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Thesis:

"Financing and Investments in Renewable Energy Sources. Opportunities and Challenges".

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Abstract

This thesis examines the financing and investment of Renewable Energy Sources (RES) in the European Union and the challenges connected to the green energy transition. It focuses on the EU's climate goals, including the European Green Deal and the Fit for 55 Package, which aim to achieve climate neutrality by 2050. The study analyses how renewable energy projects, such as solar and wind energy, are supported through public and private funding.

The research explores important financial tools, including the European Regional Development Fund (ERDF), the Just Transition Fund (JTF), green bonds and Public-Private Partnerships (PPPs). It also examines examples from different EU Member States to understand how investments and policies support renewable energy development.

The findings show that the EU has made important progress in promoting clean energy, but there are still challenges such as unequal access to funding, administrative delays and investment risks. The thesis concludes that stronger cooperation between governments, financial institutions and private investors is necessary to support sustainable energy projects and help the EU achieve its climate goals.

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Introduction

1.1. Beginning

Historical Context and Importance of RES

The global attention is currently, as we can all see, in energy. This is because we need to do something more about climate change. Burning fossil fuels is not a solution. Fuels, especially fossil make several things go into the atmosphere and Earth is losing a significant number of resources that it needs to survive. We do not own a clear picture on how much is the remaining fossil fuel which it leads to a global concern. The remedy that it is suggested is the use of Renewable Energy. This includes wind, biomass hydropower, solar, biofuels, geothermal, etc. Researchers are certain that those energies are the answer because they will never abandon our planet.

In this diplomatic research, it will be presented that the scepter in climate belongs to the European Union who by 2050 wants to achieve 0 emissions working with legislative frameworks. These include Renewable Energy Directives and European Green Deal. In addition, it comes the Fit For 55 Package who wants to end gas emissions by 2030 in the percent of 55% to defeat the 1990 estimation level. It is hoped with these decisions to accomplish technological advancements, regulatory forms and mobilize the economic side.

Aim and Range

There is a critical question on the table. Is it really possible to sponsor the energy model in a way of it being effective and efficient? It is believed that this can happen with public funds and private investment's help through hybrid finance. The main goal is to see what every state that is included in the EU needs to eventually accomplish green energy to work with success. This thesis will explain market – driven structures, the funds of ESIF, importance of saving green bonds and the part that private speculators play such as risk capital, benefit plans and the finance – risk combo mechanisms. With other words, it will be analyzed the fact that alignments can happen between innovation of finance and streams of investment with the help of several factors (Vigneron, 2025). The EU needs at this point to be available on theirs funds in order to reach its climate objectives as the total investment itself. Consequently, these tools of finance should at the end be effective, minimize risk and converge market.

Framework

The paper has 8 parts. Each part looks into the matters of economy and how it affects sustainable energy in European Union.

1st Section is the Beginning. It presents the research that has been done giving some extra details on the aims of study and the organizing stuff. The analysis is based on impartiality of EU's climate ambitions and bonds it with the need of funding in the financial field.

2nd Section tries to achieve the investigation in the climate part of the thesis and create concerns about the renewables. The field of the Energy Market has to be a priority and make EU think twice about their measures. The chapter shows how hard it is to interact European Union with the extent and the domestic systems and achieve coordinated policies.

3rd Section discovers how big is the amount of money that is necessary to fulfill the goals of climate in the EU and finance new and old sources. European Investment Bank makes it entrance here enhancing the importance to alternate economic measures, like impact bonds and low risk mechanisms to change the shape of green finance and clean energy markets.

4th Section discovers in green energy the geographical site of the matter as oppose to the outcomes that may come and the criteria for a united and equal transition on decarbonization by Member States based on reviews of framework institutions and on research and measured data.

5th Section tries to understand and explain why it is a necessity to involve finance houses like banks, PPPs whish means Public Private Partnerships and firms with stakeholders. Green Transition highlights relationships with public and non-public sectors, minimizes threats and checks methods of finance.

6th Section evaluates the evolution of green/blue bonds prioritizing the impact that it will have in the environmental and social field of investment. EU Climate Bonds Standard makes it appearance here where the conversation on the matter is consisted by regulatory frameworks (EU Climate Bonds Standard) and presents how can green bonds be used and elevate the progress of renewable energy resources.

7th Section is about evaluation of the previous sections to contrast tools of finance and jointers and adjust these results to understand if they appear with a healthy outcome without forgetting to be aware of any gaps. There will be presented proposals for green finance in the EU to enhance the investment of money that it is essentially needed for renewable energy.

8th Section is the Conclusion. Here the outcomes of the entire research of this thesis are combined to explore strategical measures for the EU in the upcoming future for renewables and proceed with some comments on how much important in the funding from the government and private investments to achieve by 2050 carbon neutrality.

The Alteration of Energy: A Source of Funds

EU has decided to take a quick turn, and not just try to deal with technology, in the economy. To maintain a reduction in the price carbon in addition with the funds and the resources that are given, it is essential to lower by 24% the emissions according to Delgado – Tellez et al. (2025). This will protect in long term the economy but the only way to be certain of this is the right distribution of resources when it comes to an advanced risk on emerging renewable energy technologies.

Financial executives alternate the moves of investors in green energy and as it can be seen, Vigneron (2025) points out how the advanced spending of companies in their quest to find green stars combines with Environmental, Social and Governance factors when it comes to EU's Taxonomy obligations. The important fact here is the meaning and understanding by investors for the good sake of sustainable financing when it comes to uniformity and clarity.

In addition, every day regional disparities become better and better even with limited funds. The results and the access that has been provided by national subsidies and structural funds explain why when coordinated and accessed the Pan European Climate Fund Model (Scherleitner & Traversa, et al. 2025) is in need of fiscal frameworks in the EU.

Moreover, green bonds alterate the view of things because a memorable increase has been seen in the last couple of years through funds and financial instruments who are obliged to help eco – friendly initiatives (Jiang, et al. 2025). Higher green bond market and many corporates of energy are being lucky due to their countries investment in renewables. The goal to be achieved is to minimize a phenomenon called "greenwashing" with the variables that are given in the previous sentence.

An increase in pension funds is being observed around green energy and according to Yuksel (et al., 2025) in 205 discovery risking is getting smaller in pensions and the money are going to clean energy making green bonds the perfect and most convenient solution to have the funds in the EU's side.

Financing need for helpful and fair systems

Risk and fear are included when it comes to the evolution of green bonds. Although, it is certain that investors are capable of succeeding in the area of clean energy, in order to lower any cost or fear of failing it is important to have public support and private resources to the nations. Enhancement should be made, for the trust and information that are going publicly in the EU abut the economical and energy standards, with prediction into measures and policies. EU cares, as it is mentioned already, about technology and financial tools in order for them to support renewable energy in the long – run but also for them to help frameworks make sure that climate goals will be achieved successfully (Jiang et al., 2025).

This paper combines the conceptual and practical results for the better understanding of renewable energy funding in the European Union showing that the stages of changing in energy are mostly around economic and political matters. In the next sections it will be discovered how the financing by investors, financing by government, private funds and conventional policies become teammates to support EU's vision in the future among nations. Data, charts, tables and analysis of them wil be examined thereafter.

1.2. Research Approach: Structure, Range and Constraints

Methodology, Literature, Information evaluation and Data driven analysis are being presented thoroughly in this diplomatic thesis which intends to justify renewable energy resources between backdrop changing regulatory and climate policy measures in environmental investment.

Study Blueprint

In this chapter it will be seen something called thematic literature analysis where the goal is to combine academic knowledge and based tools of evidence to explain better for the EU Member States the clean energy investment without getting into details on policy papers, articles and reports.

Requirements:

- References are both from native language (Greek) and national language (English)
- Reports are based on periodicals, indexed data and academic journals
- Releasement of papers, policy measures mentioned and articles : 2011 – 2025
- European Union is the main theme that it is talked about being more concerned about climate goals, clean energy green bonds, financial funds and public – private collaborations.

Databases and resources utilized comprised: Scopus, Web of Science , SpringerLink, ScienceDirect, EU Publications Office, EIB Publications, along with pertinent NGO and think – tank reports.

Plan for Analyzing Data

Information from Eurostat, EU Commission and the EIB M(European Investment Bank) are included and considered as statistics that will show growth. A lot of mentions and comments will be given on JTF and ERDF publications (Poland, Romania, Macedonia) to examine the case studies that are given to involve the help and power of government, funds, investments and socio – economic effects. Key Themes:

1. Economy
2. Efficient Policy
3. Equality
4. Risk – Danger Alerts
5. Financial Freedom

The Renewable Energy Framework Within the European Union

2.1. EU Establishment Plan and Climate Goals

European Commission came forward in the Green Deal in 2019, showing a revolutionary transition. The main goal is to achieve climate neutrality by 2050. These ambitious objectives aimed to significantly alter the economic and social landscape of the EU. The Green Deal wants tp be able to to support every country in reaching its objectives, knowing their economic power through Just Transition Mechanism which is designed to finance projects that curb pollution and coal – dependent industries. Commission launched the “Fit for 55” legislative package in the year 2021, aiming to cut emissions by at least 55% by 2023 relative to the baseline Near of 1990 (Kelleher & Daly, 2025).

Emission Trading System alternates and grows out the RES Directive (RED III) and the Carbon Border Adjustment Mechanism (CBAM) to help achieve safety in the EU’s partnerships and make better deals with other countries outside EU which cannot accomplish equal ecological standards.

EU’s energy by 2030 is probably with data analyses be by 42,5% alterated with the help of RES III Directive (RED) which revised by 2023. Allocation is unequal between EU states since countries according to **()** have their own natural resources and economic and ground working standards to adapt the new objectives which was the original goal in the first place. For example, Germany and Netherlands, and other nations of course, afforded to fulfill productiveness at the max and go beyond their 2022 potentials given when some others could not keep up with this outcome. The whole system has potential to collapse if proper notice will not be given in the combination of power and nature according to **()** and will be stopped if funds and policies are harmonically together. This will lead to RED III enhancement among EU nations.

National Energy and Climate Plans (NECPs) is an institution which was originally planned for each and every member state to achieve the best result for their climate purposes with capable strategies and have climate goals in cases like energy supply safety, renewable sources, efficiency of groundwork, etc. While NECPs provide the EU the expectation of plans for every member state, the effectiveness of their outcomes varies across those states. Studies indicate that some NECPs do not possess lofty goals or a clear plan for how the nation intends to accomplish its objectives (Kelleher and Daly, 2025).

Many organizations are part of the EU′s initiative for energy transition, including the Commission, Parliament and Council of Europe. The European Investment Bank (EIB) plays a fascinating role as a financial entity, backing clean energy initiatives via Invest EU and various other tools. The EU initiative is likewise structured around a focus on “community” to enhance the involvement of governmental entities, agencies and citizens. Gray and McArdles Analysis (2025) states that the Green Deal references energy communities, yet their implementation is encountering several challenges related to citizens and local stakeholders alongside suitable EU planning and financing.

How much affected is the EU institution about the upcoming emission policies is an issue that will be discussed giving emphasis on macroeconomy, environment and policy on EU member states. Many nations have to take into consideration measures

like their climate, geographical, social and financial sources because they may have as a backup air and solar but this does not mean they are capable of covering their expenses in order to achieve energy freedom and this leads to not enough funds. The achievement here is according to **()** the strategies like flexibility, potentially effective outcomes and reinforcement to achieve a fair and safe transition.
To sum up, renewable resources and climate action are in the field of energy in the EU very crucial and rely on governments, funds, banks, social and political entities. The aiming of Green Deal and Fit for 55 Package in the policy area can be used through collaborations and ministries.

2.2. Trends and Present Condition of RES Advancement

The last 10 years, as it is explored, in the EU have grown out renewable energy sources because of the installation by the Green Deal and EU sated an extraordinary result surpassing 56 GW in solar and 18 GW in wind facilities (). From 2022 – 2023 timeline the pace of renewable energy sources products reaches to 15% with constant investments and decarbonization efforts.

When it comes to the system oaf hydropower and photovoltaics it can be seen that the market promotes them since there are tax advantages for them and al generated energy models. By 2025 72500 MW are going to be produced by solar panels for 15% of the whole energy that comes from the solar source (Tismus et al., 2025). Also, agrivoltaics for example become a new innovation tool in the energy field since technology is always evolving and, as a result, this leads to increasement of solars and the overall capacity while protecting agricultural land. The measures that help in the advance of the net's reliability allow more and bigger quantities of energy from the RES itself.

The energy of wind to green energy plays a vital role perhaps because it holds the majority of MWs and whatever tools and measures are used hear are more upgraded than solar. For example, Germany, Denmark, Spain and Netherlands own in their field facilities that will help them achieve energy transition targets and in seabed wind technics where are known for a better result in space, strengthen efficiency and minimize land needs. 200 GW were an excess of wind power in 2024 stabilizing and advantaging the grid reliability in the EU **()**

A better and helpful form comes to the rescue in the RES area sector with innovative value – added frameworks who leverage them for green energy and agricultural aims. () explains that in the times that are given an integration would be the use of land and sea to create floating platforms and surpass the trouble of accepting the RES project. In addition, this move takes a better advantage of the local community in local land, where most investors are in the first place. The problem here is that local civilizations do not have an easy change of heart when it comes to RES since it does not need hands to help with maintaining of the project. As it can be seen, the point is to convince locals and individuals to join as producers – consumers (prosumers) with their resources that already have in the country and see the model of decentralization as a smart grid technology.

Scandinavian countries use their resources for wind and hydropower keeping a large amount of funds for their own wealth and this leads to some European Countries to not have the sources and funds that they need to achieve the same initiatives. This problem causes holdups and lower financial access which makes investors see the exist able inequality, RES trying to expand but cannot and markets offer here a settling to import bigger quantities of capital inflows and investments **().**

Numerous cons can be found in renewable energy sources in the side of electricity for controlling the temperature inside close spaces with electric heat pumps, biomass and solar heating systems which will be proved just as useful as any other form of power. A vivid sight is in front of electricity and gas where installations for heat by companies is rapid and the fact that prices go up constantly in gas offer the chance for an eco – friendly way of warmth with contemporary technologies.

Artificial Intelligence is coming here to help Renewable Energy Sources in forecasting but the timeline of it success is unknown for the RES multiple models. Arunkumar et al. (2024) shows that random forests like LSTM and SVM give an opportunity for precise predictions for RES to achieve equal grids and facilitates.

After some consideration, it is possible to say that Renewable Energy Sources in EU states have many pros in technological installations, financial resources, vivid energy landscape and government groundwork but to conquer success in the timeline of 2030 – 2050 states need to overcome their problems with the capital market, the serving portions of renewables and the low approvals.

2.3. Key Obstacles in the Advancement of Renewable Energy

Europe wants to overcome obstacles that are stopping energy transition. Renewable Energy Sources are eager to a rapid and fair allocation of the funds and with the help of Green Deal and RED III Directive, a hopeful framework can exist and prevent these current obstacles and challenges in the way. According to Chiva, 2024 the challenge that it will be faced is how long will the license according to the governmental measures and decisions will take to accomplish having private funds.

Automatically institutional disparities within the Union result in a geographical imbalance in the advancement of RES. In nations with reduced GDP per capita and unstable governments, the availability of finance and readiness to invest hinder the advancement among member states (Gajdzik et al., 2023). Socio - economic aspects are vital, as public acceptance stays limited in member states lacking adequate knowledge on the economic and fiscal advantages of RES.

A major issue is the limited integration of power grids and the absence of adaptable energy storage facilities. The variety of characteristics of solar and wind energy production make obvious of an important stability control systems, which have yet to be fully established at the European level (Milek et al., 2022).

Additionally, following the Russian – Ukrainian crisis, the EU has encouraged measures to enhance energy security and self – sufficiency. Adjusting renewables to this geopolitical landscape shows that Europe needs specific compensation systems and enhancing institutional unity (Dragoi et al., 2024).

To conclude, the engagement that exists in the energy transition is questionable and the cause of that is the lack of an organized and well active pattern which makes communities becoming less and less interested through PV installations. A mix of issues is gathered here regarding technology, institutionalism and social innovations trying to be solved by government.

Opportunities for Funding Renewable Energy Initiatives

3.1. Summary of Investment Necessities

The way to accomplish having financial resources for the year 2030 is closing the gap of investment that exists. This equals with 42,5% energy from green and 55% reduction from carbon, which are more than half precent and remains a big gap in climate energy that in 1990 was not there. Nerlich said at 2025 that the estimated amount of money is from 620 to 740 billion euros that will cover expenses like smart grids, storage spaces, energy production and clen energy infrastructure.

Private Funds are crucial for investment and their strategy is important for energy transition which makes better the strategies for EU's green energy and the outcome on capital markets reduces the risks of strong legislative frameworks. The continuing funds are expanding and becoming more and more specialized in innovative tools, the earnings of market are obvious and in green finance there are many offerings **().**

It is essential and rather obvious, we might say, that EU's climate energy program is in need of private investors to achieve the implementation of having renewable energy resources with the help of regulatory frameworks, formalities and transparency. Meek et al., 2022 imported that in some Member State, RES are usually just so unpredictable in their future procedures without rely knowing the effect that they will have in climate and states are having to face the constant lacking of investors' funds and safety measures.

3.2. Financial Tools and Private – Pubic Sectors

Two forces face each other when it comes to climate energy freedom: government and private investment. This two together decide whether or not Europe will transit to green energy. In early - stage or high – risk projects, externalities or long payback periods minimize and discomfort private investors and public ones who are still providing vital assistance. Straight support, private equity investors, grants, tariffs and pacts for difference represent some of the most effective tools for enhancing the financial capacity of renewable energy initiatives (De Jager et al., 2011). Moreover, by offering guarantees, advantageous loans and technical support, the European Investment Bank (EIB) and the EU's structural funds, including the InvestEU program, significantly contribute to reducing investment risks.

Perhaps public lone cannot fulfill the capital-intensive which EU required to accomplish a decarbonized strategy. As a result, innovative financing approaches from the private sector. Tools such as green bonds, public
private partnerships (PPPs), blended finance approaches, institutional investors – comprising pension funds and insurance firms – are increasingly participating in energy infrastructure (Maliszwska – Nienartowic, 2023). The European Green Deal and the EU Taxonomy Regulation promote this transition by providing standardized definitions and measurements that reduce information asymmetries.

Member States have at their wheel many markets and a variety of instruments in government, tools to promote private investment and taxes. There are some less fortunate countries around us where funds and deposits are not enough to succeed legislative ambiguity and administrative intricacies. The alignment of regulatory policies, when it is combined with funds and enhancing transparent sources, makes necessary to secure that the imbalances while be eliminated.

Together only is the way that public and private investment will successfully affect with green energy the EU's ecosystem with future long - term secure tools, no risk fears and team work collaboration.

3.3. Necessity of Innovation in Economy

The subject here is financial innovation in the European Union for the capacity of green energy. Risk - adjusted financial frameworks and innovative funding tools are so easy to use for the climate purposes that have become the most wanted measures and outcast the old financial instruments to have long - term and high - risk clean energy (Horky and Fidrmuc et al., 2024).

A further introducing in businesses serves secure in climate projects and green bonds. A new project called NextGenerationEU is on the line where 250 billion euros are donated for ecological projects so that EU can have under it protection the vital matter called energy bonds. Also, according to Behera (et al., 2024), there is Innovation Fund's project with the "valley of the death" being in the protagonist position protecting RES and carbon.

Countries like Netherlands and Germany are very eager to know about digital finance because they need to evolve to keep up with the solar community and the enhancement of accessibility to access smart contracts for selling solar panels via peer – to – peer energy markets. This will be accomplished by fundraising.

European Union is trying to adopt the measures and concepts that have come to the spotlight, but there are still difficulties with markets that are not as developed as others and takes banks and funds one step back. To pass and move forward from structural barriers and dangers it will be needed for risks to be minimized in innovation and source of money to be more reliable.

EU Grants and the Help by Governance on Finance

4.1. European Development Fund (ERDF)

A big impact in Europe and especially in green area has made quite an interest in the public and it is the European Regional Development Fund (ERDF). It specializes in sustainable development, regional inequalities and infrastructure resources for RES. The purpose of this project is the achievement of economic and environmental aims through becoming more powerful in the green energy growth by leading states to climate neutrality.

A way of becoming more and more familiar with the ERDF project is to update the grid, advance renewable energy and promote constantly the idea of urban transportation because they do not use more than 30% of the ERDF funds (Zamfir et al., 2011) so that the remaining 70% will be used for co – investment in aspects like solar and wind power.

Another measure is the Just Transition Mechanism (JTM) which cooperates with the ERDF for the renewable energy sources to help regions accept and adopt green energy and give up fossil fuels like oil and petroleum. A useful example heer id Poland where 2 billion euros were donated in the project in order to accomplish having solar panels, coal tools and electricity (Wolf & Zachman, 2015).

Another measure for the sake of green clean energy in being presented and it is the Integrated Territorial Investment Facility (AIF) where here the energy in in a level of multisectors to show others ways of innovation on wind, solar and hydrogen electrolysis. It will be seen how the ERDF will take advantage of the innovation systems nad the capacity to alternate the forms of energy while never stopping the continuous development of ERDF, like for example in Alentejo in Portugal.

There are many things required to accomplish the funds that are needed. ERDF is currently on the project of evaluation to understand if citizens and investors should or not allow, like Romania, stakeholder engagement and guidance that leads to solar PVs with the help of ERDF. The PV will help EU boost the program and have faster results on the design and the funding (De Jager et al., 2011). Many challenges are still though on due to the projects are very often blocked by paperwork and administrative details to secure safely ERDF. So Member States are getting driven by the needs of EU's for co – financing among states to take full advantage of the funds.

The ERDF as time goes by is growing with the EU Green Deal to successfully achieve climate change to advance transparency, be careful of the risks and monitor measurable impacts, along with boosting the funding allocated for climate initiatives. For the years 2030 – 2050 to come, the ERDF wants evolve in decarbonization and the only way to balance the effect of the previous projects with this one is to enhance climate energy capacity and minimize inequalities to make green transition equal and fair to all to balance the outcomes in the 20 - year gap that is given.

4.2. Cohesion

It is essential to notice that the national income is going downwards with leaving the 90% of the Europan Union's common income to lower percentages and that is why here it come the Cohesion Fund which will help Europe become more stable and capable in financial mechanism tools and economic and social cohesion. With the right look in the objectivity of the situation, Cohesion funds will act as a guide in economic matters and climate infrastructure in unions that are less developed to be able to access green energy. All thus comes to the match of the European Regional Develoment Fund (ERDF) with the current Cohesion to achieve clean and renewable energy systems.

The Fit for 55 package is a way of combining the current Cohesion Fund tools with The European Green Deal for the project that lasted between 2021 and its most likely to end in 2027. With a minimum of 37% on the budget for climate goals, they can surely, according to Domorenok (2024) allow Cohesion Funds to adapt climate change and have advantages in policy.

More than 500 renewables between 2014 – 2020 are consistent especially when it comes to palce like Warmian and Masovian where suggestions like solar panels and heating pumps. Cohesion Fund is the big support according to Florkowski and Rakowska (2022) for the decarbonizing of investments. A theme called "Climate Change Adaptation and Risk Prevention" has taken place in Greece including green roofs, flood mitigation systems and pilot microgrids in the largest cities that are there, Thessaloniki and Athens (Thoidou, 2017). By these measures that are being taken provide safeguarding and climate change.

For the original and agreeable members, it can be seen that the percent of 85 %, that concerns the environmental projects are being in a risk and the combining funds that are given plus with the technology given, rings a bell of precaution for the government. But in any case, there are still many inequalities among Member States то be delt with so that administration, believing in policy and financial mechanisms can be achieved. Specifically, as Domorenok said (2024), there has to be an equal solution to combine environmental projects with the prospects and advantages of infrastructure that have difficulties in the areas of funds.

Some obstacles are on the way between Cohesion Fund and the NextGeneration EU plan where financial instruments like loans and funds are given willingly by the National Bank to achieve private investments. For example, countries like Hungary and Croatia have a vivid presentation of the new cope of hybrids and smart grids.

To conclude, the union of climate goals with the Cohesion Funds are a big help to EU's decision on policy with structure, renewables, urban adaptation and transportation to move in the climate freedom in economic matters.

4.3. Just Transition

A very admirable addition to the EU's cast of climate goals is the Just Transition Fund (JTF) where it began flourishing in 2021 to be the key of Just Transition Mechanism (JTM). Through many difficulties, it is now capable for JTF to support and provide in finance and economic programs that require skills for upgrades. A shift from coal, peat, lignite which all mean the low carbon state must happen to prevent the use of carbon companies.

The framework that works here is apparently in a very good level of strategy since the objectives and and standards of cohesion policy are constantly going on and on in development with many national authorities. The European Parliament according to Leppanen and Liefferink (2022) is an important partnership that can benefit the ideas of socialism and democracy that was strongly shaped and mattered in the pandemic of Covid-19.

It is easy to see that the JTF through time has become heavier on responsibilities and is trying to emphasize and show that continuous obstacles in framework's growth. This brings inequalities and will not help in transformative policies and long-term sustainability. According to Vrespy and Munta 20230 transformation in policies is emphasized. In some certain circumstances where countries like Bulgaria and Croatia are involved in cohesive industries, the danger is getting nigger, exaggerating the long – regional stability (Kim and Shin, 2023).

Summarizing the issue of JTM, EU seeks for the fair and right participation with the funds that so generously were guven to provide tools and measures for future plans on growth and structural chanhe to perfect the model called JTM.

4.4. Member States

The JTF offers an equal and fiar climate opportunity for green energy development where many governances are obviously facing difficulties upon the matter and cannot minimize the socioeconomic results from fossils to achieve effectiveness. A country that is on the spotlight is Poland where it brings an estimated given price of 3,5 billion euros to help the EU on coal where also Silesian area contributed. Solar energy needs support for growth but in Poland is not a major protagonist at the moment with the trouble of local stakeholders ruled by state. Moesker and Pesch (2022) know and show in their researches that funds are the most important to avoid any unexpected inequalities amongst EU.

In the other hand, in Romania there is a new carbon area, called the Jiu Valley, where solar parks thrive and NGOs elaborate on green energy constantly. With the truthful JTF impact there is a major assistant but still according to Kim and Shin (2023) there are delays in the antural industrial policy.

Now when it comes to the Balkans, JTM offers gracefully 1.6 million euros to Western Macedonia for their lignite with the government prioritizing infrastructure changes, such as industrial parks and energy storage systems. There are words about favoring more the wealthy areas in Greece than the low states for the energy transitions.

A closer look at the Czech Republic, in Severozapad region shows that there is not a big achievement on fighting poverty with new jobs in the area or with the help of energy (Turitek and Klalova, 2023) and no funds for renewables are being collected.

Lastly, Neetherlands and Sweden are the first of their kind to embrace JTM and achieve actual goals with the funds that are given and were not at all affected that they were not the first recipients of JTM.

In addition to economic redistribution, institution reform is essential to bridge the justice gap. The green transition should focus on equity, clear processes and the input of community. JTM is strong and weak at the same time with numerous effects on the government, EU members, societies and policy funds.

4.5. Matrix Case Study – Just Transition Fund explained

The following theme unites the Just Transition Fund (JTF) in chosen EU Member States, emphasizing the differences in objectives, governance strategies, funding methods and socio – economic impacts. The goal here is to explain how much the JTF has aided in a just, inclusive and efficient shift from carbon – heavy economies to sustainable energy systems.

TABLE 1: Matrix Case

Country / Region	Main Project Goals	Funding Allocation	Governance & Stakeholder Involvement	Socioeconomic & Environmental Outcomes	Key Challenges / Lessons
Poland – Silesia	- Transition from coal to solar energy- Worker reskilling- SME support	€3.5+ billion (largest EU beneficiary)	Central government–led; limited local participation	- Expansion of solar capacity- Job retraining programs- Support for green SMEs	- Low procedural fairness- Need for stronger local inclusion (Moesker & Pesch, 2022)
Romania – Jiu Valley	- Solar parks on former coal sites- Community retraining centers- Regional diversification	Significant share of €1.9B JTF national budget	Strong involvement of local NGOs & municipalities	- New green infrastructure- Improved workforce skills- Social acceptance of transition	- Delays in procurement- Weak industrial policy alignment (Kim & Shin, 2023)
Greece – Western Macedonia	- Decommissioning lignite plants- Development of energy storage & green industry parks	~€1.6 billion from JTM	Top-down, government-led; limited consultation	- Infrastructure modernization- New green jobs potential	- Risk of elite capture- Weak participatory planning (Leppänen & Liefferink, 2022)

Country / Region	Main Project Goals	Funding Allocation	Governance & Stakeholder Involvement	Socioeconomic & Environmental Outcomes	Key Challenges / Lessons
Czech Republic – Severozápad	- Investment in clean energy & digital infrastructure- Support for regional innovation	Moderate share of JTF funds	Regional agencies, low community involvement	- Improved infrastructure- Limited job creation	- Energy poverty persists- Need for participatory budgeting (Žítek & Klímová, 2023)
Netherlands / Sweden	- Integration of just transition principles in national climate plans- Stakeholder empowerment	Small allocations; regulatory focus	High transparency and inclusiveness	- Strong public trust- Policy coherence with Green Deal	- Focus on process innovation rather than compensation (McCauley et al., 2023)

Source: Moesker, K. & Pesch, U. (2022), Topaloglou, L. & Ioannidis, D. (2022)

Financial distribution, quality of governance ad socioeconomic results are closely connected, as revealed by a comparative analysis of Just Transition Fund (JTF) execution across several EU Member States. The thing about the situation is many differences are there in the institutional development and in the matters of governmental issues with the recent study above showing that funds play a big role but not a pivotal one. It can be seen that nations like Poland and Greece that come out with 3.5 and 1.6 billion euros and absorb an already existing side of financial instruments and including social fairness. Moesker, Pesch, Leppanen and Liefferink share the same thoughts on the fact that JTF can rely on these patterns to conquer long – term energy viability and plan with frameworks stakeholders and citizenships.

Comin on the Jiu Valley case, Romania wants to make better of the given funds and this can be accomplished with the help of NGOs and local stakeholders. The current country wants to alterate the transformation of acceptance with the assistance of solar farms on coals, rebuilding facilities for more employees without experience or knowledge on the jobs. All is good with the enthusiasm og a renovative energy model but in Romania there is still some unfairness and according to Kim and Shin (2023) especially with industrial strategies. Governanace must be supported by national framework, domestic policy, institutional capacity and administration to designate a long term economy.

When it comes to the Czech Republic, despite being crucial, infrastructure investments do not consistently lead to substantial social or economic transformation. JTF investments has backed digital infrastructure and sustainable energy technologies in regions such as Severozapad, yet the outcomes regarding job creation, poverty reduction and regional equality remain limited. Zitek & Klimova (2023) state that this difference arises from inadequate social innovation and participatory budgeting, which are crucial for achieving the complex objectives of a fair transition. These findings suggest that to ensure fair and sustainable outcomes, technical advancement should be integrated with inclusive governance and social policy efforts.

Organization and Investment

5.1. The Power of Funding by Industries and The Need for Validation in Investment

With the euro coin it can be seen that
the main provider where the financial framework relies on are the Banking area. This kind of payment is more reliable among states for renewable
energy advancement and the venture capital is more secure without that being a problem for countries like USA tha have dollars as payment coin. Solutions for the best result of green energy are there like photovoltaic farms, offshore – winds and solar panels. The only problem with Funds from Banking is that the lending part is very fluid and the liquid assets and long – term loans with interest rate
cause concerns.This model prioritizes initiatives with minimal digital and technical ha zards and established financial flows, facilitating in green energy industry production efficiencies (Nerlich et al., 2025). Additionally,
the inclusion of official endorsement, concessional financing or co – funding scheme ,frequently offered by organizations like the European Investment Bank
(EIB), diminishes perceived risks, boots creditworthiness and increases capital afford ability for developing the energy of renewables (Delgado – Tellez et al., 2025).

In any other case, Venture Capital is being on the spot because it is not in a very safe place due to the fact that merchant banks do not fund freely new ideas and models that are not likely for sure bring profit. This meant that Venture capital has to cover the damage of this void by providing in the new projects of innovative companies by giving funds, but with an exchange. The investors of VC need stakeholders to provide help on projects like AL tools for energy storage and power grids (Yuksel et al., 2025).

The mix up that is happening between public and private funding is playing an important role on European Union's decisions with new innitiatives like InnoFin take the wheel and expand the idea of venture capital promoting his tools on on green technology issues. The point of this measurement is to minimize the risk that is already therewith the help of investment by sponsors (Bohora et al., 2024) Nonetheless, in spite of its transformative possibilities and achievements, VC funding in Europe is still relatively limited compared to the United States or China, partly on a account of a fragmented markets, differing regulatory frameworks across member states, but the culture of entrepreneurship is not as developed as it could be within the energy sector and, as someone can see, companies have historically been publicly possessed (Maliszewska – Nienartowicz, 2023). Business assets and shores work together in a series of stages within the financing process rather than functioning independently. Startups typically depend on venture capital to finance technology advancement, pilot projects and initial market launch. After proving commercial an economic feasibility, banks fund the project together with venture capitalists. This interaction is particurarly noticeable in the offshore wind industry, where early technology creators received support from VC, while subsequent large – scale deployment is funded through a mix of commercia bank loans and project bonds (Jiang et al., 2025). This is the point where a growth is noticed on capital movement.

The move here is taking in consideration the risk that is given due to pension funds and expand the environmental, social and governance standards. The decisions that

are coming from Banks and companies have come to support the pension fund project and their need for solar panels combining the energy ties (Vigneron, 2025). RES is obviously becoming more and more reliable to eventually lead in cut carbon emissions and energy conversions.

The venture capitals here have minimized their life – span in order top help the energy system achieve its goals and this has created a downfall between the investments that are happening and what the investors expect to happen. Of course this brings problems like the fears that overwhelm the Venture Capitals and want to exit the investment plans to protect energy and financial markets in order to be able to combine the funds by banks and keep the transparency on the course of VC in green energy.

Banks have proven to be very fond of renewable energy especially because they have the support of the government for projects that may come with returns. EU must ensure policy frameworks with success to make stronger connections amongst the Members. To accomplish energy and climate objective institutions, like venture capitals and financial banking, should boost the government and the investors for more efficient projects but at the same time the two of them need to co- exist in peace for the union to be successful.

5.2. Collaboration between public and private sectors (PPPs)

Public – Private Partnerships (PPPs) have become a crucial financing and implementation method for bedrock in the EU in the renewable energy sector. Through the collaboration of resources, expertise and the capacity to provide low – interest loans from both public and private. PPPs will be filling financing voids, speed up project execution and consequently enhance the efficiency of energy systems. Within the framework of the EU's green transit, PPPs play a crucial role in executing complex, capital – heavy projects like alongshore wind farms, extensive solar installations, hydrogen production sites and smart grid upgrades. The core idea of PPPs is the belief that the public sector excels in ordinance and state goals, whereas confidential associates are more skilled in designing, constructing and operating any kind of tasks (Domorenok, 2024).

PPPs when it comes to energy, manifest in different ways, including concession agreements, build – operate – transfer (BOT) contracts, joint ventures and lasting use agreements. The variety of these paragons enables customization to meet the unique requirements and limitations of various member states and shape categories. According to De Jager (2011) the state plays a crucial and critical role in wind economy with PPPs taking charge of the growing decisions private partners take to perfect the adjustments in microeconomic EU energy market.

Here we have another upcoming program, the InvestEU program. Banks reassure PPPs sectors that loans will come to help in the finance of EU mechanisms as well as private builder will come to the rescue with the program of EFSI (European Fund for Strategic Investments). This according to Nerlich (2025) will lead on overestimation and overevaluation of what the amounts of funds that are given can accomplish given the circumstances of public and private investors with the EU Investment Bank helping in this project and others like RES. Mortages and blended structures are essential for cross – border investments in energy field which brings more governance frameworks.

Countries like Denmark, Netherlands and Germany have produced a project called North Sea Wind Power Hub Project which is a special helping key to electricity and operator systems. PPP here makes governments to have offshore wind farms to maintain storage with ability among nations (Tismus et al., 2025). But also in the South, countries like Spain have established solar power plants where many agencies and developers join to long term contracts.

Renewables combining administrative moves to affect legal authorities and PPPs implementations in Member States. In some cases there are some throwbacks in the upcoming PPPs because according to Celic and Vlahinic Lenz (2025) the policy is unpowerful and unstable which is associated with EU. Those many indeferencies also make transferable energy markets with any risks and losing perhaps sustainability and private advantages by developers to exaggerating matters of energy policy and market placement.

There are still some uncertainties on PPPs because many dangers in technological areas have been spotted like the space that the changing landscape uses and the ups and downs of energy prices. Revenue sharing models that focus on capacity availability instead of energy production can reduce the effect of fluctuations on private sector income. To leave behind any conflicts there must be changes in the shift of energy markets (Horky and Fidrmuc et al.,2024).

Fit for 55 and REPowerEU have created an attraction over the years to accomplish a standard PPP policy which, according to Jiang et al., 2025, will reassure a clear and honest alignments of monetary carrots when decarbonizing is the mmain issue. Investing through these means of action is mostly for assurance and stability.

New individuals are coming to light since green hydrogen generation is one of the most famous means of energy. PPP is only expanding and taking more and more space to create an advantage on warehousing and offshore energy for the new investors that will come. It is vital that technology and regulatory frameworks have a team spirits together to achieve the many difficulties that will come. Clean energy the protagonist of the future generations that gives permission for new investments to barge in and alternative funds to come.

Simultaneously, it can be seen that PPPs is trying for a strategy to accomplish EU energy transition to weigh the future disadvantages and advantages for showing the infrastructure needs as well in the technological and in the economic side of the matter. But if PPP is handled with unreliable tools it can cause doubts in the governmental area and not reach the climate goals that are expected for 2030 and, after that, for 2050.

5.3. Hedging Strategies and Motivations in Investment

Counties on EU that affect large economies need funds to try to move to renewable energy in a short period of time and this wil be achieved with technological helps of motion and market coordination. Investment by cooperations is getting more tricky to make it the center of attraction for the green energy to have more opportunities by companies for long – lasting equipment and affordable prices. Addressing the fears that make investors ,both public and private, to avoid giving their funds and tools. The only thing for sure that everyone knows is that clean – green energy has to work, has to be successful. (Nerlich et al., 2025).

Protecting the risks and evolution of energy transition and at the same time avoid market uncertainty is what is called hedging mechanisms. They are surrounded by instruments like forward contracts which is an agreement to buy or sell an asset at a specified price an date in the future by locking in a price and options where the right is given, but not the obligation, to buy or sell an asset like put option. Moreover they have swaps where cash flow agrrements exist on exchanges often used for interest rates and currencies and short selling borrower securities with the intention of repurchasing them at alower price, protesting a lasting long position.

When the prices of market downgrade through public and producers where the main key is Contract for Difference (CfD). The CfD is a simple trading partnership here an investor and a broker are exchanging different outcomes of a story so that the opening or closing of a deal is not owned by any asset. Winning, for profitable traders, is essential for market to not fall shortly. The mechanisms here are balanced for many investors and particurarly in the UK's offshore wind industry where, according to DeJager (2011), the scales are large and there are many institutions funding the projects amongst states like Netherlands and Denmark to fit with their national energy strategies.

With the many dangers that these projects come, it is safe to say that it seems help when capital markets want to procced with funding the strategies of energy to prevent risks from short term changes. According to Horky and Fidrmuc (2024) some examples like derivatives are coming to the spotlight to help with the downpayments on wind and solar energy and be able to support power producers in markets of clean energy which is embodied with fluctuative markets and anomalies in weather. But here Hedging has to be added since its essentiality is obvious and wages and funds do not combine at all. In EU investors that are from 3rd counties, outside of EU, are extra careful with what they offer so that they can handle in the fututе bargaining the exchanges and the hopes that they have already given. This according to Celic & Vlahinic Lenz (2022) is a big all over the world banking issue where investors are subject to regions. Additionally, overly complicated incentive structures compel small developers, investors and communities to go with the project implementation (Gray & McArdle, 2025).

In the future the development of these strategies and incentive are going to be influenced by various structural trends, corporate culture and the environment objectives set by the EU. The growing presence of multifactual green energy is going to amplify the demand for elasticity, little timing hedging solutions tied to intraday and keeping the balance in markets. The adjusted support programs targeting electricity production are essential to the EU's energy transition. At a minimum, energy serves as the foundation for technologically more intelligent economies.
The European Union has a plan to make sure that money is used in a way that's

good for the environmental and this plan includes the European Union Taxonomy and the Sustainable Finance Disclosure Regulation are important for the European Union to make choices about money.

Ecologic Bonds and Financial Tools
6.1. The Green Bond of Europe’s Framework

When the talk is around Green Bonds, EU GBS can be seen as a fundamental component since what the union needs is long – term trust and clearance in energy ties. EU GBS begins its course in 2013 as a helping standard of better confidence and output the risks that may come alongside EU Taxonomy (Kelleher and Daly, 2025).

The funds that will be gathered should, according to GBS, be consumed only for tolls that are for technology and screening criteria to be able to advance as much environmental goals as possible and in the mean time, not cause any damage. The Issue here is to achieve the outcome of the given criteria which is adopting GBS and enhance opportunities and trust in the NextGenerationEU. As noted by Vigneron (2025), the standard has started to affect corporate issuance strategies, as companies modify internal ESG processes to align with the taxonomy requirements. By establishing stringent standards for environmental integrity and transparency, the EU GBS seeks to boost the credibility of green finance and develop a new asset class for the bond market that aligns with Europe's climate transition objectives.

6.2. Trends in the Market and Issuance Data

The green bond market is not just something for specialists anymore. It is now a part of finance that helps the environment all around the world. In 2023 organizations in Europe issued than 330 billion euros in green bonds. This is 40 percent of the total green bonds are becoming more important. The European Union and green bonds are becoming more important. The green bond market and the European Union and well because people believe in them.

Sovereign and supranaational entities, especially the European Commission via the NextGenerationEU recoovery initiative, have significantly contributed to the growth of the green bond market. Between 2021 and 2025, the EU issueed 250 million euro in green bonds as part of this proggram, positioning itself as the largest single issuer of green boonds globally. Corporate issuers have mirrored this trend, as energy instruments to fund solar parks, wind farms, green buildings and extensive clean mobility infrastructure (Behera et al., 2024). Green Bonds developed into a distinct category of bonds.

In spite of significant growth in the green bond market, regional inequalities continue to hinder their effectiveness. Western and Northern Europe lead in issuance due to their market credibility as predominantly developed economies, while Central and Eastern European nations experience underfunding linked to market maturity disparities.

6.3. Instances of Projects Funded by Successful Green Bonds

Those reports issues demonstrated precisely this: the variety of requests and the capacity of green bonds to catalyze significant private and public investment to support EU climate objectives.

A prominent instance is the NextGenerationEU Green Bond Programme, where the European Commission secured more than 250 billion euro to fund climate – related projects in Member State. Spain was the biggest beneficiary of national recovery plans, which directed green bond funds to upgrade the rail system, lower transport emissions and enhance public buildings for energy efficiency. A study by Jiang et al., 2025) found that these initiatives collectively lowered national GHG emissions by 1.8 % over 2 years, in addition to increasing employment and income in the construction industry.

In the business world, EDF (Électricité de France) has released more than 10 billion euro in green bonds since 2013 to finance a range of offshore and onshore wind farms, solar facilities and hydroelectric improvements. One notable project was the Norther Offshore Wind Faarm in the Belgian North Sea, which introduced 370 MW of renewable capacity and accounts for about 7% of Belgium's overall electricity consumption. Moreover, outside evaluations validated that the project fulfilled the EU Taxonomy criteria for significant climate mitigation (Behera et al., 2024).

Citified green bonds have significantly contributed to local sustainability transitions, yet their effects are not thoroughly recorded or assessed. The city of Gothenburg, Sweden became the first municipality globally to launch a green bond in 2013. Since that time, issuances have supported the ElectriCity Bus Project, a collection of public transportation that moves with electricity and hybrid measures combined with smart charging systems, leading to lower annoying sounds and infection levels in central Gothenburg. This project if frequently cited as an example of municipal bonds that promote urban low – emission transportation (Gray and McArdle, 2025). Additionally, a cross – border instance is the Nordic Investment Bank (NIB), which has released green bonds to finance projects in Baltic area. A significant case is the upgrade of the Vilnius District Heating System, where financing through NIB green bonds facilitated the switch from fossil fuels to biomass and waste – to – energy solutions. As noted by Vigneron (2025), this resulted in a 70% decrease in oxygen emissions from heating in the capital of Lithuania. What is being seen how much appreciated and needed are energy transitions to help with the processing.

6.4. Effect Matrix of Case Studies – Projects Sponsored by Green Bonds in EU

TABLE 2: EFFECTS OF MATRIX CASE

Issuer / Programme	Country / Region	Project Type	Funding Volume	Main Objectives	Key Outcomes	Challenges / Lessons Learned
NextGenerationEU Green Bonds	EU-wide (e.g. Spain, Italy, France)	Multi-sector (renewables, energy efficiency, transport)	€250 billion (2021–2025)	Financing national recovery plans aligned with Green Deal and Fit for 55	- Modernisation of rail networks (Spain)- Energy-efficient public buildings- Reduction of GHG emissions by 1.8% (Spain)	- Ensuring taxonomy compliance across diverse projects- Risk of uneven implementation across Member States (Jiang et al., 2025)
Électricité de France (EDF)	France / Belgium	Offshore wind & solar	€10+ billion (since 2013)	Expand renewable capacity and reduce reliance on fossil fuels	- Norther Offshore Wind Farm (370 MW)- 7% of Belgium's electricity demand covered- Verified taxonomy compliance	- Need for continuous impact verification- Dependence on favourable energy prices (Behera et al., 2024)
City of Gothenburg	Sweden	Urban transport & green infrastructure	~€1.8 billion (multiple issuances)	Promote sustainable urban mobility and reduce emissions	- Launch of electric/hybrid bus fleet- Reduced noise and air pollution- Public acceptance of low-emission zones	- Administrative burden of frequent reporting- Limited scalability for smaller municipalities (Gray & McArdle, 2025)

Issuer / Programme	Country / Region	Project Type	Funding Volume	Main Objectives	Key Outcomes	Challenges / Lessons Learned
Nordic Investment Bank (NIB)	Baltic Region (e.g. Lithuania)	District heating upgrade	€500 million+ in green bonds	Support transition to renewable heating sources	- Vilnius district heating shifted to biomass & waste-to-energy- 70% reduction in CO_2 emissions	- Need for stable biomass supply chains- Complexity of multi-country project coordination (Vigneron, 2025)
KfW Green Bonds	Germany	Energy efficiency & renewables	€50+ billion cumulative	Finance private sector green investments and housing efficiency	- Significant GHG reductions in housing sector- Strong investor demand- Model for national green bond design	- Managing verification at large scale- Need for unified EU-wide metrics (Behera et al., 2024)

Source: Jiang, Y. et al. (2025), European Commission (2024)

Analysis and Comparison of Financial Tools Productiveness

7.1. Assessment Standards

- Financial Further: The extent to which the instrument generates additional capital beyond what the markets could independently supply.
- Efficiency and Leverage: The ratio of private to public funding obtained for every euro invested.
- Accessibility and Inclusiveness: The degree to which resources are available to different stakeholders, including local authorities, small and medium enterprises and underserved regions.
- Responsibility and Clarity: The efficiency of monitoring, reporting and verification mechanisms (MRV).
- Environmental Influence: Measurable Role in boosting renewable capacity, cutting emissions and adjusting to climate change.
- Risk Reduction: The capability to attract institutional investors by decreasing market, credit and regulatory risks.
- Policy Alignment: Adherence to national climate strategies, the Green Deal and EU Classification.

These standards enable a structured assessment of EU Structural Funds, Public – Private Partnerships, Green Bonds and Hedging Mechanisms in meeting climate and investment goals.

7.2. Pros and Cons

TABLE 3: STRENGTHS AND LIMITATIONS

Instrument	Strengths	Limitations
EU Structural Funds (ERDF, CF, JTF)	- Strong redistributive role reducing regional disparities – Non -repayable grants enhance affordability.- Integrated with cohesion policy and NECPs .- High climate spending share (>30%).	- Bureaucratic complexity and slow absorption.- Limited flexibility for innovation.- Uneven administrative capacity across Member States.
Public-Private Partnerships (PPPs)	- Mobilise large-scale private capital.- Efficient risk-sharing between sectors.- Enable delivery of complex infrastructure (e.g., offshore wind).	- Require strong governance and legal frameworks.- Risk of fiscal burden if poorly designed.- Limited community participation in some cases.
Green Bonds	- High investor demand and ESG credibility.- Transparent, standardised via EU GBS.- Mobilise long-term capital for green projects.- Scalable across sectors (transport, housing, energy).	- Regional concentration in mature markets.- Risk of "greenwashing" if verification weak.- Requires robust reporting and taxonomy alignment.
Hedging Mechanisms (PPAs, CfDs)	- Stabilise revenues and reduce risk exposure.- Increase bankability for investors.- Enable institutional investment participation.	- Complex contract design.- May not address early-stage technology risk.- Limited accessibility for smaller developers.

Source: European Commission (2023), European Commission (2021–2027)

The comparable table illustrates how each funding instrument uniquely yet complementarily supports the EU's renewable energy objectives. Despite often causing delays in project execution due to their bureaucratic intricacies, EU Structural Funds possess significant potential to improve territorial cohesion and social equity, especially in underdeveloped areas. Government here to help and avoid and inequality has established Public Private Partnerships (PPPs) which have a distinguish strong framework environment to remain influent in more competitive financial markets. Tools like Power Purchase Agreements and Contracts for fiscal imbalances make a stable space for projects to blossom and make smaller parties at

a disadvantage with favoring larger developers. The explanation here in the chart is showing climate problems across EU and fund markets for future partnerships.

7.3. Obstacles and Constraints in Renewable Energy

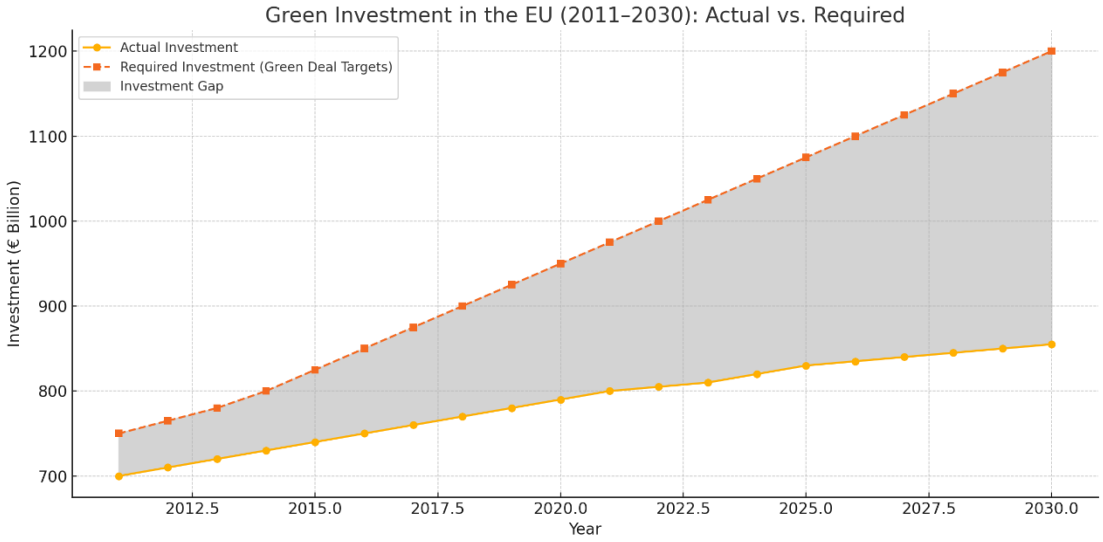

FIGURE 4: OBSTACLES OF RES

Source: European Investment Bank (EIB)

The Chart here promotes a figure called X to point out the gap between EU's climate financial gaps with tools like Just Transition Fund and InvestEU to connect the disproportional stages. Between 2011 and 2030, around to 800 billion euros each year, became the original investment line, in order to accomplish emission transportation and a modern look for projects like Fit for 55 package and European Green Deal exceeds 1.2 trillion euros by 2030 (ECB, 2025). According to Behera et al., 2024, Member States need to be flexible or try to attract private investment. For the maximum encouragement, the risks that come and go and the RED unemployment of EU the chart shows the coordination of regulatory frameworks.

7.4. recommendations for Strengthen Impact

With the help of ERDF, JTF, PPPs and green bonds in EU's advanced renewables many various matters still continue to effect the outcomes. The following essences and the progressive policy modifications aim to address the persistent investment gap and move past minor, gradual advancements toward a comprehensive, transformative model.

I. PECIP

Pan – European Climate Investment Platform is a new AI form od information to reunite and connect in an effective way all EU tools like Green Bonds, Structural funds, EIB tools, Innovation Funds and PPPs to assist governments and authorities to maintain their classified data into a transformative page for climate purposes. PECIP wants to:

1) Accomplish immediate info on accessible funds, proposal invitations, eligibility requirements and environmental performance metrics across all EU programs, ensuring a comprehensive perspective on funding opportunities.
2) Enable cross – border investment, permitting regions to combine resources and work together on renewable infrastructure (Hydrogen Pipelines)
3) Containing any overlaps between programs such as ERDF, JTF and InvestEU and coordinate private and public funds.
4) Upcoming risks and results of algorithms often combine grants with loans for the maximum unification.

II. Flexible "Impact – Connected Financing" System
1) EU seems to being able to find very often on the budget solutions instead of focusing on the fastest and most efficient ways of results based of course on funds and financial support in general to measure the advantages and disadvantages of innovation and carbon emissions.
2) In this framework, initial payments would finance project establishment whereas later disbursements would depend on indecently validated outcomes.
3) Projects may receive technical support if they prove to be unable to have automatic pipelines

III. "Just Transition Equity Index"
1) JTEI's duty is to ensure that renewables are in an exclusive asses of investment choices.
2) Metrics include local job creation, SME involvement, gender equity, public ownership and benefit distribution amongst many diversity of incomes.
3) Each and every year the advancement evaluates the areas for duplication purposes

IV. Digital – Technological – Friendly Bonds
1) For the bonds in the energy field, EU introduces Green Digital Bonds in a blockchain framework.
2) Approximately around 100 – 500 euros are gathered as investing funds by communities to accomplish initiatives like solar farms and energy fields.

3) The authentication of the procedure, the collaboration of banks and the enormous help from public owners establishes access, beneficial outcomes, and climate initiatives.

This expansion and the changes that come with it collect green financing tools with a performance based on data and frameworks. EU has in it’s plate new sources to access and fair and equal meausers to handle.

Conclusion

8.1. Conclusion of Researching and Showcases

It is essential to say that the European Union plays an important role on the implementation of renewable energy with the help of investors and their funds. The tactics that are being used are essential to the acceleration of energy and funds that are being here like Cohesion, Development and Just Transition to justify the financial economies and the resources that are given. This paper has faced European Green Deal, Fit for 55 packages, NECPs and despite all the difficulties and the circumstances the effect that came out was capable to absorb all the hold ups and the encouragement that the investments needed.

8.2. Strategic Perspective on Finance Renewable Energy in the EU

The unification in strategy is obvious when it comes to JTF and InvestEU for the evolution and vinification of the outcome. The ecosystem should be a priority for the best delivery outcomes amongst ERDF and data to perform a more aligned and united government. Mnay centric systems are in the importance of enhancinfg the performance and transparency to adjust in the accountability area to accomplish an impact on blockchain and artifiacial intelligence. Funds are essential for the transition of upcoming risks which equally are vital for the innovation capacity. Green Transition should focus on the guaranteed risks that are being taken and how to create an Equity index environment rather than only care for gas emissions and renewables. Public energy, should also be enhanced to give a little push to private investors and create a digitral and more technological space to help citizens absord the information that it s needed to learn green bonds. Financial frameworks should work on the supporting system to guarantee long – term investing strategy in Europe’s Strength and position.

8.3. Last Observations

In this thesis, EU plays its vital role with the many risks that come with that and showing than in renewable energy, financial frameworks and funds can be jeopardized because unequal situations may occur. Investor' s and Market's collaboration are essential help to keep and stabilize economic and ecological creativity to the variety of policies. EU must act like the whole investment is a transformation to green energy financial formative with a twist of digital and technological mindset that any person can access. The enhancement must come from within, as a matter of fact from the government and its funds, to adapt in the new data and procced to measures that bring solutions to the understanding of the AI systems and digital platforms. Citizens should be able to play their part in the making of everyday energy use and adjust in it smoothly. Renewables over the years are a critical matter to the EU and the future that the nation wants to provide to it' s people. It was and always will be the best outcome with the better results.

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