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Abstract

Over the past few decades, the increasing urgency of climate change and worsening environmental degradation have pushed countries and financial markets to prioritize sustainable development. Thus, the demand for financial instruments supporting environmental projects has increased. Green bonds have become a source of financing for environmental, green projects among these instruments. These bonds have supported projects such as energy-efficient buildings, clean transportation, pollution reduction, etc. As a result, they help achieve climate goals by saving energy. These bonds also have an impact on increasing social responsibility in society.

In this thesis, I will focus on the green bond market in the European and Asian regions. As an example, I have examined the markets through Germany and Japan. I have examined in this thesis work, the regulations and development trends of green bonds in both countries.In the Data and Methodology section, you will be informed of the positive impact of green bond issuance on GDP and renewable energy production worldwide. In that section, the relationship between them is statistically analyzed.

As a result, we present our proposals for Azerbaijan, taking advantage of international experiences. With the help of this thesis, we will get acquainted with the possible advantages and disadvantages for Azerbaijan, a new participant in the green bond market.

“Keywords”

Keywords; green bond, sustainable finance, Europe and Asia, financing environmental projects, financial markets, ESG investment, GDP, Renewable energy, greenwashing, greenium,

Abbreviation list

The following table explains the various abbreviations used throughout the thesis and their significance. The page where each is defined or first used is also given.

Abbreviation	Meaning	Page
ASEAN+3	Ten ASEAN Member States and the People's Republic of China, Japan, and the Republic of Korea	38

ASEAN	The Association of South-East Asian Nations	40
AUM	Assets under management	28
ADB	Asian Development Bank	*65*
bp	The basis point is that a unit of measure is used to indicate percentage changes in financial instruments.	29
BONDS	Green Bonds issuance volume	*52*
CCS	Carbon capture technologies	46
CBI	Climate Bonds Initiative	71
DBJ	Development Bank of Japan	40
DNSH	Do No Significant Harm principle	22
ESG	Environmental, Social, and Governance bonds	4
Eu-GBS	European Union Green Bond Standard	21
EU-27	European Union (EU) which consists of 27 countries	24
EBRD	European Bank for Reconstruction and Development	65
EIB	European Investment Bank	*18*
EU	European Union	*24*
FSA	Financial Services Agency	*42*
GDP	Gross Domestic Product	*4*
GBP	Green Bonds Principle	*19*
GT	Green Transformation strategy	*46*
GSSSB	Green, social, sustainability, and related bonds	*19*
ICMA	International Capital Markets Association	*16*

IFC	International Finance Corporation	*19*
IMF	International Monetary Fund	*40*
IPCC	Intergovernmental Panel on Climate Change	*12*
JBIC	Japan Bank for International Cooperation	*43*
JFM	Japan Finance Organization for Municipalities	*47*
JSDA	Japan Securities Dealers Association	*71*
LBBW	Landesbank Baden-Württemberg	*26*
MAS	Monetary Authority of Singapore	*71*
OECD	Organization for Economic Cooperation and Development	*66*
RENEW	Renewable Energy Production	*53*
SOV	Sovereign green bonds	*29*
SPO	Second-party opinion	*16*
SRI	Socially responsible investment	*15*
SQS2	Sustainability Quality Score (very good)	*48*
TSE	Tokyo Stock Exchange	*42*
UNFCCC	United Nations Framework Convention on Climate Change	*18*
UN SDG	United Nations Sustainable Development Goal	*47*
WMO	World Meteorological Organization	*12*

1. Introduction

Climate change is the most crucial problem that humanity faces. The speedily development of industry and other factors has put our planet's ecosystems and the tracking of sustainable economic growth at high risk. Many organizations and countries now understand that climate change is a powerful danger for our planet. The many regions, for example, Europe and Asia continue to finding their effective power in the green bond market. In this thesis, I aim to examine their experiences and characteristics of important green bond market participants such as Germany in Europe and Japan in Asia, as well as modern recent development trends, you will get information with the history of green bonds and their development, as well as their specific characters. And also, which opportunities are real for Azerbaijan, which is a new member to the green bond market, and suggestions based on international experiences that will increase the development of the present green bond market.

1.1 Research problem and significant

My main purpose in this thesis is to evaluate the recent development trends of green bond markets in Europe and Asia, with a mainly focus on Germany and Japan as perfect examples. It is interesting to see how green bonds, which they are new for Azerbaijan markets, can benefit from the experience of countries that are already matured in this green bonds. The main objective of this thesis is to evaluate the development trends of green bond markets in Europe and Asia, with a mainly focus on Germany and Japan as perfect examples. And also, I aim in this thesis to identify opportunities for the adaptation of green bonds into the Azerbaijani financial market applying international practices. Through a comparing analysis of different regularity frameworks, ESG standards and market mechanisms, this study looks into to suggest strategic recommendations for developing sustainable finance in Azerbaijan.

In addition, exploring significance of the positive effect of the green bonds on Gross Domestic Product and renewable energy production. It helps to increase status of the green bonds among investors and also state level.

Significance:

1. Focusing on Climate change and problems that it creates: Climate change can cause different danger and environmental problems, like as carbon emissions and also, green bonds is effective on projects which related to decrease carbon emissions to protect to environmental protection and sustainable development.

2. Investors' interests: If the positive impact of green bonds on GDP and renewable energy production is approved, investor trust and interest in this area may increase more distant.
3. Stimulating innovative financial instruments in the Azerbaijan green bond market: With the help of European and Asian green bond market experiences, Azerbaijan can also shove the issuance of green bonds, which are considered innovative financial instruments, as well as make attention to emissions that need to be appealed in the present green bond market.
4. Development of the green bond market further: If green bonds are found to be more effective than traditional bonds, this may lead to the development of green bond markets. This development may create more options for renewable energy producers to access capital and increase the transition to a low-carbon economy.
5. The government's increased interest in the issuance of green bonds: The government's interest in green bonds, mainly with the help of the effect of green bonds on GDP, can provide government support in the green bond market from a regulatory framework and economic perspective.

1.2 Research objectives

1.This thesis aims that study the development trends of the Europe and Asia green ond markets. Also determine the emission volumes and their green bonds standards of main countries, Germany for Europe and Japan for Asia.
2.Investor's interest on the green bonds and their behavior in the market.
3.Study specific market nature for Europe and Asia, separatly. And also provide examples for developing countries.
4.The effect of green bonds on GDP and effect of green bonds on renewable energy production, globally. And their economic and environmental impacts.
5.Promoting emission of the green bonds for Azerbaijan financial market. And also prepare recommendations for new member of green bond market- Azerbaijan.
All of these objectives of this research aim that to achieve trustful results for in this thesis.
Approving these goals and objectives we will see how green bonds are effective on funding environmental, social and green projects and other areas.

1.3 Research questions

1.First question of my study is that what are the main roles of the green bonds and which drivers have been cause of occurring of the green bonds?

2.Second question of this thesis? Which relationship is between green bonds issuing volume and Gross Domestic Product growth?
3.Next and third question, what is the relationship between green bonds issuing volume and renewable energy production?
4.Fourth question, what are the last development trends for Europe green bonds market and Asia green bond market, separately.
5.Last and fifth question of the this thesis is that, how opportunities and obstacles are actual for Azerbaijan green bonds market?

1.3 Research goals

1. To deeply analyze the history of the green bonds, and also how they have improved in Europe and Asia. Present green bonds market and their perspectives.
2. To approve the positive statistical impact of the issuance volume of the green bonds on GDP, globally.
3. To approve the positive statistical impact of the issuance volume of the green bonds on renewable energy production, globally.
4. To recommend policy and financial strategies for Azerbaijan green bond market which support development of Azerbaijan green bond market.
5. To give methodical and practical knowledge based on the fields which are gained from this study.

1.4 Research hypothesizes

In this study I put the two main hypothesizes which those are show us static relationship between the issuing volume of green bonds on GDP and renewable energy production, separately. I noticed that before, green bonds are very supportive financial instrument for the green projects. This support show itself on GDP and Renewable energy production. Let’s look closer the hypothesizes of the study.
1. First hypothesizes, I aim that to approve positive statistical relationship between issuing volume of the green bond and GDP;
H01 (NULL hypothesis); The issuing volume of the green bond has no impact on the GDP.
HA1 (Alternative hypothesis) The issuing volume of the green bond has positive significant impact on the GDP.

This first hypothesis aims that to approve how the issuing volume of the green bond has effect on GDP growth, not only Europe and Asia, also in globally.

2. Second hypothesis says that the issuing volume of the green bond has also positive relationship between renewable energy production. Now we can provide hypothesizes in the below;

H02(null hypothesis); The issuing volume of the green bond has no impact on the renewable energy production.

HA2(Alternative hypothesis); This hypothesis tries to approve that the issuing volume of the green bond and renewable energy production have positive significant relationship.

Research model;

I use quantitative method for approving these hypothesizes. I also use to approving hypothesizes panel data model and analyze these hypothesizes in STATA. And, It helps to analyze relationship between the issuing volume of the green bonds and GDP and also, renewable energy production.

1.5 Methodology

Literature review of the study;

In this study, I try to review the literature on topics related to European and Asian green bonds,also the Azerbaijan green bond market. Then global green bond issuance, GDP, and renewable energy production, in order to establish a theoretical framework.

Data sources: World Bank Data Climate Bonds Initiative; Dealogic; Environmental Finance Bond Database; S&P Trucost; Ember-energy; authors' calculations.

Statistical analysis: Panel data analysis, regression analysis was used to measure the impact of green bonds on GDP and renewable energy production.

Software used for the analysis: STATNow/SE 19.5 statistical software package

Case Studies: As the real examples of green bond market in Germany for Europe and Japan for Asia were examined separately.

Recommendation; In this research, I do my best to obtain useful and practical results to preparing reliable recommendations for developing countries such as Azerbaijan

Expected results:

1. Obtaining empirical results on the positive impact of green bond issuance on GDP.
2. Obtaining empirical results on the positive impact of green bond issuance on renewable energy production.
3. Determining the effectiveness of the impact of green bonds on the economy

4.Providing recommendations aimed at the development of this market based on the positive effects of green bonds in Azerbaijan.

The results of this analysis are expected to highlight the existing potential of green bonds as a means of ensuring sustainable development in emerging markets, especially in new entrants such as Azerbaijan. In addition, the study aims to provide insights into how Azerbaijan can adopt best practices from Europe and Asia to create a competitive and sustainable green bond market.The World Meteorological Organization (WMO) reported that 2023 was the warmest year on record, with temperatures soaring 1.45C above pre-industrial averages. This alarming rise of 1.1C since the 19th century is a dire warning of the icreasing global warming crisis. According to the Intergovernmental Panel on Climate Change (IPCC), if we do not act quickly, global warming could over the critical degree of 1.5 C by 2030.By that time, keeping temperature increases below 2C will likely be unpossible.
Unfortunately, one of the most critical ecological problem of the climate change, threaten significant sectors such as water resources, agriculture, energy production, and industry. This danger not only damages significant economic harm but also destroy the comfort of people worldwide. But, it is not too late to change this prediction stiuation.Investors are starting to finance useful ecological projects directed at protecting our planet and stimulate sustainable economic growth. Between the most positive investment lines are green bonds, which have came up as crucial financial instruments in the last years.
These bonds help us to funding envirometal projects from a debt instrument.The earnings are reserved for ambitions which are designed to stimulate sustainable growth and make sure a hopefull future .The market for green bonds is developing speedly. Interesting of that, the World Bank noted that the total value of green bonds issued in the second quarter of 2024 reached $33 billion, 76% increase compared to the same quarter in 2023. Factors such as the demand for sustainable economic development, connected with the obligations outlined in the Paris Agreement. It can cause of the stimulate interst to green bonds. Countries accept that these financial instruments are very helpful in decreasing the impact of climate change. Azerbaijan is not careless in the face of this global danger and prediction. Our country is actively stepping up to protect its natural environment and address the problems occured by climate change. A essential example of this process is the very significant COP29 event, during which SOCAR began issuing green bonds , aiming to join these bonds into its financial

strategy.This step looking for to finance environmentally focused projects while holding fast to international clarity standards. Futhermore, the trend of public-private partnerships is getting inside the market of green investments.

Green bonds are debt instruments issued for the purpose of financing environmental projects. The proceeds from these bonds are planned to focus on the implementation of environmental projects and ensure sustainable development for the future. Green bonds and other financial instruments play an important role in the implementation of environmental projects.If we look at the indicators for the last decade, we can see that countries around the world, especially European and Asian countries, have a significant volume in the green bond market. This can be attributed to the fact that nature oriented projects are not increasing further. One of the main objectives of this study is to examine the development trends of green bonds in Europe and Asia and assess their application possibilities in the Azerbaijani financial market.The study aims to identify the role of green bonds in ensuring sustainable economic development, the legal and institutional conditions required for the adaptation of international practices in our country, and potential difficulties and ways to overcome them. This approach is intended to contribute to the development of Azerbaijan's green financial sector. In this study, you will be able to get acquainted with the concept of bonds, green bonds, and their working principle, as well as the European and Asian regions, their impact and contribution to the green bond market, the advantages of Azerbaijan in green bonds, and the results of applying this method.

Chapter 2.Theoretical Framework

In this thesis, a theoretical framework has been established based on four main theories to examine the development of green bond markets in Europe and Asia and the possibilities of applying this instrument in Azerbaijan: institutional economics, sustainable finance, socially responsible investment (SRI), and stakeholder theory. Together, these approaches explain both the formation and market acceptance of green bonds, and help determine what conditions are important for the development of this sector in Azerbaijan.

2.1 Institutional economics

In the theory of institutional economics, the government, laws, regulations, and other institutional structures are all taken into account in relation to economic processes (North, 1990). Transparency, accountability, a strong and reliable legal system, and independent oversight procedures are all

necessary for the expansion of the green bond market.These principles increase investor confidence and ensure the efficient functioning of markets.For example, the expansion of green bonds in European and Asian countries is directly related to the creation of strong institutional structures in these countries (CICERO, 2020). This approach emphasizes the importance of creating an appropriate institutional environment for Azerbaijan. For the Azerbaijani green bond market to grow, it is imperative that the legal and regulatory framework be strengthened and that transparency and independent oversight measures be put in place. Second-party opinion (SPO) mechanisms in the European and Chinese green bond markets enhance market credibility.The company or organization issuing a green bond says, "I will spend the proceeds from this bond on environmentally friendly and sustainable projects." But it is important for investors to know whether this declaration is true and reliable. Because in some cases, companies can issue bonds under the name of a "green" project, but in reality they can direct this money to non-environmental projects. This problem we call greenwashing. To prevent this, a third neutral party - an independent expert organization not related to the project - comes and examines and evaluates the project, the purpose of the bond, and the spending plan. As a result of its evaluation, this expert group issues an opinion called a Second Party Opinion (SOP). This opinion is written in a document and shared with investors This opinion ensures that the bond directly serves green and environmental purposes, that it complies with standards (for example, the ICMA Green Bond Principles),and that the expenses are made clearly.

2.2 Sustainable Finance

The cornerstone of sustainable finance theory is the notion that financial choices should be made with the environment and society in mind in addition to profit (Sullivan & Mackenzie, 2017). One of the key instruments of this idea is green bonds. They give investors the chance to fund clean technology, energy efficiency, and climate change. Green bonds are a major component of the sustainable finance industry, which is already growing internationally, according to research (Flammer, 2021).European and Asian countries share their experiences with funds investing in green finance, and these experiences can be applied in Azerbaijan to create environmental and economic value. The sustainable finance approach theoretically justifies the potential of green bonds to create economic and environmental value.

2.3 Socially Responsible Investments (SRI)

The main principle of this theory, socially responsible investment suggests that investors should consider both financial gains and environmental and social factors when making investment decisions (Hamilton et al., 2009). The growing interest in green bonds between investors in Europe and Asia suggests that they are basing their decisions on sustainability and eviromental principles (Harrison and Freeman, 1999). Promoting this approach in Azerbaijan is crucial since it is founded on studies on the impact of socially conscious investments on the economy and society. Regulatory incentives and investor education might increase interest in green bonds, especially in Azerbaijan.

2.4 Stakeholder Theory

According to the stakeholder theory, companies should take into account not only the interests of shareholders, but also those of society, employees, the state and the environment (Freeman, 1984). This theory explains why green bonds are important: because through this financial instrument, corporations and states directly target public welfare and environmental sustainability. Green bonds allow investors to invest not only considering financial returns, but also considering social responsibility. Stakeholder theory supports the adoption of financial decisions that take into account the interests of society and the environment (Ehrenfeld, 2008). For the formation of a green bond market in Azerbaijan, both the public and private sectors must adopt this broad concept of responsibility.

This theoretical framework will be the main reference point in the analytical part of the study when evaluating European and Asian experiences and formulating recommendations for the green finance market in Azerbaijan.

Chapter 3. Bonds as Financial Instruments

Bonds are debt financial instruments. Bonds can come in many different types, including municipal bonds, government bonds, and corporate bonds. Bonds are also classified based on their purpose and operating principle. Environmental, social, and government or green bonds.

The main purpose of issuing bonds is to finance or refinance a company or a project, increase its authorized capital, establish a business activity, etc. In recent times, companies and countries around the world have been aiming to support the process of protecting the environment and social conditions, both during the business process and through the efficient use of resources, for the sake of future generations and sustainable development, with ethical norms and principles.

3.1 Main role of the Green Bond

In modern times, companies are increasingly considering environmental, social, and governance (ESG) criteria when formulating their strategies. The problems faced during previous financial crises were based on unethical breakings of ESG and other sustainability criteria. However, in modern times, unethical violations are punished and environmental, social and governance norms are most important.

Moreover, companies in the corporate sector are already making certain efforts to keep our planet clean and green and are looking for various ways to finance environmentally friendly projects.

Among these solutions, Green Bonds occupy a unique place in the corporate sector. Green bonds not only finance green projects and environmentally friendly projects but also attract various developed or developing countries, transnational companies, and international institutions to invest in green projects that are compatible with the green environment.

The United Nations also plays a key role in identifying and implementing green solutions to reduce our carbon footprint for a cleaner planet. The United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, the first treaty in the 2015 Paris Agreement, unite all countries in a common goal. It provides a platform for collective action against climate change and a public agreement to play its part in combating climate change. Another goal of this agreement is to shift the financial flow from fossil fuels to clean and green forms of fuel and to stimulate the transition to alternative energy sources.

Chapter 4. The Emergence and Evolution of Green Bonds

The term "green bond" began to take shape as institutions such as the European Investment Bank (EIB) and the World Bank looked at ways to finance environmental projects. If we look at the history of green bonds, we can see that this dates back to the early 2000s, more precisely, in 2007, when the first green bond issued by the European Investment Bank was known as the "Climate Education Bond." A year later, in 2008, the World Bank followed suit by issuing its green bonds aimed at financing projects aimed at solving climate change and environmental problems.

4.1 Institutionalization and Green Bond Principles

In general, any organization or body that can issue any conventional bond can also issue Green Bonds. This means that this is also an opportunity for "Brown Companies"; that is, companies that work with or invest in mineral resources can issue Green Bonds while respecting all the standards and principles of Green Bonds. In order to promote green investment and meet the demands of climate change, multinational companies

worldwide, Bank of America, the Norwegian government pension fund Global, the Rockefeller Brothers Foundation, and many other institutions and organizations have come up with investment initiatives for projects that are affected by coal or any other type of non-renewable and less sustainable sources (Glomsrød & Taoyuan, 2016). Early green bonds were mostly targeted at institutional investors and meant to generate money for renewable energy, energy efficiency, and other climate-friendly projects. The green bond market, on the other hand, was still somewhat specialised, with few issuers and little sums of money collected. Since the 2010s, green bond markets have been reviving. There was justification for this comeback. The Green Bond Principles (GBP), which have four key components—use of proceeds, project appraisal and selection process, proceeds management, and accountability—were developed by the International Capital Markets Association (ICMA) in 2013. The GBP offers investors openness on how their money will be spent and ensures that the proceeds are used only for environmental projects by providing rules for the issue of green bonds. These ideas mix qualities including openness, honesty, and responsibility in the issuance process. The International Finance Corporation and Amundi Asset Management (Amundi). May 2024.

4.2 Recent and Global Expansion

Global issuance developing new highs drove the green bond market to keep growing in the 2020s. About $270 billion was global green bond issuance in 2020.The market also saw the introduction of other labeled bonds, such as social bonds and blue bonds, which focus on social and marine environmental projects, respectively.

Currently, as far as history is concerned, interest and focus on green bonds still remain relevant. Therefore, green bonds are expected to grow further in order to support environmental and social projects.https://blogs.worldbank.org/en/voices/green-bonds-evolution-revolution)

According to S&P Global, annual issuance of all GSSSBs (green, social, sustainability, and related bonds) could reach $1.05 trillion in 2024, up from $0.98 trillion in 2023. This is still just a fraction of the total global bond market, but GSSSB's share of global bond issuance could reach 14% in 2024.

According to Standard & Poor's latest 2023 report, the GSSSB (green, social, sustainability, and related bonds) bond market is forecast to grow by 1% in 2024 compared to 2023, accounting for 14% of the global bond market. Many countries, including emerging economies that are new to the green bond market, continue to take steps at the national level to introduce green bonds.To this end, these

countries are trying to benefit from the experiences of Europe and Asia, which have a large share of the green bond market. Let's take a closer look at the European green bond market and its characteristics.

Chapter 5. The Development of European Green Bond Markets.

As I have mentioned, Europe has significant experience in this area and is emerging as a leading player in the green bond market. Europe’s leadership is demonstrated by the issuance of the first green bond. European financial markets have seen a dramatic transformation since the introduction of green bonds, which are an important tool for financing social and environmental sustainability initiatives.Green bonds, a novel financial instrument designed to finance projects with a positive environmental impact, are an important part of Europe's climate change strategy. Initiatives such as the EU Green Bond Standard and commitments to attain net-zero emissions by 2050 provide support for them.According to the Climate Bonds Initiative, Europe had issued 110 billion in green bonds by the end of the third quarter of 2024, with around 140 different issuers contributing. As the demand for green investment continues to rise, the EUGB is poised to enter a new market segment with strong potential for further transformation. The fact that there are four different issuer types-corporate, municipal, private financial institution, encouraging because it shows that different investors are already showing a growing interest in green bonds.

European Investment Bank Provides EU Green Bond Issuance Example (https://ieefa.org/resources)

The swift growth of green bonds as a significant financing instrument is stimulated by European governments and businesses. In particular, the European Commission is applying the European Green Bond Standard to monitor and set certain requirements for green bonds.

5.1 Characteristics of European Green Bonds

What distinguishes the European green bond market from others is the strict implementation of green policy-oriented legal requirements imposed by the state on green bond issuers, i.e. companies. Companies are more careful when making such investments due to these strict regulations and financial rewards. Europe mostly does this through rules, requirements for reporting, and financial benefits, which makes their approach to green bond markets unique and successful.. It helps people find things that are good for the environment. To get people from other countries to invest in European green bonds and make sure that all green bonds meet certain standards, the rule was

made. The European Commission's active involvement in this process shows how strong the regulations are that support the green bond market. The European Parliament and Council of the European Union also agreed on the European Green Bond Standard (EU-GBS) on November 22, 2023. It has been in effect since 2024. Setting a standard for green bonds is part of the law that supports sustainable finance. It makes sure that the money raised by green bonds will be used to pay for green projects. The EU-GBS is based on the different factors set out in the EU taxonomy for identifying green economic activities. It helps buyers find investments that are good for the environment. The rule aims to set a standard for environmentally friendly bonds and bring in buyers from other countries for European green bonds. The EU Green Bond Standard says that companies in Europe that want to issue green bonds must follow certain rules. These details of needs and conditions are given below. Taxonomy Follow-Up The European Union's Green Taxonomy has a lot to do with how green bonds are named and how they are used. There is a way to prove that an action is good for the environment called the Green Taxonomy. This framework looks at how green investment projects will affect people and the environment and decides that green bonds can only be given to projects that are good for the environment. The main purpose of the Green Taxonomy is to correctly label actions that help protect the environment and give investors clear and open standards. The bond money should only be used for the things below: Putting money into solar, wind, hydro, and other clean energy sources is called green energy. Energy economy means taking steps to make the best use of energy, use less energy, or keep it from going to waste.

1. Reduce trash: Green projects are focused on recycling, reusing, and cutting down on waste. Biological variety goes into to the steps that are taken to trying keep environments safe and increase biological diversity. To being sure that green bonds are only used in these places makes sure that the projects help the environment and struggle climate change.

2. Being open and in charge of: It is important for green bond issuers to be open and responsible. This is also very important for investors, who need to keep track of where their money spends and figure out how it impacts people and the world. If a company wants to issue green bonds, it has to first confirm a green investment plan and then report every year on how it is following through on this plan. The following things must be in the report: Places where money is spent: Where payments are made and how they are spent.

3. Results on the environment: Details on how projects change the climate and

ecosystem.The social effect of an investment shows how a project improves people's lives and the society. Investors can see that these investments will help companies meet their green-goals and become more responsible in this area.

4. Control and auditing by a third party sides: Green bond projects should be quite well reviewed and carried out by independent experts. These audits inspect to see if the project meets the set standards and look at other crucial factors like the return on investment. After being looked over by outside experts, the report results are made public. This control and auditing inspect builds trust in the green bond market and gives buyers more faith in these financial instruments. Third-party audits make sure that projects really help the environment and stop any possible wrongdoing or wasteful spending.

5. The application of the principle of do no significant harm (DNSH) : Green bonds must be used to fund projects that are good for the environment, but it's not enough for a project to be called green just because it's good for the environment. The Do No Significant Harm (DNSH) approach is one of the main ideas behind the green bond market. It looks at the environmental goals of a project as well as how it will affect other social and environmental areas. This idea makes sure that projects not only help the environment but also help with long-term and all-around growth. If a project hurts other areas (like water resources, land, ecosystems, or local communities), then it's not green, according to this concept.

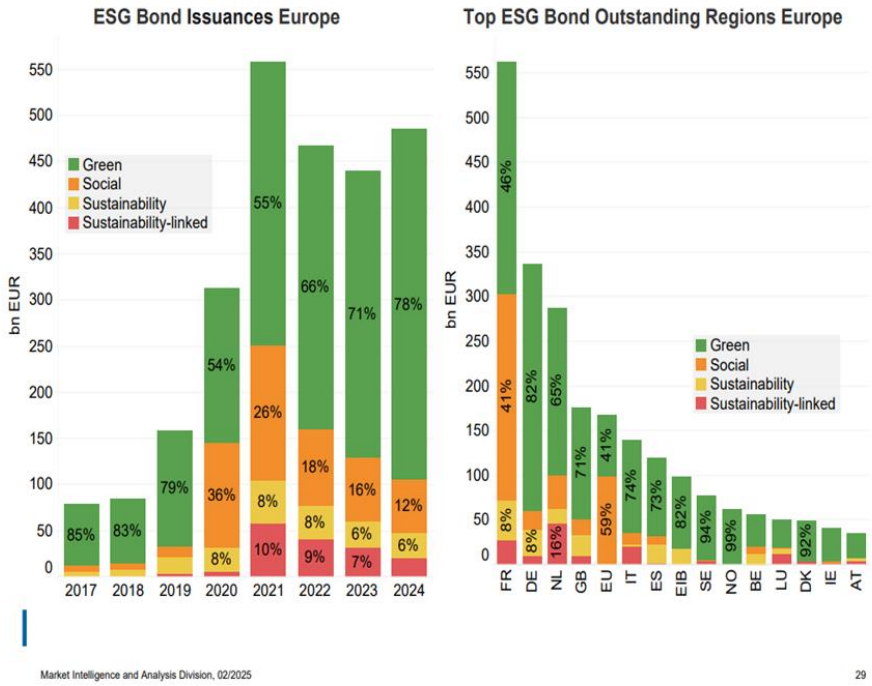
I want to say that also, the project shouldn't damage the water supply system. The main idea might not be as green as it seems if it litters or uses too much water.Projects shouldn't do a lot of damage to local habitats or land rights. For instance, farming that isn't sustainable or quickly taking out natural resources can do a lot of damage to habitats.

And also, the project shouldn't hurt people, social justice, or local neighbourshipss. It is important to follow this principle,so the DNSH principle to make sure that projects not only help the environment but also lead to long-term, enviromentally growth. Green bonds are a functional way to raise funding to fight climate change and promote sustainable development, but they need to follow certain rules and guidelines.

The European Union Green Taxonomy, transparency, independent audit, and the DNSH principle are some of these principles. They make green bonds more credible and successful by making sure they work. These ways of thinking not only help get environmental protection projects funded, but they also help people deal with social and environmental problems in a way that doesn't hurt either.

At the present time, European countries are very important in the market for green bonds. As was already said, Europe, which came up with green bonds, is a big part of growing the green bond market. Even though fewer GSSSB bonds will be issued in the second half of 2023 because the US dollar has lost 6% of its value against the euro in Europe and fewer social and sustainability-related bonds will be issued, Europe will still be the biggest market for GSSSB bonds around the world. GSSSB (green, social, sustainability, and sustainability-related bonds) bonds are issued all over the world. Europe has the biggest share of the market, at 45%, while the Middle East and Africa have the smallest share, at 2%. The issue of ESG bonds in Europe is shown visually in Figure 1. The number in the graph shows how many ESG bonds were released in 2024. Figure 1 also shows that most of the ESG bonds issued in Europe are green bonds, both for Europe as a whole and for each area.

Figure 1: Issuance of ESG Bonds in Europe

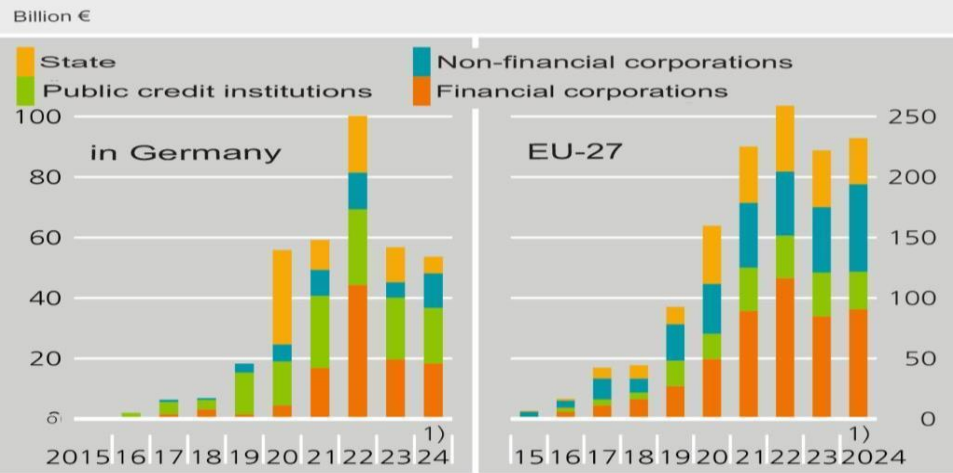


Source: Bundesbank

5.2 Germany as a case study of European green bonds

Let us look at the green bond market and its development trends in Germany, one of the leading countries in Europe for green bonds, based on indicators in recent years.

Figure 2. Volume of Green Bonds issued in Germany and EU-27



Source: CSDB. * Green bonds: certified securities and value- papers that have been verified by a third party according to a standard as green or which the issuer itself designates as green according to a standard- become net. The proportion of the volume that issuers themselves refer to as green-neten bonds amounts to 7% in Germany and 8% in the EU-27.
1 As of: November 2024.
Deutsche Bundesbank

Source : Deutsche Bundesbank

First of all, I want to notice that, the first green bond in Germany was issued by the German Development Bank ,so KfW (Kreditanstalt Wiederaufbau) in 2014. These bonds were mainly aimed that to financing renewable energy projects. By the way, in 2014, when first green bond of Germany was issued, KfW issued bonds valued in 1 billion in US dollars. The proceeds of these bonds were directed to KfW's "Renewable Energies Programme Standard". The Germany government issued their first green bond in 2020.

An analysis of Figure 2. Volume of Green Bonds issued in Germany and EU-27 ,green bond issuance in Germany and the 27 EU member states for the period 2015-2024 shows that interest in this financial instrument has increased significantly in the past five years. Since 2020, there has been a sharp increase in green bond issuance, which can be directly linked to the acceleration of sustainable finance initiatives at the international level and the European Union's Green Deal policy.

In the German context, the main issuers of the green bond market were state and public financial institutions. In particular, in 2021 and 2022, green bond issuance reached around €100 billion, which marked the peak of the market. This clearly demonstrates that the state provides direct financial support to green infrastructure and climate-related projects. However, a little bit decline in issuance in 2023 and 2024 says that the market has entered a period of some constancy, with the fisrt speedy growth slowing down. In the other side, results for the European Union-27 says that the private sector, in specific non-financial and financial capital companies, has played a importantly larger role in green bond issuance. This reflects the deeper combination of ESG in the

EU domestic market and the increasing participation of the corporate sector in sustainable finance sector. Green bond issuance, which peaked at around 250 billion in 2022, continued at a high but stable level in 2023-2024. This stability is an indication that the market is entering a phase of institutional maturity. In addition, data provided by the Bundesbank shows that only 7% of green bonds in Germany and 8% in the EU-27 were issued as green by the issuers themselves. This means that the vast majority of green bonds have been verified by independent third parties according to international standards. This fact confirms the increased transparency and accountability in the market and the strengthening of investor confidence.

If summarise all , these results suggest that regulatory incentives, initial state leadership, and active private sector participation play a key role in the development of the green bond market.At the same time, the introduction of international verification systems reduces investor risk and increases capital inflows. It would be appropriate for Azerbaijan to benefit from this experience and promote the development of the green bond market with state leadership at the initial stage, and then create conditions for the active integration of the private sector. Green bonds in Germany are considered important financial instruments to contribute to the country's environmental protection and sustainable development goals.

The green bonds are issued by various public and private financial institutions in the Germany. These green bonds play a crucial role in money raising for environmental projects and realizing these projects. Let's look into some of the different examples of green bonds in Germany which are presented below:

Grne Anleihe der Bundesregierung (Federal Government Green Bond): The German government has been issuing federal green bonds called "Grne Anleihe" (green bonds) since 2020. The main purpose of these bonds is to provide financial support for strategic projects related to the country's environmental protection and sustainable energy transition. The German government's green bonds also support the country's "green economy" policy and help increase investments in environmental projects. These bonds are of great importance as a tool for achieving Germany's sustainable development goals.

KfW Bankengruppe Green Bonds: KfW Bankengruppe, as a German development bank, issues various green bonds to provide financial support for projects in the field of sustainable development and environmental protection.KfW's green bonds are aimed at projects in areas such as energy efficiency, clean energy, water and waste management.

KfW Bankengruppe, Germany development bank Green Bonds:

KfW Bankengruppe, which one is the German development bank, issues different green bonds to supply financial support for projects in the main of sustainable development and environmental protection.KfW's green bonds are aimed at projects in different spheras, such as energy efficiency, clean energy, water and waste management.

KfW Bank's green bonds are one of the most traded green bonds in the Germany financial markets and are also boardly got interest by globally investors.KfW's green bonds are counted an important financial instrument for environmental protection and sustainable growth.

The other green bond issuer is Landesbank Baden-Württemberg (LBBW) Green Bonds:

Landesbank Baden-Württemberg(LBBW) green bonds aim to finance environmental protection and sustainable energy projects.LBBW invests in projects related to the energy transition and the development of sustainable infrastructures in particular. LBBW's green bonds are in demand from a variety of investors worldwide and help the bank to fulfill its environmental social responsibilities.

These bonds also provide financial support for innovative and environmentally friendly projects in the energy sector. The overall objective of these green bonds is to contribute to environmental protection and sustainable development goals.They also support the greening of the German economy and, by reducing its environmental impact, contribute to the country's fight against global climate change. The development of the green bond market has increased the interest of not only governments and banks but also individual and institutional investors in such projects. The finance obtained from these sources allows for the financing of investment projects aimed at building an environmentally friendly and sustainable future.Germany and the European Union are in the process of transitioning to a climate-neutral, resource-efficient and sustainable economy. More and more capital market participants are considering climate change and environmental pollution as important risk factors when making investment decisions. Green securities summarize the green costs of an issuer and thus create transparency. The characteristics of green federal securities is that they are issued under a dual concept.This helps to better compare traditional and green securities and increase market transparency. In this concept, in turn, demonstrates the advantages of green securities to everyone:

So, Green Federal Securities are designed to be related to and have the same characteristics (same maturity and same coupon) as traditional federal securities, which are always available to provide the high liquidity required by investors. Green federal

securities are structured as "binary bonds."Easy trading between green binary bonds and traditional "binaries" is possible. The Financial Agency supports trading here, in addition to secondary market operations, with on-demand buy/sell transactions (Switch).In this way, the green "binary" essentially "takes over" the liquidity of the traditional "binary".Further details and technical specifications can be found on the Financial Agency's website.The German government published the Green Bond Framework on 24 August 2020, setting out the main terms and conditions for its green bonds. Under this framework, Green Federal Securities (Green Bonds) operate in accordance with the Green Bonds Principles (GBP) published by the International Capital Markets Association (ICMA) and widely accepted in the market. These principles ensure the transparency and market credibility of green bonds.Each year's issuances are assigned to expenditures completed in the previous fiscal year. The advantage of this is that the actual expenditures incurred are already determined, which eliminates any conflict with the right of parliamentary budget approval. Thus, the budget expenditures associated with green bonds are presented openly and any legal conflicts are avoided. In addition, the Green Bond Framework and expenditure categories are subject to an external assessment (SecondParty Opinion) process. This assessment ensures the compliance and flexibility of green bonds. (https://www.deutsche-finanzagentur.de/bundeswertpapiere/bundeswertpapierearten/gruene-bundeswertpapiere)

In 2023, the Federal Republic of Germany issued green federal securities worth 17.25 billion euros. On the one hand, the green yield curve was further widened with two new issues. On the other hand, the government made additional issues to support the liquidity of green federal securities already traded. In total, eight issues were carried out in 2023. The total volume of green federal securities issued during the year reached 55.75 billion euros.

These expenditures are grouped into five main sectors:Transportation,International cooperation,Research, innovation and information,Energy and industry (including the National Climate Change Initiative),Agriculture and forestry, natural areas and biodiversity.

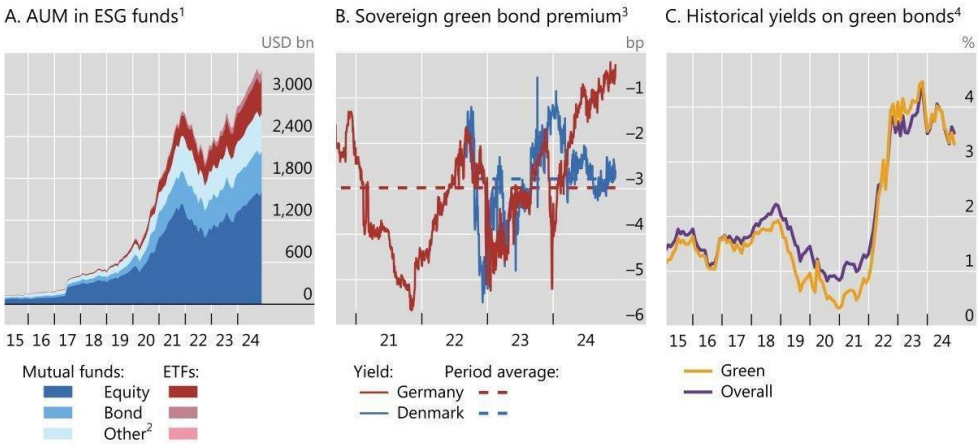
5.3 Development dynamics of the ESG bond market in Germany: analysis in terms of types and institutional structure

Trends In the last decade, green financial instruments, especially green bonds, have emerged as strategic investment vehicles in the global financial system.The shift in

capital flows towards "green" directions in line with the UN Sustainable Development Goals (SDGs) and the Paris Climate Agreement has led to structural changes in international financial markets. In this situation, green bonds issued by both the private and public sectors are playing an important role in financing energy transition, environmental infrastructure and sustainable development projects.

The European Union (EU) is in a leading position in creating an institutional framework and regulation for green finance. In particular, Germany is one of the pioneers in the development of the green bond market within the EU. The country's strong legislative framework, the sustainability of financial institutions and state policies integrated with ESG(Environmental, Social Responsibility, Governance) principles have strengthened its leadership in this area.The data in the chart in Figure 3 visually confirm this. (Look Figure 3)

Figure 3 Some characteristics of green financial instruments



[1] Includes funds with socially responsible investment mandates, an older designation. AUM = assets under management; ESG = environmental, social and governance; ETFs = exchange-traded funds. [2] Includes multi-asset, money market and alternative funds. [3] The lines show the simple average of spreads on a green bond over a conventional sovereign bond with identical characteristics issued by Germany and Denmark. For Germany, bonds maturing in 2025, 2027, 2029, 2030, 2031, 2033, 2050 and 2053. For Denmark, bonds maturing in 2031 and 2033. Dashed lines show sample averages. [4] Global yield to maturity of overall global index (Bloomberg Global-Aggregate) and green bond global index (Bloomberg MSCI Global Green Bond Index).

Sources: Bloomberg; EPFR; authors' calculations.

Charts on the Figure 3 show that green financial markets have grown rapidly over the past decade, with demand for green bonds being higher than for conventional bonds (expressed in a negative premium), and the yield dynamics of green transbonds evolving in parallel with other bonds in the market. The flow into ESG funds and interest in green financial instruments demonstrates the growing trend of investors towards sustainable and socially responsible investing.

Panel A depicts the dynamic development of assets under management (AUM) in ESG funds over the period 2015-2024. The volume of ESG funds grew at a relatively steady pace between 2015 and 2019, and the market witnessed the initial formation of

investment approaches based on sustainability principles. During this period, ESG investments were mainly supported by early-stage investors. Interests in ESG investment products has grown speeddy in 2020-2021 years following the global effect of the COVID-19 pandemic time. As sustainability and social responsibility issues became more important due to the pandemic, capital inflows into ESG funds increased significantly. This period is famed as a period of sharply growth for ESG funds. Regardless of some market changes, the volume of capitals managed by ESG funds reached about $3 trillion in 2022-2024, which confirms that ESG investments have become a strategic insturment in global financial markets. Let's breakdown by fund type:

Equities ,so stocks: Organize the largest share of ESG funds, showing that equities play a leading role in ESG approaches.

Bonds: Highly demand for ESG bonds has increased, especially in recent periods.

Other: In this section covers money market, multi-asset, and alternative investment classes and provides ample opportunities for market diversification.

This dynamic proves that the ESG investment sector is no longer just a "niche" (specialized) market, but a fundamental and sustainable segment of the global financial system.

Then, looking at Panel B, we see that SOV (sovereign green bonds)issued by Germany and Denmark show a "spread" premium compared to regular sovereign bonds with the same characteristics. Here, the spread of green bonds is observed to be negative, which confirms the concept of "greenium". Based on this panel, the following observations can show us these facts: The total average premium for Germany was around -3 basis points (bp) and for Denmark it was -4 basis points (bp). Although high volatility was observed in premiums during 2021-2022, premium values became more stable in 2023-2024.

And a negative premium shows that investors are also willing to pay a lower yield for green bonds than for regular sovereign bonds.This investor behavior decribes the strong demand for green financial instruments and their increasing market value. However, the green bonds provide investors with not only financial yeilds, but also social and environmental different benefits. It demonstrates the Greenium (green bond yield advantage) phenomenon, meaning investors are willing to accept lower yields to support environmental and sustainability goals.

Regardless of decreasing gains, Green Federal Securities are for the time being in demand, reflecting a growing appreciation for socially responsible investing and a

growing number of investors seeking to positively impact their environmental impact.Finally, looking at Panel C, it is noticeable that Panel C presents the comparative profitability indicators of green bonds and general global bonds over the period 2015-2024.

The main points observed in Panel C can be noted as follows: Troughout the 2015-2020 years, green bond yields moved in parallel with the total bond market yields.The yields of both types of bonds rose sharply during 2021-2023, between global inflation pressures and interest rate increases.In 2023-2024 years, green bond yields were slightly higher, but remained closely related to the overall market trend.

These results indicate that green bonds no longer act as an independent asset class, but rather respond to macroeconomic shocks and interest rate changes in parallel with the general bond market. This confirms that green bonds are also competitive in terms of financial performance. Green Federal Bonds due 2025 and 2027 have a higher yield curve, showing that green bonds are more likely to be admited as long-term investments.This suggests that green bonds are consistent with long-term financial strategies focused on sustainable development and environmental goals.Yield curves stimulate wider market acceptance of green financial instruments and the use of various financial instruments to support sustainable development.If we compare the periods before and after the green economy, we can find changes in many areas. For example, before green bonds, the number of financial resources for financing environmental projects was smaller, in the pre-green bond period, there was no specific legal framework that would affect the negative environmental impacts of companies and other institutions, in addition, financial resources were mainly directed to the development of the traditional economy, and sustainability-oriented investments were limited.

Behind the introducing of green bonds, after 2020 GDP growth was noticed, as Germany's GDP continued to grow fast with the introduction of Green Bonds. The capitals are raised by these bonds were invested in innovative sectors such as green energy and technologies. Over the past decade, the importance of green and more broadly ESG (Environmental, Social and Governance) bonds in global financial markets has increased significantly. This process has been particularly rapid in European countries, where the strategic priorities of states have been aligned with the principles of environmental sustainability and social responsibility. In this regard, Germany is one of the leading countries in the implementation and development of ESG bonds within the European Union.

The graphs presented below cover two main aspects of the German ESG bond market - bond types and structural changes in issuers - from a visual and statistical perspective.Breakdown by ESG bond type (2016-2024) The upper part of the graph presents the breakdown of ESG bonds issued in Germany from 2016 to 2024 by type. The data obtained show that green bonds have emerged as the main financial instrument during this period, taking a dominant position in the overall ESG bond market. Thus, 88% of ESG bonds issued in 2024 were green bonds. This demonstrates, on the one hand, the strengthening of capital flows to environmental projects in Germany,and on the other hand, the high confidence of investors in this instrument. Such an advantage of green bonds is related to their specific characteristics. The funds obtained through these bonds are mainly directed to areas such as renewable energy, energy efficiency, waste management and the fight against climate change. This creates an attractive opportunity for both public and institutional investors to promote sustainable financing. On the other hand, social bonds,demonstrated higher activity, mainly between 2020-2022 years period. The main reason for this was the additional financial needs of areas such as healthcare, social help and education during the COVID-19 pandemic period. Governments and corporate bond issuers have been able to support social welfare programs through this instrument.

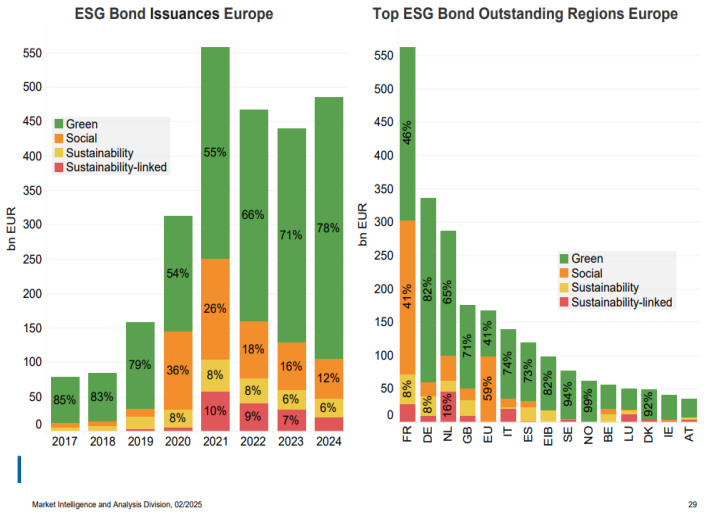
Sustainability bonds and sustainability-linked bonds, despite their relatively small share, are of particular importance in terms of diversifying the market and meeting different investor requirements. Sustainability bonds are considered multifunctional instruments as they are used to finance both environmental and social projects. Sustainability-linked bonds, on the other hand, differ in terms of different interest rates or other conditions, depending on whether the issuer has achieved certain sustainability goals. This, i.e. structural diversity, shows that the ESG market in Germany is not limited to a single direction (green bonds), but rather encompasses a variety of strategies.

This approach is important both in terms of investor diversification and compliance with national sustainability policies. Breakdown by ESG bond issuers (2016-2024) The second, lower part of the graph shows the breakdown of institutional entities issuing ESG bonds in Germany. This breakdown is divided between banks, central government, private companies (corporate), non-bank financial institutions, other public sectors and other financial institutions. Banks and financial institutions had the highest share in 2021-2024 and acted as the main driving force of the ESG bond market. For example, in 2021, their share was 50%, and in 2024, it was 40%. This

dynamic is explained by the active adoption of ESG principles by the banking sector and the restructuring of its financial intermediation function in the context of sustainability. The high activity of banks is also due to the increasing demand for ESG-rated assets in their client portfolios.The share of the central government has increased sharply since 2020. This mainly demonstrates the political will of the federal government to attract financing for climate and social projects through green and social bonds. The high rating of government-issued bonds and their stable income source were also key factors in ensuring market depth.

The high activity of banks is also due to the increasing demand for ESG-rated assets in their client portfolios.The share of the central government has increased sharply since 2020. This mainly demonstrates the political will of the federal government to attract financing for climate and social projects through green and social bonds. The high rating of government bonds and their stable source of income can also be considered as one of the main factors ensuring the depth of the market. In 2024, the share of the private sector in this area reached 32%, which indicates a further increase in the interest of corporate issuers in the ESG market. This growing interest is important both in terms of creating a sustainable brand image and attracting financial resources on more favorable terms. The interest of the corporate sector in ESG bonds is also conditioned by international market requirements, as many international investors accept ESG compliance as a key investment criterion. Although the share of other public sector participants and non-bank financial institutions is relatively small, their participation in the market is expected to increase in 2023 and 2024 years. This increasing can be considered an indicator of the wider spread of ESG finance within the country.

Figure 4.ESG Bond issuances Europe



It would be more accurate to attribute the low Green Bond Issuance in Germany in 2021 to the significant impact of the COVID-19 pandemic on Germany's GDP and the volume of green bonds in 2020 and 2021. Because this pandemic, which has a major impact on the world level, could not bypass green bonds.

Economic Crisis of 2020: The pandemic has caused a severe economic crisis, with Germany's GDP shrinking by 5.0%. This was the most severe recession since the 2008-2009 financial crisis. However, strict lockdowns and restrictions have severely affected various sectors, especially the service sector, manufacturing, and trade. The disruption of global supply chains has affected industrial production and reduced economic output.

Decrease in Investmenting : Indecisiveness and lack of economic stability have led to a decrease in investment in green projects, which also has led to a decline in green bonds issuance. In 2021, although GDP growth had recovered to 10.05%, the economy was still recovering from the previous year's crisis. This year, the recovering process was slow, and while green bond issuance increased compared to 2020, it was still below the level of last years.

Market Indecision: Continued indecision and cautious investor sentiment have impacted the volume of green bond issuances. The impact of the pandemic on the economy and investor confidence played a significant role in the decline in GDP and green bonds in these years. The European green bond market is one of the leading centers of the global green finance system, both in terms of legal and regulatory framework and institutional practices.

The single taxonomy, transparency and accountability mechanisms implemented by the European Union, as well as the balanced distribution of green bonds between the public and private sectors, demonstrate the sustainability and ideal nature of this model. In particular, in the case of Germany, the positive correlation of green bonds with GDP growth and the "dua-bond" mechanism created within the framework of green federal securities further strengthen Europe's innovative position in this area.

These experiences provide ideal models that can be applied to many developing countries, both politically and technically. But the fight against global climate change cannot be limited to Europe. Now, let's look at the government and characteristics of the green finance market in the Asia-Pacific region, another key region where green bonds are rapidly developing.

Chapter 6. Development of Asian Green Bond Markets

Following the 2015 Paris Climate Conference, most states and sovereign entities have agreed to a global climate change agreement,they aimed that. From a financial perspective, green and sustainable finance is essential to achieving one of the Sustainable Development Goals by 2030, reducing carbon emissions, supporting climate-resilient infrastructure, and promoting environmental sustainability. Millions of individuals and households in the Asia-Pacific region, particularly farmers in Vietnam's Mekong Delta, are deeply affected by drought and saltwater intrusion into their rice and fruit crops.This can be attributed to climate change, global warming, and the construction of hydroelectric dams in the upper Mekong River. This illustrates the impact of climate change on economic sectors. The main requirement is the allocation of funds. Green bonds differ from other bonds in that the proceeds are allocated exclusively to green projects, including climate change mitigation and adaptation, as well as the conservation of natural resources.The next requirement is project assessment and selection. To ensure the reliability of project assessments, national green bond regulations advocate assessments conducted by external expert agencies. This acts as a credibility assessment for potential investors, as certain investors, such as pension funds, may not be authorized to invest in bonds that are not externally assessed. The third requirement concerns the management of proceeds.Monitoring the proceeds of green bonds is important from the time of receipt until the project is completed, as these funds must be allocated for specific purposes.

In addition, project proceeds and investor returns are tracked and monitored to maintain overall transparency. The fourth requirement is that issuers list the projects financed by green bond proceeds and their expected environmental impacts in accordance with the report. The recommendations advocate for accurate, fair, and standardized reporting of all aspects of the project to maintain transparency.

Thus, for the first time in Asia, in 2010, the Japan Development Bank issued its first green bond worth 10 billion Japanese Yen. With this step, Japan laid the foundation for the Green Bond market in Asia. Japan has since increased the volume of green financing with the support of the private sector and the government.

Asia's first significant green bond issuance was in 2010 when "Sumitomo Mitsui Banking Corporation" issued a yen-denominated green bond. However, since this bond was later recognized as a green bond, the first official Asian green bond was issued by South Korea. The first official green bond issued by the Export-Import Bank of Korea (KEXIM) in 2013 can be considered the beginning of the history of Asian green bonds.

6.1 Types of Asian Green Bonds

The development of the green bond market in the Asia-Pacific region has been highly diversified, not only in terms of quantity but also in terms of the form and function of the instruments. The economic, social, and legal diversity of the countries in the region has also added different nuances to their approaches to green finance. These differences are particularly evident in the types of bonds issued.Below, the more common types of green bonds in Asia are systematically explained.

1. Standard Green Bonds Standard green bonds, which retain the legal and structural model of traditional bonds, are among the most widely used financial instruments in Asia. The proceeds from these bonds are directed exclusively to financing environmentally sound projects. These projects include renewable energy generation, waste management, energy efficiency programs, and sustainable transportation systems.Most green bonds issued in Japan, South Korea, and Singapore are of this type. These bonds are typically rated in accordance with internationally recognized standards (such as ICMA's Green Bond Principles) and are based on transparent reporting requirements. They can be issued by both the public and private sectors and offer investors a stable income while at the same time creating an investment environment that is consistent with the principles of social responsibility.

2. Sovereign Green Bonds Sovereign green bonds are issued by governments and are intended to provide financial support for nationally defined environmental strategies. This type of bond is the first of its kind in Asia.Indonesia Introduced in 2018 and has attracted wide international interest.The one of the main advantages of sovereign green bonds is their high credibility and low risk. Through them, states can finance renewable energy, environmental infrastructure, water conservation and climate change adaptation programs. The rapid development of sovereign green bonds in Asia proves that this instrument has symbolic and strategic importance not only for providing financial resources, but also for demonstrating political will of states in the green transformation process.

3. Green Sukuk (Islamic Finance-Adapted Bonds)

One of the important features of green finance in the Asian region isPrinciples of Islamic finance of eligible bonds, i.e.Green Sukuk. These bonds are widely used, especially in countries such as Malaysia, Indonesia and the United Arab Emirates. Unlike traditional bonds, Green Sukuk Not interest based,on the contrary, has an asset-based and income-sharing structure.

At the same time, the proceeds from these bonds are directed only to financing projects that comply with both Sharia and environmental criteria. For example, they are used in areas such as clean water infrastructure, solar energy projects, and sustainable modernization of the agriculture.

The one of the main advantages of this model is that it at the same time meets both religious and environmental objectives in countries that are appropriate with the Islamic finance system. Thereby, Green Sukuk allows green finance to reach wider social groups in the region.

4. Social and Sustainability Bonds while traditional green bonds are focusing just on environmental effects, social and sustainability bonds also finance social objectives.This type of bonds mainly supports projects such as affordable housing for low-income populations, developing water systems, gender equality and improving health services. If we take a look closer in the Asian region, these bonds are especially common in countries with high social problems, such as India, Bangladesh and the Philippines.

This type of bond offers investors a wide impact investment opportunity by combineing all three parts of ESG - environment, social responsibility and corporate governance. Sustainability bonds are issued by both international development banks and local public and private organizations.

5.The next one is - Transition Bonds- These bonds, i.e. Transition bonds are one of the latest and most flexible forms of green finance. These bonds are organized to finance projects that are not directly "green" but serve to gradually reduce carbon emissions. For example, activities such as the introduction of clean technologies in coal-fired industrial facilities or

the transition to hybrid technologies in the transport sector can be financed with this bond.Transition bonds play an important role, especially in countries

that have not yet fully industrialized, such as China, Vietnam, and India. These bonds represent a more flexible and inclusive approach to green finance

and serve as a bridge for companies that are moving closer to ESG criteria. Their adoption reflects both regulatory flexibility and the potential to support

real economic transformation.

The key strength of the Asian green bond market lies in its systematic flexibility and the capacity to provide instruments that can meet diverse investment needs. Standard, sovereign, Islamic, social, and transitional bonds are designed to different financing models, ideological and religious frameworks, and levels of economic development.

This richness of the green bonds, allows for a deeper and more sustainable formation of green finance in the region and paves the way for Asia to act as a key player in the global green finance agenda.

Over the past decade, green financial instruments, especially
green bonds, have become one of the main pillars of the international financial system in order to combat climate change and ensure sustainable economic development. In this context, the Asian region stands out with its unique dynamics and initiatives. Countries in the region have taken important steps towards the issuance and development of green bonds, both at the public and private sector levels.

Digital indicators and market analyses provided by Asian Bonds Online (the official information platform of the Asian Development Bank) clearly confirm this development trajectory. Analysis shows that green bond issuance in Asian countries is observed with a steady growth trend. The People's Republic of China leads the region in terms of the nominal value of green bonds. According to the results of 2023, the volume of green bonds issued by China exceeded 150 billion US dollars.

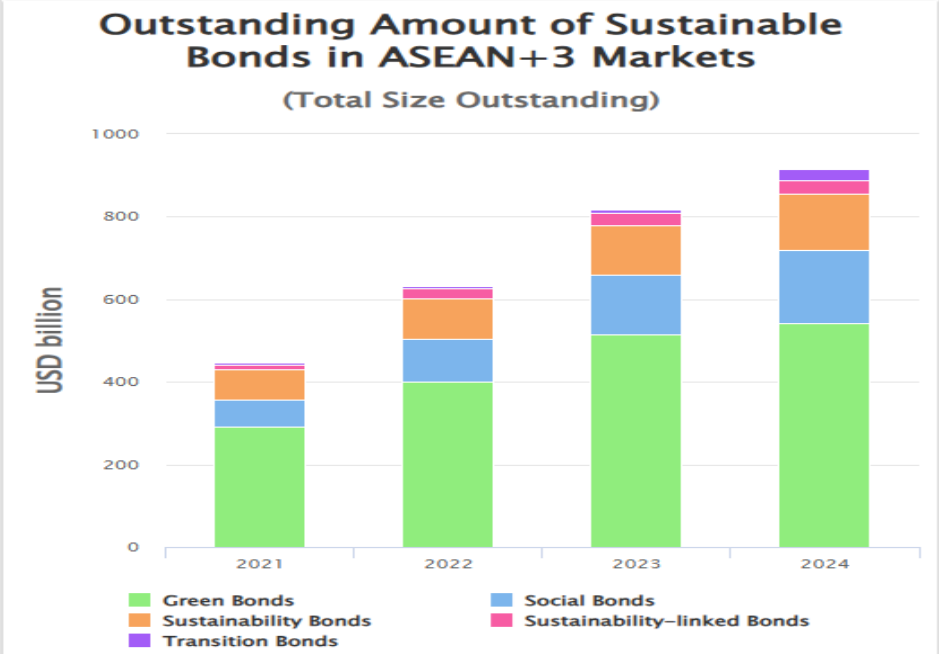
This indicator confirms that large-scale financing is directed to green infrastructure and clean energy projects in order to achieve the country's climate goals. South Korea, another important player in the region, is also rapidly developing its green bond market. The Korean governments legal and institutional reforms as part of its green transition strategy have further stimulated investor interest in the country.

The green bonds market is also getting large in other Asian countries. Let's look an example, India issued its first sovereign green bonds in 2023, and these bonds were used to finance green energy, energy efficiency, and clean transportation projects. According to the Asian Bonds Online database, green bonds in the region mainly cover the following areas which are in the below: energy efficiency, renewable energy, clean water and sanitation systems, sustainable urbanization development, and climate-proof infrastructure. All of these indicators say that green bonds are not only an environmental but also a socio-economic financial tool. Issuing entities include government-owned enterprises, banks, multinational corporations, and local private companies. One important trend is that countries in the region have begun to look over second-party reviews (SPOs), accountability frameworks, and project arrangement systems in accordance with international standards in order to increase the attraction of green bonds to international investors.

Another specific feature of the Asian market is the active participation of sovereign and semi-sovereign (e.g. city and regional governments) bond issuers. This approach

creates conditions for local support for green projects and for a wider geographical coverage. Initiatives by central banks and financial supervisors to improve the regulatory and regulatory framework in the field of green finance also increase the institutional depth of this market. Consequently, the development of the green bond market in Asia is of strategic importance not only in terms of achieving climate goals, but also in the context of diversifying capital markets and increasing the sustainability of the investment environment. This model can serve as an important experience and roadmap for emerging markets such as Azerbaijan. In particular, the regulatory approaches, project classification methodologies and investment promotion mechanisms of countries such as China, India and Korea can be considered as examples for Azerbaijan.

Figure 5. Outstanding Amount of Sustainable Bonds in ASEAN+3 Markets



Thus, as if we compera the Asian and European green bonds markets, we will also see that European green bond markets are subject to strict regulations. Different from Europe, the Asian green bond market is not controled by unique law. Thus, regulatory rules in Asia vary from country to country. This in turn causes different problems in the regulatory process of green bonds. However, it is expected that the European and Asian markets will gradually adapt to each other.

Because climate change is a global problem, both in Asia and also in Europe. Also, green finance has become a key priority at the global level within the framework of the UN Sustainable Development Goals (SDGs) and the Paris Agreement. At the same time, Asian markets are interested in adapting to

uniform rules to attract the attention of European investors and reduce greenwashing.These and other reasons, in turn, have a positive impact on the development of green bonds around the world, and continue to call for uniform regulation of green bond markets. The European green bond market is governed by a single and robust legal framework. The EU Green Bond Standard, developed by the European Union, provides uniform principles and transparency systems for market members.Moreover, ESG reporting standards and a taxonomy system are thoroughly established in Europe. In Asia, however, there is no such unified framework. Green bonds are regulated differently from country to country. Countries such as China, Japan, Singapore and Indonesia have their own standards, leading to regulatory inconsistencies and investor uncertainty in the regional market. The main faced power in the green bond market in Europe is the private sector.Banks, insurance companies and large corporations account for the part of green bonds issuance.

Now, I want to talk about Asia green bonds market , the role of the public sector is greater in this green bond market. In the countries such as China and Indonesia, in particular, government supported green bond issuances account for a large portion of the market volume. Japan has also actively supported the structuring of the market through its governments banks. A specific financial instrument has developed in the Asian green bond market that does not exist in Europe: the Green Sukuk.This is a form of green bond adapted to the principles of Islamic finance and is particularly widely used in countries such as Malaysia and Indonesia. In Europe, however, there is no such financial mechanism. This difference shows that the need to adapt green finance to the cultural and religious contexts of the regions. Closer integration of Asian and European green bond markets is expected in the near future.European Union investors are already showing increasing interest in green projects in the Asian market.

This interest is consistent with global efforts to contribute to the implementation of both the Paris Agreement and the UN Sustainable Development Goals (SDGs). In terms of regulation, initiatives towards convergence towards uniform standards in the Asian region have already begun. Initiatives such as the ASEAN Green Bond Standards and the China-EU Common Ground Taxonomy are the first steps in the process of regional and global unity.Moreover, the harmonisation of European and Asian markets is expected to speed up under the initiatives of international organizations such as ICMA (International Capital Market Association), IMF (International Monetary Fund) and World Bank.

This unity will getting strengthen investor confidence in green bond markets and increase outline financing opportunities. The Asian green bond market is emerging as a speedly developing and highly active region.Even though the regulatory framework is not yet fully perfect compared to the European market,government support, innovative financial models and green financial instruments (Sukuk) compatible with Islamic finance are making Asia one of the future global centers of green finance. The role played by this region in green finance will be decisive in the future in both solving global climate change and ensuring sustainable economic development.The Japanese government has implemented a number of incentive systems to promote the development of the green bond market. The main incentives include subsidies for green bond issuance costs, tax breaks, and government guarantees. Moreover, the Ministry of Finance and the Ministry of the Environment have developed guidelines for green bonds and adopted the "Green Bond Guidelines" in 2017. The private sector has also actively participated in these initiatives.In particular, banks and large corporations (e.g. Mitsubishi UFJ Financial Group, Toyota) have made a significant contribution to deepening the market by implementing their own green bond programs. Japan has begun to rank high in international ESG rankings with its green finance initiatives. The increase in the ESG performance ratings of economic entities has accelerated the flow of foreign investment into the country and made Japan more competitive in international financial markets.Despite the dynamic development of the Asian green bond market, there are serious challenges in the field of regulation and standardization of this market. Compared to the European Union, there is no single and common regulatory framework for green bond issuance in Asia. The lack of a common and binding system such as the EU Green Bond Standard applied in Europe leads to varying regulatory approaches from country to country in the Asian market and, as a result, uneven market development.A key feature of the green bond market in the Asian region is its fragmentation. Each country - for example, China, Japan,Singapore and Indonesia - has its own regulatory framework and green bond issuance rules. These differences lead to significant inconsistencies in the market, not only in the regulatory field, but also in terms of green project classification, reporting standards and audit requirements.For example, while a certain energy project may be considered a green project in one country, the same project may not be in another. This creates legal uncertainty for market participants. The fact that regulations differs across countries creates serious problems. The first and most important problem is legal riskiness.

The lack of a clear classification of green bonds and their eligibility criteria for investors creates additional legal risk.This can limit both domestic and international investment flows. The second critical issue is the risk of greenwashing. The lack of standards allows some issuers to present projects as green that are not actually fully green. Such situations seriously undermine the credibility of the green bond market and pose a threat to the long-term sustainability of the market infrastructure. Greenwashing negatively affects both investors' return expectations and the reputation of the ESG investment sector as a whole.The third major challenge is the lack of investor confidence. Regulatory inconsistencies and lack of transparency create additional risk factors for investors. International investors in particular are wary of the Asian green bond market due to the lack of one and standardized reporting sytems. In such an environment, investment decisions are subject to greater uncertainty and hinder the potential growth of the market.Given all these challenges, a number of initiatives have been applied in recent years to improve the regulation of green bonds in the Asian region. One of the most important of these initiatives is the implementation of the ASEAN Green Bond Standards. These standards, adopted by ASEAN countries in 2017, define minimum compliance requirements for issuers issuing green bonds, rules for the use of proceeds, project selection and procedures for monitoring proceeds.The ASEAN standards are based on the ICMA international Green Bond Principles, but have been adapted to take into account regional specificities. This initiative has created a certain degree of regulatory harmonization within the region, but is still far from covering all of Asia. In addition, China's Green Taxonomy (China's Green Bond Endorsed Project Catalogue) is also an important example of standardization efforts in the region.The Chinese government has established a detailed and sector-specific framework for classifying green projects.

In 2021, cooperation between China and the European Commission under the "Common Ground Taxonomy" initiative was also launched, which could promote closer integration of Asian and European green finance markets in the future. Despite all these efforts, there is still a long way to go to fully and effectively regulate the Asian green bond market. In the future, the introduction of more regionally coordinated regulatory mechanisms that are aligned with international standards will be a key condition for the sustainable development of the green finance market.This issuance laid the foundation for green finance in Asia and spurred the formation of a regional market.

6.2 Japan as a case study of Asian Green Bond Market

The leadership of Japan in the green bond market in Asia has been made possible by a combination of fundamental economic, institutional and international factors. The country’s strong financial infrastructure, government policies that prioritize sustainable development, the active role of experienced public financial institutions, and a high level of commitment to international commitments have made Japan a leading actor in the green finance sector.

First of all, Japan's advanced financial infrastructure has played a key role in the origin of green bonds. Japanese capital markets have the highest level of liquidity and is one of the deep institutional base in the world. The high level of activity of institutional investors such as pension funds, insurance companies, and investment institutions has supported the growing demand for green financial products.

Moreover, organizations such as the Financial Services Agency (FSA) and the Tokyo Stock Exchange (TSE) have developed regulatory and running mechanisms that simplify the quick digestion of new financial instruments, also including green bonds. This structure has allowed the green bond market to develop in more safer and transparent way.

The second important factor is Japan's targeted public policy on sustainable development and reducing carbon emissions. After the Fukushima nuclear accident in 2011, Japan made radical changes in its energy policy and began to invest more in renewable energy and energy efficiency. The 2030 climate plan and the 2050 carbon neutrality target have become the centerpiece of the policy in this area. The "Green Bond Guidelines" (2017; updated 2020 and 2022) developed by the government have strengthened the legal framework supporting green bond issuance and created a truthfull investment environment for both domestic and foreign investors.

The next, so third key factor is the active and proactive role of public financial institutions. The first green bond issued by the Development Bank of Japan (DBJ) in 2014 was an exemplary step not only for the Japan bond market but also for emerging markets as a whole. In addition, other public financial institutions, such as the Japan Bank for International Cooperation (JBIC), have contributed to the diversification and expansion of the market by promoting investments in international green projects. This active public sector has also set the direction of action for the private sector towards green finance. The issuance of green and sustainable bonds in Japan has shown remarkable development since 2014.

The issuance of the first green bond in that year marked the beginning of Japan's entry into the green financial market. This step has increased interest in Japanese green

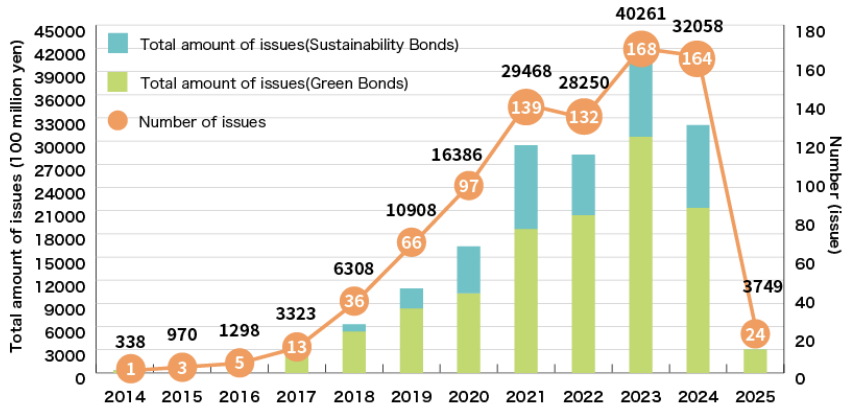
financial instruments not only for domestic investors but also in international markets.Green bond issuance has persisted since 2015, and the market has grown over time. Let's take a closer look at Figure 5.2 to get a closer look at the chronological development.For instance, Japan issued a total of 1 trillion yen (roughly 9.1 billion USD) in green bonds in 2020. This amount rose to 2.3 trillion yen (roughly 21 billion USD) in 2023. Green bonds totalling 1.46 trillion yen (roughly 13.3 billion USD) were issued in 2024. This rise suggests that green financial instruments and environmental investments in Japan are becoming more significant. The issuance of sustainable bonds began in 2019 and, although it was relatively small in the early years, this market has also begun to develop over time.In 2020, the volume of sustainable bonds issued in Japan reached 443.6 billion yen (approximately 4.0 billion USD). In 2023, this figure increased to 805.2 billion yen (approximately 7.3 billion USD). In 2024, 609.1 billion yen (approximately 5.5 billion USD) of sustainable bonds were issued. In early 2025, this figure decreased to 60 billion yen (approximately 0.5 billion USD). These indicators indicate that the demand for financial instruments in line with Japan's sustainable development goals is increasing and this area will expand further in the future.In general, Japan has seen a notable rise in the issuance of sustainable and green bonds. The total amount of these bonds issued in 2023 was 3.1 trillion yen, or roughly 28 billion US dollars. (Expectations for Issuance and Investment of Green Bonds in Japan,2025.
https://greenfinanceportal.env.go.jp/en/bond/issuance_data/market_status.html)
This amount dropped to 2.07 trillion yen (roughly 18.7 billion US dollars) in 2024, and by the beginning of 2025, bonds totalling 293.4 billion yen (roughly 2.7 billion US dollars) had been issued. This growth shows that Japan's green finance market is strengthening and increasing the potential of this market for both domestic and international investors.At the same time, the development of Japan's green finance market faces some challenges. The biggest of these is the issue of greening. In some cases, companies may present green bonds as green and sustainable projects, even though they finance projects that have no environmental impact. (Expectations for Issuance and Investment of Green Bonds in Japan,2025.
https://greenfinanceportal.env.go.jp/en/bond/issuance_data/market_status.html)
This situation undermines investor confidence and reduces the effectiveness of green financial instruments. For this reason, the Japanese government is trying to introduce stricter regulations and transparency standards for the issuance of green bonds.This is aimed at ensuring that investors make more informed and effective decisions. The

development of Japan's green and sustainable bond market offers significant investment opportunities for both the domestic economy and international investors. This growth not only reflects Japan's commitment to the environment, but also strengthens the country's commitment to the green financial market. Japan's issuance of these bonds

contributes to the growing popularity of green financial instruments in the international financial market and may further strengthen Japan's role in this area in the future.If we want to follow the volume of Japanese green bond issuance in chronological order, we will look at the graph in Figure 5.2.

The presented graph serves as important empirical evidence reflecting the transformation that the Japanese green bond market has undergone in the last decade, both in terms of quantity and quality. The indicators show the extent to which green finance has deepened in the Japanese economy, the extent to which the public and private sectors are integrated into this instrument, as well as the market approaching institutional maturity.

Figure 6 .Issuance of Green Bonds and Sustainability Bonds by Japanese Companies and Other Entities



(https://greenfinanceportal.env.go.jp/en/bond/issuance_data/market_status.html)

The development of Japan’s green and sustainable bond market demonstrates the country’s focus on the environment and the use of financial instruments to achieve its sustainable development goals. The issuance of these bonds reflects the growing interest in green financial instruments among both domestic and international investors, and Japan’s efforts to achieve carbon neutrality and the SDGs are intensifying. However, there are also some challenges to issuing green bonds. For example, some investors raise the issue of greenwashing that is, some companies claim to invest in

projects that do not actually have an impact on the environment. For this reason, the Japanese government is working to strengthen the rules and standards for issuing green bonds.

Generally, the development of Japan's sustainable and green bonds market displays the country's focus on the environment and the use of financial instruments to reach its sustainable development goals.This development also increases the opportunities for international investors to invest in Japan's green financial market.

At the end, Japan's commitment to international commitments - particularly the Paris Climate Agreement and the UN Sustainable Development Goals (SDGs) - has charged the speedy development of domestic green finance enterprises. Japan has achieved the trust of global investors and united its market into the international financial system by arranged its green bond issuance with international standards such as the ICMA's Green Bond Principles.

Thus, Japan's leadership in the green bond market is explained not only by domestic factors, but also by its strategic approach to responding to global challenges. The result shows that for the effective development of green finance, financial infrastructure, public policy, institutional support, and international cooperation must operate in a unified and coordinated manner.

6.3 Japan's Leadership in Green Finance: The Role of Climate Transition Bonds and Local Government Initiatives

The Role of Climate Transition Bonds and Local Government Initiatives Japan is one of the key countries in systematically adopting green finance mechanisms to combat global climate change and ensure a sustainable economic transition. The Climate Transition Bond Framework Document, presented in November 2023, provides a detailed overview of Japan's steps in this area and a long-term strategy. The document systematically describes Japan's carbon neutrality transition goals, sectors to be financed through green bonds, public-private sector cooperation, and steps taken to strengthen ESG standards. Japan's pioneering role in the green bond market has been observed since 2014. It was this year that the first green bond issued by the Development Bank of Japan (DBJ) marked the beginning of the practical application of green financial instruments in the region.All of the proceeds were mainly focused to financing projects in the field of energy efficiency and renewable energy.

As you know green bonds also have effect on stimulating renewable energy and related areas like this. In next section we will analyse statistically this data and methodology part of this thesis. So, this step has stimulated further structuring of the green bond

market and created conditions for the entry of new institutional players into the market. Japan's national climate policy aims to reduce greenhouse gas emissions by 46% by 2030 and achieve carbon neutrality by 2050. (Japan Climate Transition Bond Framework, November 2023)

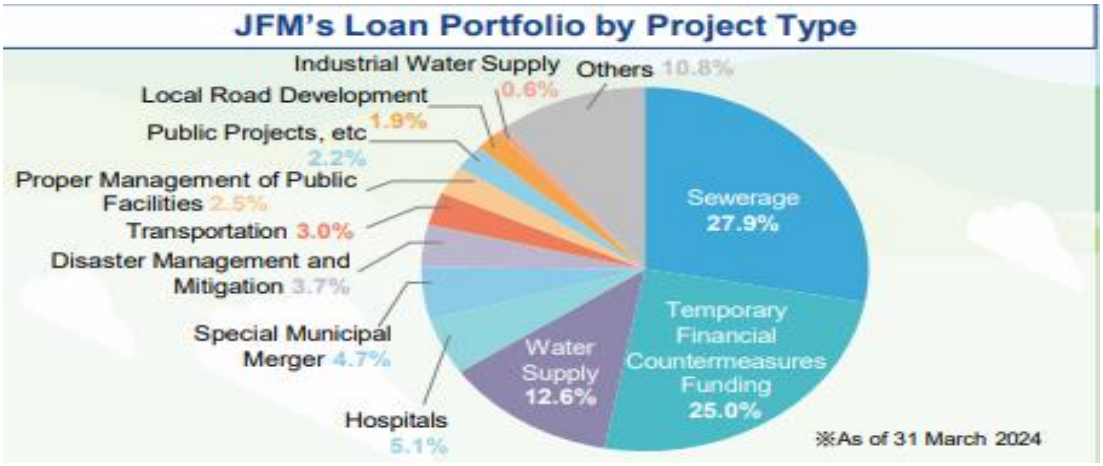
These goals are implemented within the framework of the "Green Transformation" (GT) strategy. The GT initiative aims to make fundamental changes in the country's industrial, energy, transport and urban development sectors. The main strategy is based on ensuring the synergy of public and private sector resources.In this context, the Japanese government has planned to mobilize a total of 150 trillion yen in investment, of which 20 trillion yen will be provided through new government support. The goal of this government program is to get private sector money and make it easier for new technologies to be used on a big scale. Lots of different types of projects are planned to be paid for by the Climate Transition Bond. Some of these projects are developing solar and wind energy, making businesses use less energy, building clean transport systems, expanding electrified railways, using hydrogen and ammonia technologies, and pushing carbon capture technologies (CCS).

Through these measures, Japan plans to not only reduce carbon emissions, but also achieve a fully sustainable transformation of the economic structure.As noted in the document, strengthening ESG principles and increasing the credibility of green bond issuances is one of the main priorities for Japan. In order to do this, the Green Bond Guidelines and Sustainability Linked Loan Guidelines were created. These set the basic standards for issuing and keeping an eye on green bonds. Projects that are funded by Climate Transition Bonds must also be evaluated by a third party and report every year. All of the these steps will make the market more open, lower the chances of greenwashing, and keep investors' trust in the long run.

Overall, the Climate Transition Bond Framework confirms Japan's pioneering role in green finance and demonstrates that the country is taking a systematic, coordinated, and focused approach to combating climate change. Japan is accelerating the transition to a sustainable economic model through green bonds and transition bonds and is becoming an important actor in shaping green finance standards at the regional and global levels.Green financial instruments are becoming increasingly important in combating global climate change and achieving the Sustainable Development Goals (SDGs). Japan is one of the leading countries in this direction. In particular, green bonds issued by the Japan Finance Organization for Municipalities (JFM) help local governments finance projects with environmental impact. The JFM Green Bonds Report for 2024

provides an analysis of the structure, effectiveness, and socio-economic impact of these activities.The report is based on the green bond issuance carried out by JFM between January 29, 2024 and March 28, 2024. The amount of the bond issued was 500 million euros (approximately 79.7 billion yen). The proceeds from the bonds were mainly directed to financing local governments' sewage infrastructure modernization and clean water supply projects. This approach aims to have a positive impact not only on the technical development of infrastructure but also on environmental sustainability and human health.The statistics presented in the JFM Green Bond Impact Report 2024 show that the use of green bonds produces concrete and measurable results. With the help of the funds received, 603.5 km of new pipeline systems were built. As a result of these infrastructure projects, clean water supply was improved in areas inhabited by more than 21 million people. In total, 3.3 billion cubic meters of water were treated and reused without harming the ecosystem.These results contribute to both the UN SDG 6 (Clean Water and Sanitation) and SDG 11 (Sustainable Cities and Communities) goals. Energy efficiency is also one of the main areas of impact of the projects. The report notes that 18,108,765 kWh of electricity was saved thanks to the implemented projects. This has both reduced the operating costs of local governments and made a significant contribution to reducing carbon emissions**.** Such a result proves that infrastructure investments made through green bonds are rational from both an ecological and economic point of view. When looking at the distribution by type of projects, it is observed that 60% of the funds allocated from green bonds are directed to the construction of new pipeline systems. (Figure 7) Treatment plant projects accounted for 11% of the total portfolio. Sludge treatment projects accounted for 4%, pumping station modernization for 9%, and other infrastructure projects for 15%. This distribution shows that the environmental impact is mainly concentrated in the area of water resource protection and water infrastructure optimization.

Figure 7



The green bond program implemented by JFM is not limited to technical and infrastructure development. At the same time, it also has a direct impact on improving the socio-economic environment. A survey was sent to 74 local governments, and confirmed responses were received from 70, which indicates a high response rate of 95%. These data indicate that the green bond program has broad support at the local level and meets the expectations of participants from the projects. (Figure 9)

In addition, JFM's green bond issuances have been independently assessed by Moody's and rated at "SQS2 (very good)".This rating confirms that too, green bonds meet high standards in terms of aimed use, project transparency, and can be measurable of results. Getting a good rating from a trust-worthy rating agency like Moody's is a big part of getting investors to trust you and protecting yourself from the risks of greenwashing.

Green bonds are used to fund projects that have effects that go beyond the earth. People are healthier, living conditions are better, and businesses are stronger in areas in which more people have access to clean water and sanitation services. At the same time, this helps the business grow and society stay stable over time.

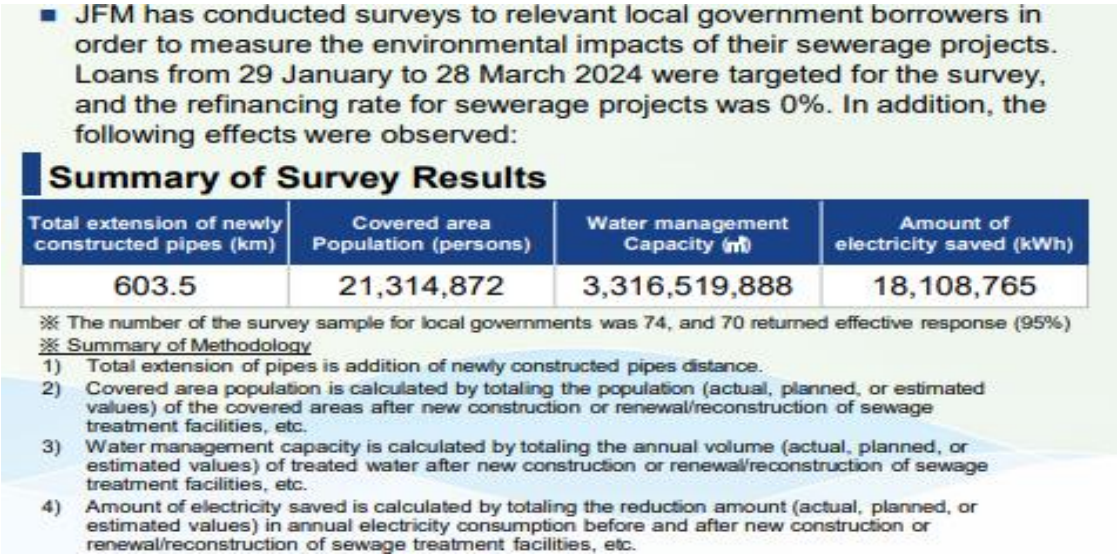
This last report from JFM Green Bond 2024 shows that green bonds are more than just a way to get money to help the environment.They are also a complete way to spend that improves people's lives and makes the economy more stable. It's clear from JFM's experience that green finance can lead to real economic and social benefits. This can be a great starting point for future green finance projects on a bigger scale. (https://www.jfm.go.jp/en/investors/bond/c24f5t0000000344-att/impactreport2024.pdf)

Figure 8.

GBP Eligible Green Project Category	Eligibility Criteria	Environmental Objective	Alignment with UN SDGs
Sustainable water and wastewater management	Development, construction, maintenance, updates, operation of sewerage related assets, which comply with sewage drainage standards set by Japanese law including: ▪ Sewerage Management-Related Facilities ▪ Facility/Equipment ▪ Pipes	Pollution Prevention and Control Water Resource Conservation Energy use of sewage sludge, sewage sludge recycle	

Source: Green Finance Portal – Ministry of the Environment, Japan

Figure 9



▪ JFM has conducted surveys to relevant local government borrowers in order to measure the environmental impacts of their sewerage projects. Loans from 29 January to 28 March 2024 were targeted for the survey, and the refinancing rate for sewerage projects was 0%. In addition, the following effects were observed:

Summary of Survey Results

Total extension of newly constructed pipes (km)	Covered area Population (persons)	Water management Capacity (㎥)	Amount of electricity saved (kWh)
603.5	21,314,872	3,316,519,888	18,108,765

※ The number of the survey sample for local governments was 74, and 70 returned effective response (95%)

※ Summary of Methodology

1) Total extension of pipes is addition of newly constructed pipes distance.
2) Covered area population is calculated by totaling the population (actual, planned, or estimated values) of the covered areas after new construction or renewal/reconstruction of sewage treatment facilities, etc.
3) Water management capacity is calculated by totaling the annual volume (actual, planned, or estimated values) of treated water after new construction or renewal/reconstruction of sewage treatment facilities, etc.
4) Amount of electricity saved is calculated by totaling the reduction amount (actual, planned, or estimated values) in annual electricity consumption before and after new construction or renewal/reconstruction of sewage treatment facilities, etc.

Source: Green Finance Portal – Ministry of the Environment, Japan https://greenfinanceportal.env.go.jp/en/bond/

Japan is one of the countries that has played a leading role in the formation and shaping of the green finance market in the Asia-Pacific region. Behind its leadership in the green bond market are four key strategic factors that form a unity: a developed financial infrastructure, a state strategy based on climate policy, strong institutional support, and a high commitment to international obligations. This section analyzes these factors and justifies Japan's advantage in the market. Developed Financial Infrastructure and Market Maturity The main foundation of Japan's success in the green bond market is its developed financial infrastructure.The country has one of the deepest and most liquid capital markets in the world. This feature is an important condition for the rapid placement and adoption of new financial instruments, including green bonds, in the market. Institutional investors such as pension funds, banks, and insurance companies operating in Japan are showing great interest in switching to investment

portfolios in accordance with ESG (Environmental, Social Responsibility and Governance) principles.This transition is shaping both investor behavior and the policies of issuers in the market. In addition, regulatory bodies such as the Financial Services Agency (FSA) and the Tokyo Stock Exchange (TSE) have taken progressive steps in creating legal frameworks that will ensure market flexibility and transparency. Thus, Japan's developed financial ecosystem has provided a favorable environment for the functional integration of green finance into the market.State-Level Sustainable Development and Climate Strategy Japan's leadership in the green bond market is also closely linked to the government's policy direction. After the 2011 Fukushima nuclear accident, energy security and sustainable development became a government priority. In this context, reducing carbon emissions, increasing energy efficiency, and supporting renewable energy technologies have come to the fore.The government has promoted the structuring of green finance by setting a goal of achieving carbon neutrality by 2050 and specific climate change targets by 2030.The Japanese government developed the Green Bond Guidelines in 2017 to help reach these goals. They will be changed in 2020 and 2022. These rules tell people who want to issue green bonds what kinds of projects are allowed, how to track results, how to be accountable, and how to give information to investors.The government's promotion in this direction has created an

environment of trust and stability in the market. The Active Role of Experienced Public Financial Institutions. One of the main driving forces in the development of the Japanese green bond market is the active activity of state-owned financial institutions.The Development Bank of Japan (DBJ), which in 2014 put out Japan's first green bond, was a big part of this project. The bonds were meant to pay for projects that save energy and use renewable energy. This process also set a great example for the business sector. There are other state-run banks, like the Japan Bank for International Cooperation (JBIC), that have also helped fund green projects in Japan and other countries. These organisations have made it easier for businesses and governments to work together, which has helped the market grow, become more standardised, and appeal to investors from other countries. Promises to other countries and the integration of the world Japan is the leader in the green bond market for a number of reasons, including the fact that the country works hard to keep its foreign promises. As part of the Paris Climate Agreement, Japan has set very high goals for cutting carbon pollution. With these goals in place, supporting green finance in the country has political legitimacy. Japan has also used the green bond tool to help reach

the UN's Sustainable Development Goals (SDGs). The main focus is Goals 7 (affordable and clean energy) and 13 (climate action). At the same time, Japan has ensured integration with global financial markets by aligning its green bond issuance with the ICMA Green Bond Principles and other international standards.
This step has made foreign investors more interested in investing in green bonds and has stimulated the issuance of more green bonds. It is no coincidence that Japan is one of the leading countries in the green bond market. This success is due to a strong financial system, a targeted climate policy, strategic actions by government agencies, and a coordinated effort to fulfill international commitments. Japan's approach to green finance is structured and long-term, and can be used as a model for other developed and developing countries in this area.

Chapter 7. Data Description and Sampling Methodology

This study used a dataset with 108 factors from the 2018 to 2023, it covers total Eurpe and Asia 18 countries.These countries are China, Japan, India,Indonesia, Republic of Korea,Malaysia,Philippines,Singapore,Thailand,Belgium,Denmark,France,Germany,Italy,Netherlands,Poland,Spain,Sweden which they are green bond issuers.
This six-year period is a major transitional time that shows how environmental laws and the economy are changing. When you collect data from every country, you can do more in-depth analyses and keep a close eye on economic and environmental trends. All of this information makes it easier to see both short-term and long-term changes in the economy, and it gives us a solid foundation for predicting the future.All analyses were performed using the STATA/Now SE 19.5 statistical software package.

7.1 Variables involved in the analysis

This study is based on three main variables to examine the impact of green finance on economic growth and renewable energy production.These all variables play an important role in achieving global environmental goals, promoting economic development and increasing sustainable energy production. As I already said, green bonds are a type of fixed-income security that is meant to fund projects that have especially positive effects on the environment and climate. These investments are meant to pay for projects that use renewable energy sources like solar, wind, and hydroelectric power; make buildings and infrastructure more energy efficient; stop and control pollution; and handle water in a way that is sustainable. Green Bonds are based on the idea of financing sustainable development. Investors are urged to back projects that are in line with global environmental goals, such as the Paris Agreement and the

UN Sustainable Development Goals (SDGs). These bonds not only bring in investors who care about the environment, but they also help support sustainable market practices by putting money into low-carbon and long-lasting infrastructure. In this paper, Green Bonds (BONDS) are a separate variable that has an impact on both economic output and the creation of renewable energy. This idea says that Green Bonds, which are a long-term form of financing, will help environmentally friendly projects grow and progress. This will have big effects on both the economy and the environment. Gross Domestic Product (GDP) Gross domestic product, or GDP, is a broad way to measure how productive an area or country's economy is. It figures out how much all the things and services made in a certain amount of time are worth. A lot of different things can affect GDP, which is often seen as a good sign of the health of the economy. Some of these factors are:

1. Private and public investment;
2. Government spending;
3. Consumer spending; and
4. Net exports.

By taking GDP as the dependent variable, we can examine the extent to which green bonds, as a tool for green finance, can contribute to economic growth.The underlying idea behind these bonds is that they will strengthen the economy by financing long-term infrastructure projects and green energy, creating jobs, reducing the long-term costs of environmental damage, and increasing productivity in areas that use less energy.This study tries to find out if higher Green Bond prices are linked to bigger GDP growth in order to show that sustainable spending is good for the economy as a whole. Renewable enrgy , which stands for "renewable energy production," is the total amount of energy that comes from clean, natural sources.

Solar power,

Wind energy,

Hydroelectric power,

Biomass and geothermal energy.

As global priorities shift towards sustainable development and zero carbon-footprint, the growth of renewable energy production is necessary for merging climate change and decreasing dependency on fossil fuels. Investments in renewable energy are often capital intensive, requiring significant funding to achieve technological advancements and expandability.This is where Green Bonds play a main role by providing

the necessary capital to give large sustainable energy projects. In this thesis, the dependent variable is the renewable energy production model (RENEW), and the independent predictor is Green Bonds. The study points out to determine whether funds raised through green bond investments are effectively aimed towards increasing renewable energy production in line with international sustainability requirements.

Time period and sample

There are 108 observations for each of the all variables in the datasheet over a 6-year period (2018-2023). These 108 observation samples involve globally GDP,foreign direct investment net inflows, WJP Rule of law index, renewable energy production and green bond issuance volume, Per capita CO2 emission. These samples is collected from World Bank Data Climate Bonds Initiative, Dealogic, Environmental Finance Bond Database,S&P Trucost,Ember-energy, authors' calculations, Country economy web-site.This yearly and covered by countries data distribution is important for various reasons:

It allows us to detect some seasonal trends and a few transient fluctuations that may affect renewable energy production and economic outputs.

It captures both short-term unpredictability and long-term trends, offering an overcharging perspective on the impact of Green Bonds over time.

The choice of the time frame (2018-2023) is also strategic, as it is covered factors in the below:

Key global climate agreements,

Increasing regulatory emphasis on sustainable investments,

Rapid technological innovations in renewable energy.

Data collection and validation

The data for this analysis were obtained from creditworthy financial and economic databases that track bond issuance, energy production indicators, and macroeconomic indicators. Given the structured nature of the yearly data, you will find data for each hypothesis in Appendix A and Appendix B.

The data are cleaned and free from missing values, and also during analysis I replaced all variables from numeric to log transformed variables. This transformation helps to analysis all variables in same volume. In addition, statistical tests for heteroscedasticity, correlation, , multi regression, unit root llc and ips were considered necessary steps before proceeding with econometric modeling to validate the validity of the results.The structured dataset provides a basis for rigorous econometric analysis by calculating the relationship between Green Bonds, GDP and Renewable Energy Production and also

other factors, foreign direct investment net inflows, WJP Rule of law index, Per capita CO2 emission. . The main point is to significantly confirm the hypothesis that investments in sustainable financial instruments not only support environmental goals, but also contribute to the spread of economic growth. Assumptions for the simple linear regression analysis The main purpose of this simple linear regression analysis is to review the impact of Green Bonds (BONDS) driven by sustainable financial investments on two key economic indicators:

Renewable Energy Production , which gives back the level of energy production from sustainable sources, and Gross Domestic Product (GDP), which reflects the total economic output and growth of the economy. The main idea behind the analyses is to understand that investments in Green Bonds can significantly speed up sustainable energy development and economic growth, in line with the global goals of the green transition and all datas are collected from these Sources: World Bank Data Climate Bonds Initiative; Dealogic; Environmental Finance Bond Database; S&P Trucost; Ember-energy authors' calculations , IMF Copyright and Usage,Eurostat,World Justice Project,The United Nations Trade and Development Data Hub.

7.2 Hypotheses for Green Bonds and Renewable Energy Production

The hypothesizes about GDP and Green Bonds. In the second part of the study, things like green bonds (BONDS) and GDP are looked at. We think that green bonds help the economy grow by making it possible to build facilities that will last. This is because long-lasting infrastructure makes work possible, advances technology, and lowers the cost to the environment. Nothing but the truth (H 02): Green bonds don't change the GDP in a scientific way. This idea says that changes in investments in green bonds don't cause changes in economic growth that can be measured. From an economic point of view, the green bond coefficient in the regression equation is zero:

H 02:beta 2 = 0

Here, beta 2 constitutes the effect of green bonds on GDP. Approaching the null hypothesis (HA2) suggests that sustainable financing through bonds does not affect macroeconomic growth, potentially calling into question their role in economic policy.

Alternative Hypothesis (HA2):

Green Bonds have a statistically significant and positive impact on GDP. This hypothesis is based on the expectation that investments in green projects will contribute to economic productivity, further stimulate new markets, and strengthen long-term economic stability.The theory that has been made can be written like this:

H A2 :beta2>0

A significant and positive beta2 value shows that for every rise in Green Bonds, there is a corresponding rise in GDP. This suggests that green investments are beneficial for long-term economic growth.

Rejection of the null hypothesis in favuor of the alternative hypothesis would confirm the effective powers of green financing mechanisms in driving macroeconomic performance.

The relationship between Green Bonds (BONDS) and Renewable Energy Production (RENEW) is explored through the panel data and multiple regression model. This relationship is based on the expectation that investments raised through green bonds are related with renewable energy projects, to help to increase production volume and technological advancements in sustainable energy sources.

Null Hypothesis (H01):

There is no statistically main issue of Green Bonds on Renewable Energy Production. This hypothesis shows that fluctuations in green bond investments do not cover observable changes in renewable energy output. In econometric terms, the coefficient of Green Bonds in the regression equation is equal to zero as per shown below:

H0:beta1=0

where beta1 is the coefficient of Green Bonds in the regression equation.

Alternative Hypothesis (HA1):

Investment in Green Bonds has a statistically significant positive effect on Renewable Energy Production.

HA1:beta1>0

Alternative Hypothesis (HA1):

There is a statistically significant and positive effect of Green Bonds on Renewable Energy Production. This hypothesis shows the expectancy that capital raised through green bonds is effectively allocated towards sustainable energy projects, thereby going up speedly production levels. In econometric terms:

HA1:beta1>0

A positive and statistically significant beta1 would exhibit that as investments in Green Bonds increase, Gross Domestic Product (GDP) also increases commensurately. In this paper I used 108 observations from 18 countries and applied panel data 2018-2023 years.

From the results, it can be seen that GDP is positively affected by all independent factors. I have tested these effects using random effects, fixed effects, and pooled OLS models. Statistical tests, in turn, prove that estimating based on the obtained result would be a more appropriate choice and also when there is a possibility of heteroscedasticity, robust standard errors are needed. In addition, the empirical results obtained as a result of applying unit root tests also show that the values are stable. The figures show how important clean energy and sustainable finance are for economic growth. Also applying od White test helps to approving all observations are out from heteroscedasticity. And using robust standard errors help to show all results are obtaining constant estimates.

The correlation coefficients show a strong positive relationship between LOG_gdp and log_greenbond 0.63 and a positive and significantly positive correlation with log_renew 0.81 and log_fdinet 0.56, suggesting that there is no serious multicollinearity based on these results. Hausman test results are also recommend choosing FE, Polled OLS and Random effects give positive relationship between GDP and green bonds also. Let's intuducing all of results and tests in below.

Invalidation of the null hypothesis in favor of the alternative would recommend that green financial instruments are effective in driving sustainable energy outcomes, orienting with global sustainability goals. All results tables are from Stata.
First of all, I applied multiple regression test for my data. You can recognized formula of the multiple regression in the below:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_i$$

Y : Dependent variable
β_0 : Intercept
β_i : Slope for X_i
X = Independent variable

Let's apply an OLS regression with robust test for my data and we will see results in the below:

Table 1. Regression for Green bond and GDP

```
. regress log_gdp log_greenb~d log_fdinet log_renew, robust

Linear regression                               Number of obs     =        100
                                                F(3, 96)          =     328.98
                                                Prob > F          =     0.0000
                                                R-squared         =     0.7786
                                                Root MSE          =     .51644
```

log_gdp	Coefficient	Robust std. err.	t	P>|t|	[95% conf.	interval]
log_greenbond	.1838118	.0461759	3.98	0.000	.0921534	.2754702
log_fdinet	.2986512	.0525083	5.69	0.000	.194423	.4028794
log_renew	.4574934	.0329638	13.88	0.000	.3920607	.522926
_cons	.6796948	.3229461	2.10	0.038	.0386519	1.320738

Table 2. Summarize and correlation table of Data

```
.  summarize log_gdp log_greenbond log_fdinet log_renew

    Variable |        Obs        Mean    Std. dev.       Min        Max
-------------+---------------------------------------------------------
     log_gdp |        108    7.120137     1.05326    5.821447   9.815084
log_greenb~d |        108    2.061743    1.251188    .0676586   4.574505
  log_fdinet |        100     3.20635    .9434654    .8628899   5.247708
   log_renew |        108    11.21749    1.419881    7.423568   14.84513

. correlate log_gdp log_greenbond log_fdinet log_renew
(obs=100)

             | log_gdp log_gr~d log_fd~t log_re~w
-------------+------------------------------------
     log_gdp |  1.0000
log_greenb~d |  0.6272   1.0000
  log_fdinet |  0.5596   0.4512   1.0000
   log_renew |  0.8069   0.4807   0.3283   1.0000
```

In this correlation table you can see relationship between GDP and Green bonds clearly.

Table 3. White test for Heteroscedasticity

```
. estat imtest, white

White's test
H0: Homoskedasticity
Ha: Unrestricted heteroskedasticity

    chi2(9) =  20.75
Prob > chi2 = 0.0138

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	20.75	9	0.0138
Skewness	9.81	3	0.0202
Kurtosis	1.47	1	0.2251
Total	32.03	13	0.0024

Lack of short-term period data in this paper we faced heteroscedasticity probability. For smoothing this problem I applied Unit Root test for every variables .

Table 4. Unit Root Tests

```
Levin-Lin-Chu unit-root test for D.log_greenbond
-------------------------------------------------
H0: Panels contain unit roots               Number of panels  =      6
Ha: Panels are stationary                   Number of periods =     17

AR parameter: Common                        Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
```

	Statistic	p-value
Unadjusted t	-13.0086	
Adjusted t*	-6.2195	0.0000

```
. xtunitroot ips log_fdinet, lags(1) demean

Im-Pesaran-Shin unit-root test for log_fdinet
------------------------------------------------

H0: All panels contain unit roots           Number of panels       =      6
Ha: Some panels are stationary              Avg. number of periods =  16.67

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                   sequentially
Time trend:   Not included                  Cross-sectional means removed

ADF regressions: 1 lag
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 W-t-bar              -0.4923        0.3113
------------------------------------------------------------------------------
```

```
. xtunitroot llc D.log_renew, lags(1)

Levin-Lin-Chu unit-root test for D.log_renew
------------------------------------------------

H0: Panels contain unit roots               Number of panels  =      6
Ha: Panels are stationary                   Number of periods =     17

AR parameter: Common                        Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t        -15.7693
 Adjusted t*          -6.5563        0.0000
------------------------------------------------------------------------------
```

```
. xtunitroot llc D_log_gdp, lags(1)

Levin-Lin-Chu unit-root test for D_log_gdp
------------------------------------------------

H0: Panels contain unit roots               Number of panels  =      6
Ha: Panels are stationary                   Number of periods =     17

AR parameter: Common                        Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 8.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t        -12.9420
 Adjusted t*          -2.5583        0.0053
------------------------------------------------------------------------------
```

You can see from the results that the panels are stationary and this helps to approve our results statistically. Next step I applied Breusch-Pagan Lagrange Multiplier (LM) test for random effects test and p <0.01 this result says that I should use Random effect my panel.

Table.5 Breusch-Pagan Lagrange Multiplier (LM) test for random effects

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        log_gdp[country_id,t] = Xb + u[country_id] + e[country_id,t]

        Estimated results:
                         |       Var     SD = sqrt(Var)
                 --------+------------------------------
                  log_gdp|   1.168157       1.080813
                       e |   .0052411       .0723951
                       u |   .2839287       .5328496

        Test: Var(u) = 0
                                   chibar2(01) =   150.64
                               Prob > chibar2 =   0.0000
```

Table 6. Random Effect

```
Random-effects GLS regression                   Number of obs     =       100
Group variable: year                            Number of groups  =         6

R-squared:                                      Obs per group:
     Within  = 0.7867                                         min =        15
     Between = 0.6463                                         avg =      16.7
     Overall = 0.7786                                         max =        18

                                                Wald chi2(3)      =    337.60
corr(u_i, X) = 0 (assumed)                      Prob > chi2       =    0.0000

------------------------------------------------------------------------------
      log_gdp | Coefficient  Std. err.      z    P>|z|     [95% conf. interval]
--------------+---------------------------------------------------------------
log_greenbond |   .1838118   .0508209     3.62   0.000     .0842046    .283419
   log_fdinet |   .2986512   .0622808     4.80   0.000     .1765831    .4207193
    log_renew |   .4574934   .0408615    11.20   0.000     .3774063    .5375805
```

We can see clearly that Green bond has a significant effect on GDP and R squared (within- 79% and also overall- 78 %) says that green bond is strongly related to GDP. And also 1% changes in green bonds , GDP will change 0.18 % additionally. Also P values are not greater than 0.05 , this also approved that our statistics results are significant .

Based on the data, we can say that:

Investing in green bonds will increase economic growth, so GDP and green bonds are positively related.

Let's look into relationship between Renewable energy and green bond, in this hypothesis I will approve positive relation between green bond and renewable energy also I add CO2 emission per capita also. Sustainable financing instruments such as green bonds have become increasingly important in helping to mitigate the consequences of global challenges posed by climate change. In examining the second hypothesis, I will examine in detail how green bonds and CO2 emissions are related to the development of renewable energy generation. In particular, we analyze whether a positive increase in green bond issuance attracts more investment in renewable energy sources and whether CO2 emissions act as a disincentive or a motivation for the adoption of cleaner energy. The correlation coefficients show a strong positive relationship between LOG_renew and log_greenbond 0.49 and a negative correlation with log_renew and log_CO2 -0.27 suggesting that there is no serious multicollinearity based on these results. Hausman test results are also recommend choosing RE , Random effect gives positive relationship between renewable energy generation and green bonds also. Let's introducing all of results and tests in below. In addition, the empirical results obtained as a result of applying unit root tests also show that the values are stable. The figures show how important clean energy and sustainable finance are for economic growth. Also applying od White test helps to approving all observations are out from heteroscedasticity. And using robust standard errors help to show all results are obtaining constant estimates.

The relationship between Green Bonds and Renewable Energy Generation is explored through the simple linear regression model. This relationship is based on the expectation that investments raised through green bonds are related with renewable energy projects, to help to increase production volume and technological advancements in sustainable energy sources.

Null Hypothesis (H01):

There is no statistically main issue of Green Bonds on Renewable Energy Production. This hypothesis shows that fluctuations in green bond investments do not cover observable changes in renewable energy output. In econometric terms, the coefficient of Green Bonds in the regression equation is equal to zero as per shown below:

$H01: \beta 1 = 0$

where $\beta 1$ is the coefficient of Green Bonds in the regression equation.

Alternative Hypothesis (HA1):

Investment in Green Bonds has a statistically significant positive effect on Renewable Energy Production.

HA1:β1>0

Alternative Hypothesis (HA1):

There is a statistically significant and positive effect of Green Bonds on Renewable Energy Production. This hypothesis shows the expectancy that capital raised through green bonds is effectively allocated towards sustainable energy projects, thereby going up speedly production levels. In econometric terms:

HA1:β1>0

Now start to analyse green bond and renewable energy generation relationship.First of all summarize data.

Table 7. Summarize table for data Renewable case

```
. summarize  log_renew log_gbondb log_CO2

    Variable |        Obs        Mean    Std. dev.       Min        Max
-------------+---------------------------------------------------------
   log_renew |        108    11.21749    1.419881   7.423568   14.84513
  log_gbondb |        108    2.061743    1.251188   .0676586   4.574505
     log_CO2 |        108    2.036375    .5843762   .8415672   3.444576
```

Table 8. Correlation table for Renewable case

```
. correlate log_renew log_gbondb log_CO2
(obs=108)

             | log_re~w log_gb~b  log_CO2
-------------+---------------------------
   log_renew |   1.0000
  log_gbondb |   0.4900   1.0000
     log_CO2 |  -0.2716   0.2459   1.0000
```

In this analysis I followed step by step the same processes as GDP and Green bond cases.

Approving the correctness of our dataset I applied Unit root test for all data for this hypothesis.

Table 9. Unit root tests for Renewable case

```
. xtunitroot llc log_gbondb , lags(1) demean

Levin-Lin-Chu unit-root test for log_gbondb
-------------------------------------------
H0: Panels contain unit roots              Number of panels  =     18
Ha: Panels are stationary                  Number of periods =      6

AR parameter: Common                       Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included                 Cross-sectional means removed

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 5.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                      Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t          -24.1956
 Adjusted t*           -25.5613        0.0000
------------------------------------------------------------------------------
```

```
. xtunitroot llc log_renew , lags(1) demean

Levin-Lin-Chu unit-root test for log_renew
------------------------------------------
H0: Panels contain unit roots              Number of panels  =     18
Ha: Panels are stationary                  Number of periods =      6

AR parameter: Common                       Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included                 Cross-sectional means removed

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 5.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                      Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t          -25.0191
 Adjusted t*           -26.5138        0.0000
------------------------------------------------------------------------------
```

```
Levin-Lin-Chu unit-root test for log_CO2
```

H0: Panels contain unit roots		Number of panels	= 18
Ha: Panels are stationary		Number of periods	= 6
AR parameter: Common		Asymptotics: N/T -> 0	
Panel means: Included			
Time trend: Not included		Cross-sectional means removed	

ADF regressions: 1 lag
LR variance: Bartlett kernel, 5.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-10.5101	
Adjusted t*	-9.9970	0.0000

From these results we can say that panels are stationary. This says that variables are related to each other and they don't fluctuate separately .Panel regression results are trustworthy for analysis.

I applied a regression formula for renewable energy generation, green bond and CO2 emission per capita.

Table 10. Regression result for Renewable energy

```
. regress  log_renew log_gbondb log_CO2
```

Source	SS	df	MS		
				Number of obs	= 108
				F(2, 105)	= 35.55
Model	87.1000502	2	43.5500251	Prob > F	= 0.0000
Residual	128.618465	105	1.22493776	R-squared	= 0.4038
				Adj R-squared	= 0.3924
Total	215.718515	107	2.01606089	Root MSE	= 1.1068

log_renew	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
log_gbondb	.6725361	.0882235	7.62	0.000	.4976051	.8474671
log_CO2	-1.014062	.1888924	-5.37	0.000	-1.388601	-.6395233
_cons	11.89591	.3974674	29.93	0.000	11.1078	12.68401

We can clearly see that green bonds have a positive effect on Renewable energy generation. Also CO2 has a negative effect on renewable energy generation. It helps to say that using of Renewable energy sources help to reduce carbon footprint, also green bonds stimulate and directly fund renewable energy projects.

In the next step I checked heteroscedasticity with White test.

Table 11. White test for Renewable case

```
. estat imtest, white

White's test
H0: Homoskedasticity
Ha: Unrestricted heteroskedasticity

    chi2(5) =   7.14
Prob > chi2 = 0.2105

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	7.14	5	0.2105
Skewness	10.53	2	0.0052
Kurtosis	0.21	1	0.6493
Total	17.88	8	0.0222

I can say that from this result in this analysis there is no heteroscedasticity . Now we can apply the Hausman test for choosing fixed or random effects.

Table 12. Hausman Test for Renewable case

```
. hausman FE1 RE1
```

	Coefficients (b) FE1	(B) RE1	(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
log_renew	-.5968123	-.2402655	-.3565468	.127411
log_gbondb	.0350686	.0173707	.0176979	.0084414

```
                b = Consistent under H0 and Ha; obtained from xtreg.
B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

    chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
            =   4.38
Prob > chi2 = 0.1118
(V_b-V_B is not positive definite)
```

In this table we can see that P value is greater than 0.05, it says that we should choose Random effect for this analysis. Now let's look at the result for this Random effect application.

Table 13. Random Effect for Renewable

```
. xtreg  log_renew log_gbondb log_CO2, re vce(cluster country_id)

Random-effects GLS regression                   Number of obs     =       108
Group variable: country_id                      Number of groups  =        18

R-squared:                                      Obs per group:
     Within  = 0.3700                                         min =         6
     Between = 0.3980                                         avg =       6.0
     Overall = 0.3453                                         max =         6

                                                Wald chi2(2)      =     49.33
corr(u_i, X) = 0 (assumed)                      Prob > chi2       =    0.0000

                          (Std. err. adjusted for 18 clusters in country_id)
------------------------------------------------------------------------------
             |               Robust
   log_renew |      Coef.   Std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
  log_gbondb |   .0943732   .0255061     3.70   0.000     .0443822    .1443642
     log_CO2 |  -.2648112   .0542858    -4.88   0.000    -.3712094   -.158413
------------------------------------------------------------------------------
```

For these results, we can say that green bonds also have a positive effect on renewable energy generation. R squared is 35% this approves our hypothesis. P values are statistically significant. Also we can say that from table 10. 1% change on green bonds will have an effect on renewable energy generation 0.09%. Also 1% change in CO2 emission will negatively affect renewable energy generation (-0.27 %).

7.3 Conclusion

The empirical results of the regression analyses support the following findings:
Green Bonds are effective in promoting Renewable Energy Generation, confirming their objective of financing environmentally friendly projects.
These findings show that Green Bonds have an important impact on economic growth by increasing GDP in addition to their environmental benefits.
The adoption of these alternative hypotheses highlights the importance of sustainable finance as a double driver of environmental sustainability and Economic growth. These results demonstrate how financial instruments such as Green Bonds can contribute to getting globally significant goals such as the Paris Agreement and the UN Sustainable Development Goals (SDGs), those are recognised as important tools for getting climate and economic sustainability.

The analysis with clarity shows that:Investments in Green Bonds are not only productive for Renewable Energy Production, but also have a huge impact on overall economic growth (GDP).

High correlation indicators and significant regression coefficients have a direct and strong impact, which makes Green Bonds a prudent tool for both environmental sustainability and economic development.

In addition, as mentioned earlier, green bonds are financial instruments directed primarily at environmental protection in order to support sustainable development. It has been confirmed:The positive impact of green bonds on GDP and renewable energy production can also be considered as a supporting result.

Taking into account the existing experiences of Europe and Asia, in the next chapter you can also get acquainted with the proposal of opportunities and recommendations for the Azerbaijani green bond market.

Opportunities and recommendations for Azerbaijan:

Based on the analysis conducted, you should identify the opportunities for the development of the Green Bonds market in Azerbaijan. In this part of this study, you will get information about the importance of applying international experience for Azerbaijan.

In the end I want to show green bonds, GDP and renewable energy relations visually in the figure 10 and 11. We can see clearly green bonds, GDP and renewable energy are related positively each other’s. Putting investing in green bonds will positively effect on economic growth and renewable energy production.

Figure 10. Relationship between Green Bonds and GDP

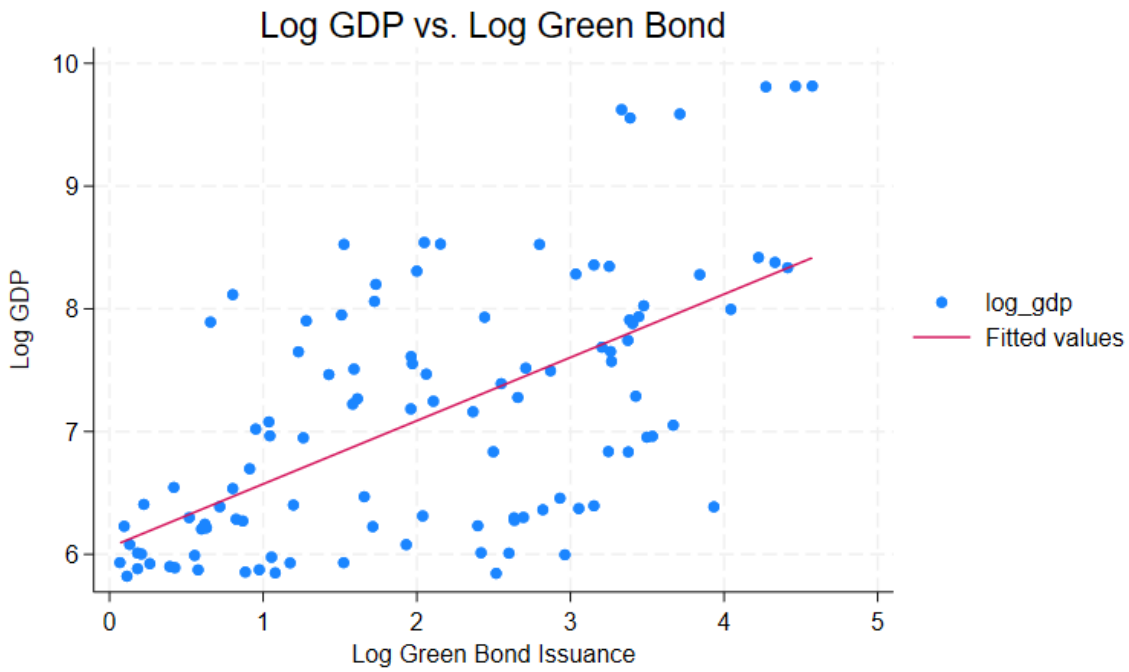
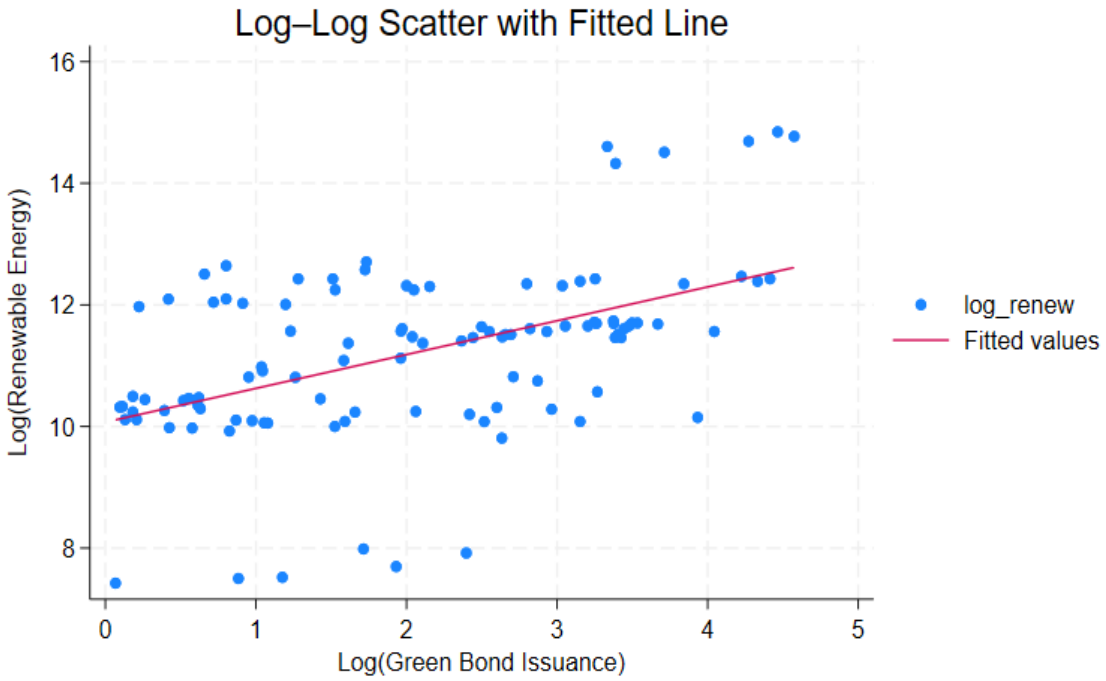


Figure 11. Relationship between Green Bonds and Renewable Energy Generation



7.4 Recommendations and limitations

1. Development of a national green bond framework

Azerbaijan should develop a clear and effective regulatory framework for green bonds that is consistent with international standards (e.g., the ICMA Green Bond Principles). This will both increase investor confidence in this area and increase the attraction of international financial resources.

2. Creation of incentive mechanisms for green bond issuers:

Incentives such as tax breaks for green bonds, favorable loan guarantees, or interest rate subsidies are appropriate for the development of this area.

3.Education and capacity building of participants

Organization and implementation of training programs on green financial instruments and sustainable investments for issuers, investors, and regulatory authorities is necessary for this area.

4. Developing regional and international partnerships Cooperation with regional financial institutions such as the European Bank for Reconstruction and Development and the Asian Development Bank and learning from the experiences of advanced countries in this field can accelerate market development.

Limitations:

There are no enough data for green bonds and yearly data is not available for last years and I think in the next research works yearly data will be cover more longer-term. Also more countries don’t share their green bond data for public and this information is not available for us.

Moreover, countries must start today to protect the future, which is threatened by the environmental pollution they have ignored for centuries, whether it is economic, ecological, or to ensure sustainable development. Although green bonds are a new instrument for Azerbaijan, they are already taking big steps towards our country.These bonds, which are intended for financing ecological, social, and environmental projects, also help investors in protecting the environment. In the implementation of the government's "Green Development and Low Carbon Economy" strategy, international financial institutions such as the World Bank, the European Bank for Reconstruction and Development (EBRD), and the Asian Development Bank (ADB) play a major role in expanding green development in Azerbaijan.

As mentioned, in the European and Chinese green bond markets, second party opinion (SPO) mechanisms are one of the factors that increase the credibility of the market. Special arrangements are used to ensure that the company or organization issuing the

green bond is really issuing this bond with green objectives. It is important for investors to know whether the declaration is true and reliable. Because in some cases, companies can issue bonds under the name of a “green” project, but in reality they can direct this money to non-ecological projects. Here, the problem of green-washing has to be faced. To prevent this, a third, neutral party - an independent expert organization that is not related to the project - comes and examines and evaluates the project, the purpose of the bond, and the spending plan, that is, issues an opinion called a Second Party Opinion (SPO). As a result of the evaluation, this expert group writes an opinion called a Second Party Opinion (SPO) in a document and shares it with investors. This opinion also ensures that the bond directly serves green and environmental purposes, complies with accepted standards (e.g. the ICMA Green Bond Principles), and ensures that the costs are transparently accounted for. One of the most important conditions for the successful implementation of green bonds is a reliable and transparent regulatory environment in the market. Investors want to be sure that the project they are investing in truly serves green purposes.

If this regulatory and supervisory system is weak and the risk of “greenwashing” is high, investors increase their risk and start to withdraw from the market. This idea has been repeatedly emphasized in reports on green finance by a number of international organizations, including the OECD. (OECD (2017), Mobilising Bond Markets for a Low-Carbon Transition”)

Although green bonds are relatively new in Azerbaijan, the first Green Bond was issued by the Baku Stock Exchange in 2023. Later, on January 15, 2025, SOCAR also took another step towards expanding the green bond market in Azerbaijan by issuing its own green bonds. With a 5-year fixed income option, the Socar Green Bond offers its holder an annual yield of 6%, as well as quarterly coupon payments. These green bonds are also tax-exempt by the government.

Proceeds from SOCAR’s green bonds will be used primarily to finance renewable energy projects in line with the company’s “green agenda”. The funds raised through these bonds are intended to support environmentally sustainable projects implemented by SOCAR Green LLC. One of the key projects implemented by SOCAR Green is a 760 MW solar power project developed jointly with Masdar. These projects include the Bilasuvar (445 MW) and Neftchala (315 MW) solar power plants. The total cost of the projects is estimated at US$600 million and is scheduled to be commissioned in the first quarter of 2027.

(https://masdar.ae/en/news/newsroom/masdar-socar-green-and-acwa-power-sign-mou)

In recent years, Azerbaijan has made some calculated moves to move toward a green economy. 2024 was designated as the "Year of Solidarity for a Green World" throughout the nation by an order issued by President Ilham Aliyev of the Republic of Azerbaijan on December 25, 2023. One of the five national priorities for Azerbaijan's socio-economic development until 2030, according to this order, so decree, is the direction of "A Country of Clean Environment and Green Growth." The decree also highlighted the implementation of the "smart city" and "smart village" ideas in the East Zangezur and Karabakh regions, which were designated as green energy zones. Furthermore, the directive mirrored the objective of augmenting the proportion of renewable energy sources in Azerbaijan's energy.Azerbaijan's five national objectives for its socioeconomic development until 2030 are listed in this decree. "A Country of Clean Environment and Green Growth" is one of the steps. There was also talk in the order that it indicates that "A Country of Clean Environment and Green Growth" is one of the five national priorities for Azerbaijan's economic development until 2030. The order also talked about how the "smart city" and "smart village" ideas would be used in the green energy zones of East Zangezur and Karabakh. In addition, the order reflected the goal of increasing the share of renewable energy sources in Azerbaijan's energy policy to 30% by 2030.

On the other hand, Azerbaijan wants to do the following things to protect the environment and make sure that growth is sustainable.tting the "smart city" and "smart village" ideas into action in East Zangezur and Karabakh, which were named green energy zones. The order also reflected the goal of increasing the share of renewable energy sources in Azerbaijan's energy policy to 30% by 2030. In this link you can get more information about this section:

(Azərbaycan Respublikasında 2024-cü ilin “Yaşıl dünya naminə həmrəylik ili” elan edilməsi haqqında Azərbaycan Respublikası Prezidentinin Sərəncamı)

Azerbaijan, on the other hand, wants to do the following things to protect the environment and make sure that growth is sustainable. Our country has already hosted the “COP 29” event organized in November 2024, which provides solutions to problems such as global warming, which is a global threat, etc. During his speech at the opening ceremony of the event, President Ilham Aliyev noted “We plan to build six gigawatts of solar, wind, and hydropower plants by 2030.

However, this is not all of our full plans, contracts, and memorandums of understanding have been signed on 10 gigawatts of renewable energy projects.” As can

be seen, states are already finding various solutions to solve global problems.As can be seen, states are now also finding various solutions to solve global problems. Green bonds also play a unique role in ensuring both the environment and a sustainable economy by providing financing for projects aimed at solving these problems. The application of green bonds also has a positive impact on technological development, as after the application of green bonds, the competitiveness of the economy increases in the long term as a result of environmental projects and investments in green technologies.The implementation of new environmental and green projects creates new job opportunities for the population, which also has a positive impact on the employment level. Although green bonds are a new instrument for Azerbaijan, they are already taking big steps towards our country. These bonds, which are intended for financing ecological, social, and environmental projects, also help investors in protecting the environment.In the implementation of the government's "Green Development and Low Carbon Economy" strategy, international financial institutions such as the World Bank, the European Bank for Reconstruction and Development (EBRD), and the Asian Development Bank (ADB) play a major role in expanding green development in Azerbaijan. As new as green bonds are in Azerbaijan, the first Green bond was issued by the Baku Stock Exchange in 2023.

Later, SOCAR also issued its own green bond on January 15, 2025, and with this, the next steps were taken to increase the green bond market in Azerbaijan. Azerbaijan, in turn, is interested in taking the following steps for the sake of environmental protection and ensuring sustainable and sustainable development. Our country has already hosted the COP 29 event organized in November 2024, which provides solutions to problems such as global warming, which is a global threat, etc. During his speech at the opening ceremony of the event, President Ilham Aliyev noted We plan to build six gigawatts of solar, wind, and hydro-power plants by 2030. However, this is not all of our full plans, contracts, and memorandums of understanding have been signed on 10 gigawatts of renewable energy projects. As can be seen, states are already finding various solutions to solve global problems.

8.1 Suggestions for Azerbaijan from the world experience on green bonds

The development of the green bond market in Azerbaijan requires a phased and targeted approach. This approach includes important steps for the creation and development of the country's green financial market. To this end, taking into account the current situation, we can put forward the following proposals for stimulating green bonds:

The first and main condition for the effective functioning of the green bond market is the strengthening of legal regulations.Currently, specific legislative mechanisms related to the issuance of green bonds in Azerbaijan have not been fully formed. Therefore, it is necessary to create a separate legal framework for green financial instruments. This framework should cover not only the issuance and circulation of bonds, but also the compliance of projects with green classification and reporting requirements. In addition, in order to adapt to international practice, the Green Bond Principles (GBP) presented by ICMA should be adopted as the main basis and these principles should be adapted to local conditions.This approach will not only increase legal transparency, but also create a reliable investment environment for foreign investors. Economic incentives are considered to be a very effective tool for promoting financial instruments. In order to make the issuance and purchase of green bonds attractive, it is important to introduce fiscal incentives - in particular tax breaks - to compensate investors for risks and generate additional income.

For example, exempting interest income from green bonds
from income tax or taxing it at a preferential rate, as well as providing state subsidies to issuers related to green projects, can significantly increase interest in this area. Such incentives have shown their positive effect in the experience of many developed and developing countries (for example,Poland, China and Indonesia).

The existence of a single state strategy is of great importance for the comprehensive development of green finance. This strategy should promote the development of not only green bonds, but also all green financial instruments in general, and should include long-term goals, priority sectors and financial mechanisms to be used. The strategy should include financing green projects in areas such as energy, transport, agriculture, waste management and water resources protection as one of the main priorities. This document can become a single platform for action that will ensure coordination between state institutions, the private sector and international partners.The experience and financial resources of international financial institutions are of particular importance for the development of the green bond market in Azerbaijan. Technical assistance programs and credit lines can be implemented in cooperation with the World Bank, the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD), and other institutions. Within the framework of this cooperation, a co-financing model for pilot green projects can be applied. Such joint projects would both increase international confidence and create an opportunity for local market participants to learn and gain experience. At the same

time, the requirements of these institutions for monitoring and reporting of green projects can accelerate the implementation of international standards in Azerbaijan. The sustainable and efficient development of the green bond market is directly related not only to the institutional and legal framework, but also to the level of knowledge, skills and awareness of market participants. I would say that the first of the most important factors is the development of human capital.

Human capital development and awareness initiatives are of significant strategic importance in the green finance ecosystem, and the experience of countries around the world provides valuable examples in this regard. In particular, European and Asian countries are distinguished by their extensive training programs, academic events and professional certification systems in this area. Thus, different education and training attempts have been applied in Europe to promote green finance. For example, the Green Finance Certificate program offered by the Frankfurt School of Finance and Management in Germany consists of specialized courses covering the basic principles of green finance, ESG criteria and green bond structures. Thus, different education and training attempts have been applied in Europe to promote green finance. For example, the Green Finance Certificate program offered by the Frankfurt School of Finance and Management in Germany consists of specialized courses covering the basic principles of green finance, ESG criteria and green bond structures. In the France case, respected higher education institutions such as HEC Paris and Universite` Paris-Dauphine offer master's programs in green finance. All of these examples show how training is effective in the green finance skills for the countries. When I was my bachelors', I asked a question from my Finance teacher A. Alakbarov ," How we can popularize tax culture to the people?", he said that "From a young age, that is, from kindergartens, because it will be effective to teach people financial literacy through education from a young age.". In general, if we want to change people's attitudes towards the environment, etc. behavior in a positive way, publicity plays an important role. Furthermore, the European Commission's Green Comp (European Sustainability Competence Framework) initiative aims to integrate sustainability knowledge and skills into education. European countries have also made significant progress in raising awareness. For example, events such as EU Green Week and EU Sustainable Energy Week provide opportunities for open discussions and workshops on green finance for the general public.

At the same time, the European Investment Bank (EIB) and the European Central Bank (ECB) provide training on green bonds and support for professionals working in this

field. Another notable aspect of the European experience is the certification carried out by regulatory and professional organizations - for example, green bond training and the widespread use of documents issued by ICMA (International Capital Markets Association). Asian countries have also paid great attention to raising awareness and developing human capital in the field of green finance in recent years. China, Singapore and Japan in particular have advanced experience in this area. Within the framework of the Green Finance Committee established at the initiative of the People's Bank of China, research and training centers on green finance operate in cooperation with a number of universities. Peking University and Tsinghua University have special programs for training specialists in this field. In Singapore, the Green Finance Academy, supported by the Monetary Authority of Singapore (MAS), organizes training courses on green bonds and sustainable finance for representatives of the banking sector and civil servants. SMU (Singapore Management University) offers professional certificate programs in this area.Similarly, in Japan, the Japan Securities Dealers Association (JSDA) has developed training programs on green bonds and recommends them for financial institutions. All these experiences show that for the successful development of green finance, technical and financial tools alone are not enough; in addition, it is necessary to form knowledgeable and informed human resources.

Educational events and training programs positively shape the behavior, decision-making mechanisms and risk assessment criteria of green
bond market participants.Azerbaijan is recommended to implement the following initiatives in this area, using regional and international experience:
establishing master's programs in green finance in higher education institutions; developing certification programs through a joint initiative of the Central Bank, the Ministry of Finance, and the State Securities Committee; organizing training and education programs in cooperation with international organizations; as well as conducting awareness campaigns for the general public about the benefits and principles of green finance.For the successful implementation of new and innovative financial instruments, especially green bonds, the implementation of pilot projects at the initial stage is considered an important strategic step. Such projects play not only a technical test role, but also serve as a signal to the market, contributing to the formation of investor confidence and the start of the normalization process. Global experience shows that in most cases, both in developed and developing countries, the first green bond issues were carried out at the initiative of the state or state-owned enterprises.This

step creates a positive precedent for the private sector to take the initiative and lays the foundation for the market structure. It is advisable to focus pilot emission projects mainly on areas such as energy efficiency, renewable energy, waste management and environmental protection. On the one hand, these areas demonstrate compliance with the country's environmental strategy, and on the other hand, they are able to meet the high expectations of investors in terms of social and environmental impact.Also, the fact that these areas are economically profitable ensures the solvency and sustainability of green bonds. This is also important for the international accreditation and recognition of pilot projects.

For example, if we want to gain the trust and interest of investors. Obtaining certifications such as the Certification by the Climate Bonds Initiative (CBI), which confirms that green bonds meet international standards and provides additional credibility for investors, can help in this regard. Since this certification process assesses the project's compliance with green classification criteria and environmental benefits, i.e., generally reducing the threat of greenwashing as I mentioned earlier, this internationally recognized certification can increase investor interest in green bonds not only in the domestic market, but also in regional and global financial markets.Successful pilot issues also serve as a model for incentives for other issuers, especially private sector participants and local governments. These issues serve as a roadmap in terms of practical examples and technical methodologies. Looking at global experience, the first sovereign green bond issues in countries such as Mexico, Indonesia and Poland paved the way for the private sector to enter this field.

In the Azerbaijani context, a pilot green bond issue with state support could be a fundamental step towards establishing a green finance market in the country. The main goal here is not only to finance the project, but also to test the mechanisms for implementing green financial instruments across the country, test the legal and technical framework, study investor reactions and gather reliable experience for future expansion plans.In addition, the implementation of such pilot projects in cooperation with local and international financial institutions is of great importance in terms of technical assistance and risk sharing. For example, the first issues to be implemented within the framework of joint programs with institutions such as the World Bank, the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD) would ensure both financial stability and allow for the transfer of technical knowledge.As a result, pilot green bond issues are not only an integral part

of the initial stage, but also a strategic start that will determine the widespread application of green financial instruments in the future. Their successful implementation plays a key role in accelerating the transition to green finance, increasing the interest of market participants and attracting institutional investors.

Summary

As can be seen, currently, states are looking for various solutions to global problems.Green bonds play a unique role in ensuring both the environment and a sustainable economy by providing financing for projects aimed at solving these problems. The introduction of green bonds also has a positive impact on technological development, because after the introduction of green bonds, the competitiveness of the economy increases in the long term as a result of investments in environmental projects and green technologies. The implementation of new environmental and green projects creates new job opportunities for the population, which has a positive impact on the employment level.

In the Data and Methodology section of this paper, I deeply analyze the effects of green bonds on GDP and renewable energy generation. Also considering other factors, too. We recognized statistical results of green bonds emissions.

This study gave us information and empirical measures about green bonds issuance volume and its effect on GDP and renewable energy production. Every step taken today, thinking about the future, will definitely have a positive impact. It would be more appropriate to support development, without forgetting that the constantly developing world is our home.

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Appendix A. GDP, Green Bond volume, FDI,RLI, Renewable energy generation

YEAR	COUNTRY	GDP, current prices (Billions of U.S. dollars)	GREEN BOND (Billion US Dollars)	Foreign direct investment, net inflows (in at current prices in billion US dollars)	WJP Rule of Law Index: Overall Score	Renewable energy generation (GWh)
2018	China	14110.96	28.64	138.31	0.50	1664816.00
2018	Japan	5040.88	3.60	9.96	0.79	208350.00
2018	India	2702.93	2.60	42.16	0.52	249661.00
2018	Indonesia	1042.27	2.53	20.56	0.52	49449.00
2018	Korea, Rep. Of	1824.25	3.91	12.18	0.72	23929.00
2018	Malaysia	358.78	0.20	7.62	0.54	27957.00
2018	Philippines	346.84	1.94	9.95	0.47	23315.00
2018	Singapore	377.12	0.07	73.12	0.80	1674.00
2018	Thailand	506.75	0.10	11.71	0.51	30297.00
2018	Belgium	542.89	12.92	27.14	0.77	18189.00
2018	Denmark	355.29	0.78	-2.50	0.89	21464.00
2018	France	2782.84	10.49	34.67	0.74	95114.00

2018	Germany	4053.85	6.39	72.02	0.84	223080.00
2018	Italy	2100.39	2.42	37.68	0.65	105675.00
2018	Netherlands	930.16	11.16	102.13	0.85	113539.00
2018	Poland	594.64	1.05	16.00	0.67	170040.00
2018	Spain	1432.29	4.02	58.06	0.70	86642.00
2018	Sweden	551.31	6.68	5.27	0.86	96247.00
2019	China	14572.41	39.96	141.23	0.49	2003044.00
2019	Japan	5118.00	6.76	13.76	0.78	208350.00
2019	India	2835.61	3.53	50.56	0.51	249661.00
2019	Indonesia	1119.10	1.59	23.88	0.52	49623.00
2019	Korea, Rep. Of	1751.05	6.86	9.63	0.73	28215.00
2019	Malaysia	365.18	0.48	7.81	0.55	28654.00
2019	Philippines	376.82	3.59	8.67	0.47	22032.00
2019	Singapore	376.16	2.24	97.53	0.80	1843.00
2019	Thailand	543.98	0.68	3.77	0.50	33748.00
2019	Belgium	536.79	1.28	11.86	0.79	20460.00
2019	Denmark	345.40	11.39	27.03	0.90	23868.00
2019	France	2723.09	28.52	20.43	0.74	95114.00

2019	Germany	3957.65	19.80	52.68	0.84	223080.00
2019	Italy	2019.83	6.12	22.72	0.66	105675.00
2019	Netherlands	929.01	28.27	15.94	0.84	119814.00
2019	Poland	602.59	2.31	13.51	0.66	163990.00
2019	Spain	1403.65	7.23	17.84	0.72	86642.00
2019	Sweden	532.17	12.95	8.76	0.86	96247.00
2020	China	15103.36	27.03	149.34	0.48	2200000.00
2020	Japan	5054.07	7.62	11.77	0.78	220000.00
2020	India	2674.85	0.93	64.07	0.51	270000.00
2020	Indonesia	1059.06	1.84	18.59	0.53	55000.00
2020	Korea, Rep. Of	1744.46	3.17	8.77	0.73	34692.00
2020	Malaysia	337.46	0.12	3.16	0.58	30565.00
2020	Philippines	361.75	0.53	6.82	0.47	21600.00
2020	Singapore	349.17	1.42	74.86	0.79	1808.00
2020	Thailand	500.46	0.88	-6.28	0.51	29549.00
2020	Belgium	529.27	1.38	3.13	0.79	24443.00
2020	Denmark	355.63	1.65	1.37	0.90	24224.00
2020	France	2645.81	29.10	13.17	0.73	100000.00

2020	Germany	3936.99	45.62	69.95	0.84	230000.00
2020	Italy	1905.96	6.18	-18.58	0.66	110000.00
2020	Netherlands	931.81	24.72	-81.65	0.84	122108.00
2020	Poland	605.93	0.25	15.20	0.66	158040.00
2020	Spain	1288.75	9.65	14.24	0.73	90000.00
2020	Sweden	545.15	13.79	20.88	0.86	100000.00
2021	China	18190.80	70.70	180.96	0.47	2400000.00
2021	Japan	5039.15	15.42	34.29	0.79	230000.00
2021	India	3167.27	4.61	44.76	0.50	290000.00
2021	Indonesia	1186.51	1.82	21.13	0.52	58691.00
2021	Korea, Rep. Of	1942.31	25.24	22.06	0.74	38928.00
2021	Malaysia	373.79	0.30	12.17	0.57	34353.00
2021	Philippines	394.09	1.87	11.98	0.46	23387.00
2021	Singapore	436.59	5.90	126.67	0.78	2200.00
2021	Thailand	506.20	0.85	14.42	0.50	31049.00
2021	Belgium	598.89	22.41	9.91	0.79	23908.00
2021	Denmark	408.38	10.23	7.10	0.90	26893.00
2021	France	2968.41	56.07	34.11	0.72	105000.00

2021	Germany	4351.19	75.08	51.22	0.84	240000.00
2021	Italy	2180.66	23.64	-2.95	0.67	115000.00
2021	Netherlands	1055.17	33.25	-70.24	0.83	120821.00
2021	Poland	689.25	1.23	29.24	0.64	179630.00
2021	Spain	1462.22	29.73	38.32	0.73	95000.00
2021	Sweden	637.19	17.77	22.36	0.86	105000.00
2022	China	18307.82	95.98	189.13	0.47	2600000.00
2022	Japan	4262.15	22.41	34.19	0.79	240000.00
2022	India	3346.11	1.23	49.38	0.50	310000.00
2022	Indonesia	1319.10	6.11	25.39	0.53	67746.00
2022	Korea, Rep. Of	1799.36	16.64	25.05	0.73	46614.00
2022	Malaysia	407.61	0.20	16.94	0.57	36170.00
2022	Philippines	404.35	0.23	5.94	0.47	24684.00
2022	Singapore	509.02	9.99	141.12	0.78	2749.00
2022	Thailand	495.65	0.82	11.08	0.50	34072.00
2022	Belgium	593.91	50.11	11.55	0.79	25566.00
2022	Denmark	401.95	18.38	7.75	0.90	29259.00
2022	France	2797.05	30.33	75.98	0.73	110000.00

2022	Germany	4166.87	81.63	27.41	0.83	250000.00
2022	Italy	2105.72	25.09	32.18	0.67	120000.00
2022	Netherlands	1047.36	32.05	-80.44	0.83	120840.00
2022	Poland	695.73	0.52	31.47	0.64	178800.00
2022	Spain	1447.64	13.26	44.89	0.73	100000.00
2022	Sweden	579.90	15.78	44.71	0.86	110000.00
2023	China	18270.35	85.90	163.25	0.47	2800000.00
2023	Japan	4213.17	24.87	21.43	0.79	250000.00
2023	India	3638.49	4.66	28.16	0.49	330000.00
2023	Indonesia	1371.17	3.87	21.63	0.53	65200.00
2023	Korea, Rep. Of	1839.06	14.02	15.18	0.74	49894.00
2023	Malaysia	399.71	0.74	8.65	0.57	34952.00
2023	Philippines	437.06	0.14	6.21	0.46	24684.00
2023	Singapore	505.44	4.55	159.67	0.78	2940.00
2023	Thailand	515.91	0.86	4.55	0.49	35449.00
2023	Belgium	644.97	4.25	23.02	0.78	27892.00
2023	Denmark	407.09	12.46	8.76	0.90	30116.00
2023	France	3056.88	31.36	42.03	0.73	115000.00

2023	Germany	4527.01	67.34	36.70	0.83	260000.00
2023	Italy	2305.27	28.20	18.22	0.66	125000.00
2023	Netherlands	1154.69	38.23	-168.45	0.83	118736.00
2023	Poland	809.71	1.49	28.69	0.64	167030.00
2023	Spain	1620.56	11.80	35.91	0.72	105000.00
2023	Sweden	585.49	20.21	29.42	0.85	115000.00

Appendix B. Data for Renewable energy generation and Green bond volume, CO2 emission per capita

Year	COUNTRY	Renewable energy generation (GWh)	GREEN BOND (Billion US Dollars)	Per capita consumption-based CO2,, emissions(tonnes per person)
2018	China	1,664,816.00	28.64	6.76
2018	Japan	208,350.00	3.60	10.08
2018	India	249,661.00	2.60	1.77
2018	Indonesia	49,449.00	2.53	2.24

2018	Korea, Rep. Of	23,929.00	3.91	13.97
2018	Malaysia	27,957.00	0.20	7.52
2018	Philippines	23,315.00	1.94	1.60
2018	Singapore	1,674.00	0.07	28.43
2018	Thailand	30,297.00	0.10	3.82
2018	Belgium	18,189.00	12.92	18.22
2018	Denmark	21,464.00	0.78	8.66
2018	France	95,114.00	10.49	6.51
2018	Germany	223,080.00	6.39	10.63
2018	Italy	105,675.00	2.42	7.47
2018	Netherlands	113,539.00	11.16	9.71
2018	Poland	170,040.00	1.05	8.68
2018	Spain	86,642.00	4.02	6.30
2018	Sweden	96,247.00	6.68	7.16
2019	China	2,003,044.00	39.96	6.98
2019	Japan	208,350.00	6.76	9.87
2019	India	249,661.00	3.53	1.77
2019	Indonesia	49,623.00	1.59	2.44

2019	Korea, Rep. Of	28,215.00	6.86	13.68
2019	Malaysia	28,654.00	0.48	7.72
2019	Philippines	22,032.00	3.59	1.60
2019	Singapore	1,843.00	2.24	28.32
2019	Thailand	33,748.00	0.68	3.82
2019	Belgium	20,460.00	1.28	17.55
2019	Denmark	23,868.00	11.39	8.01
2019	France	95,114.00	28.52	6.31
2019	Germany	223,080.00	19.80	10.07
2019	Italy	105,675.00	6.12	7.23
2019	Netherlands	119,814.00	28.27	9.52
2019	Poland	163,990.00	2.31	8.18
2019	Spain	86,642.00	7.23	5.95
2019	Sweden	96,247.00	12.95	6.71
2020	China	2,200,000.00	27.03	6.99
2020	Japan	220,000.00	7.62	9.39
2020	India	270,000.00	0.93	1.60
2020	Indonesia	55,000.00	1.84	2.27

2020	Korea, Rep. Of	34,692.00	3.17	12.69
2020	Malaysia	30,565.00	0.12	7.25
2020	Philippines	21,600.00	0.53	1.48
2020	Singapore	1,808.00	1.42	25.31
2020	Thailand	29,549.00	0.88	3.80
2020	Belgium	24,443.00	1.38	15.46
2020	Denmark	24,224.00	1.65	7.28
2020	France	100,000.00	29.10	5.69
2020	Germany	230,000.00	45.62	9.22
2020	Italy	110,000.00	6.18	6.44
2020	Netherlands	122,108.00	24.72	8.54
2020	Poland	158,040.00	0.25	7.61
2020	Spain	90,000.00	9.65	5.23
2020	Sweden	100,000.00	13.79	5.92
2021	China	2,400,000.00	70.70	7.29
2021	Japan	230,000.00	15.42	9.73
2021	India	290,000.00	4.61	1.73
2021	Indonesia	58,691.00	1.82	2.27

2021	Korea, Rep. Of	38,928.00	25.24	13.28
2021	Malaysia	34,353.00	0.30	7.48
2021	Philippines	23,387.00	1.87	1.61
2021	Singapore	2,200.00	5.90	28.82
2021	Thailand	31,049.00	0.85	3.87
2021	Belgium	23,908.00	22.41	17.13
2021	Denmark	26,893.00	10.23	8.00
2021	France	105,000.00	56.07	6.25
2021	Germany	240,000.00	75.08	9.90
2021	Italy	115,000.00	23.64	7.26
2021	Netherlands	120,821.00	33.25	9.10
2021	Poland	179,630.00	1.23	8.35
2021	Spain	95,000.00	29.73	5.71
2021	Sweden	105,000.00	17.77	6.51
2022	China	2,600,000.00	95.98	7.23
2022	Japan	240,000.00	22.41	9.57
2022	India	310,000.00	1.23	1.80
2022	Indonesia	67,746.00	6.11	2.56

2022	Korea, Rep. Of	46,614.00	16.64	13.17
2022	Malaysia	36,170.00	0.20	7.64
2022	Philippines	24,684.00	0.23	1.64
2022	Singapore	2,749.00	9.99	30.33
2022	Thailand	34,072.00	0.82	3.90
2022	Belgium	25,566.00	50.11	17.35
2022	Denmark	29,259.00	18.38	7.69
2022	France	110,000.00	30.33	6.16
2022	Germany	250,000.00	81.63	9.90
2022	Italy	120,000.00	25.09	7.39
2022	Netherlands	120,840.00	32.05	8.80
2022	Poland	178,800.00	0.52	7.91
2022	Spain	100,000.00	13.26	5.70
2022	Sweden	110,000.00	15.78	6.53
2023	China	2,800,000.00	85.90	8.35
2023	Japan	250,000.00	24.87	8.02
2023	India	330,000.00	4.66	2.14
2023	Indonesia	65,200.00	3.87	2.64

2023	Korea, Rep. Of	49,894.00	14.02	11.15
2023	Malaysia	34,952.00	0.74	8.42
2023	Philippines	24,684.00	0.14	1.32
2023	Singapore	2,940.00	4.55	8.19
2023	Thailand	35,449.00	0.86	3.68
2023	Belgium	27,892.00	4.25	7.13
2023	Denmark	30,116.00	12.46	4.61
2023	France	115,000.00	31.36	4.21
2023	Germany	260,000.00	67.34	7.16
2023	Italy	125,000.00	28.20	5.32
2023	Netherlands	118,736.00	38.23	6.74
2023	Poland	167,030.00	1.49	7.05
2023	Spain	105,000.00	11.80	4.66
2023	Sweden	115,000.00	20.21	3.44