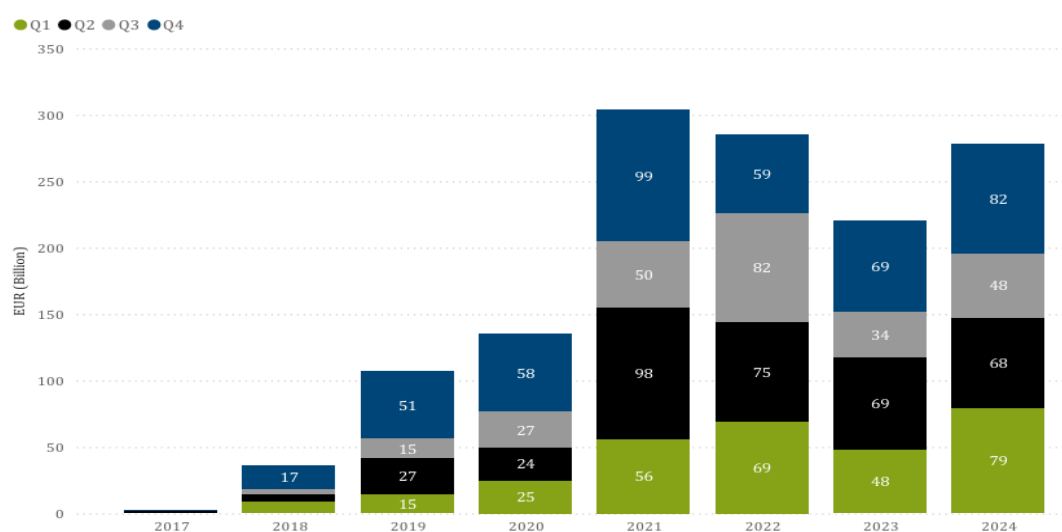
The table shows the developments in the volume of renewable energy production during the period 2022-2023. We notice an increase in production volume, which constitutes 47% of the total energy production. The productivity of solar energy reached more than 280,000 gigawatts, representing 23%. In 2024, it reached over 500,000 gigawatts, accompanied by a 30% increase in energy

networks. After that, the productivity of bioenergy increased by 1% and wind energy of various types by 26%, with a total production exceeding 500,000 gigawatts. Nuclear energy, solid biofuels, and renewable waste production also increased by 1.5% and 2%, respectively. European countries have actively worked on developing renewable energy sources by adopting the new concept of development, which includes innovation, coordination, greenness, openness, participation, and continuous leveraging of their industrial advantages to reduce the carbon footprint. Both centralized development and distributed use were adopted, and the construction of seven new land energy bases in strategic areas was accelerated.

IV.3 The evolution of Europe's issuance of Green banking instruments;

Europe has witnessed significant progress in issuing green banking instruments as part of its efforts to achieve sustainable development goals and carbon neutrality. This growth reflects the commitment of the European financial sector to directing investments towards environmentally friendly projects and contributing to the transition to a low-carbon economy.

Figure (05) : European sustainability linked and Green Loans Issuance 2017-2024



Source: (afme(finance for Europe), 2024, p. 6)

The curve represents the development of the volume of sustainable and green loan issuance in Europe during the period 2017-2024. Europe has consistently witnessed an upward trend in the balance of green loans. We notice that starting from 2017, environmental loans were almost nonexistent, as they did not exceed one billion euros. However, it began to rise from 2018 to 2021, reaching 303 billion euros, an increase of 126% compared to 2020. This growth was driven by encouraging banks to integrate environmental and sustainability considerations into their portfolios, in addition to the policies and regulations governing this context. Especially including environmental

disclosure programs. It declined during the years 2022 and 2023 due to the Ukrainian crisis. As of the end of 2024, the balance of green loans reached 277 billion euros, exceeding the growth rate of various traditional loan types by 28.1 percentage points, recording an annual growth rate of 37.7% in terms of usage. Green loans are primarily directed towards industries related to updating green infrastructure, promoting clean energy initiatives, improving energy efficiency, and protecting the environment. A diverse range of financial institutions have participated in broad and innovative strategies. The financing of major European banks in sustainable finance in 2024:

- €4 billion to support offshore wind and solar energy projects Deutsche Bank
- €7 billion in support of renewable energy projects by BNP Paribas Bank;
- €5 billion in support of wind energy and environmental technology projects from Santander Bank;
- €2.5 billion to support transportation and electric vehicle projects from BGL BNP Paribas Bank;
- €3 billion to support wind and solar energy financing from Société Générale Bank;
- Financing of €1.5 billion to support organic farming and environmental technologies from Rabobank;

Figure (06): European ESG, Sustainability linked and Transition Bond Issuance 2020-2024 unit: billion€

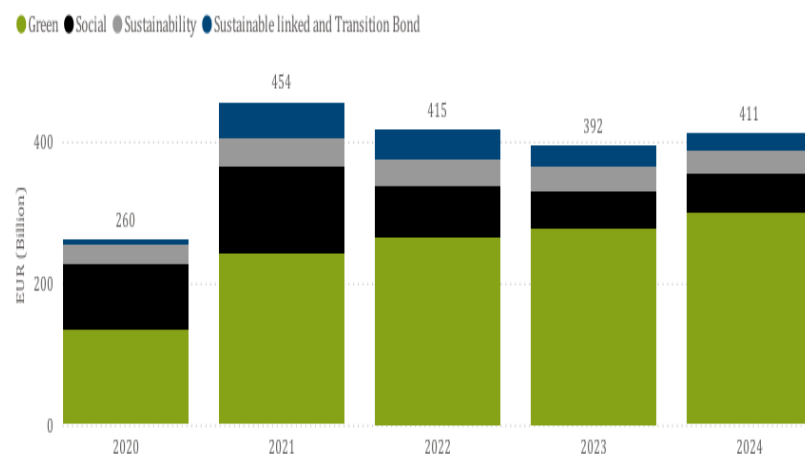
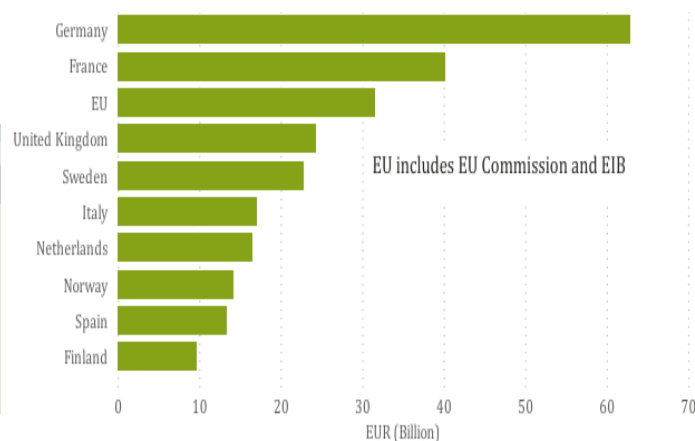


Figure (07): Green Bond Issuance by Country (top10) 2024



Source: (afme(finance for Europe), 2024, pp. 12-13)

The chart represents the development of sustainable bond issuance during the period 2020-2024. The issuance of green bonds in Europe reached a new annual high in 2021. With the increasing integration of climate commitments into public policies and the economic system, green bonds have gained importance as a channel to support green activities and projects. European issuers and financial institutions priced a total of 280 billion € of green bonds, both terrestrial and maritime, representing a 65% year-on-year increase. Followed by social bonds

amounting to 110 billion €, representing 28%, followed by sustainable bonds and transition bonds at 8%. The issuance volume decreased in 2022 and 2023 but rebounded in 2024, with green bond issuance exceeding 310 billion €, representing 70% of the total issuance volume, followed by social bonds with a volume of 60 billion €, which represent 5.85 billion €. Thus, the cumulative volumes reached 411 billion € by the end of the year. Figure (07) represents green bond issuance by country (top 10). In 2024, Germany leads in green bond issuance with 61 billion €, followed by France, the European Commission, the European Investment Bank, and the United Kingdom with 41 billion €, 32 billion €, and 22 billion € respectively, while Finland has the lowest issuance at 9 billion €.

Europe offers a variety of sustainable crowdfunding platforms, focused on environmentally friendly and socially responsible projects. The following are some notable platforms: (thecrowdspace, 2025)

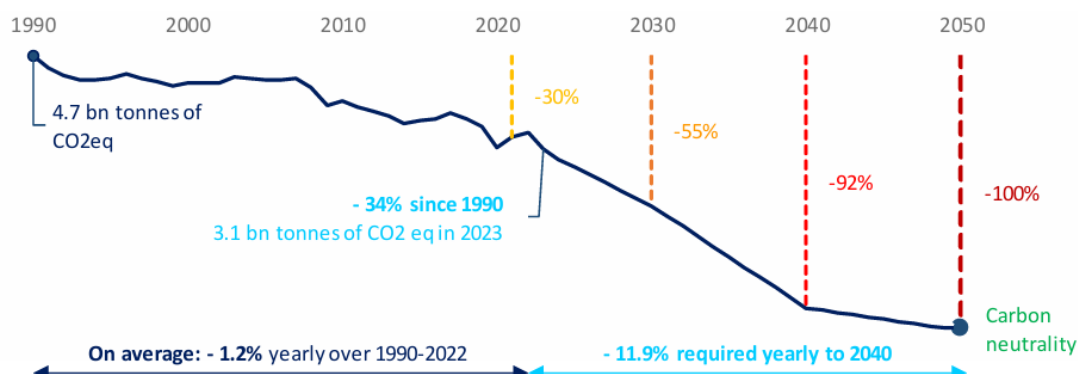
- ✓ **Investor:** a platform for impact investing, supporting startups with sustainable tasks;
- ✓ **Lend a helping hand:** connects investors with entrepreneurs in developing countries, promoting sustainable growth;
- ✓ **The ethnic axis:** focuses on agricultural projects, enabling direct contributions to sustainable agricultural communities;
- ✓ **Ener2crud:** specializes in sustainable energy-related projects, offering equity and crowdfunding opportunities;
- ✓ **Ecology:** allows investment in solar energy projects in emerging markets, contributing to CO2 reduction;
- ✓ **The fund:** a Spanish platform dedicated to sustainable projects;

-Robo-advisors in Europe are increasingly integrating green finance principles into their investment strategies. These platforms leverage AI and machine learning to offer automated financial advice while prioritizing Environmental, Social, and Governance (ESG) factors;

-In 2024, carbon pricing in Europe continued to play a pivotal role in reducing emissions. The EU Emissions Trading System (EU ETS) achieved a historic 16.5% reduction in emissions from energy and industrial facilities. This was driven by an increase in renewable energy production. The EU Emissions Trading System (EU ETS) has also raised around 200 billion euros so far, which have been used to fund climate initiatives such as the ETS Innovation Fund and the Modernisation Fund. Additionally, the EU's Carbon Border Adjustment Mechanism (CBAM) has entered its transitional phase, encouraging governments to consider carbon pricing for sectors such as steel, cement, and electricity .

IV.4 Review of carbon emission levels in Europe;

Figure (08): Net GHG emissions over 1990-2050 to reach carbon neutrality in Europe



Source : (Platform on sustainable finance, 2025, p. 16)

The curve shows the development of carbon emissions in Europe from 1990 to 2050. In 1990, carbon emissions in Europe were 4.7 billion tonnes. Since then, emissions began to decline gradually, reaching a reduction of 3.1 billion tonnes by 2023, reflecting a 34% decrease since 1990. Despite this continuous decline, the curve shows that the annual decrease was at a rate of 1.2% between 1990 and 2022. But the transition to carbon neutrality by 2050 requires a much larger reduction. To meet the EU's climate goals, it will be necessary to reduce emissions by 11.9% annually from 2020 to 2040, indicating the need for faster and more decisive actions. Green banks come as one of the main factors that contributed to this reduction, as green funds were directed to support sustainable projects such as renewable energy and clean technology, leading to a decrease in reliance on fossil fuels. Additionally, systems such as carbon pricing and carbon financial markets have contributed to pushing the industrial sector towards adopting lower-emission technologies.

V. conclusion

Green banks represent a fundamental pillar in supporting the transition to a low-carbon economy in Europe and the world. By directing financing towards sustainable projects such as renewable energy and clean technologies, European banks help achieve the EU's climate goals and contribute to reaching carbon neutrality. This transition requires massive investments and cooperation between governments and the private sector. The model of green banks in Europe serves as an inspiration for other countries and reflects the long-term commitment of the financial sector to achieving environmental sustainability, especially through the roles of European central banks, the European Investment Bank, and the European Central Bank.

The results: based on the preceding discussion, the following results were obtained that:

- Green banks have contributed to achieving carbon reduction goals by investing in clean and renewable projects and technologies. Through a comprehensive framework of green policies and financial instruments.
- With European banks committing to support the EU's climate goals, such as reducing emissions by 55% by 2030, green banking has helped lay a strong foundation for the transition to a low-carbon economy.
- Climate financial stress tests and environmental disclosure have contributed to increased transparency in banks' financial reports, and making green finance more attractive to investors and leading to greater support for green projects.
- The cooperation between European banks, governments, and international institutions has helped finance green projects by establishing a legal and legislative framework, which has accelerated the environmental transition and increased investment in sustainable activities.

The Recommendations: based on the results of this study, the following recommendations are proposed:

- The Cooperation between green banks and the industrial sector should be strengthened to finance industrial transformation projects that rely on green technologies, such as clean manufacturing techniques and environmental innovations. These partnerships can lead to an increase in the volume of green investments and support innovation in sustainable industries.
- Algeria can benefit from international experiences in green banking, especially within the framework of the transition towards carbon neutrality.

VI. References

- IFC(*International Finance Corporation*) . (2024, 12 11). Retrieved from Green Financial Instruments: <https://www.intficorp.com/sovereign-financing/through-carbon-credits/>
- afme(finance for Europe). (2024). *ESG Finance Report European Sustainable Finance*. Retrieved from <https://www.afme.eu/Portals/0/DispatchFeaturedImages/ESG%20Finance%20Report%204Q24.pdf>
- Anu Sahi and Anurag Pahuja. (2017). Changing Scenario of Banking :An Empirical Study on customers'Perspective on Green banking. *Amity Business school*, 18(1), 49.
- Bank of England. (2023, 07 06). *The Bank of England's Climate Transition Plan*. Retrieved 01 22, 2025, from <https://www.bankofengland.co.uk/climate-change/the-bank-of-englands-climate-transition-plan>
- Bloomberg NEF. (2024, 01 30). *Global Clean Energy Investment in 2023*. Retrieved 12 2024, 30, from <https://about.bnef.com/blog/global-clean-energy-investment-jumps-17-hits-1-8-trillion-in-2023-according-to-bloombergnef-report/>
- cambridge, u. o. (2020). *Bank 2030 acceleating the transition to low carbon economy*. Retrieved from <https://www.cisl.cam.ac.uk/system/files/documents/bank-2030.pdf>
- climate.ec.europa.eu. (2025, 03 23). *climate.ec.europa.eu*. Retrieved from https://climate.ec.europa.eu/news-your-voice/news/2024-carbon-market-report-stable-and-well-functioning-market-driving-emissions-power-and-industry-2024-11-19_en
- commission, E. (2020). *EU Taxonomy Regulation*. Retrieved from <https://eur-lex.europa.eu/eli/reg/2020/852/oj/eng>

- Daniel Cardona Valencia&Carlos Calabuig-Tormo. (2023). The impact of green banking activities on Banks'green financing and enviromental performance. *Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration*, 31(1), 3.
- Ebikapade Amasuomo& Jim Baird. (2016, Nov). The cencept of waste and waste management. *management and sustainability*, 6(4), 93.
- Fanny Septina. (2017). Testing the green banking model: the effect of performance to the bank index securities price of srkehati. *international journal of academic research in economics and management sciencies*, 6(4), 164.
- finance, E. p. (2023). *final report*. Retrieved from <https://www.bancaditalia.it/media/notizia/sustainable-finance-platform-2023-annual-report-now-online/?dotcache=refresh>
- Giuseppe Cortellin and Ida Claudia Panetta . (2021). Green bond :A systematic Literature Review for future Research Agends. *Journal of risk and Financial Management*, 14(589), 2.
- horizon-europe.gouv.fr. (2025, 03 22). Retrieved from <https://www.horizon-europe.gouv.fr/horizon-europe-c-est-quoi-24104>
- Hyoungkun Park &Jong Dae Kim. (2020). Transition towards green banking:role of financial regulators and financial institutions. *asian journal of sustainability and social responsibility*, 5(5). doi:<https://doi.org/10.1186/s41180-020-00034-3>
- Hyoungkun Park and Jong Dae Kim. (2022). Transition towards green banking:role of financial regulators and financial institutions. *Asian journal of Sustainability and social responsibility*, 5(5), 18.
- IEA. (2023). *Carbon Capture, Utilisation and Storage: The Opportunity in Europe*. *intereconomics.eu*. (2025, 03 22). Retrieved from <https://www.intereconomics.eu/contents/year/2021/number/6/article/green-finance-in-europe-strategy-regulation-and-instruments.html>
- Intiative, C. B. (2023). *Gree bonds global state of the market*. Retrieved from https://www.climatebonds.net/files/reports/cbi_sotm23_02h.pdf
- Irene Monasterolo et al. (2022). The role of Green Financial sector Initiatives in the low-carbon transition. *policy research working paper*. Retrieved from <https://openknowledge.worldbank.org/server/api/core/bitstreams/50b4b0d8-a194-597d-9a82-10fdd6d0c188/content>
- IWRA. (2025, 03 27). *IWRA*. Retrieved from <https://www.iwra.org/about-us/>
- Jingyan Fu& Artie W Ng. (2020). Green finance Reform and innovation for sustainable Development of Greater Bay Area: Towards an Ecosystem for Sustainability. In *Sustaitainable Energy and Green finance for a Low-carbon Economy* (p. 6).
- K.Ozili, P. (2022). Gren finance research around the the world. *International Journal of green economics*, 06.
- Linderberry, N. (2014). *Definition of Green Finance*. (DIE, Ed.) German Development Institue.
- Liu T, et al. (2022, Nov). Sustainability Considerations of green buildings: A etailles Overview on current Advancements and future. *Considerations sustainability*, 2-3.
- Lukas Stricker and al . (2022). Green Insurance: a Roadmap for Executive Management. *Journal of risk and financial Management*, 15(221), 7.
- Mahyar Kamali saraji&Dalia Streikiene. (2023). challenges to the low carbon energy transition:a systematic literture review and research agenda. *energy strategy reviews*, 9, 05. doi:<https://doi.org/10.1016/j.esr.2023.101163>
- Manajo sangisetti and Pechetty Venkata Purna Kumari. (2023). Green Banking Practices and Strategies for sustainbale. *Res Militaris Social Science journal*, 13(1), 383.
- Maria J.Nleto & Chryssa Papathanassiou. (2023). Financing the ordely transition to a low carbon economy in the EU: the regulatory framework for the banking channel. *journal of banking regulation*, 25.
- Platform on sustainable finance. (2025). *Financing a Clean and Competitive Transition Monitoring capital flows to sustainable investement*. Retrieved from https://finance.ec.europa.eu/document/download/87c48ab4-34d2-4cd7-997e-efc1310e62c5_en?filename=250311-sustain
- Platzerm, K. (2021). sustainable transport sustainable development united nations. *second global sustainble transport* , (p. 2). Beijing .
- PrathimaB .J& Gowri Hebbar. (2017). impact of green banking. *International journal of recent research in commerce, economics and management*, 4(4), 372.
- Sheya Das et al. (2020, Sep). Sustainable argiculture: a Path towards better future. *food and scientific reports*, 1(9), 23-24.



- Taslina Julia&Salina kassim. (2020). green banking. In *Banking and finance* (pp. 3-4).
- thecrowdspace. (2025, 03 24). *thecrowdspace*. Retrieved from <https://thecrowdspace.com/directory/green-energy-crowdfunding-platforms/>
- UN. (2019). *Principle for responsible banking guidance document*. Retrieved from <https://www.unepfi.org/wordpress/wp-content/uploads/2022/04/PRB-Guidance-Documents-Jan-2022-D3.pdf>
- UNFCCC. (2015). Paris agreement . Retrieved from https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf
- vegclubmagazine.com. (2025, 03 23). Retrieved from <https://vegclubmagazine.com/article/top-10-most-sustainable-banks-in-europe>
- Vikas Natha et al. (2014). Green banking practices -a review. *International journal of resarch in bussnies management*, 2(4), 46.
- Wiebe Draijer&Bouke de Vries. (2021). Greening the economy: the role of banks in the climate transition and challenges. In . S. Andreas Dombret, *Green banking and green central banking* (p. 21). Retrieved from https://www.google.dz/books/edition/Green_Banking_and_Green_Central_Banking/48xMEAAQBAJ?hl=en&gbpv=1&dq=green%20banking&pg=PA22&printsec=frontcover
- C. M. Орлов and al . (2024). Green bonds, transition to a low-carbon economy, and intertemporal welfare allocation:Evidence from an extended DICE model . *AIMS enviremental sciences* .