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Green Bonds: an alternative source of financing in the Era of Climate Change

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INTRODUCTION

At the end of 2007 a group of Swedish pension funds had the intuition to invest in climate friendly projects. They did not know how to invest in green projects and they asked to the World Bank for support. A year later, in 2008, the World Bank issued its first green bond, introducing a new tool in the market that allowed financial investors and projects to join forces against climate change.

The object of this thesis is to study and shed light on an innovative tool: green bonds. Climate change is the reason behind the birth of these new green financial instruments, highlighting the global need of stimulating financial investors towards environmental sustainability projects, thus avoiding the need to allocate resources on projects that produce high CO_2 emissions and greenhouse gases.

The purpose of green bonds is therefore a kind of win-win strategy, where investors increase their profits and, at the same time, individual governments are able to comply with the Paris Agreement guidelines. In this context, energy industry plays a key role against climate change. In fact, the energy transition aims to shift from fossil fuel-centered energy to a carbon-neutral one, based primarily on renewable sources. Renewable energy is placed at the foundation of the thesis, highlighting how the issuance of green bonds can facilitate the energy transition in Italy.

After having extensively studied climate change, climate finance and green bonds in general, the objective of this thesis is to analyze whether the issuance of a green bond in the renewable energy market can be a viable alternative to conventional sources of financing used in Italy such as project finance, from a shareholder perspective. In particular, the analysis is conducted on the debt refinancing of a hypothetical company that has a wind farm located in Italy as its core asset. Through the construction of a financial model, the 10-year financial statements forecast of the company will be proposed, assuming two different scenarios: the first one with a refinancing using project finance and the second one issuing a green bond. The proposed analysis does not aim at stating a general and univocal result but rather to foster further future research on the topic.

The motivation behind this thesis is the desire of inspiring the new generations to a greater sensitivity around climate change, trying to combine both economic and environmental interests. Climate change is now an acknowledged problem, as it is the key role played by economics and finance in the future of our planet. The Covid-19 pandemic crisis must be considered as a wake-up call. In fact, it has shown that humans are not invincible and, on the contrary, they are vulnerable without a common global effort. In the financial field, green bonds represent the viable way to move from the profit maximization paradigm to a more sustainable and fairer future. The symbol that those instruments represent in sectors where profit maximization has always been the main goal is the main reason behind this research.

The structure of this thesis is designed to gradually introduce green bonds, starting, as mentioned above, from its roots in climate change, exploring similar instruments of climate finance and finally demonstrating empirically how they can be a viable alternative to project finance in the renewable energy market in Italy.

The chapters will be organized as follows.
Chapter 1 introduces the climate change issue, highlighting the main global warming causes. The chapter is focused on how modern society has dealt with climate change throughout history, from the first conference in Rio de Janeiro in 1992, through the Kyoto Protocol in 1997, the Copenhagen Agreement in 2009, and finally with the most important agreement, the Paris Agreement in 2015. The final part of the chapter is dedicated to the description of the SDGs (Sustainable Development Goals) and the importance of the energy sector in the fight against climate change. In addition, a final paragraph discusses the relationship between climate change and the Covid-19 pandemic.
Chapter 2 is dedicated to the description of climate finance. In particular, the first part of the chapter focuses on the low-carbon transition, highlighting the public and private actors in climate finance and how the relationship between public and private is fundamental in the energy transition. The second part of the chapter focuses on climate finance instruments, from the instruments to raise funds (Green Bonds, Climate Policy Performance Bonds, Catastrophe Bonds and Debt for Climate Swaps) to the instruments to distribute funds (Capital Instruments and Risk Management Instruments). Finally, the final part discusses the consequences of climate finance after the Covid-19 pandemic.

Chapter 3 is entirely focused on describing green bonds, highlighting how these innovative instruments work. In addition, it outlines the Green Bond Principles and the Green Bond Standards, which are the key elements in the green bonds classification and categorization. Moreover, the developments in recent years have showed how their use has grown exponentially in the current decade. Finally, the last part of the chapter is dedicated to the characteristics of green bonds, the so-called "greenium" and a final focus on the green bond market in Italy, supported by the example of the green bond issued by Enel S.p.A.

Chapter 4 proposes an empirical analysis about the issuance of a green bond. In particular, as described above, the analysis compares the debt refinancing of a hypothetical company operating in the renewable energy market in Italy with the use of project finance and the issuance of a green bond. The proposed analysis is constructed from the point of view of the project shareholders/sponsors, obtaining a final NPV (Net Present Value) of the project for both cases.

The literature on the topic has proved to be still fledgling as confirmed by Conde et al. (2020). Their work is taken as a reference to develop the analysis of this thesis.

Therefore, the chapter is structured by introducing the project finance instrument, currently the most widely used source of financing in Italy in the renewable energy market. After a brief description of the current market situation in Italy, with particular regard to the incentive system, the last part will be dedicated to the empirical analysis described above.

1. CHAPTER: CLIMATE CHANGE

Climate Change surrounds us and we cannot avoid it. It is one of the major challenges of our century and it is emerging as one of the greatest challenges of our society[1]. It is well established that climatic variations are the most important threat of the modern age, considering that its effects affect the human society, the economies and the destiny of our planet. The causes of the so-called "Global Warming" are relatively easy to define. Studies and academic research agree that humans are constantly influencing both climate and the temperature of the Earth by burning fossil fuels, this being one of the most important causes of global warming. The process of burning fossil fuels has the consequence to add enormous amount of greenhouse gases to the atmosphere, sustaining and increasing the greenhouse effect and the global warming.

According to Kaddo and Jameel R. (2016), greenhouse gases are the main contributors to climate change. They are very efficient in trapping heat into the atmosphere generating the greenhouse effect. Solar energy is absorbed by the Earth's surface and then reflected back to the atmosphere as heat. As the heat goes out to space, greenhouse gases absorb a part of the heat. After that, they radiate the heat back to the earth's surface, to another greenhouse gas molecule, or to space.

The main concern for scientists is the emission of CO_2 since it is about 75% of the total global emission of greenhouse gases (Burghila et al., 2015).

The increasing urbanization and industrialization led to the chaotic consumption of natural resources, severe pollution, natural disasters and an irreversible imbalance of the Earth's system[2]. Greenhouse gases are considered the main human-induced drivers of climate change[3]. Among the gases that contribute to sustain the greenhouse effect (like carbon dioxide, methane and nitrous oxide), carbon dioxide is certainly the most dominant cause of this kind of change, representing the 75% of global emissions. The concentration of CO_2 is rising as a result of fossil fuel burning[4].

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[1] Burghila et al. (2015) - *Climate Change Effects – What's Next?,* Agriculture and Agricultural Science Procedia 6, 405 – 412

[2] Burghila et al. (2015) - *Climate Change Effects – What's Next?,* Agriculture and Agricultural Science Procedia 6, 405 – 412

[3] OECD (2008) - *Annual Report 2008*

[4] American Meteorological Society (2008) - *Weather Analysis and Forecasting Committee 2008 Annual Report*

On a daily basis, the process of climate change is represented as the increase in temperature that affects populations all over the world, altering social systems, economies and the environment around us. Very hot or cold waves, periods of drought, hurricanes, floods and fires are putting food safety in serious danger and, at the same time, our homes and our cities, our companies and our health.

In this particular scenario, it is interesting to reflect on how the modern society has dealt with the evidence of climate change, starting from the recognition of the threats to the creation of new ways of funding green projects, pointing out that climate finance has a central role on this battle against climate change.

1.1 Rio de Janeiro 1992

At the beginning of 1800, the first studies about the importance of the atmosphere and its connection with the climate were carried out.

The real breakthrough was in 1970, when the World Meteorological Organization (WMO) started to study the connection between human activities, CO_2 and the growth of temperature on the planet. The connections were confirmed and finally the WMO issued the IPCC (*International Panel on Climate Change*) in 1988. Its goal was to summarize scientific evidence on climate change and to partially reassess governmental control over the climate change issue. After the first studies, the worries about greenhouse gases and their connection with the temperature of the planet were confirmed and the Framework Convention on Climate Change (FCCC) was established in May 1992 in Rio de Janeiro. The Convention was not an end-point but rather the start of an ongoing process , the beginning of the guidelines to fight the global warming. In particular, Article 2 represents the main objective of the conference: "*Stabilize greenhouse gas emissions in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system*"[5].

The conference in Rio was also important because it launched a new way of interacting between developed and developing countries. Indeed, specific commitments for industrialized countries and the former Eastern Bloc were defined: they had to "take the lead" in the GHG (greenhouse gases) emission reduction and advanced reporting[6].

[5] UNFCCC (1992) - *Article 2*, Rio de Janeiro 3-14 June 1992
[6] UNFCCC (1992) - *Article 4.2*, Rio de Janeiro 3-14 June 1992

Moreover, industrialized countries excluding the former Eastern Bloc had to provide "new and additional" financial resources needed to cover costs of reporting obligations as well as mitigation and adaptation activities costs supported by developing countries[7]. In 1994 more than 50 states approved the UNFCCC and it finally entered into force. The IPCC's second assessment report in 1996 underlined the fact that climate change mitigation was a necessity[8].

1.2 Kyoto Protocol

During 1997 in Kyoto, Japan, 160 countries of the UFCCC[9] (United Framework Convention on Climate Change) adopted the Kyoto Protocol, which established legal limits for industrialized countries on emissions of carbon dioxide and other "greenhouse gases"[10]. The complexity of the Kyoto Protocol reflected the economic and social issues raised by climate change[11]. In particular, the protocol aimed to "reduce emissions of greenhouse gases in developed countries and the global emissions target was 5,2% below the 1990 level to be achieved over the 2008-2012"[12].

In fact, the art. 3 par. 1 of the protocol states that the overall reduction should be at least 5 per cent[13].

The Kyoto Protocol also provided a possibility for countries to use a system of flexible mechanisms for the acquisition of emission credits.

The first mechanism was called "Clean Development Mechanism" (CDM) and it allowed industrialized countries and economies in transition to implement projects in developing countries that produce environmental benefits in terms of reducing greenhouse gas emissions, in order to achieve emission credits.

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[7] UNFCCC (1992) - *Article 4.3*, Rio de Janeiro 3-14 June 1992
[8] Bodansky, D (2001) - *The History of the Global Climate Change Regime*, International relations and global climate change
[9] United Framework Convention on Climate Change (1992) - *opened for signature June 4 1992*, S. Treaty, DOC no. 102-38, 1992
[10] Clare Breidenich et al. (1998) - *The American Journal of International Law*, Vol. 92, No. 2 (Apr., 1998), pp. 315-331
[11] Chamber of Commerce and Industry of WA (1999) - *The Kyoto Protocol And Greenhouse Gas Emissions*
[12] Wigley T (2008) - *Geophysical Research Letters*, Vol. 25, No.13, Pages 2285-2288, July 1, 1998
[13] UNFCCC (1998) - *Kyoto Protocol to the United Nations Framework on Climate Change*

The second mechanism, called "Joined Implementation" (JI), allowed industrialized countries and economies in transition to implement projects for the reduction of greenhouse gas emissions in another country of the same group and to use the linked credits jointly with the host country.
The third and last mechanism was called "Emission Trading" (ET) and it consisted in the possibility for industrialized countries and economies in transition to "trade" the emission credits. In other words, a country which reduces the emission of greenhouse gases more than the objective can exchange that credits to other countries which are unable to achieve those objectives, maintaining the overall balance.[14]
The most important condition of the Protocol stated that, in order for the agreement to come into force, it had to be ratified by no less than 55 signatory states among those producing at least 55% of pollutant emissions. This last condition was achieved only during 2004, when Russia signed the agreement.

1.3 Development after the Kyoto Protocol: The Stern Review

After the first meetings organized and studies produced to mitigate the emission of greenhouse gases and, in general, climate change, a particularly insightful research (and the following book, "A blueprint for a safer planet") was the Stern review, published in 2006 by Nicolas Stern, helping the community to understand the real risks of the climate change.
The general opinion before the Stern Review was that the overall costs of mitigating the actions against the climate change were too high and, consequently, the cost of climate change was underestimated. In fact, Stern, after a life lived alongside poor people in order to combat global poverty, in 2006, with the support of the Britain government, showed with his review that "*costs of climate change would be higher than the costs of reducing GHG emissions and, as a consequence, strong political initiatives were unavoidable and were needed as soon as possible*"[15]. Stern's approach had little to do with the pessimistic environmentalism way to act that, trying to raise awareness through shock, all too often leads to resignation. The central message was simple: the risks are enormous (social,

[14] European Commission (2005) - *The Kyoto Protocol*
[15] Stern N. (2007) - *The economics of climate change. The Stern review*, Cambridge University Press, Cambridge

economic and environmental) but it is possible to contain them significantly if we act quickly and decisively. The watchword is one: investing.

Moreover, in April 2008 Stern said that the severity of his studies were confirmed by the 2007 IPCC report. That report showed that the presence of greenhouse gases such as methane, carbon dioxide and nitrous oxide in the atmosphere had been rising from 1800 until today[16]. They admitted that in the Stern Review "(…) *we underestimated the risks and we underestimated the damage associated with the rise in temperature. We underestimated the probabilities of temperature increases*". In 2008, Stern said also that, since climate change was going faster than expected, "the cost of reducing carbon would be even higher, by about 2% of GDP instead of 1% in the original report".[17]

1.4 The Copenhagen Agreement

On December 19 2009, the Copenhagen Conference ended with a result far below expectations. Despite the presence of over a hundred heads of state and government, the climate summit did not succeed in creating a global agreement to replace the Kyoto Protocol, which was going to expired in 2012. Without an agreement, the 190 member countries of the UNFCCC postponed negotiations to 2010 and, as a conclusion of the conference, a broad agreement on the targets for reducing 2020 greenhouse effect was achieved: the Copenhagen Agreement. The Copenhagen Agreement was a 5 page document that recognized climate change as "*one of the greatest challenges of our times*" and stressed the need to limit the increase in global temperature below 2° C. The text did not contain mandatory obligations but invited the industrialized countries to indicate their reduction targets and developing countries to indicate the actions that were intended to be put into practice in order to limit the expected emissions growth in the next ten years. On 31 January 2010, the deadline set for joining the agreement, 55 countries had formally adhered to the document, indicating their plans and reduction targets.

[16] Solomon S. et al (2007) - *Climate change 2007. The Physical Science Basis. Contribution of Working Group*, to the Fourth assessment report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, New York

[17] Jowit, Juliette; Wintour, Patrick (2008) - *Cost of tackling global climate change has doubled, warns Stern,* The Guardian. London.

On the other hand, the indications presented were far below what was considered necessary by the international scientific community and would have not prevented an increase in the global temperature above 3° C. For this reason, that agreement represents only an intermediate stage to be quickly surpassed by far more ambitious goals and commitments. Until 2015, the regulations to combat climate change were dedicated only to few states, leaving the others without rules or guidelines. In 2015, during COP21, a new fundamental agreement between nations was signed, as we will see in the next paragraph.

1.5 The COP 21 (Paris Agreement)

During 2015 in the *Climate Change Conference of Parties* held in Paris, the so-called COP21, 197 countries reached a common political agreement: the Paris Agreement. This agreement has been fundamental in the fight against global climate change and against the impacts generated by global warming, recognizing that "*climate change represents an urgent and potentially irreversible threat to human societies and to the planet*"[18]. One year later, on 5 October 2016, the threshold for the entry into force of the agreement was achieved. The Paris Agreement entered into force on 4 November 2016, thirty days after the date on which at least 55 Parties to the Convention (accounting in total for at least an estimated 55 % of the total global greenhouse gas emissions) deposited their instruments of ratification, acceptance, approval or accession[19].

The states already involved in the previous treaties acknowledged that the effort of a few nations was no longer enough and a common commitment was needed to limit the emissions of greenhouse gases. In fact, the Paris Agreement represented the largest global effort with the aim of involving all the nations of the world in the fight against climate change, with particular attention to developing countries, declaring that climate change was the greatest threat to the future of our planet.

In particular, the parties committed to transform their development trajectories so that they set the world on a course towards sustainable development, aiming at limiting global warming to 1.5° to 2° degrees above pre-industrial levels.

[18] IPCC (2020) - Link: https://www.ipcc.ch/sr15/faq/faq-chapter-1/

[19] UNCC (2015) - *Paris Agreement – Status of Ratification*, link: https://unfccc.int/process/the-parisagreement/status-of-ratification

Through the Paris Agreement, the parties also agreed to a long-term goal to increase the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production. Additionally, they agreed to work towards "*making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development*"[20].

The heads of Governments also understood the need to reach the global peak of greenhouse gas emissions as soon as possible in order to proceed in the future with rapid reductions depending on the available technologies, achieving a balance between emissions and removals by sinks of greenhouse gases in the second half of this century. In fact, as stated by UNFCCC, "*it is understood the peaking of emissions will take longer for developing countries, and that emission reductions are undertaken on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty, which are critical development priorities for many developing countries*".[21]

The agreement is divided into different areas, in order to meet these challenging goals. In particular, the areas are adaptation, loss and damage, mitigation, finance, technology, capacity building and reporting and accounting. Moreover, the COP21 proposed a new transparency framework, fostering the financial and technical innovation in order to help developing countries in mitigating the disruptive consequences of climate change.

Moreover, it promoted the favorable conditions for a transition from fossil fuels toward renewable energy sources.

Finally, the agreement stressed the importance of the commitment made in 2009 during the COP15 in Copenhagen by developed countries to "*jointly mobilize $100 billion a year until 2020*" to developing countries for mitigation and adaptation actions.

1.5.1 The INDCs

In order to pursue these long-term objectives, art. 4 of the agreement states that each country has to prepare, communicate and maintain a list of activities and binding

[20] UNCC (2017) - *Nationally Determined Contributions (NDCs)*, link: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement/nationally-determined-contributions-ndcs#eq-1

[21] UNCC (2017) - *Nationally Determined Contributions (NDCs)*

commitments to be implemented post-2020: the so-called *Intended Nationally Determined Contributions* (INDCs), which are called Nationally Determined Contributions (NDCs) once the agreement has been approved and ratified. "These plans are the first instrument through which governments communicate at international level the steps they intend to take to combat climate change in their territories".[22]

So far, not all the parties ratifying the agreement have also deposited their NDCs: only 189 out of 197 nations, which ratified the agreement have done it, while some other countries have only deposited the INDCs.

Moreover, in paragraphs 9, 11 and 13 it is stated that "*governments will have to increase their efforts not only to achieve the objective of the agreement and to communicate supplementary updates every five years, but also operate in the field of transparent reporting of their emissions and the progress of implementation processes*".[23]

Indeed, the agreement states that action plans must be drawn up in accordance with the principle of equity, taking into account the internal capacities and circumstances of each nation, thus ensuring that each country plays its part. They must also be as ambitious as possible in directing the process of decarbonizing carbon-intensive sectors.

As described in art. 14, countries must report on the progress made internally with respect to their NDCs and the long-term objectives of the agreement every five years starting from 2023: this procedure is called "global stock take".[24]

The key question is whether the commitments and objectives within the NDCs will be sufficient to maintain a level of global warming below 2°C by 2030.

The answer, as described by CAT (Climate Action Tracker), is negative. The emissions reductions targets put forward in the INDCs, if fully implemented, are projected to lead to a global warming of around 2.7°C (2.2-3.4°C)(or, in probabilistic terms, are likely to limit warming to below 3°C) by 2100.[25] This constitutes an increase of 0.4°C since December 2014, before any INDCs were formally submitted.

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[22] UNCC (2015) - link: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement/nationally-determined-contributions-ndcs

[23] UNCC (2015) - *The Paris Agreement*, link: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[24] World Research Institute (2015) - *What is an INDC?*

[25] Jeffery L. et al. (2015) - *Climate Action Tracker Update*, link: https://climateactiontracker.org/documents/44/CAT_2015-12-08_2.7degCNotEnough_CATUpdate.pdf

The figure below **(see Figure 1)** shows the trends that the emissions should follow in order to maintain the warming below the 2°C.

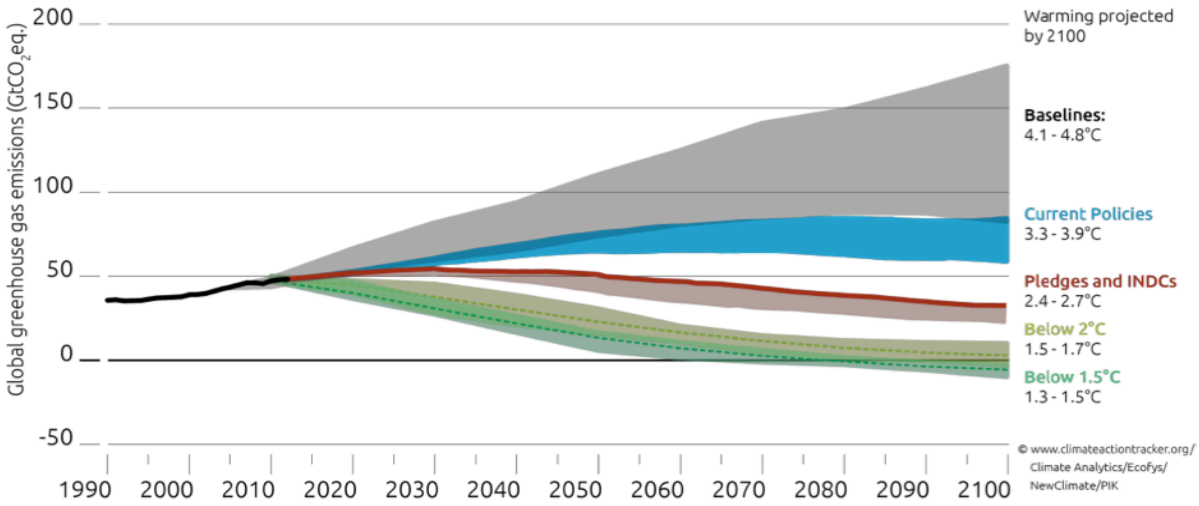

Figure 1: GHG emission in different scenarios. Source: CAT (2015)

The efforts made with the INDCs show a substantial improvement from the scenarios before the start of the INDC process. However, the impact of these INDCs is still much lower than that required to limit heating to 1,5 °C or less than 2 °C.

Regarding the Paris Agreement, a relevant decision by the US has been taken during 2017. On August 4 (2017), the Trump administration handed the United Nations an official notice that the United States intended to terminate from the Paris Agreement as soon as it was legally admissible to do so. The formal notice of withdrawal could not be submitted until the agreement was in force for 3 years for the United States (4 November 2019). On 4 November, the United States Government deposited its notice of withdrawal with the Secretary-General of the United Nations, the depositary of the agreement.
The withdrawal of the United States, the second most polluting country in the world, from the Paris Agreement risks to undermine the international efforts to combat climate change. The data published by the World Bank, according to which "*the impact of extreme natural disasters is equivalent to a global loss of 520 billion dollars in annual consumption and annually forces about 26 million people to poverty*"[26], shows that climate

[26] The World Bank (2016) - link: https://www.worldbank.org/en/news/press-release/2016/11/14/natural-disasters-force-26-million-people-into-poverty-and-cost-520bn-in-losses-every-year-new-world-bank-analysis-finds

challenges need a multilateral approach and cannot focus on simplistic and national responses. The new technologies are ready to direct the current energy and production in a very green direction. However, such dimensions cannot be separated from a strong political leadership capable of overcoming geographical and ideological differences. Without the United States, this leadership gap, even if it can be filled, is bound to be felt. Moreover, in February 2021 the President Joe Biden reentered the United States in the Paris Agreement, few hours after his inauguration.

However, the Paris Agreement highlights the economic and financial field as a central actor for the fight against the climate change. Article 2.1c of the Agreement commits the parties to "making finance flows consistent with a path towards lower greenhouse gas emissions and a climate-resilient development".[27]

As we will see in the next chapters, the funds required to meet the threshold of 2°C are large, and there are many studies to estimate them showing different results.

The researchers agreed that the gap between climate-friendly finance flows and those needed to achieve the climate stabilization objective is large but technology and innovation are ready to limit it.[28]

1.6 Sustainable Development Goals (SDGs)

In September 2015, in New York, more than 150 international leaders met at the United Nations to contribute to global development, promoting human well-being and protect the environment. The States endorsed the Sustainable Development Agenda 2030, whose essential elements are the 17 Sustainable Development Goals (SDGs) **(see Figure 2)** together with 169 sub-objectives, which aim to end poverty, combat inequality and support social and economic development. In addition, it includes aspects of fundamental importance for sustainable development such as the opposition to climate change and the sustainment of peaceful societies by the year 2030. After 2 years of public consultations around the world, the 17 Sustainable Development Goals came into force on 1 January 2016. The SDGs replaced the Millennium Development Goals (MDGs) by merging the

[27] United Nations (2015) - *The Paris Agreement*, link: https://unfccc.int/sites/default/files/english_paris_agreement.pdf#page=5

[28] Stephen Peake & Paul Ekins (2016) - *Exploring the financial and investment implications of the Paris Agreement,* Climate Policy

agendas of development and environment [29] and the difference between SDGs and MDGs is that the latter make no distinction between developed and developing countries, covering all states without distinction. In particular, the objectives, which are interlinked and indivisible, balance the three dimensions of sustainable development: economic growth, social inclusion and environmental protection, by extending Agenda 2030 from the social dimension of the MDGs to the other two dimensions, economic and environmental.

Figure 2: The SDGs. Source: United Nations

The SDGs are based on the five "P"s: People, Planet, Prosperity, Peace and Partnership. In this particular framework, the focus on finance is crucial. The financial dimension, comprehensive and consistent with the achievement of the SDGs, was outlined in the Addis Ababa Action Plan. Signed in July 2015 by the 193 member countries of the United Nations at the Third International Conference on Financing for Development, the plan identifies more than a hundred concrete measures to meet economic challenges, as well as social and environmental issues faced by the world. The priority of action at national level is highlighted with the development of favorable and coherent policies, favoring also

[29] Magdalena Bexell & Kristina Jönsson (2017) - *Responsibility and the United Nations' Sustainable Development Goals*, Forum for Development Studies, 44:1, 13-29

the role of the private sector. About this last aspect, the document emphasizes the importance to align the private investments to the attainment of the SDGs. Countries are invited to put in place appropriate measures to combat both evasion and illicit financial flows. As we will see in the next chapters, the health crisis caused by the COVID-19 pandemic has radically changed the plan of action. In particular, it is crucial to analyze the Financing for Sustainable Development Report 2020, edited by the United Nations in collaboration with 60 agencies of the Inter-Agency Task Force on Financing for Development, which brings together ONU agencies and international partner organizations. The document, published on 4 April 2020, prepared in the light of the very serious economic, social and health crisis caused by the COVID-19 pandemic, calls governments to act with appropriate measures to respond to immediate needs and to prevent a global debt crisis with potentially devastating consequences.

1.7 Mitigation and Adaptation

All actions aimed at reducing the amount of greenhouse gases in the atmosphere are included in the concept of "mitigation". Acting in this direction is crucial, because it is precisely by emitting an excessive amount of these gases - whose atmospheric concentration has no precedent in the last 800 thousand years - that we are causing climate change. The only effective way for reducing the concentration of greenhouse gases in the atmosphere is to emit less. In other words, to "mitigate" the quantities produced. It is, however, a solution that is as simple to identify as it is difficult to put into practice, because the emission of greenhouse gases, and in particular CO_2, is at the basis of almost all human activities.

In order to avoid the most serious consequences of climate change, the countries of the United Nations Framework Convention on Climate Change (UNFCCC) agreed to limit the increase in overall average surface temperature compared to the pre-industrial period to below 2°C. In order to achieve this objective, global greenhouse gas emissions must peak as quickly as possible and therefore decrease rapidly. By 2050, global emissions must be reduced by 50% compared to 1990 levels, and by the end of the century, carbon neutrality must be achieved.

Regarding the greenhouse gas emissions by economic sectors **(see Figure 3)**, the primary sources of emissions are the process of burning fossil fuel for electricity and heat

generation (25%), followed by industry (21%), transportation (14%), other energy (10%), buildings (6%). Finally, agriculture, forestry, and other land uses contribute to the 24% of greenhouse gas emissions.

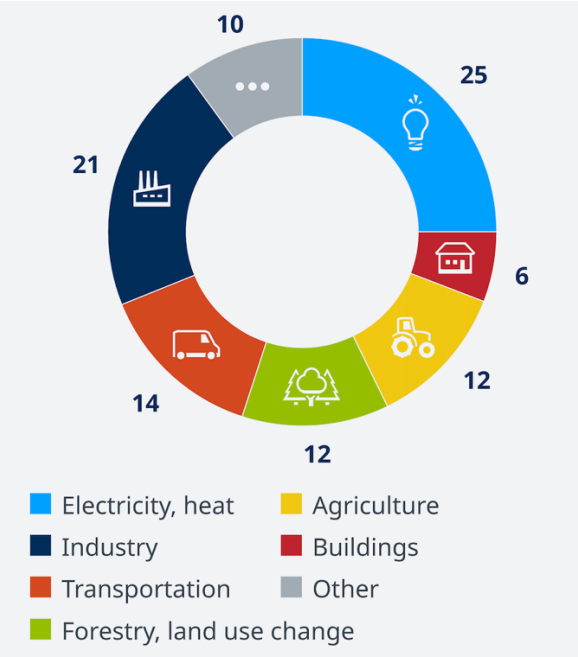

Figure 3: Greenhouse gas emissions by economic sectors. Source: Statista

In this particular scenario, the energy sector represents a fundamental process to limit GHG (greenhouse gases) emissions, followed by agriculture, forestry and other land use (AFOLU)[30]. As a civil society, we have two options to follow in order to “mitigate” the greenhouse gas emission in the energy sector. On one hand, energy consumption can be reduced by investing in energy efficiency. On the other hand, it is crucial to replace fossil fuels with "clean" energy sources, in particular with renewable energy, such as solar panels or wind, which produce energy using the natural resources of the Earth (such as sunlight, wind, but also the flow of rivers and the motion of waves). Focusing on renewable sources, currently relegated to a second role, means producing energy without emitting greenhouse gases, and therefore "mitigating" global emissions.

[30] Smith et al., (2014) - *Agriculture, Forestry and Other Land Use (AFOLU)*. In: *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change,* Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Indeed, several European initiatives aim to reduce greenhouse gas emissions. After the achievement of the Kyoto Protocol targets for the period from 2008 to 2012, the EU has adopted legislation to foster the use of renewable energies, such as wind, solar, hydroelectric and biomass, and to improve the energy efficiency of a wide range of appliances and equipment. The EU also intends to support the development of carbon capture and storage technologies to trap and store CO_2 from power plants and other large installations.

However, as the International Energy Agency (IEA) estimated, around "USD 3.5 trillion yearly in energy sector investments would be necessary between 2016 and 2050 in order to maintain the rising of temperature below 2°C".[31]

The other concept closely connected to "mitigation" is the need to "adapt" to a changing climate. In practice, this means minimizing the impact of climate change on the well-being of citizens, the supply of resources and the stability of ecosystems. "Adaptation" has been defined by the Intergovernmental Panel on Climate Change (IPCC) as the "*adjustments in practices, processes or structures which can moderate or offset the potential damage or take advantage for opportunities created by a given change in climate".*[32]

Climate change affects many aspects of our society and, in order to manage its consequences, it will be essential to integrate adaptation policies in every sector. At the basis of this concept, there are all the consequences that climate change has on agriculture and livestock (drought, desertification) and on fishing (melting glaciers, acidification of the oceans) which are only a part of the problems that future generations will have to face, together with other fundamental issues such as poverty, lack of food security and water scarcity. In addition, urban and engineering challenges will have to be faced in order to prevent cities such as Venice, New York or Cairo from suffering the effects of rising sea levels.

In this framework, the role of innovation is crucial, because it allows finding more efficient technologies for energy conversion, or to use alternative sources of energy, or even to

[31] IEA (2019); Link: https://www.iea.org/reports/the-critical-role-of-buildings

[32] IPCC (2018) - *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*

capture and store CO_2. The following areas may cover these and other mitigation activities[33]:

- Energy
- Transportation
- Buildings
- Industry
- Agriculture
- Forestry and Other Land Use

As it will be showed in the next chapters, the renewable energy sector has become crucial for the mitigation against climate change and one of the roles of public finance is to foster the investments in this growing sector. Indeed, for the purposes of this research, the energy sector will be the sector that will be taken as example to mitigate climate change, highlighting in particular the European (or Community) policies that foster the energy transition from fossil-based energy towards renewable energy.

1.7.1 Energy Sector

Energy supply is the main cause of global greenhouse gas emissions with 35% of the total: its growth accelerated from 1.7% per year from 1990 to 2000 to 3.1% per year from 2000 to 2010. [34]

Complying with the Paris Agreement would mean progressively reducing the use of fossil fuels to zero by the end of 2100, since they are responsible for about 70% of greenhouse gas emissions and, combined, meet about 86% of energy demand. Moreover, as stated by IRENA (2019), "*the energy production sector offers a multitude of options for reducing emissions: improving energy efficiency and using sources that reduce emissions from fuel*

[33] Link: https://archive.ipcc.ch/pdf/reports-nonUN-translations/italian/ar4-wg3-spm.pdf
[34] IPCC (2014)

extraction, energy conversion, transmission and distribution systems, or new low-emission energy production technologies such as renewable and nuclear".[35]

However, in the first half of 2020 a positive report was published by Ember, focusing on the analysis of Europe's electricity transaction.

The main finding of this report is that renewable electricity generation exceeded fossil fuel generation, for the first time ever. In the first half of 2020, renewables (wind, solar, hydro and bioenergy) generated 40% of the EU-27's electricity, whereas fossil fuels generated 34%. In particular **(see Figure 4)**, renewables rose by 11%. This growth was due to new wind and solar installations and favorable conditions. Wind and solar recorded a 21% increase in Europe's total electricity generation, and reached a higher production in Denmark (64%), Ireland (49%) and Germany (42%). Fossil fuels consumption fell by 18%. Fossil fuel usage decreased for two reasons: by rising renewable energy generation and for a 7% fall in electricity demand due to COVID-19. Finally, coal fell by 32%. Within this framework, hard coal generation decreased by 34% and lignite fell by 29%. Gas generation also reduced by 6%, in eleven countries. As a result, EU-27 power sector CO_2 emissions fell by about 23%.[36]

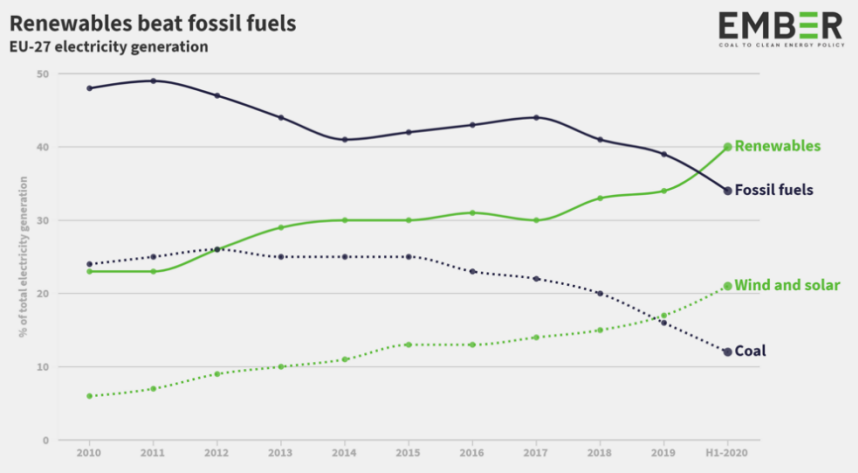

Figure 4: Renewables beat fossil fuels. Source: Ember

[35] IRENA (2019) - Link: https://www.irena.org/DigitalArticles/2019/Apr/How-To-Transform-Energy-System-And-Reduce-Carbon-Emissions

[36] Dave Jones and Charles Moore (2020) - *Renewables beat fossil fuels - A half-yearly analysis of Europe's electricity transition*

1.7.1.1 GSE Incentive

The energy transaction towards a renewable and sustainable future passes through market-based instruments such as subsidies or emission taxes, control over the use of specific fuels, the performance to be supported or the maximum emissions granted.

One of the examples of the energy transition to renewable energy in Italy is the mechanism of incentives managed by the company GSE S.p.a. (Gestore dei Servizi Energetici).

The company is an Italian limited company, wholly controlled by the Ministry of Economy and Finance that carries out its tasks in accordance with the strategic and operational guidelines defined by the Ministry of Economic Development.[37]

The GSE plays a central role in the promotion and development of renewable sources in Italy. The main activity is the promotion, also through the provision of economic incentives, of electricity produced from renewable sources.

In particular, it acquires and redistributes energy from renewable sources into the market. It provides incentives for production, it verifies that the same production takes place according to regulations and provides the Green Certificates. The GSE also deals with the monitoring of renewable energy with the goal of achieving the targets set for 2020. It is responsible for providing data and technical advice to institutions, public administrations and operators in the sector in order to encourage the dissemination of sustainable energy sources.[38]

In 2018, more than 1 GW of additional renewable energy power was installed in Italy. 450 MW are represented by solar photovoltaics.

Moreover, Enarray (2019) suggests that *"thanks to over 113 TWh of energy produced from renewable sources, Italy has exceeded, in 2018 and for the fifth consecutive year, the threshold of 17% of consumption satisfied by renewables"*.[39]

[37] Link: https://www.gse.it/en/company
[38] Link: https://www.gse.it/en/company
[39] Enerray (2019) - *2018 Renewable energy statistics in Italy,* Link: https://www.enerray.com/blog/renewable-energy-statistics-italy-2018/

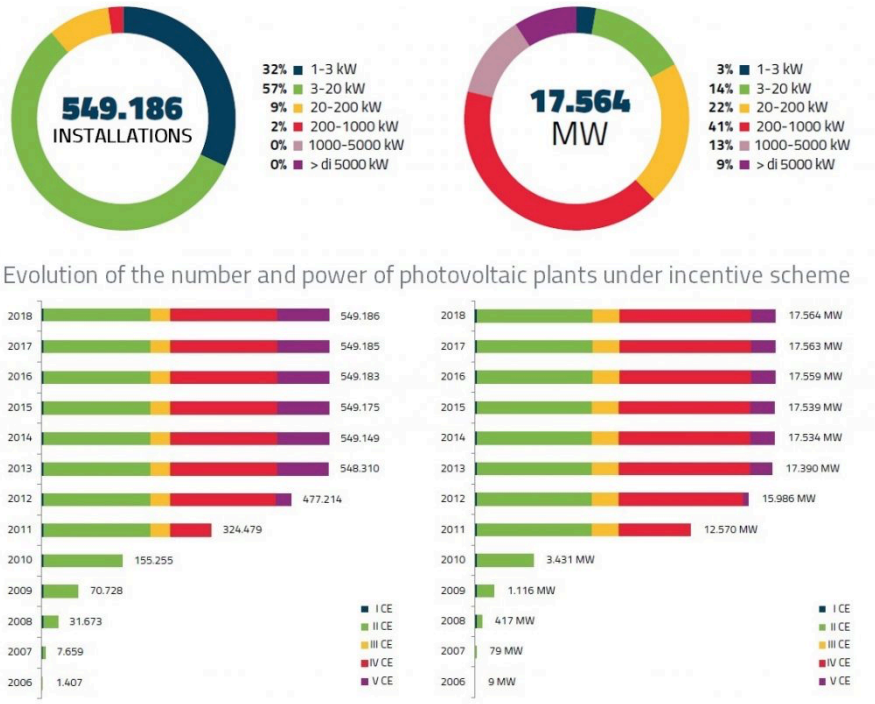

Figure 5: Evolution of photovoltaic plants in Italy. Source: Enerray

The Italian promotion and feed-in tariff system for renewable energy sources is characterized by a multiplicity of mechanisms that have followed over the years in a logic of progressive market orientation and reduction of the incentive level in line with the decrease of generation costs[40] **(see Figure 5)**. The FiT program Conto Energia[41], operating in Italy since the end of 2005, guaranteed a significant growth in the photovoltaic sector during its operations, especially between 2011 and 2012.

1.8. Climate Change and COVID-19

On March 11, 2020, the World Health Organization declared the COVID-19 outbreak a pandemic. As defined by the U.S. Department of Health and Human Services (2020), *"data from China have indicated that older adults, particularly those with serious underlying*

[40] Enerray (2019) - *2018 Renewable energy statistics in Italy*, Link: https://www.enerray.com/blog/renewable-energy-statistics-italy-2018/
[41] Link: https://www.gse.it/servizi-per-te/fotovoltaico/conto-energia

health conditions, are at higher risk for severe COVID-19–associated illness and death than are younger people".[42]

COVID-19 pandemic has radically changed people's lives around the world. The consequences of lockdowns in various countries have shown, probably as never before, that human society is vulnerable. A constantly changing situation that has forced all sectors linked to human activity to rethink production, social and economic processes.

Climate change has also been affected by the COVID-19 pandemic and the Sustainable Development Goals Report 2020 well frames the current and future consequences of the pandemic.

In general, the annual Sustainable Development Goals Report provides an overview of the world's implementation efforts to date, highlighting areas of progress and areas where more action needs to be taken to ensure no one is left behind. As described by the report, "the COVID-19 pandemic has unleashed an unprecedented crisis, causing further disruption to the progress of SDGs, with the world's poorest and most vulnerable affected the most"[43] (United Nations, 2020). Using the latest data and estimates, this annual stocktaking report on progress across the 17 Goals shows that it is the poorest and most vulnerable – including children, older persons, persons with disabilities, migrants and refugees – who are being hit the hardest by the effects of the COVID-19 pandemic. Women are also bearing the heaviest brunt of the pandemic's effects.

From an environmental point of view, lockdown restrictions have had positive effects on GHG emissions. However, these effects are calculated in the short term and it is necessary to analyze the effects in the medium-long term. According to Forster et al. (2020), "the climate effect of the immediate COVID-19 related restrictions is close to negligible and lasting effects, if any, will only arise from the recovery strategy adopted in the medium term". In their analysis, they studied the effect of different scenarios, including a fossil-fuelled recovery and two different scenarios of green stimulus **(see Figure 6)**.

[42] U.S. Department of Health and Human Services - Centers for Disease Control and Prevention (2020) - *Severe Outcomes Among Patients with Coronavirus Disease 2019 (COVID-19) — United States, February 12–March 16, 2020*

[43] United Nations (2020) - *The Sustainable Development Goals Report 2020*

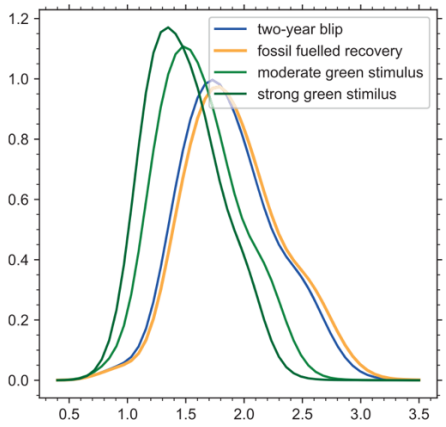

Figure 6: Probability distributions of passing 2050 global warming levels. Source: Nature Climate Change

They found that both the two-year blip pathway, where the economic recovery maintains current investment levels, and the fossil-fuelled recovery pathways are likely to exceed 1.5 °C above pre-industrial limit by 2050. Conversely, "choosing a way with strong green stimulus assumptions, including climate policy measures, has a good chance of keeping global temperature change above pre-industrial within the 1.5°C limit, saving around 0.3°C of future warming by 2050".[44]

However, the conclusion is that the global temperature signal due to the short-term dynamics of the pandemic is likely to be minor. Pursuing a green stimulus recovery out of the post-COVID-19 economic crisis can set the world on track for keeping the long-term temperature goal of the Paris Agreement within sight.

What is clear is that future policies have two paths to choose: a short-term approach, which does not consider the consequences of future climate complications and which aims at an immediate economic recovery, or a long-term approach, towards green investments. The most important thing to realize is that a short-term approach to the COVID-19 response that does not consider the climate issues is more costly and less effective than tackling these issues together. Indeed, we can choose between financing now a carbon intensive economic recovery and later a low-carbon transition or to finance right away a green economic recovery.[45]

[44] Forster, P.M., Forster, H.I., Evans, M.J. et al. (2020) - *Current and future global climate impacts resulting from COVID-19*. Nat. Clim. Chang.(2020). https://doi.org/10.1038/s41558-020-0883-0

[45] Billio Monica & Varotto Simone (2020) - *A New World Post COVID-19. Lessons for Business*, the Finance Industry and Policy Makers, 1. ed., Venezia: Edizioni Ca' Foscari - Digital Publishing, 2020. — 374 pp.; 23 cm. — (Innovation in Business, Economics & Finance; 1)

According to Battiston, Billio and Monasterolo (2020), "reinforcing the socio-economic resilience against future pandemics calls for recovery measures that are fully aligned to the objectives of the EU Green Deal", as it will be showed in the next chapters. Tackling these objectives together is more cost effective than addressing the COVID-19 crisis with short-term measures. Remarkably, because of the inter-connectedness between climate risk, pandemic risk and financial risk (Monasterolo, Billio, Battiston, 2020), this may be actually the only feasible way to build resilience to future crises. The economic response to COVID should rather take place within a framework of hard constraints on greenhouse gas emissions. Suitable policies exist, but plausibly require to implement international cooperation.[46]

[46] Bardsley N. (2020), *Avoiding a Great Depression in the Era of Climate Change*

2. CHAPTER: CLIMATE FINANCE

Climate change is not just an environmental issue. It is an issue of global economic importance that concerns the prospects for growth, the exit from poverty in developing countries, a careful use of resources to avoid penalizing future generations. In this complex framework, the world of finance plays a decisive role.

Climate finance is defined by the United Nations Framework Convention on Climate Change (UNFCCC) to be "*local, national, or transnational financing — drawn from public, private, and alternative sources of financing — that seeks to support mitigation and adaptation actions that will address climate change*." It is about investments that governments, corporations, and households have "*to undertake to transition the world's economy to a low-carbon path, to reduce greenhouse gas concentrations levels, and to build resilience of countries to climate change*".[47] For mitigation, climate finance is needed in order to foster large-scale investments and to reduce emissions. It is equally fundamental for adaptation because new financial resources are needed to reduce the effects of climate change.

Along with the goals of "*pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels*" and "*increasing the ability to adapt to the adverse impacts of climate change*," Article 2 of the Paris Agreement recognized that "finance flows" are essential to achieve these longstanding goals of "*low greenhouse gas emissions and climate-resilient development*"[48] (COP21, 2015). Moreover, the UNFCCC's Standing Committee on Finance (SCF) takes a comprehensive view of climate finance, defining it as finance aimed at "*reducing emissions, and enhancing sinks of greenhouse gases and at reducing vulnerability of, and maintaining and increasing the resilience of, human and ecological systems to negative climate change impacts*"[49]. More specifically, climate finance typically consists of grants, loans, equity in the form of purchased shares, and debt relief. In the SCF's Biennial

[47] Hong H., Karolyi G. A., Scheinkman J. A. (2020) - *Climate Finance*, Review of Financial Studies
[48] Whitley S, Thwaites J, Wright H, Ott C (2018) - *Making Finance Consistent with Climate Goals: Insights for Operationalising Article 2.1c of the UNFCCC Paris Agreement*. Overseas Development Institute, London
[49] SCF (2014) - *UNFCCC Standing Committee on Finance: 2014 Biennial Assessment and Overview of Climate Finance Flows Report*. UNFCCC Bonn.

Assessment and Overview of Climate Finance Flows, is stated that "*total global funding in 2016 was calculated to be USD 681 billion, as a high-bound estimate, an increase of 17% over the previous two years, with most of the growth occurring in new private investments in renewable energy projects*"[50].

However, literature on climate investment and finance is very poor, quantitative information is limited and incomplete, as is the accounting system. The crucial problem is that capital monitoring and verification systems invested in green projects at an international level have not been shared and implemented yet. Thus, the available data are often obtained using different methodologies depending on the projects. For example, data referred to mitigation and adaptation costs changing with the policy and technological development considered in the analysis.

2.1 Low-Carbon Economy Transition

The transition to a low-carbon economy will require further investment in the coming decades and will require that the efforts, especially financial, of the recent years are definitely strengthened. We are still at the beginning of the transition from a high-carbon economy to a low-carbon economy. Transforming our energy system will take time and a significant amount of capital and it will also require close coordination among three key elements: policy, technology and capital.

According to the International Energy Agency (IAE, 2010), "*$10.5 trillion in global incremental investments in low-carbon energy technologies and energy efficiency by 2030 will be necessary*". This estimate is across all sectors, including power, transport, residential and commercial building equipment, and industrial sectors, in order to limit global temperature increases to 2 C°, the threshold that the United Nations Intergovernmental Panel on Climate Change has identified as necessary for "*avoiding catastrophic climate change.*"[51]

Moreover, the energy transition is affected by the problem of world overpopulation, which grew from 3 billion people at the beginning of the 20th century to 7 billion people at the beginning of the 21st century. The shock caused by the scarcity of fossil energy

[50] SCF. (2018) - *Summary and Recommendations by the Standing Committee on Finance on the 2018 Biennial Assessment and Overview of Climate Finance Flows.* UNFCCC Bonn.

[51] Goldman Sachs (2010) - *Opportunities and Challenges of the Emerging Clean Energy Industry*

sources, in the absence of alternative energy sources, will drastically reduce world agricultural production resulting in food shock for the world population.

To understand the climate finance flows over the past years and amount of investments needed to reach the Paris Agreement targets, three different analysis will be showed: IEA, IRENA and Climate Policy Initiative analysis.

According to IEA, clean-energy investments, in particular solar and wind power, have been growing rapidly in recent years[52]. For example, in 2015, investments in renewable energy amounted to more than 300 billion per year. However, considering fossil energy investments, they still dominate the energy industry.

To achieve the ambitious targets of the Paris Agreement, an important effort in terms of investment in renewables and energy efficiency, combined with rapid disinvestments of fossil fuels, will be necessary. The impact of future energy and climate policies on total energy investments depends on the nature of the policies **(see Figure 7)**. The NDC scenario would likely only necessitate a marginal increase in total future investments globally. In contrast, according to most models, "*more aggressive policies promoting decarbonization through a global energy system transformation ('2C' and '1.5C' scenarios) will require a marked increase*".[53]

[52] OECD/IEA (2016) - *World Energy Investment 2016. (Organisation for Economic Co-operation and Development (OECD)*, International Energy Agency (IEA), 2016

[53] McCollum, D. L. et al (2018) - *Energy investment needs for fulfilling the Paris Agreement and achieving the Sustainable Development Goals*. Nature Energy 3, 589-599, doi:10.1038/ s41560-018-0179-z (2018)

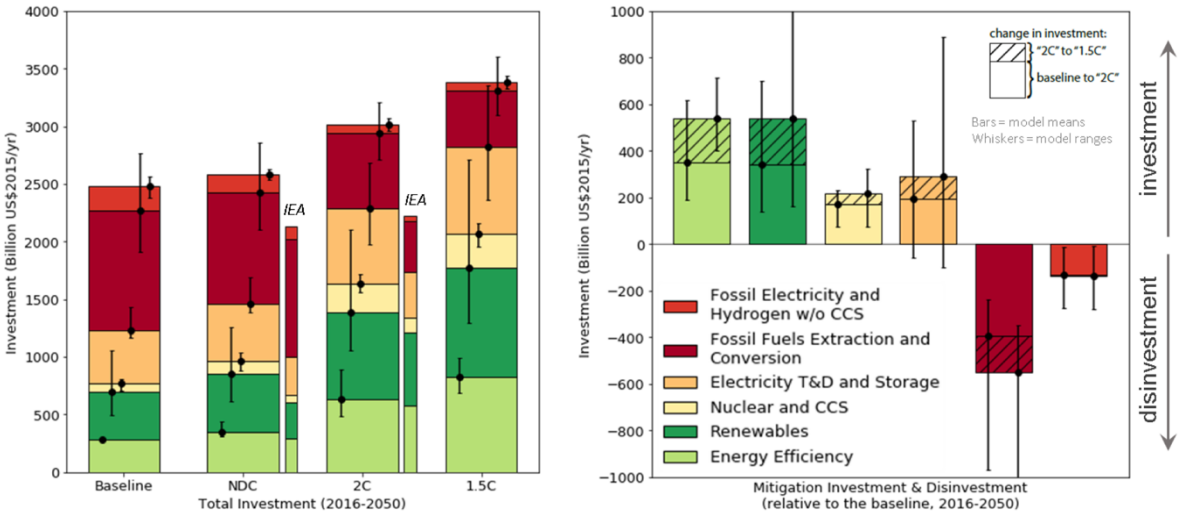

Figure 7: Global average annual investments in different climate policies (left). incremental investments and disinvestments by category relative to the baseline (right). Source: IEA

In order to achieve the 1,5 °C target, renewable energy investments, on average, have to increase up to 550 billion every year. In contrast, fossil energy disinvestment would need to be greater. Finally, to reach the Paris Agreement targets, low-carbon investments would need to account for more than 50% of all energy supply investments by around 2025 and then rise to 80% or above by around 2035 in the 1.5 °C scenario or 2050 in the 2 °C scenario.[54]

Moreover, IRENA (International Renewable Energy Agency) sustains that in order to meet the low-carbon energy transition the investments in renewable energy need to be scaled up significantly. In its latest analysis, "Global energy transformation: A roadmap to 2050", IRENA estimates that "*to put the world on track with the objectives of the Paris Agreement, cumulative investment in renewable energy needs to reach 27 trillion in the 2016-2050 period*" **(see Figure 8)**.[55]

[54] IIASA (2018) - *What investments are needed in the global energy system in order to satisfy the NDCs and 2 and 1.5 °C goals?*

[55] IRENA (2019) - *Global energy transformation: A roadmap to 2050 (2019 edition), International Renewable Energy Agency*, Abu Dhabi.

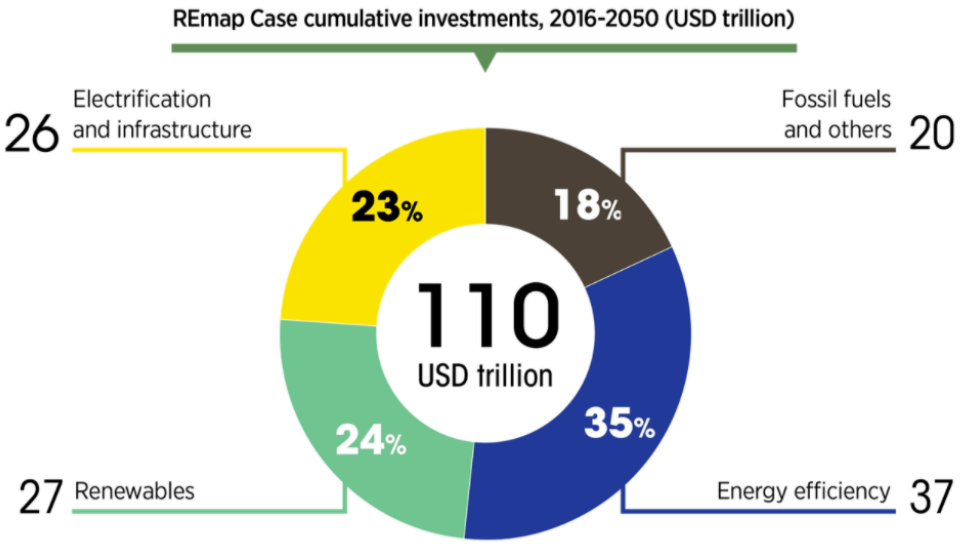

Figure 8: Investments need. Source: IRENA

In particular, in the power sector, the low-carbon energy transition would need investment of 22.5 trillion in new renewable installed capacity. This would mean at least double annual investments compared to the levels of 2018, from almost 310 billion to over 660 billion **(see Figure 9)**.

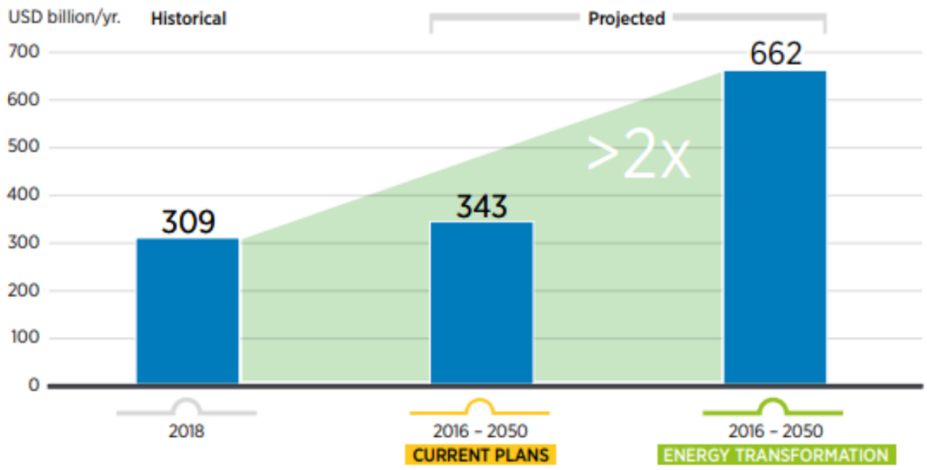

Figure 9: Source: IRENA

Finally, the 2019 edition of Climate Policy Initiative's Global Landscape of Climate Finance provides one of the most comprehensive overview of global climate-related primary investment.

Climate Finance flows increased of 25% during the period 2017/18. Moreover, green flows for climate reached a high record of 612 billion in 2017, driven particularly by

renewable energy capacity additions in China, the U.S., and India, as well as increased public commitments to land use and energy efficiency and this was followed by an 11% drop in 2018 to 546 billion **(see Figure 10)**.[56]

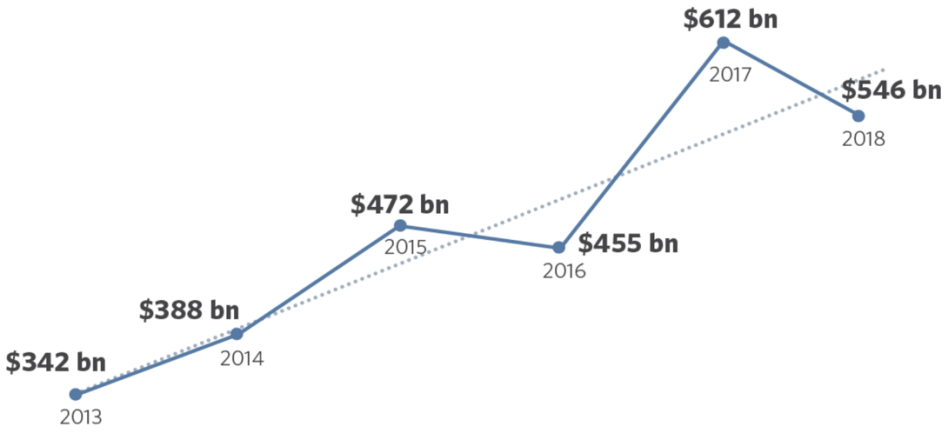

Figure 10: Global climate finance flows 2013-2018. Source: CPI Report

However, as described by the report, climate finance has reached record levels but not enough with respect to what is needed under a 1.5°C scenario. Estimates of the investment required to achieve the low-carbon transition range from 1.6 trillion to 3.8 trillion annually between 2016 and 2050[57], while the Global Commission on Adaptation[58] estimates costs of 180 billion annually from 2020 to 2030.

2.2 Climate Finance Actors

After describing the investments necessary for the Low-Carbon Economy Transition, it is important to understand who the actors of climate finance are and what role they have in the global context.

Two categories of actors are recognized at international level: public actors and private actors. The first category comprises governments and their agencies, the so-called "Development Finance Institutions" (DFIs) (national, multilateral and bilateral) and

[56] CPI (2019) - *Global Landscape of Climate Finance 2019* [Barbara Buchner, Alex Clark, Angela Falconer, Rob Macquarie, Chavi Meattle, Rowena Tolentino, Cooper Wetherbee]. Climate Policy Initiative, London.

[57] IPCC (2018) - *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*

[58] GCA (2019)

climate funds. The second category is private actors: project developers, commercial banks, financial organizations and intermediaries, multinational corporations, small and medium-sized enterprises, cooperatives, entrepreneurs and households, private equiters and venture capitalists and private institutional investors (pension funds, insurance companies, foundations, etc.).

As described by CPI (Climate Policy Initiative) in its "Global Landscape of Climate Finance 2019", "*average annual public climate finance investments totaled 253 billion in 2017/2018, 44% of total commitments, while private finance, which reached 326 billion annually on average in 2017/2018, continues to account for the majority of climate finance, at around 56%*" **(see Figure 11)**[59].

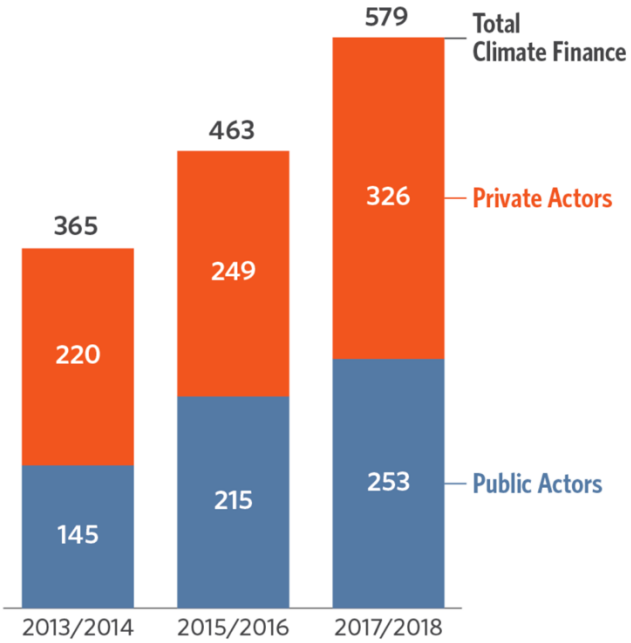

Figure 11: Global climate finance flows by public and private actors 2013-2018. Source: CPI Report

As showed by previous figure, the global climate finance flows, given by the sum of private actors and public actors, are growing in the last 5 years with an increase of 37% from 365 billion in 2013 to 579 billion in 2018. According to this framework, it will be necessary to strengthen the collaboration between governments, regulators, development banks and

[59] CPI (2019) - *Global Landscape of Climate Finance 2019* [Barbara Buchner, Alex Clark, Angela Falconer, Rob Macquarie, Chavi Meattle, Rowena Tolentino, Cooper Wetherbee]. Climate Policy Initiative, London.

private investors in order to match all financing with climate and sustainable development goals (SDGs).

2.2.1 Public Finance Actors

As described before, the definition of public finance actors includes governments and their agencies, the Development Finance Institutions (national, multilateral and bilateral) and climate funds.

Investments by public actors increased of 18%, from 215 billion annually in 2015 to 253 billion in 2018.

DFIs provide the majority of public finance investments, contributing with 213 billion annually, compared to 194 billion in 2015/2016. Bilateral and multilateral DFIs have continued increasing investments **(see Figure 12)** by 47% and 24%, respectively. Finally, Government Budgets and Agencies doubled the financing up to 42 billion in 2018, contributing for 15% of public flows. Climate funds increased annual financing to USD 3.2 billion in 2017/2018, 43% more with respect to 2015/2016.[60]

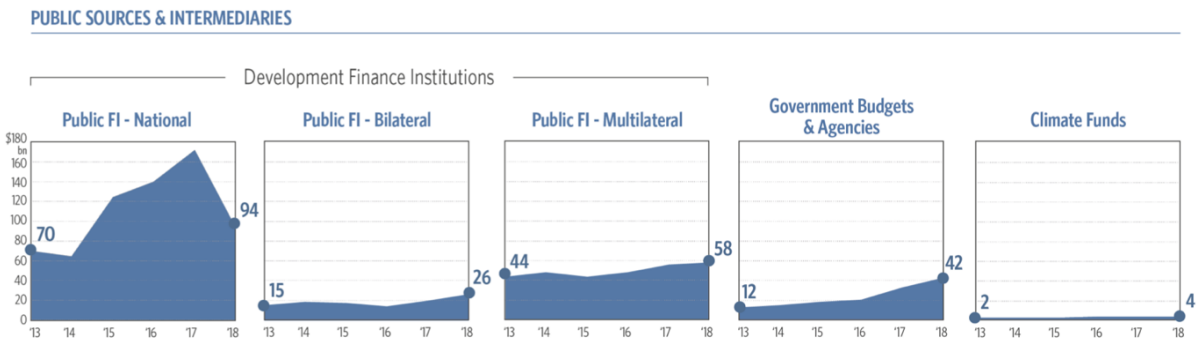

Figure 12: Public Sources and Intermediaries of Climate Finance (USD billion). Source: CPI

In this framework, public actors can operate in two different ways: through public finance methods or public policy. The first way is a direct financing from public interventions, by governments or firms owned by the state. Examples of public finance are grants, loans and bonds, debt bonds, equity investments.

[60] CPI (2019) - *Global Landscape of Climate Finance 2019* [Barbara Buchner, Alex Clark, Angela Falconer, Rob Macquarie, Chavi Meattle, Rowena Tolentino, Cooper Wetherbee]. Climate Policy Initiative, London.

In contrast, public policy methods offer different sources to finance climate projects. In this way, a public actor should create incentives that are attractive to private investors. Examples of public policy are regulatory and fiscal policies, such as the European Green Deal and the Financing Sustainable Growth issued by the European Commission.

2.2.1.1 Financing Sustainable Growth and The Green Deal

The EU vision on the role of finance in sustainable development is represented by the implementation of the “Action Plan” and the “European Green Deal”.
On 8 March 2018, the European Commission issued the Financing Sustainable Growth (Action Plan) in order to finance sustainable growth. In particular, the purpose of the “Action Plan” is to implement a financial system in order to support the European Union’s activities on climate and sustainable development. The Plan represented a key step towards the implementation of the Paris Agreement and the UN Agenda 2030 for Sustainable Development and contributes to the sustainable development objectives set out in the Commission Communication "*Europe’s sustainable future: next steps. European action in favour of sustainability*".
The Plan aims to meet three challenges:

- orienting investment flows towards sustainability to achieve green growth;
- integrating sustainability into risk management;
- fostering transparency and long-term vision in economic and financial activities.

These three objectives are followed by ten specific actions that should facilitate to achieve them:

1) establishing an EU classification system for sustainable activities,
2) creating standards and labels for green financial products,
3) fostering investment in sustainable products,
4) incorporating sustainability when providing financial advice,

5) developing sustainability benchmark,
6) a new system of ratings based on sustainability factors,
7) clarifying duties of institutional investors and asset managers,
8) incorporating sustainability in prudential requirements,
9) strengthening sustainability disclosure and accounting rule-making,
10) fostering sustainable corporate governance and attenuating short-termism in capital markets.

In particular, for the purpose of this research, the creation of EU Green Bonds standards and labels for green financial products is crucial. Based on the final report and usability guide of the Technical Expert Group (TEG), the Commission is exploring the development of a voluntary EU Green Bond Standard. Moreover, the Commission is working on an EU Ecolabel for retail investment products. The extension of the Ecolabel framework to financial products, by way of a Commission Decision, is expected for Q3 2021.[61]

The policy areas of the Action Plan are:

- **Environment**: first, with regard to the mitigation of climate change, as well as the wider environment and the risks associated with it. Climate change and the response to it by the public sector and society in general have led to the identification of new sources of financial risk that the regulatory and supervisory community is paying more attention to;
- **Social and governance**: where the hottest issues are equity, inclusiveness, working conditions and relationships, investment in human capital and community.

[61] European Commission (2020) - *Renewed sustainable finance strategy and implementation of the action plan on financing sustainable growth*

In 2019, the European Commission President Ursula von der Leyen has promised to strengthen EU climate policy[62]. She proposed a European Climate Law that "*would require the EU to become climate neutral by 2050, making Europe the first continent to reach this goal. The steps to get to the climate neutrality require a comprehensive policy, comprising climate, energy, environmental, industrial, economic and social aspects of this unprecedented process. This is what the European Green Deal is about.*"[63]

Concretely, the European Green Deal represents a "strategy", a series of measures of different nature, including new laws and investments that will be implemented in the next thirty years. At the moment, the Commission has made precise plans for the first two years, the most important one being the setup of a structure capable of supporting such an ambitious project. The Green Deal will be funded with a large amount of public and private money. In the first ten years, the objective will be to mobilize about 1000 billion to finance it, more or less 100 billion per year.

The main objective is to limit the increase in global warming, which has to remain within 1.5° C compared to the pre-industrial years, according to the estimates of the IPCC. To meet this target, the European Union has committed itself to put to zero its net pollutant emissions by 2050, and to meet intermediate targets for 2030 and 2040. From this main objective, a series of consequent more specific moves should derive **(see Figure 13)**.

[62] von der Leyen, Ursula (2019) - *A Union that strives for more: My agenda for Europe*, Political Guidelines for the Next European Commission 2019-2024

[63] Grégory Claeys, Simone Tagliapietra and Georg Zachmann (2019) - *How to make the European Green Deal work*

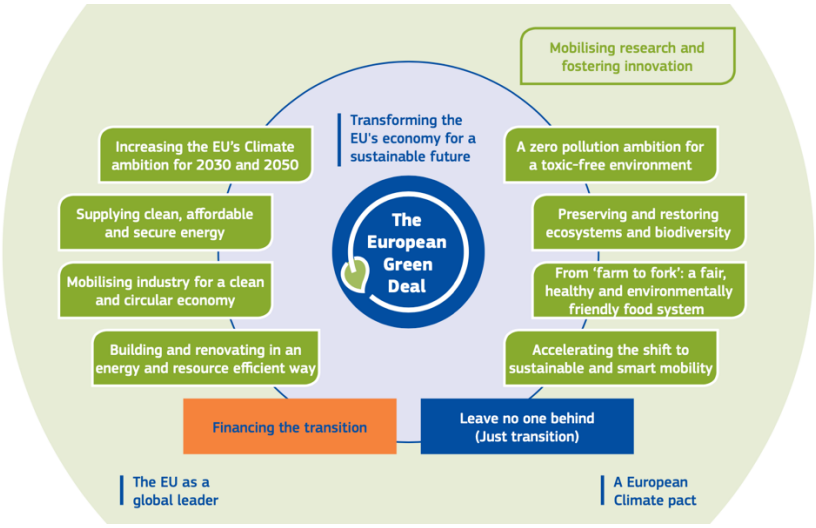

Figure 13: The European Green Deal goals. Source: European Union

The most important objective will be to make the production of electricity cleaner, which is currently responsible for 75 % of greenhouse gas emissions throughout the European Union. It means increasing the spread of renewable energies and at the same time stopping encouraging the use of fossil fuels. It will be a problem especially for the countries of Eastern Europe, where the spread of renewable energies is still limited. As an example, Poland still gets 80% of its electricity from coal. For this reason, it is the only country that has not yet officially agreed to zero its net emissions by 2050.

Another important objective will be to make more sustainable a series of human activities that currently consume a large amount of energy. This will imply introducing new rules for building or renovating homes and industries in Europe, making production processes less polluting, and enhancing public and rail transport, promoting biodiversity (protecting forests and animal species from extinction), making the circular economy more widespread, and reserving a fixed share of European funds for sustainable initiatives.

As we will describe in the next chapters, the COVID-19 outbreak had a crucial impact in climate finance factors. In particular, in a context of recovery from the pandemic impact, the European Commission announced a new sustainable finance strategy, in order to sustain the business transition towards sustainability. In order to foster private investments and public sector initiatives, the renewed strategy will match the objectives of the European Green Deal investment plan. It will build on previous initiatives and

reports, such as the action plan on financing sustainable growth and the reports of the Technical Expert Group on Sustainable Finance (TEG).[64]

2.2.2 Private Finance Actors

The definition of private actors comprises households, non-financial corporations, banks (financial institutions), institutional investors (asset managers, insurance companies) and private equity, venture capital and infrastructure funds.

Private finance investments increased by 31% from 2015 to 2018, providing on average (during 2017-2018) 326 billion per year.

As sources of private finance, corporations account for 183 billion per year on average, the 56% of private investments (2018) **(see Figure 14)**. Moreover, the investments provided by private firms decreased in the last five/six years. In fact, CPI (2019) stated that "*the decline in the share provided by corporations is due to commercial financial institutions and households engaging in more climate-related finance and consumption, respectively, than in previous years*".[65]

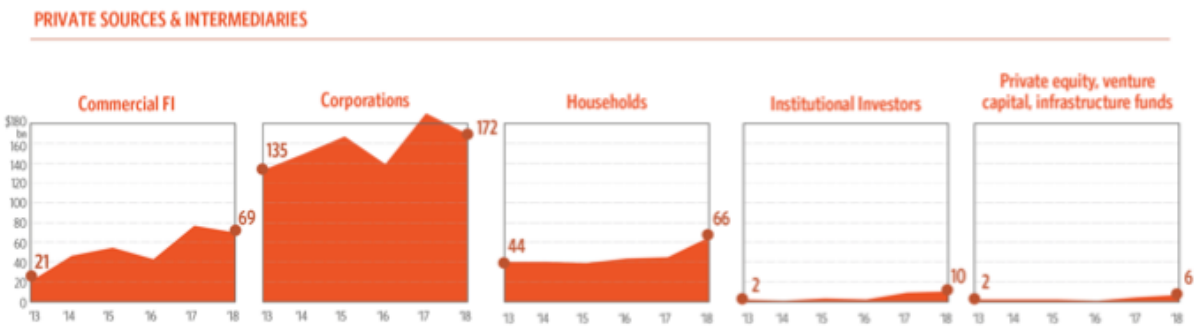

Figure 14: Private sources and intermediaries. Source: CPI Report

Commercial financial institutions increased annual investments in climate finance by 25 billion per year compared to 2015 and 69 billion in 2018.[66]

[64] European Commission (2020) - *Renewed sustainable finance strategy and implementation of the action plan on financing sustainable growth*

[65] CPI (2019) - *Global Landscape of Climate Finance 2019* [Barbara Buchner, Alex Clark, Angela Falconer, Rob Macquarie, Chavi Meattle, Rowena Tolentino, Cooper Wetherbee]. Climate Policy Initiative, London.

[66] CPI (2019) - *Global Landscape of Climate Finance 2019* [Barbara Buchner, Alex Clark, Angela Falconer, Rob Macquarie, Chavi Meattle, Rowena Tolentino, Cooper Wetherbee]. Climate Policy Initiative, London.

The growth of investments by banks reflects the transition to sustainability in financial markets, in particular for renewable energies, which represent 93% of bank investments in climate finance during 2017-2018. Although investments in renewable energy are growing, the majority of bank investments are represented by loans (650 billion) to fossil fuel companies[67].

Although they go beyond the scope of direct project finance, these figures indicate that commercial lenders still have to implement a major shift in investment strategy to align their financing activities with decarbonization pathways under the Paris Agreement.[68]

Finally, as we can see in the last graph, private equity, venture capital and infrastructure funds doubled their investments in the last 5 years, from 2 billion of 2013 to 6 billion of 2018. Also in this sector, 75% of the investments are addressed to renewable energies. This rapid increase shows the growth of renewable energy markets and a lower perceived risks among international investors.

2.2.3 The importance of Public and Private relationship

As previously showed, the majority of investments in the climate finance sector are made by private actors. As a consequence, the private sector plays a central role in financing mitigation and adaptation actions in most countries.

The private sector, however, tends to invest in countries with a well-developed capital market, where regulation is clear and where there are low transaction costs and stable prices, i.e. countries with low country and currency risks. Such risks are frequently high in developing countries, where there is a high need for investment, especially in adaptation actions. Public intervention by national and international governments and banks to encourage private investment is therefore crucial.

Appropriate policies and common actions between public and private sectors allow mobilizing financial resources and human capital and to create an environment suitable for attracting private investment through a clear and stable regulatory framework. Finally, risk-sharing through public-private relationships is very important, especially in

[67] RAN, Banktrack et al. (2019) - *Banking on Climate Change – fossil fuel finance report card 2019* relations and global climate change

[68] CPI (2019) - *Global Landscape of Climate Finance 2019* [Barbara Buchner, Alex Clark, Angela Falconer, Rob Macquarie, Chavi Meattle, Rowena Tolentino, Cooper Wetherbee]. Climate Policy Initiative, London.

the case of green investments, which often require substantial initial funding and suffer from a more uncertain and longer return on investment.

The public sector therefore plays an important role in this context in stimulating investment in green projects. European governments are experimenting different ways to attract institutional investors, including pension funds, which have huge resources and a lower level of risk than the market. In this context it is of fundamental importance for climate finance the concept and the development of Blended Finance.

2.2.3.1 Blended Finance

OECD describes Blended Finance as "*strategic use of development finance for the mobilization of additional finance towards sustainable development in developing countries*"[69]. It offers a potential solution to close the development funding gap between development and developing countries. As defined by OECD in the World Economic Forum, Blended Finance is composed by three characteristics:

- leverage, i.e. using finance development funds to attract private capital,
- impact, i.e. investments that drive social, environmental and economic progress,
- returns, i.e. as described by World Economic Forum (2015) "*financial returns for private investors in line with market expectations, based on real and perceived risks*".[70]

In the last years, it has become very common to confuse the concept of Blended Finance with the "Public Private Partnerships" one, which are a subset of Blended Finance and represent a form of cooperation between public authorities and private individuals, with the aim of financing, building and managing infrastructure or providing services of public interest. This form of cooperation with private entities allows public administrations to attract more investment resources and expertise not available within it.

[69] OECD (2020)

[70] World Economic Forum (2015) - *Blended Finance Vol. 1: A Primer for Development Finance and Philanthropic Funders*

As stated by OECD, Blended Finance is a tool with the purpose of mobilizing private investments in developing countries. Geographically, there is a concentration of 35% of the initiatives in the sub-Saharan Africa and 19% in Asia. 31% of the initiatives is addressed to multiple unspecified regions. Instead, Latin America, Eastern Europe, Middle East and North Africa have fewer investments and initiatives with respect to the South Africa and Asia.

As described by Climate Policy Initiative (2018), typically a clean energy project lifecycle is composed by three stages: the development stage, the construction stage, and the operational stage, with decreasing risk as the project moves towards operation. Because of the changing risk and return profiles throughout the clean energy lifecycle, different types of equity and debt investors are often active in different stages of the project through vehicles that match their risk appetite. In this framework, the role of risk is fundamental both for investors and project itself. These risks and barriers to investors are summarized in four macro categories: political, technical risks, commercial and market risks, and other investor barriers that are not manageable or apparent at the project level.[71]

In particular, as described by the Climate Policy Initiative (2018) in "*A report for the Business & Sustainable Development Commission and the Blended Finance Taskforce*", these four macro categories of risk are divided as follows:

- **Political Risks**, which comprise political and social risks, administrative risks and regulatory risks as changes of support to tariffs or level of subsidization;
- **Technical Risks**, which regard construction risks and operation risks like uncertainty over the timing of construction and risks related to the technical operations in the plant;
- **Market Risks**, including access to capital, financial and operation costs increases, currency risks and credit risks. In particular, all related risks for the project developer to access capital and cost of capital for financing;
- **Other Investor Risks**, which are not manageable at project level and refer to the investment horizon and the scale of investment (size of investment).

[71] CPI (2018) - *Blended Finance in Clean Energy: Experiences and Opportunities*

In some studies, it was found that in many initiatives, the most common risks are the access to capital and the information gaps, also known as information asymmetries, between the lenders and their counterparts, such as the investors' lack of market knowledge **(see Figure 15).**

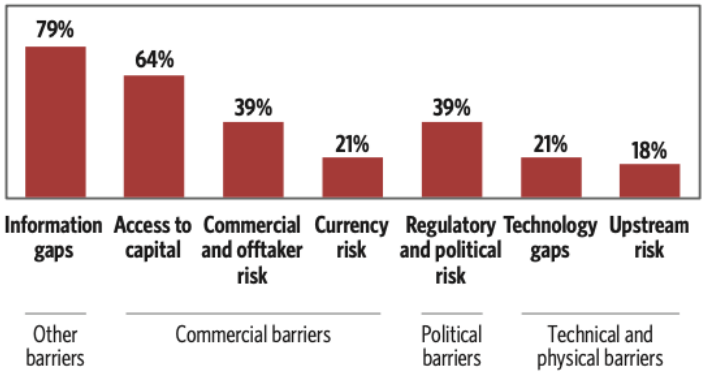

Figure 15: Proportion of risks and barriers in Blended Finance. Source: CPI

In Blended Finance, the risk perceived by the actors is also a fundamental component and it could influence the choices regarding investments. For this reason, institutional investors are under-represented.

Therefore, private investors, Venture Capital and Private Equity investors represent the 26% of the initiative investments, due to the high risk tolerance. Banks, Corporations and Hedge funds are involved in the 20% of the initiatives. Insurance and pension funds participate only to the 8% of the initiatives, due to the low risk tolerance.

Finally, the Blended Finance instruments **(see Figure 16)** comprise investments directly to the projects through different types of equity and debt, indirect investments through insurance, hedging, swap and derivative instruments.[72]

CPI, describing the different sources of investments in the report, exclude many other instruments that are fundamental in the Blended Finance field and Clean Energy sector, such as the PPAs (Power Purchase Agreements, typical contractual mechanisms) and subsidies, such as tariffs and tax credit.

[72] CPI (2018) - *Blended Finance in Clean Energy: Experiences and Opportunities*

INSTRUMENT TYPE	DESCRIPTION	EXAMPLES	ADDRESSES WHICH SPECIFIC RISKS/ BARRIERS
Direct Investment	Debt or equity instruments with direct contribution into a blended finance vehicle (e.g., project or fund)	Junior/ subordinated capital (e.g., concessional equity & debt)	Multiple risks including off-taker risks, construction risks, revenues attractiveness, etc.
		Commercial capital (catalytic when used for demonstration effect, also known as "anchor capital")	Access to capital
Guarantees	Generally, three party agreements, where a third party provides an extra layer of protection for the beneficiary of a service, e.g. debt service, in case the entity who would normally provide a service fails to do so	Loan guarantees	Access to capital, counterparty / off-taker / credit risk
		Performance guarantees	Technical risk
Hedging instruments, swaps, and derivatives	Contractual instruments to help manage different types of risks faced by an investor or borrower	Local currency hedges/swaps	Currency risk
		Securitization	Liquidity/time horizon, scale, counterparty / off-taker / credit risk
Insurance	Two party contracts between the insurer and the policy holder. The insurance provider promises to provide financial compensation in the instance of an event that results in a financial loss	Political risk insurance	Political and social risks
		Performance insurance	Construction risks, operation and output risks Upstream resource-related risks
Commercially oriented preparation support	Grant or concessional funding specifically to address early stage development risks	Project preparation funding or technical assistance	Administrative risks, Access to capital, capacity at local level

Figure 16: Blended Finance instruments. Source: CPI

Recent climate summits have revealed that finance is critical for the implementation of Intended Nationally Determined Contributions (INDCs), in which nearly 200 countries have publicly outlined their intentions in terms of greenhouse gas reduction.[73] For many developing countries, these intentions are highly dependent on the pledges of developed countries to provide them with USD 100 billion a year for their adaptation and mitigation projects[74]. However, the current economic turmoil that prevails in most developed countries[75] and the lack of common understanding about the balancing between adaptation and mitigation finance[76] suggest that developing countries are unlikely to achieve their emission reduction targets by solely relying on those pledges. Rather, developing countries must also explore new financing mechanisms, such as green bonds if their commitments should be respected.

[73] Banga, J. (2019) - *The green bond market: A potential source of climate finance for developing countries*. J. Sustain. Invest. 2019, 9, 17–32.
[74] UNFCCC (2009)
[75] King (2017)
[76] Pickering, J., Jotzo, F., & Wood, P. (2015) - *Sharing the global climate finance effort fairly with limited coordination*. Global Environmental Politics, 15(4), 39–62.

2.3 Climate Finance Instruments

Climate Finance needs to be seen as an essential tool for accelerating climate action and effectively managing the risks and opportunities associated with climate change and must play a leading role in supporting this process. As described in the previous chapters, strengthening the role of finance in achieving an efficient economy that also achieves environmental and social objectives is one of the goals set by the European Community. With the first action plan on sustainable finance, which provides a unified system to foster clarity and guidance on the activities to be considered "sustainable" and useful to the mitigation of climate change, Europe is committed to promoting a more sustainable society and a low-carbon economy. The implementation of Sustainable Finance to combat climate change is crucial in order to bring sustainable financial instruments closer to businesses with the purpose to foster global climate change awareness.

In the wake of the Paris agreement, concern about climate change has become a driving force, new "green" financial products have appeared and climate-related bonds continue to show strong demand. Finally, pension funds around the world are demonstrating that they see sustainable investments as critical to long-term investment, increasingly requiring the integration of environmental, social and governance (ESG) elements in their investments.

Before studying in a deep way the climate finance instruments, it is crucial to mention the ESG elements in the investments. As described by CFA Institute, ESG stands for Environmental, Social, and Governance. "*Investors are increasingly applying these non-financial factors as part of their analysis process to identify material risks and growth opportunities*"[77]. Numerous institutions, such as the Sustainability Accounting Standards Board (SASB), the Global Reporting Initiative (GRI), and the Task Force on Climate-related Financial Disclosures (TCFD) are working to form standards and define materiality to facilitate incorporation of these factors into the investment process. ESG factors are "*often interlinked, and it can be challenging to classify an ESG issue as only an environmental, social, or governance issue*"[78] (**see Figure 17**). These ESG factors can often be measured

[77] CFA (2021) - *EGS Investing and Analysis*, Link: https://www.cfainstitute.org/en/research/esg-investing
[78] CFA (2021) - Link: https://www.cfainstitute.org/en/research/esg-investing

(e.g., what the employee turnover for a company is), but it can be difficult to assign them a monetary value (e.g., what the cost of employee turnover for a company is).

Figure 17: ESG Factors. Source: DNB Asset Management

As described by Gulati (2018), climate change mitigation projects and programs have drawn on a wide range of financial instruments.[79] In particular, these instruments can be broadly grouped in two different categories:

- **financial instruments to raise funds**, used to mobilized funds and raise funds;
- **financial Instruments to deploy funds**, used as financial products to provide capital to specific projects or to address specific risks of mitigation projects.

2.3.1 Financial Instruments to Raise Funds

Inside the category of financial instrument to raise funds we can identify different instruments, some of them already existing and others proposed for the next years, that we will study in deep in the next paragraphs:

- Green Bonds
- Climate Bonds

[79] Gulati, M. (2018) - *Financial instruments used by governments for climate change mitigation*

- Climate Policy Performance Bonds
- Catastrophe Bonds
- Insurances
- Debt for Climate Swaps

2.3.1.1 Green Bonds

As we will see in more detail in the next chapter, green bonds are relatively new financial instruments, with an extraordinary growth rate since 2007 to nowadays. They are bonds like any others, but the goal of the issue is linked to projects that have a positive impact on the environment, such as energy efficiency, the production of energy from clean sources, the sustainable use of land. Indeed, green bonds allow to finance various types of projects with environmental sustainable characteristics, such as water and waste treatment, initiatives related to pollution prevention and control and in general, the Renewable Energy industry. The differences between green bonds and traditional bonds are four:

1) the project which needs to be financed has to be selected before the issuance of the bond;
2) the proceeds must be constrained to the selected project. The money must be deposited into a specific account or otherwise traced by the issuer;
3) at least once a year a statement of the use of the proceeds must be made indicating the projects for which they are used;
4) there must be a second opinion, or an external auditor must certify documents and objectives.

2.3.1.2 Climate Policy Performance Bonds

In order to sustain and foster the low-carbon transition of countries, new financial instruments have been introduced by governments. As said, green bonds in the last years

are the most used and powerful among these instruments. 2015 was the fourth consecutive record issuance year, with green bonds issued for a total value of over 45 billion[80]. However, this impressive growth raised some challenges linked to transparency of green bonds and "green washing" risks, as the market is not transparent regarding what constitutes the "green" quality of a bond.[81] In contrast to green bonds and inspired by Social Impact Bonds, new bonds called Climate Policy Performance Bonds (CPPB) have been established, as an innovative asset class with the potential to mobilize significant resources for climate change mitigation projects on the ground while tackling the challenges that green bonds are encountering[82].

In general, Governments issue Climate Policy Performance Bonds paying an interest based on climate policy performance and targets. These targets can be based for example on greenhouse gas emission reductions or an increase of renewable energy percentage on total energy production. If these kind of bonds are directly connected with GHG emissions and targets, there is an incentive for the issuer to reduce the level of emissions. This process is the most important difference with green bonds. In this way the risk of "green washing", which is undermining the credibility of the growing green bond market, is significantly reduced.[83]

Climate policy performance bonds could provide advantages, depending on the investors (see **Figure 18**). Insurance companies, for example, can be advantaged by hedging their exposure to climate risk.

[80] Bloomberg (2016) - *Bond Market Asking `What Is Green?' Curbs Climate-Friendly Debt*; http://www.bloomberg.com/news/articles/2016-03-07/bond-market-asking-what-is-green-curbs- climate-friendly-debt

[81] Michaelowa, A., Bouzidi, A. & Friedmann, V. (2016) - *Boosting climate action through innovative debt instruments. Combining debt for climate swaps and climate policy performance bonds*. Concept Note. Perspectives Climate Research gGmbH & Emena Advisory. Freiburg, Germany.

[82] Bouzidi and Mainelli (2015) - *Environmental Policy Performance Bonds*, Climate 2020, p. 152-153

[83] I4CE (2016)

Investor type	Advantages
Insurance companies	Hedging climate risk
State pension funds	Portfolio diversification
Development banks	Generating co-benefits from climate change mitigation
Sovereign funds	Decarbonizing portfolio/support climate policy

Figure 18: Advantages for CPPB investors. Source: Michaelowa A. et al. (2016)

Although climate policy performance bonds have not been deployed anywhere yet, a variant of the concept can be found in Brazil's Amazon Fund.[84]

The Amazon Fund is a mechanism created to raise donations for non-reimbursable investments to prevent, monitor and combat deforestation, as well as to promote the preservation and sustainable use of the Brazilian Amazon.[85] Indeed, as stated by FAO (2015). "*the aim of this fund is to stop and reduce the deforestation in Brazil and to build a process in which financing is based on effective reduction of greenhouse gas emission. In this process, resources are only raised when emissions in the Amazon fall below an historical 10-year average, which is revised every five years*".[86]

2.3.1.3 Catastrophe Bonds

The catastrophe bonds are usually issued by an insurance or reinsurance company to transfer part of the risks related to exceptional events (hurricanes, earthquakes, floods, etc.) to other operators reducing their exposure to natural disasters. In the case of classical bonds, coupons and repayment of principal are the result of the classic mathematical formula. For the catastrophe bonds, which are issued on the category of «Insurance Linked Securities» (ILS), , the formula is based on the occurrence of a predefined natural event. Upon the occurrence of the claim, the underwriter of the obligation loses part or all of the interest or principal. These bonds have a relatively short duration (3 years on average). These instruments, which made their appearance during '90s, have features that convinced investors, first of all diversification. The fluctuations of

[84] Leitmann, J. & Bishop, V. (2011) - *Concessional Climate Finance: MDB Experience and Opportunities*. FY11 ENV Knowledge Product
[85] Amazon Fund. Link: http://www.amazonfund.gov.br/en/home/
[86] Fao (2015) - *Emerging approaches to Forest Reference Emission Levels and/or Forest Reference Levels for REDD+*

these assets are independent from the performance of the economy and very little correlated to that of other assets. In addition, they exhibit reduced volatility and their risk/return ratio is generally considered attractive. Insurers are the predominant part of the total volume of catastrophe bonds, but these assets have also attracted other types of issuers, including supranational bodies such as the World Bank, which issues bonds on behalf of countries at risk of natural disasters, and private companies.

As described by Artemis Insurance Report (see **Figure 19**), in Q3 2020 catastrophe bond issuance totaled 1.63 billions of dollars, the third highest record in the last decade, and in total at September 2020 the issuance reached 10.44 billions of dollars, 2.64 billion higher than the total 2019.

The Artemis Insurance report shows that as at the end of Q3 2020, the outstanding Catastrophe bond market size stood at 41.97 billions of dollars, which, while up on the end of Q2, remains lower than the 42.4 billions outstanding market size recorded at the end of Q1 2020.[87]

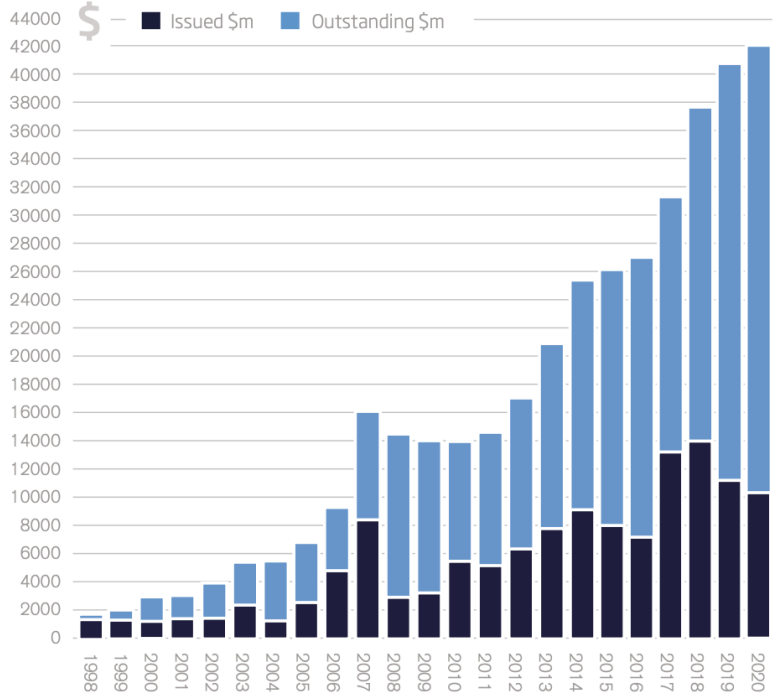

Figure 19: Catastrophe Bonds issued and outstanding over years. Source: Artemis Insurance

[87] Artemis (2020) - *Q3 2020 Catastrophe Bond & ILS Market Report*

2.3.1.4 Debt for Climate Swaps

In general, a debt swap is a transaction in which the obligations or debts of a company, individual or a country (developed or developing country) are exchanged for something of value, namely, equity.[88] In other cases, equity is substituted with bonds or stocks whose value is determined by the market. This process is typical in public traded companies. A debt/equity swap is a refinancing process in which a debt holder receives an equity position in exchange for the delay of the debt. This kind of process, called swap, is done to help a company to continue to operate.

This deal may be advantageous to both the debtor and the creditor, in particular if the creditor has cancelled part of the debt because he/she does not expect full repayment by the debtor. In case of debt swaps between countries and governments, in exchange for this partial cancellation of the debt, the debtor government commits to mobilize the equivalent of the reduced amount in local currency for agreed purposes on agreed terms.[89]

In this Debt/Equity Swaps framework, there is a particular debt swap instrument called debt for nature swap. A debt for nature swap is a deal between countries that reduce a country's debt outstanding in exchange for an investment to protect nature. These are voluntary transactions whereby the donor(s) cancels some or all of the debt owned by a country's Government [90]. As described by Fuller F. et al. (2018), "*Debt for climate swaps are a variation of debt for nature swaps. In debt for climate swaps, bilateral and multilateral debt relief could enable vulnerable developing countries, including SIDS, to reduce their external debt while investing the liberated funds in national climate adaptation and mitigation programs*." [91]

Traditional debt for nature swaps are agreements between a donor and debtor country, as described by Figure 20 (**see Figure 20**).

[88] Chen j. (2020) - *Debt/Equity Swap.* Link: https://www.investopedia.com/terms/d/debtequityswap.asp

[89] OECD (2007) - *Green Investment Banks. Innovative Public Financial Institutions Scaling up Private*

[90] UNDP (2018) – link: http://www.undp.org/content/sdfinance/en/home/glossary.html

[91] Fuller F. et al. (2018) - *Debt for Climate Swaps: Caribbean Outlook*

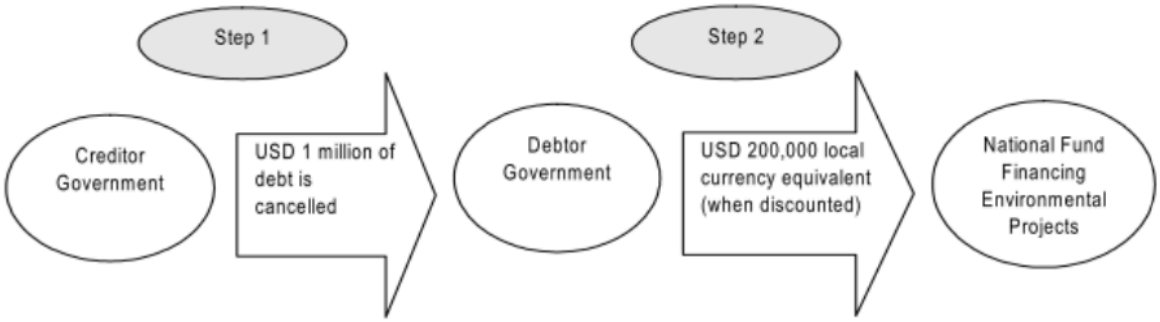

Figure 20: Debt for Nature Swap Basic Model. Source: OECD (2007).

Usually there are debt for nature with a third non-governmental actor involved as described by Figure 21 (**see Figure 21**).

Figure 21: Debt fo Nature Swap Tripartite Model. Source: OECD (2007)

The Organization for Economic Co-operation and Development (OECD) estimates that between 1991 and 2003, debt for nature swaps generated almost US$1.1 billion for conservation measures, in return for debt with face value volumes of almost US$3.6 billion.[92]

The most effective example of a debt for climate swap is provided by Poland. In 1991, Poland restructured its bilateral debt with its Paris Club creditors (a group of officials from major creditor countries whose role is to find coordinated and sustainable solutions to the payment of difficulties experienced by debtor countries[93]), wherein creditors cancelled 50% of their claims. In exchange for five creditors cancelling an additional 10% of their claims, Poland financed an EcoFund of $474 million with an equivalent amount of

[92] OECD (2007) - Green Investment Banks. Innovative Public Financial Institutions Scaling up Private, Low-carbon Investment. OECD Environment Policy Paper No. 6.
[93] Gulati, M. (2018) - *Financial instruments used by governments for climate change mitigation*

hard currency used to finance projects that reduce transboundary air pollution, reduce pollution in the Baltic Sea, lower GHG emissions, and protect the country's biodiversity.[94]

2.3.2 Financial Instruments to Deploy Funds

There are two types of instruments that provide funding to climate change mitigation projects[95]:

- **Capital Instruments**
- **Risk Management Instruments**

2.3.2.1 Capital Instruments

There are three different types of capital instruments used to mitigate climate change (see **Figure 22**):

- Debt Finance
- Subordinated Debt / Mezzanine Finance
- Equity

In particular, Debt Finance is called also Senior Debt, Mezzanine Finance can be considered ad a subordinated senior debt and Equity comprises preferred stocks and common stocks.

[94] Development Finance International (2009).
[95] Gulati, M. (2018) - *Financial instruments used by governments for climate change mitigation*

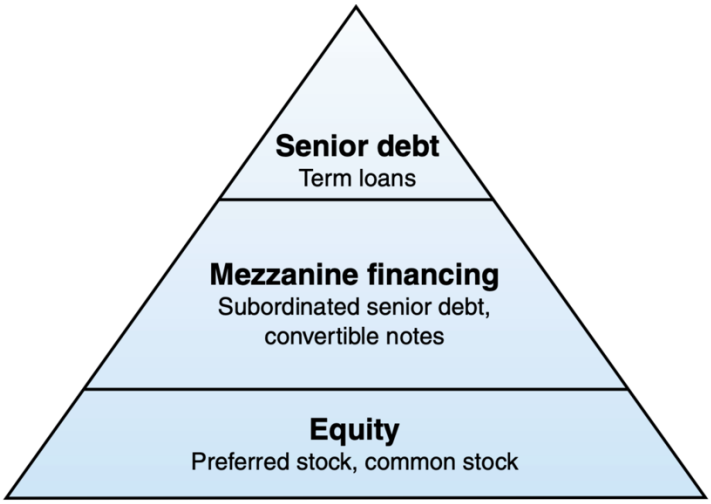

Figure 22: Capital Instruments.

2.3.2.1.1 Debt Finance

a) Project Finance (Senior Debt)

With this instrument, debt is borrowed for a specific project; the amount of debt made available will be linked to the revenue the project will generate over a period of time, as this is the means to pay back the debt. This amount lent is then adjusted to reflect inherent risks, e.g. the banks will establish first 'charge' or claim over the assets of a business, as described above. The first tranche of debt to get repaid from the project is usually called 'senior debt'.

It is different from an usual corporate lending because in this latter case banks provide finance to companies to support everyday operations. An assessment is made of the company's financial strength and stability, and debt is priced accordingly.

b) Subordinated Debt / Mezzanine Finance

The instrument of mezzanine finance is between senior debt and equity. It comprises quasi-equity finance and it includes a mix of debt and equity financing in which a lender has the right to convert the debt in equity in case of default of the company, in general after the senior lenders are paid.

Mezzanine Finance, also called subordinated debt, stands between the top level of senior bank debt and the equity ownership of a project.

From a risk point of view, mezzanine loans are riskier than senior debts because in the event of insolvency, it shall be repaid after the balance of all other debts which are defined as "senior". In comparison with other debts, it is usually shorter and more expensive for the borrowers but it is more profitable for the lender and it may be provided by banks or other financial institutions.

c) Refinancing

In this case, there is a project which has already a debt and wants, or needs, to replace existing financing with a new one. This process is equal to refinancing a mortgage.
There are several reasons to refinance a project, for example if there are terms that are more profitable available in the market or if the lenders become more familiar with the technology of the project. Another reason could be in terms of duration, as loans are usually more expensive over time because the risk increases as the market condition or regulations changes.
Loans measure the degree of security and feasibility of a climate mitigation project. For the public lender, granting loans means allowing repayment to finance or refinance more projects. However, the process of using public loans to mobilize private funds presents several challenges for example it is difficult for the public lender to estimate the degree of lending needed to provide useful finance to the project without wasting public money.

2.3.2.1.1 Equity Finance

Equity Finance consists in contributions directly in cash. In particular, in the cases in which the owner (in sole proprietorships) or members (in collective enterprises) self-finance the enterprises.
The contributions constitute the capital injection, the size of which is given by the value of the share capital and, in the case of an increase in capital through the issue of new shares above par, by the excess premium reserve. In the companies, it coincides with equity. Capital injections are formed at the time of establishment or at subsequent times in the life of the company, when additional financing is required.
From a private investor's point of view, the entities that use equity finance among financial investors include, in addition to private investors, private equity funds,

infrastructure funds and pension funds. These funds invest into companies or directly into projects or portfolios of assets.
The equity investors differ by the type of business, the degree of technology and the risk associated. In particular, venture capital investors focus on early stage or growth stage of a project. Private equity firms are focused more on later stage of a project and they expect to disinvest, making returns, in 3 or 5 years. Instead, infrastructure funds will be focused on lower risk infrastructure such as roads projects, renewable energy and other projects in which they have a longer term investment horizon with lower returns in the first period. Finally, institutional investors, for example pension funds, have longer time horizons and larger investment amounts than Infrastructure Funds, with lower risk.

Funds, in order to decide the investments projects, use typically the Net Present Value (NPV) and Internal Rate of Return (IRR) rules. NPV is the most reliable and appropriate method to assess the economic and financial convenience of different investment alternatives. Instead, the IRR is unable to compare investment projects of different size scale.
The Net Present Value (NPV) is the value of the sum of cash flows discounted at zero time at a rate equal to the opportunity cost of capital. The model assumes the presence of a perfect market in which investors have free access to the financial market in order to calculate the opportunity cost of the alternative investment with equal risk.
The Internal Rate of Return (IRR) is the discount rate that makes zero the net present value of the cash flows generated by an investment project. It expresses the implicit return of an investment project. Although it is easy and of common application, this methodology hides numerous pitfalls that can lead to errors or manipulation of results.

From a public perspective, governments invest in equity for climate change mitigation projects providing a capital injection without receiving any guarantee of repayment.
Given that equity financing requires high levels of commitment, only highly qualified projects are selected and the number of projects that can be upscaled through this instrument is limited.[96]

[96] Lindenberg, Nannette (2014) - *Definition of Green Finance*. DIE mimeo, 2014, Available at SSRN: https://ssrn.com/abstract=2446496

2.3.2.2 Risk Management Instruments

Risk Management Instruments in "Climate Finance" comprise both insurances and guarantees. Instead of financing directly the project, these instruments reduce the risk perceived by the investors in order to foster investments for a specific project, reducing costs.

Natural consequences of climate change are extreme weather events such as floods, droughts, heat waves and storms. These climate change consequences are becoming more common, accompanied by an overall increase in risk. In order to reduce these risks, insurance mechanisms can make companies and governments more resilient to the impacts of extreme weather events in several ways. As defined by European Commission (2018), "*insurance mechanisms can provide financial compensation for large disaster losses so that those affected can recover faster and they can play a large role in assessing, communicating and signaling risk through premiums, deductibles and payments, so that those at risk can have a better understanding of the threats posed.*"[97]

Insurances involve an agreement by the insurer, to pay part of the costs or losses incurred by a project in exchange for a fee in the event of non- performance of the project or default of obligations by the borrower.[98]

On the other hand, a guarantee involves three parties – a guarantor who offers the guarantee, a financier who gets the guarantee, and the project that receives the finance.[99] Guarantees enable project-based investors to transfer risks they cannot easily absorb or manage and are particularly effective at mobilizing investment. They should only cover part of potential losses to avoid encouraging over investment in risky projects.[100] Guarantees can assume different forms:

- Credit Guarantees
- Partial Credit Guarantees

[97] European Commission (2018) - *Using insurance in adaptation to climate change*
[98] Gulati, M. (2018) - *Financial instruments used by governments for climate change mitigation*
[99] Gulati, M. (2018) - *Financial instruments used by governments for climate change mitigation*
[100] The World Bank (2020) - *Transformative Climate Finance: A new approach for climate finance to achieve low-carbon resilient development in developing countries*

- Performance Risk Guarantees
- Revenue Guarantees

Finally, also structured finance can be assess as a form of guarantee. Indeed, as stated by Gulati M. (2018), it is "*a mechanism that layers public guarantees, usually at concessional terms or in a junior position, as part of an overall investment package. In the event of a partial default, senior investors would be repaid first, with the guarantor and other junior partners potentially receiving no repayments*".[101]

Regardless of the different forms, guarantees are divided into "Pari Passu" and Subordinated.
With the term "Pari Passu", we refer to the practice that guarantees all bondholders a level playing field. All of them must be treated in the same way. This means that the holders of the same obligation have the same degree of pre-emption: it is not possible that some are privileged in the event of insolvency. The principle must be interpreted as a level playing field: it does not mean that in the event of default, everyone is entitled to a 100% refund. Instead, a subordinated guarantee, in its easiest form, gives the financier the first right to be refunded.[102]

2.4 Sustainable Finance and Covid-19

The Covid-19 pandemic is changing people's lives like few other events in our recent history and the sustainable finance industry is reacting quickly, in order to respond to the huge demand for capital to address the emergency and finance the recovery.
Since the beginning of the emergency, we are seeing the creation of a new category of financial instruments launched precisely in response to the crisis. These instruments are the so-called "Covid-19 bonds", issued to finance the fight against the virus and support businesses and individuals affected by the pandemic.
In the bond market, until the beginning of 2020, green bonds were the most issued in the market. The green bonds, focused on energy efficiency projects and mitigation of

[101] Gulati, M. (2018) - *Financial instruments used by governments for climate change mitigation*
[102] The World Bank (2009), London School of Economics

environmental impact, are the preferred tool to financing the transition to the low-carbon economy.

The Covid-19 pandemic is broadening the perspective to give more space to social issues, the “S” acronym within ESG (Environmental, Social and Governance). During the peak of the pandemic, many institutions and companies immediately mobilized to raise capital on the market with the aim of financing activities in response to the health emergency and its serious consequences on the most vulnerable categories. In the pandemic, the most used tools are Social Bonds or Sustainability Bonds. Since the beginning of 2020, Social and Sustainability Bonds have covered 40% of emissions, while in 2019 their share was 23%.[103]

The bonds in response to the Covid-19 have been issued by supranational entities, governments, regions and companies that will use the proceeds to support the fight against the virus and to help the most affected populations and businesses. These bonds are issued in line with the Social Bond Principles or the Sustainability Bond Principles of the International Capital Market Associations (ICMA) and they have the denomination of Social Bonds or Sustainability bonds, while other bonds have been issued as "response bonds", "Covid bonds" or without a specific label.

Internationally, the $1 billion Social Bond issued on March 11 2020 by the International Finance Corporation (IFC - World Bank Group agency) was one of the first to be issued on the market. Among the institutional investors who have joined the issue, aimed in supporting the operation of companies engaged in the production and shipment of medical and pharmaceutical materials, there was the Swedish pension group Alecta and insurance industry operators, always Swedes, Lansforsakringar and Folksam.

The World Bank has issued on the market a sustainability bond of 8 billion dollars, a record for an issue in dollars by a supranational body. The 5-year bond received funds of 12.5 billion from nearly 190 investors, mainly central banks, treasuries, asset managers, pension funds, and insurance. The use of revenues will be focused on health projects and programs considered crucial for countries' immediate response to COVID-19.

[103] Bloomberg (2021)

At European level, the Council of Europe Development Bank (CEB) has launched the "COVID-19 Response Social Inclusion Bond", a social bond with a 7-year maturity of 1 billion Euros. The proceeds will be used to support Member States in mitigating the economic and social impacts of the health crisis and may also finance ongoing projects to support small and medium-sized enterprises in creating or preserving employment.
In Italy, the Covid-19 Social Response Bond launched by Cdp (Cassa Depositi e Prestiti) in support of Italian companies and the local area has received requests almost twice than the issue. The Bond was issued in two tranches, at 3 and 7 years of 500 million euros each, and was subscribed by over 130 investors, mostly (53%) Italians. The proceeds are intended both for short-term projects, to respond to the emergency, and to support the recovery, to finance activities that will contribute to the achievement of the Sustainable Development Goals.

3. CHAPTER: GREEN BONDS

3.1 What is a Bond

A bond is a fixed income instrument, a document issued by a state or a company to finance itself. Therefore, it is a contract issued by an entity that needs financing. Issuing an obligation means to create and offer it to potential investors for subscription: those who subscribe it will become the creditors of the issuing institution. Therefore, there are two fundamental subjects: the issuer, called the debtor, and the underwriter, called the creditor.

A bond, in its simplest form, is a document that contains some basic information as the date of issue, the expiry date, the nominal value in a given currency and the interest rate. The dates of issue and maturity indicate how long the loan will last. At the maturity, so the end of the bond loan, the issuer of the bond has the obligation to return the capital received to each holder of the bond and in a single settlement. Instead, the holder, that is the investor, receives interests periodically (coupons) on the amount invested (usually quarterly, half-yearly or annually), or at maturity with the invested capital (zero coupon bonds).
The main difference with a simple bank loan is that the payments of the bond go to whoever holds it at that time. In fact, the underwriter could transfer the bond, sell it to another investor, who will receive the remaining payments as written in the bond.
The issue price of a bond may be:

a) **at par**, when it coincides with the nominal value of the principal that is redeemed at maturity;

b) **below par**, when it is less than the nominal value. For companies, issuing below par is a way to foster investors with a discounted price. The coupon will be calculated, as always, with the nominal value and the interest rate, but at maturity the investor will receive more than the paid-up capital: he/she will receive the difference between the subscription price and the nominal value;

c) **above par**, when it is above the nominal value recognized at maturity. This scenario may occur if the bond is paying a higher coupon than other bonds outstanding. In addition, it may be the result of a general fall in interest rates on new bonds issued by the same companies or governments: the older bonds with higher interest rates guarantee higher annual returns. Thus, the market plays an important role in the valuation of bonds, mainly referring to the risk associated with issuers and the system in general.

The yield of the bond is the sum of the interest received and the difference between the nominal value and the issue price paid. The value obtained must then be reduced by the amounts equal to taxation and trading fees.
Even if the interest rate remains unchanged, in the analysis it is fundamental the so called Yield-to-Maturity, the rate that makes future payments equivalent to the price paid at the beginning.
If the price paid to buy the bond is equal to the principal repaid at maturity, the rate of return will be equal to the interest rate. If the price paid is lower, the rate of return will be higher than the interest rate and vice versa. Since the interest rate is usually fixed and the maturities vary from bond to bond, in the markets the rate of return is more comprehensive and it allows the comparison between bonds with different maturities. Indeed, the rate of return is expressed as an annual rate, irrespective of the maturity of the individual bond. So it is possible to compare different bonds for maturity, but also for different interest rates.
Regarding the interest rate, there are two categories: fixed-rate bonds and floating-rate bonds. In the first case, the interest rate is set before the issue and recorded in the bond document. The bondholder will receive the same interest rate (the same coupon) at each maturity specified in the bond.
In the second case, the interest rate may vary over the life of the bond. Then, the value of the rate will depend on the performance of other rates or prices of other assets that serve as a benchmark.
Finally, if there is not a final payment, it is called perpetual annuity. At regular intervals, the underwriter (or bondholder) will receive a coupon. The particularity is given by not receiving a final repayment of the principal, but continuing to receive the same amount of interest over time.

3.2 The Green Bonds

Green bonds are fixed income securities, which finance investments with environmental or climate-related benefits.[104] Green bonds are a component of the more general "green finance", which aims to "internalize environmental externalities and adjust risk perceptions" for the sake of increasing environmentally friendly investments.[105]

In particular, a green bond is a special kind of bond in which the revenues may be used exclusively to finance or re-finance, in part or in whole, new and existing green projects. Currently, there is no global standard to certify a certain bond as "green", but there are guidelines developed by the International Capital Market Association (ICMA). As defined by ICMA, "*The Green Bond Principles (GBP) are voluntary process guidelines that recommend transparency and disclosure and promote integrity in the development of the Green Bond market by clarifying the approach for issuance of a Green Bond*" and they will be analyzed in the next paragraph. Given the strong expansion of green bonds and its growing presence in the financial markets, the need for clear rules from rating agencies and institutional investors is increasingly crucial. The ICMA also provides guidance on eligible environmental issues, but the list is purely illustrative and not exhaustive. In fact, it is a self-regulation. In case of non-compliance with the principles in the years following the issue, there are no penalties, other than those given by the reputational market itself. In general, green bonds are a tool created to increase liquidity in financial markets and to facilitate the low-carbon transition financing specific projects. Green bonds can often be a more convenient and "comfortable" solution than shorter-term bank loans, particularly financing low-carbon projects and high interest rate environments. As described by Zerbib O. (2017), "*they are highly attractive financial instruments that foster the environmental transition while enabling low-carbon project holders to expand their funding capacity*".[106] Therefore, the innovation for this type of instrument is to be a traditional investment, characterized by a risk component and the related return, but also it adds a contribution that goes beyond the purely traditional investment, sensitizing the investor with its "green" characteristic.

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[104] Ehlers, Torsten, and Frank Packer (2017) - *Green bond finance and certification*. BIS Quarterly Review September: 89–104.
[105] G20 Green Finance Study Group (2016) - *Green finance synthesis report 2016*, September.
[106] Zerbib O. (2017) - *The green bond premium*, Department of Finance, Tilburg School of Economics and Management

Green bonds act as traditional bonds and, in their simplest form, they raise capital of fixed amount and return it to maturity, while they periodically pay off interest. In order to pursue this goal, the issuer must generate enough cash flows.
Depending on the structure of the bonds, the market have classified green bonds in four different categories[107]:

- **Standard Green Use of Proceeds Bonds:** a bond consistent to the Green Bond Principles and issued directly by the issuer, acting as guarantor. The investor is remunerated over time with the profits from the funded project;
- **Green Revenue Bonds:** a type of bond aligned with the Green Bond Principles where investors are rewarded using pledged revenues such as commissions or fees and where proceeds are used for environmental projects that are or are not related to these flows;
- **Green Project Bonds:** as defined by Banga j. (2019) it is a "*bond issued for a single, or a pooled, green project(s) for which risks are entirely bore by the underwriter, with or without potential recourse to the issuer*".[108]
- **Green Securitized Bonds:** a kind of bond aligned with the Green Bond Principles that uses the underlying assets as collateral. The first source of repayment is usually cash flows from such underlying assets.

Financed green projects may also have social co-benefits. For this reason, the issuers of a green bond must define the use of the capital raised according to the main purpose. In addition, green bonds are exempt from taxes, or can have the so called "tax credits", because national and local governments know about the positive impacts that they can have in the fight against climate change. For these reasons, in addition to those explained before, the green bond instrument attracts not only socially responsible investors, but also investors who are looking for a safe vehicle to invest their savings.

[107] Equita (2019) - *Green Bond: new funding opportunity*, Research team, June 10, 2019
[108] Josué Banga (2019) - *The green bond market: a potential source of climate finance for developing countries*, Journal of Sustainable Finance & Investment, 9:1, 17-32, DOI: 10.1080/20430795.2018.1498617

Given the lack of universal standards and definition for green bonds, it is likely that their characteristics may differ from one issuer to another.[109] Nevertheless, the goal remains the same, collect financing to green projects.

3.2.1 Green Bonds Principles and Climate Bonds Standard

In order to guarantee investors in their green investment, ensuring that both the capital raised is actually used to contribute to the fight against climate change and the credibility of the instrument itself, the Green Bonds Principles and the Climate Bonds Standards have been established. They provide voluntary guidelines that those who intend to issue green bonds can follow so that they are more credible and reliable. In particular, these principles recommend transparency, reporting and disclosure, clarifying the approach to follow for their issuance, as we will describe in the next paragraph. In general, they provide the basic features that the tool and the project must have in order to be financed for the green transition[110].
The Green Bonds Principles are four:

1) **Use of Proceeds**

   This is the key aspect that characterizes a bond as green. The capital raised by the issuing must be exclusively used for projects with clear, and possibly measurable, environmental benefits. Among the environmental objectives we can acknowledge: climate mitigation, adaptation, conservation of natural resources and biodiversity, prevention and control of pollution. They can be interrelated at the same time and therefore involve more than one environmental category and objective. Projects that aim to contribute to the green transition and climate-resilient economy are called "climate-aligned green bonds". The categories allowed by the Green Bond Principles (see **Figure 19**) will be analyzed at the end of the paragraph.

[109] Flaherty, M., A. Gevorkyan, S. Radpour, and W. Semmler. (2017) - *Financing Climate Policies Through Climate Bonds–A Three-Stage Model and Empirics*. Research in International Business and Finance 42: 468–479. https://10.1016/j.ribaf.2016.06.001
[110] International Capital Market Association (ICMA) (2018) – The Green Bond Principles

2) Process for Project Evaluation and Selection

The issuer of a green bond has to provide, in addition to the traditional project information, a disclosure to investors about the environmental sustainability objectives, the process that determines the classification within one or more of the categories just mentioned, the eligibility criteria and the potential material environmental and social risks associated with the project. [111]

In particular, the Green Bond Principles recommend a high degree of transparency and that the project evaluation process is also supported and validated by external professionals.

3) Management of Proceeds

One of the major disputes relates to the traceability of income collected from the bond sale. The Green Bonds Principles suggest that the net proceeds from the issue are credited to a specific account, either transferred within a specific portfolio, or otherwise properly controlled by the issuer to ensure traceability and documentation. This documentation has to be updated periodically, until all the collected capital is allocated to the project for which the bonds were issued. The issuer has to report on the temporary allocation of capital not yet addressed.

4) Reporting

The issuer shall ensure and make available updates and documentation on the use of the capital raised. They must be reviewed annually until the total allocation of capital is raised, or whenever there are relevant developments. In addition, they must provide a list of the projects financed with a description of them, together with the expected impacts. However, if there are confidentiality agreements, market considerations or other aspects that limit the information to be provided, the Green Bond Principles suggest that the information has to be disclosed in a generic manner. Finally, the communication of the impacts must be supported by qualitative analyses and quantitative performance indicators. Every green bond is different because the project behind is different. As a result, the evaluation of the

[111] ICMA (2018) - *Green Bond Principles, Voluntary Process Guidelines for Issuing Green Bonds*

positive environmental impacts generated and the negative ones avoided often takes place differently from green bonds to green bonds, from project to project.

Although well outlined, these principles are still incomplete, because they are still voluntary. In addition, there is a lack of reporting, monitoring and penalties for infringements.

As it is possible to observe from **Figure 23,** the green project categories are mapped for their contribution to combat climate change and to their specific objectives. The process for project evaluation and selection, under the second core component of the Green Bonds Principles, calls for an issuer of a green bond to communicate to investors the environmental sustainability objectives of their green project.[112]

[112] ICMA (2019) - Green Project Mapping

Environmental objectives					
GBP-project categories	Climate change mitigation	Climate change adaptation	Biodiversity	Natural resource conservation	Pollution prevention and control
Renewable energy	●●●			●	●
Energy efficiency	●●●				●
Pollution prevention and control				●	●●●
Environmentally sustainable management of living natural resources and land use	●	●●	●●●	●●●	
Terrestrial and aquatic biodiversity conservation		●	●●●	●●●	
Clean transportation	●●●			●	●●●
Sustainable water and wastewater management		●●	●●	●●	●●●
Climate change adaptation		●●●			
Eco-efficient and/or circular economy adapted products, production technologies and processes	●●		●	●●●	●
Green buildings	●●●	●		●●●	●

Contribution to objective:

primary ●●● secondary ●● tertiary ●

Figure 23: Mapping the categories to environmental objectives. *Source: ICMA (2019)*

The Climate Bonds Initiative is an international non-profit organization with the main objective of informing investors. It was founded in 2010 to foster large investments that support the transition to a global low-carbon economy. The Climate Bonds Initiative aims to stimulate investors, industry and governments to increase green investments to the scale necessary to avoid the dangerous climate change described in the previous chapters and to achieve the objectives of the Paris Agreement. A fundamental component of the Climate Bonds Initiative is the "Climate Bonds Standard & Certification Scheme", the so-called "Certification Scheme". Indeed, "*the Certification Scheme allows investors,*

governments and other stakeholders to identify and priorities 'low-carbon and climate resilient' investments and avoid 'greenwash'".[113]

The Climate Bonds Standard & Certification Scheme aims to provide the green bond market with the confidence and assurance it needs to stimulate large investments. Moreover, CBI (2019) stated that "activating the mainstream debt capital markets to finance and refinance climate-aligned projects is critical to achieve international climate goals and robust labelling of green bonds and is a key requirement for that mainstream participation".[114]

The requirements are divided into pre-emission and post-issue (see **Figure 24**). The former refer to all aspects ranging from project selection to internal traceability processes and, if respected, it provides the issuer support during internal activities and, to the investor, identification of obligations linked to improve environmental performance. The latter instead, allows the issuer to demonstrate to the investor the successes, the use of capital and the status of the projects implemented.

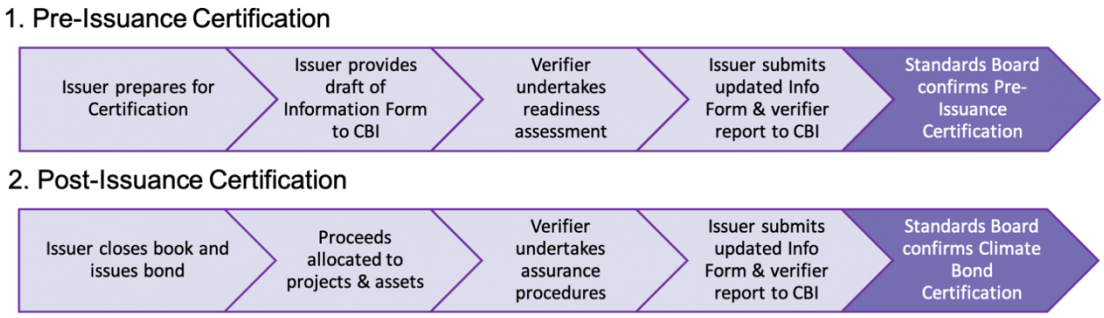

Figure 24: Process for certification. *Source: Climate Bonds Initiative (2019)*

Once the process is over, the bond gets the certification. Therefore, the Climate Bonds Initiative check the four key assumptions to define a bond as a "green bond" and the suitability of projects or activities. The audit must be carried out by independent verifiers who ensure investors, governments and other stakeholders that the funds raised have the promised final destination. In addition, investors can easily screen green bonds on the

[113] Climate Bonds Initiative (2019) - Climate Bond Standard 3.0
[114] Climate Bonds Initiative (2019) - Climate Bond Standard & Certification Scheme 2.0. Guidance for Verifiers.

market and issuers can sell a guaranteed and certified instrument. However, the request for certification is voluntary and recommended above all as a guarantee.

3.2.2 Issuing a Green Bond

The process of issuing a certified green bond involves at least three major market players, including the issuer, an independent reviewer, and the underwriters (see **Figure 25**).[115]

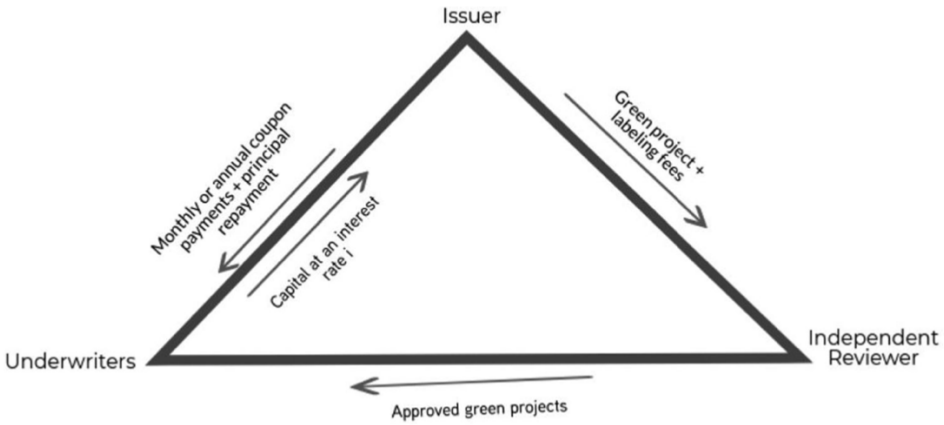

Figure 25: The process for issuing a green bond. *Source: Banga J. (2019)*

The process begins when a company, or private entity, starts a green project. In the project presentation, the company is required to include, as far as possible, the expected positive impacts of its project on the environment. To avoid subjective assessments regarding impacts, an independent auditor, specialized in environmental impact assessment, is required to confirm whether the project is actually environmentally friendly. The role of the independent auditor is to make a quantitative and qualitative assessment of the actual impacts of the project, based on the following criteria suggested by ICMA (2017):

- **The use of proceeds**: before the issuance, a legal document has to guarantee how the proceeds of the bond will be invested;

[115] Josué Banga (2019) - The green bond market: a potential source of climate finance for developing countries, Journal of Sustainable Finance & Investment, 9:1, 17-32, DOI: 10.1080/20430795.2018.1498617

- A **technical assessment,** regarding the risks and opportunities related to the specific project and the probability of default of the green bond issuer;
- **The monitoring, reporting, and traceability requirements**: several reports must be published regularly to monitor the project and the use of the proceeds to ensure that they have been invested in accordance with the Green Bonds Principles.

Failure to comply with these steps will result in the exclusion of the company from the green bond market. At the end of the external auditor's process, which certifies the green nature of the project to be financed, the company is authorized to issue a certified green bond to raise funds in the debt market. Green bond underwriters then provide capital to the issuer for a certain period of time at a fixed or variable interest rate[116]. As will be described in the following paragraphs, this green bond issuance process may involve some significant transaction costs that represent the main disadvantage of green bonds.
However, it is important to consider that the process illustrated is simplified compared to reality. In practice, this process may vary from one market to another.

3.3 Green Bond Market

At the end of 2007, a group of Swedish pension funds wanted to invest in climate-friendly projects, but they did not know how to find these projects. They asked to the World Bank for help. A year later, the World Bank issued the first green bond and by doing it, it created a new way to connect investor finance to climate projects. The concept of a bond dedicated to a specific type of project had never been tested before.
The green bond turned out to be a historic event that radically changed the way investors, development experts, politicians and scientists work together.
Green bonds have changed the behavior of investors: ten years later, investors publish their names and provide quotes when they buy green bonds and they are much more aware of their power to support initiatives with their investments.

[116] German Development Institute (2016) - *Green Bonds: Taking Off the Rose-Coloured Glasses*. Briefing Paper n° 2. https://www.die-gdi.de/uploads/media/BP__24.2016.korr_01.pdf.

The basic premise of the green bond - with its process for the selection of projects, the second-party opinion and the impact report - is applied to other areas. As a result, there are now social bonds, blue bonds and other bonds that collect funds dedicated to a specific development purpose. They all follow the green bond model, with a focus on reporting impacts.

In March 2013, the IFC issued the first billion green bond that was fully subscribed within an hour from its issuance.[117] A few months later, Vasakronan, a Swedish real estate company, issued the first corporate green bond. In any case, they were mainly international institutions. Also in 2013, the first American green municipal bond was issued by Massachusetts. In 2014, the instrument began to be issued continuously, and around 37 billion were issued, more than three times as much as in 2013.

In addition, a group of banks and rating agencies launched the first green bonds indices. These indices are intended to lower information barriers, providing investors with clear data on the risks and returns of the instrument.

Especially since 2015, the instrument has had a great success, thanks to the Paris Agreement, and it began to be used by companies and, from the following year, widely also by municipalities such as New York. In 2016, emerging economies also entered this landscape, especially China.

3.3.1 Development of the last years

As described in the previous paragraphs, the Climate Bonds Initiative (CBI) is an international, non-profit organization dedicated to mobilizing the global bond market towards solutions that facilitate the transition to a low-carbon economy. In addition to providing the Climate Bonds Standards, as discussed above, they provide every year a report about the conditions of the Green Bond Market.

As describe by the figure below (see **Figure 26**), in 2019 all regions increased the volume of the Green Bond Market. It was the first time since 2016. In particular, Europe reached the largest increase, i.e. 50 billion respect to 2018, representing 57% of the global

[117] Trompeter L. (2017) - *Green is Good: How Green Bonds Cultivated into Wall Street's Environmental Paradox*, Sustainable Development Law and Policy Brief, Vol. XVII, No. 2, 2017. 1 maggio 2017

expansion. All European issuer, apart from loans and ABS, reached their highest level, with non-financial corporates, government-backed entities and development banks standing out as particularly strong.[118]

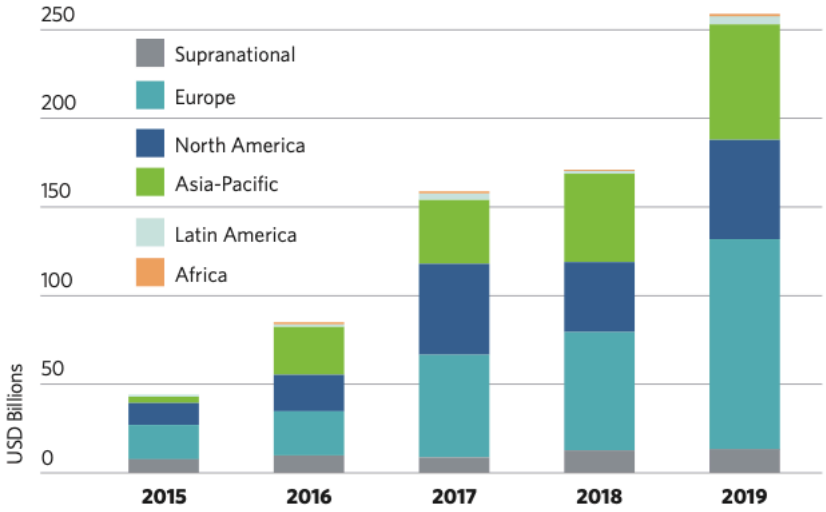

Figure 26: Issuance of Green Bonds by region. *Source: CBI (2020)*

These percentages suggest that "the green bond market is well-established, both in developed and emerging countries, supported by growing climate-awareness among investors".[119] As Banga J. (2019) highlights, in developing countries, the market is still comparatively young.[120] However, as stated by CBI (2017), the rise of the green bond market in emerging economies, such as Brazil, India, Mexico, and China, is boosting cross-regional trades and demonstrating international trading opportunities.[121]

As seen with regions, the whole volume by issuer type increased in 2019 (see **Figure 27**). The same applies to the number of issuers and transactions, apart from a small decrease in the number of ABS transactions. In the area of private sector issues, non-financial corporations achieved particularly positive results, reaching the first place in the ranking of issuers. The amount of bonds issued has more than doubled to 59.1 billion dollars,

[118] Almeida, M. (2020) - *Global Green Bond State of the Market 2019*, Climate Bonds Initiative
[119] Alonso-Conde, Ana & Rojo-Suárez, Javier. (2020) - *On the Effect of Green Bonds on the Profitability and Credit Quality of Project Financing.* Sustainability. 12. 6695. 10.3390/su12166695.
[120] Banga, J. (2019) - *The green bond market: A potential source of climate finance for developing countries*. J. Sustain. Invest. 2019, 9, 17–32.
[121] Climate Bonds Initiative (2017) - The Role of Exchanges in Accelerating the Growth of the Green Bond Market, May 2017. Available online: https://www.climatebonds.net/files/files/RoleStock%20Exchanges.pdf

surpassing the financial companies, which increased by only 12%, the last compared to other issuers. In particular, it represents an inverted trend compared to 2018, which has seen the volume of financial companies more than doubled while non-financial companies have decreased. Green loans were the second largest in 2019, with a growth of 98%.
Issues from the public sector have also experienced significant growth, with all types of issuers achieving record size, with the exception of local governments. Most of the increase is due to a strong push from public authorities, most of them European, and from development banks, which have both almost doubled.

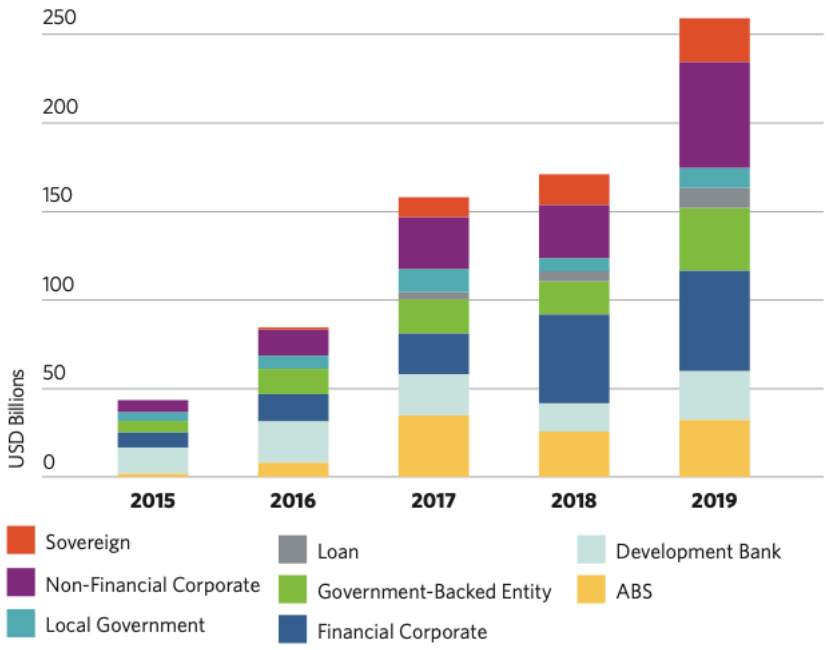

Figure 27: Issuance of Green Bonds by issuer. *Source: CBI (2020)*

All categories of use of proceeds showed a significant increase in volumes in 2019. This statistic is in contrast with 2018, when the increases were less pronounced. While allocations rose across the board, the top 3 categories - Energy, Buildings and Transport were the best performers, accounting for 80 billion dollars of the overall 88 billion dollars added.[122] Buildings registered the highest absolute increase on an annual basis (+30.1 billion dollars), reducing the difference with the energy sector. The transport sector, on the other hand, reached the highest record in relative terms, reaching 71%. With 82% overall, their share has reached the highest level since 2015.

[122] Almeida, M. (2020) - *Global Green Bond State of the Market 2019*, Climate Bonds Initiative

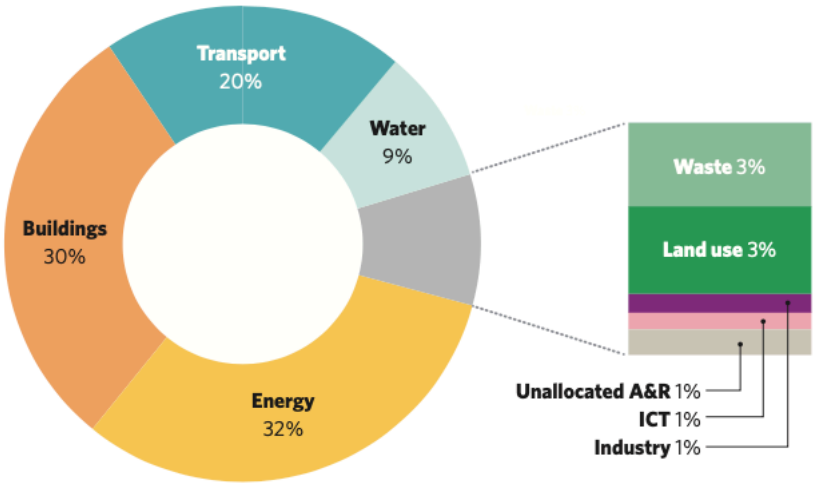

Figure 28: Use of proceeds categories for 2019 Green Bonds issuance. *Source: CBI (2020)*

Finally, the average size of green bonds increased from 108 millions of dollars in 2018 to 144 millions of dollars in 2019 (see **Figure 29**). This statistics is extremely important for the green bond market because larger transactions provide liquidity and knowledge to the market, stimulating additional investors and integrating the green bond market through the creation of additional market indices, while at the same time, allocating more funds for green projects from a single corporate issuance. In 2019, 11% of the global market was represented by the first 10 transactions together, issued by 36 different issuers, for a total of 1 billions of dollars. The majority of the bonds issued, in particular the largest transactions, was issued by sovereign states, financial companies (mainly Chinese), development banks (both national and supranational) and large private or public entities supported by the government (mainly European). However, a good number of smaller issuers got also a positive record, demonstrating that the market is an effective source of capital for many issuer profiles, including those with smaller funding requirements.

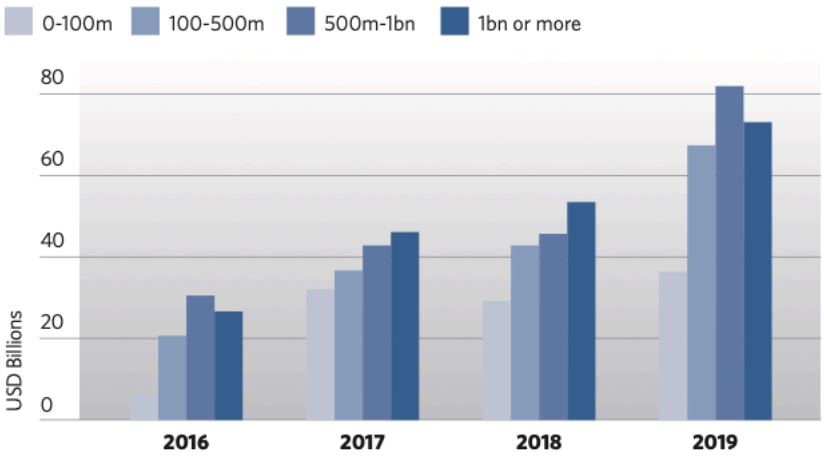

Figure 29: Volume of Green Bonds issuance. *Source: CBI (2020)*

3.4 Characteristics of Green Bonds

The green bonds, being relatively new innovative instruments, have advantages but also disadvantages and risks due to the limited experience of the instrument.

As stated by Flammer (2020), "the issuance of green bonds may serve as a credible signal of the company's commitment to the environment". The signaling provides different consequences. First, the literature has shown that "shareholders respond positively to companies' engagement towards the environment".[123] Several researches and studies, such as Flammer (2013), Klassen and McLaughlin (1996), Krueger (2015), show positive returns in response to companies green behavior. In addition, Flammer (2015) finds that the stock market responds positively to the adoption of close-call shareholder proposals advocating the pursuit of eco-friendly policies.[124] Another implication is that, following the issuance of green bonds, issuers would improve their environmental performance (e.g., the volume of CO_2 emissions).[125] In fact, as showed by the literature, if green bonds signal a credible commitment to the environment, this should, in the end, result in improved environmental performance. In addition, following the issuance of green bonds, an increase in long-term green investors is expected. In fact, if companies can

[123] Flammer C. (2020) - *Corporate Green Bonds*. Questrom School of Business, Boston University.
[124] Flammer, C. (2015) - *Does corporate social responsibility lead to superior financial performance? A regression discontinuity approach*. Management Science 61, 2549–2568.
[125] Flammer C. (2020) - *Corporate Green Bonds*. Questrom School of Business, Boston University.

demonstrate their commitment to the environment by issuing green bonds, they expect more environmentally sensitive investors to be stimulated to invest.
From a financial point of view, green bonds have the same risk and return characteristics as traditional bonds, but regarding the issuers, they can borrow capital by paying lower interest than traditional bank loans. In addition, another key benefit of this innovative instrument is that it allows to raise large amounts of capital to finance ambitious environmental projects, given that other financing instruments would not be so cheap.

One of the most commonly cited challenges to the expansion of green bond markets at a national or global scale was the lack of a strict agreement upon the definition of what 'green' is.[126] Although voluntary principles such as the Green Bonds Principles and the Climate Bond Standards have attempted to resolve this challenge, it appears that the issue is not completely resolved, as the guidelines are not mandatory and tend to focus on procedures.[127] In addition, transparency and reporting are often weak and, in a few cases, voluntarily better. In any case, as the market grows, these aspects will be increasingly important and globally shared in a more uniform way.
The lack of a definition of what green is, is strictly connected to another disadvantage of the Green Bonds Market, the so called "Greenwashing".
As stated by several studies, such as Berrone, Fosfuri, and Gelabert (2017), Lyon and Montgomery (2015), Marquis, Toffel, and Zhou (2016), "greenwashing" is the practice of making unsubstantiated or misleading claims about the company's environmental commitment. Moreover, Flammer C. (2020) defined that "*the greenwashing concern roots in the lack of public governance of green bonds and the green bond market relies on private governance regimes such as the certification standards described in the previous paragraphs*".[128] These methods of regulating market governance privately do not have the same effects as public regulation enforcement mechanisms. Despite the strong growth and a steadily growing share, the size of the green bond market remains small compared to the total bond market. One of the factors limiting expansion is the lack of liquidity.
However, the problem of lack of liquidity is experiencing positive signs in recent years. In fact, the increasing emissions are helping to strengthen the liquidity profile and to create

[126] DuPont, C., Levitt, J. and Bilmes, L. (2015) - *Green Bonds and Land Conservation: The Evolution of a New Financing Tool Faculty Research Working Paper Series*. Karvard Kennedy School.
[127] Peter Cripps (2017) - How to grow the US green bond market. Environmental Finance
[128] Flammer C. (2020) - *Corporate Green Bonds*. Questrom School of Business, Boston University.

opportunities for portfolio investment. Another positive sign in this framework is that liquidity in the secondary market improved during 2019 thanks to France's "jumbo" transaction and the creation of liquid green benchmarks in countries such as Ireland.

Finally, the risks of green bonds are similar to the traditional bonds' ones: the investors are subject to the default risk of the issuer who is not able to generate sufficient cash flows to repay the principal and pay interest to investors. If this happens, the credit rating of the issuers will be negatively downgraded for a long time, especially in regulated markets. Other risks also depend on the structure of the bond. For example, bonds with variable or index-linked interest rates may, as appropriate, benefit one and disadvantage the counterparty. Variability in taxation can also act as disincentive for investors, especially if high rates of taxation are present.

3.4.1 The "greenium" of Green Bonds

The green bond issuance process is "similar to that of a regular bond, with an added emphasis on governance, traceability and transparency designed to increase investors' confidence in the green credentials of the bond".[129] In general, the structure of green bonds is similar to their brown equivalents and, for this reason, they are not more expensive than conventional vanilla bonds. However, what makes a green bond more cost-effective than a traditional bond is the cost that arises when the bond has to be verified by a third party, from the monitoring and reporting process.

Regarding the pricing of green bonds, the literature shows different opinions among researches. In particular, many papers and articles study the pricing in the primary and secondary market in order to discover if a green bond yield discount exists (also known as "greenium"). On one side, many academic articles showed that in the primary market there is no green yield discount. Larcker and Watts (2020) examined matched pairs of green and non-green municipal bonds and showed that when risks and returns are held

[129] Liaw Thomas K. (2020) - *Survey of Green Bond Pricing and Investment Performance*. Tobin College of Business, St. John's University, Queens, NY 11439, USA

constant, municipal investors view green and non-green bonds by the same issuer as almost exact substitutes and thus, they conclude that the "greenium" is essentially zero.[130] Östlund (2015) "analyzes the spread differentials between green and conventional bonds of the same issuer to find out whether investors exhibit a green preference. As the previous article, he concludes that "there is not evidence of a "greenium" and instead he shows that green bonds are traded at a discount compared to their conventional counterparts".[131]

On the other side, many academic papers showed an evidence of a "greenium".

Nanayakkara and Colombage (2019) analyze the pricing difference between green bonds and conventional bonds. In particular, they use option-adjusted credit spread to investigate if investors are willing to pay a premium price for green bonds over conventional bonds.[132] The results of their analysis shows that green bonds have a "greenium". Baker et al. (2018) study US municipal green bonds and find that municipal green bonds are priced at a premium to similar ordinary bonds. Kapraun and Scheins (2019) "consider a large sample of over 1500 green bonds issued worldwide and estimate the differences in yields of green and comparable conventional bonds".[133] The analysis on primary market shows a significant "greenium" for Green Bonds. However, they show also that this particular yield varies across issuers, currencies, and maturity. Green bonds issued by secured entities or green bonds issued in specific currencies are priced at lower yields.

Finally, the Climate Bonds Initiative (CBI) provides every year a report regarding the pricing of Green Bonds in the primary market. Their studies indicate that some green bonds are priced below while some others are priced on or above their own yield curve and thus, there is no guarantee that green bonds benefit from a lower cost.[134] In general, the conflict among researchers is explained by the differences in data selection,

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[130] Larcker, David F., and Edward M. Watts (2020) - *Where's the greenium*. Journal of Accounting and Economics 6: 101312.

[131] Östlund, Emmi (2015) - *Are Investors Rational Profit Maximizers or Do They Exhibit a Green Preference?—Evidence from the Green Bond Market*. Master's thesis, Stockholm School of Economics, Stockholm, Sweden.

[132] Nanayakkara, Madurika, and Sisira Colombage (2019) - *Do investors in green bond market pay a premium? Global evidence*. Applied Economics 51: 1–13.

[133] Kapraun, Julia, and Christopher Scheins. (2019) - *(In)-Credibly Green: Which Bonds Trade at a Green Bond Premium?* Working Paper. Frankfurt: Goethe Universität Frankfurt.

[134] Liaw Thomas K. (2020) - *Survey of Green Bond Pricing and Investment Performance*. Tobin College of Business, St. John's University, Queens, NY 11439, USA

maturities, methodologies, ratings, currencies, and the characteristics of the issuing entity and the bond.

Regarding the secondary market, there is evidence that concerns a slight "greenium", with a price advantage in favor of green bonds, especially thanks to an increasing demand with respect to the available supply. Another explanation for the price advantage in the secondary market is due to the lower volatility of the green bond price compared to traditional. However, the studies carried out regarding the presence of a green bond yield discount on the secondary market are not conclusive, due to the differences on the composition of the green bond indexes. Indices have the ability to allow investors to invest in a portfolio of green bonds in order to diversify the specific risks of the company while maintaining green investments. The most important green bond indices are: Solactive Green Bond Index, S&P Green Bond Index, BofAML Green Bond Index, and Bloomberg Barclays MSCI Green Bond Index. Each of these indexes comprises different portfolios of green bonds and for this reason the returns of these indexes (see **Figure 30**) do not show any pattern.[135]

Time Period	S&P Green Bond Index	Bloomberg Barclays MSCI Green Bond	Solactive Green Bond Index	Bloomberg Barclays US Aggregate Index
01/02/2015–12/30/2015	−6.71%	0.50%	3.79%	0.14%
01/02/2016–12/30/2016	1.80%	1.96%	3.74%	2.53%
01/03/2017–12/30/2017	11.19%	2.20%	−2.51%	3.58%
01/03/2018–12/28/2018	−2.80%	−0.72%	1.79%	−0.02%
01/03/2019–10/30/2019	5.11%	6.94%	8.74%	8.04%

Figure 30: Performance of Green Bond indexes. *Source: Bloomberg*

In conclusion, it can be argued that the price of green bonds is similar to traditional bonds. Usually, the issue price is the same as a conventional bond, as the risk characteristics are. This is because they are basically the same as traditional bonds, they only have a particular purpose and reporting obligations. In this context, Ehlers and Packer (2017)

[135] Liaw Thomas K. (2020) - *Survey of Green Bond Pricing and Investment Performance*. Tobin College of Business, St. John's University, Queens, NY 11439, USA

argue that “more consistent standards for issuing green bonds across jurisdictions will help further developing the market”.[136]

3.5 Green Bond Market in Italy

More than half of Italian issuers debuted in 2017 although the Italian green bond market was launched in 2014 with offers from the multi-utility company Hera and the energy companies Enna Energia and Innovatec. Energy companies dominate the market with 77% of total emissions. Within the sector, 73% of emissions come from energy companies, a quarter of utilities and 2% of grid companies.
In 2017, Intesa Sanpaolo became the first Italian bank to enter the market with a green bond of 500 million euros for renewable energy sources and green loans for construction. The first public sector agreement came with Ferrovie dello Stato Italiane, the national railway company, with 94 billion euros of investment identified in the company's 2017-2026 business plan. In terms of composition, 70% is allocated to renewable energy; transport has reached 20% and the rest of the proceeds are distributed between buildings, water and waste. The diversity of debt instruments is also emerging in Italy: the energy company Terna issued the first green project loan to finance the Tacuarembo Transmission Line in Uruguay and at the end of 2017 Enel issued a 5.6 million euro green bond to finance two wind energy projects in Italy and Brazil. This is also the first certified Italian agreement on climate constraints.

Borsa Italiana plays an active role in promoting the definition of information standards able to promote the development of Green Bonds. In fact, it is a member of the Climate Bonds Initiative through the London Stock Exchange Group and is one of the observers of the Green Bonds Principles of the ICMA, International Capital Markets Association.[137]
Moreover, it has made available to the market a series of tools to better identify and analyze the world of sustainable finance, in particular the list of green and social instruments traded on the MOT and ExtraMOT markets. In fact, starting from 13 March

[136] Ehlers, Torsten, and Frank Packer (2017) - *Green bond finance and certification*. BIS Quarterly Review September: 89–104.
[137] Borsa Italiana (2020)

2017, Borsa Italiana decided to offer institutional and retail investors the opportunity to identify the instruments whose proceeds are allocated to the financing of projects with specific environmental benefits or impacts (green bonds and/or social bonds). The identification requires the initial certification by an independent third party and the renewal, at least annually, of the information regarding the use of the proceeds.

3.5.1 Example of Green Bond – Enel S.p.A.

Enel S.p.A. is a multinational energy company and a leading integrated operator in the global electricity and gas markets, with a particular focus on the European and Latin American markets.[138] The Enel group is present across 35 countries, it manages the production of 84.9 GW of capacity and it distributes electricity and gas through a network of approximately 2 million kilometers.
Enel invested a lot in the renewable energy sources, research and development of new green technologies. In fact, it has recently changed its position in the market, committing itself to phase out new investments in coal and natural gas.
Being aware that energy from renewable sources is the key to a sustainable future, in 2016 it created Enel Green Power (EGP), a company dedicated to the development and management of clean energy. Enel Green Power is present in 5 continents with over 1,200 plants and has a managed capacity of over 42 GW (over 14GW in Italy) including photovoltaic, wind, hydroelectric and geothermal. From a financial point of view, Enel is included in the most important sustainability indexes such as the Dow Jones Sustainability Index World and the FTSE4Good and it has been included by Cassa Depositi e Prestiti in the A list, among the best companies that have demonstrated to have implemented a valid approach to climate change mitigation and information disclosure.

Enel has placed environmental, social and economic sustainability as the foundation of its corporate culture and it is implementing the development of a sustainable system based on the creation of shared value, both inside and outside the company. In line with the 2018 strategic plan, during the 2017, Enel has launched the first green bond in Europe for

[138] Enel (2020), link: https://www.enel.com.co/en/the-companies/enel-group.html

institutional investors. In particular, the group issued 1.25 billion euros and included the repayment in a single installment on 16 September 2024 with the payment of a fixed rate coupon of 1%, payable annually starting from 2018. The issue price has been set at 99.001% and the effective yield to maturity is equal to 1.137%.[139] The green bond was issued by "Enel Finance International NV, a wholly owned subsidiary of Enel S.p.A. (Enel, rated BBB + for S & P's, Baa2 for Moody's, and BBB + for Fitch) and was reserved for institutional investors and supported by a guarantee issued by Enel".
The green bond has been listed on the regulated markets of the Irish and Luxembourg stock exchanges and is admitted to trading on the "ExtraMOT PRO" multilateral trading facility organized and managed by Borsa Italiana.

At the end of 2019, Enel S.p.A. placed three green bonds on the European market for a total of 3.50 billion euros, through its subsidiary Enel Finance International NV. In addition to the Green Bond just described, two other Green Bonds were issued, the first in 2018 (1.25 billion euros) and the second in 2019 (1 billion euros). Both Green Bonds are intended for institutional investors and guaranteed by Enel SpA. Net proceeds from the issue have been dedicated to projects in line with the Green Bonds Principles.
In particular, as it is possible to see from Green Bond Report 2019 published by Enel S.p.A.:

- Green Bond 2017 (see **Figure 31**): new projects for the construction and repowering of plants for the production of electricity from renewable sources.

[139] Enel (2020), Link: https://corporate.enel.it/en/media/press/d/2017/01/enel-group-launches-its-first-green-bond-totalling-1250-million-euros-on-european-market-

Country	Project name	Technology	Status	Capacity (MW)	Commercial operation date	Investment (value in currency)			GB proceeds allocated in 2017 (mil euros)	GB proceeds allocated in 2019 (mil euros) [2]
						Currency	Value in currency (mil)	Equivalent in euro (mil) [1]		
USA	Red Dirt	Wind	In Operation	300	nov-17	USD	420	378	77	-
USA	Thunder Ranch	Wind	In Operation	298	nov-17	USD	435	392	132	-
USA	Hilltopper	Wind	In Operation	185	nov-18	USD	325	293	166	-
USA	Stillwater Solar II	Solar	In Operation	27	may-18	USD	40	36	48	-
USA	Woods Hill	Solar	In Operation	25	dec-17	USD	44	41	36	-
USA	Rattlesnake Creek	Wind	In Operation	320	dec-18	USD	430	387	204	-
USA	Rock Creek	Wind	In Operation	300	oct-17	USD	500	450	73	-
BRAZIL	Horizonte MP	Solar	In Operation	103	feb-18	USD	110	99	43	-
BRAZIL	Delfina	Wind	In Operation	209	aug-17	USD	440	364	33	-
CHILE	Cerro Pabellón	Geothermal	In Operation	81	aug-17	USD	420	347	57	-
CHILE	Sierra Gorda	Wind	In Operation	112	dec-16	USD	215	194	17	-
PERU	Wayra	Wind	In Operation	132	mar-18	USD	165	149	82	-
PERU	Rubi	Solar	In Operation	180	nov-17	USD	170	153	68	-
ITALY	Various projects [3]	Biomass/ Geothermal/ Hydroelectric		35		EUR	129	130	70	-
CANADA	Riverview	Wind	Under Construction	115	apr-20	USD	170	143	8	81
CANADA	Castle Rock Ridge 2	Wind	Under Construction	31	feb-20				2	23
MEXICO	Magdalena 2	Solar	In Operation	220	sep-19	USD	165	136	9	112
MEXICO	Amistad II	Wind	In Operation	100	dec-19	USD	115	97	22	55
MEXICO	Amistad III	Wind	Under Construction	100	feb-20	USD	104	86	11	59
MEXICO	Amistad IV	Wind	Under Construction	149	apr-20	USD	149	123	13	50
MEXICO	Dolores	Wind	Under Construction	244	mar-20	USD	280	235	36	192
PANAMA	Estrella Solar	Solar	In Operation	8	aug-18	USD	8	7	5	-
ZAMBIA	Ngonye	Solar	In Operation	34	mar-19	USD	40	34	10	-
ITALY	Various projects [4]	Geothermal/ Hydroelectric		11		EUR	43	36	14	-
Total									**1,237**	**572**

Figure 31: Investment in euros and the share of Green Bond proceeds in 2017. *Source: Enel S.p.A.*

- Green Bond 2018 (see **Figure 32**): new projects for the construction and repowering of plants for the production of electricity from renewable sources and transmission, distribution and smart grid projects.

Country	Project name	Technology	Status	Capacity (MW)	Commercial operation date	Investment (value in currency)			GB proceeds allocated in 2018 (mil euros)	GB proceeds allocated in 2019 (mil euros) [2]
						Currency	Value in currency (mil)	Equivalent in euro (mil) [1]		
USA	Diamond Vista	Wind	In Operation	300	dec-18	USD	400	336	100	-
USA	Fenner Repowering	Wind	In Operation	29	dec-18	USD	29	24	21	-
USA	High Lonesome	Wind	In Operation	501	dec-18	USD	720	595	81	75
USA	Roadrunner	Solar	Under Construction	497	jun-20	USD	436	366	30	141
GERMANY	Cremzow	Other	In Operation	22	feb-19	USD	17	17	9	-
GREECE	Kafireas	Wind	In Operation	154	oct-19	USD	300	300	64	126
COLOMBIA	El Paso	Solar	In Operation	86	oct-19	USD	70	59	54	-
USA	Aurora	Solar	In Operation	150	jun-17	USD	290	244	181	-
USA	Little Elk	Wind	In Operation	74	dec-15	USD	130	107	5	-
USA	Chisholm View II	Wind	In Operation	65	dec-16	USD	90	76	29	-
Total									**575**	**342.5**

n.a. not applicable
(1) Indicative value in euros (EUR), although the investment in US dollars (USD) applies where present. The exchange rate used for projects allocated in the 2017 green bond is 1.11 USD/EUR, for projects allocated in the 2018 green bond is 1.19 USD/EUR whereas for projects whose investment value has been updated – including those with the new Capex identified in GB 2019 – the exchange rate is 1.21.
(2) Additional proceeds were allocated for some renewable projects that were already identified in the 2017 and 2018 Green Bond, for which new capitalized costs emerged.

Figure 32: Investment in euros and the share of Green Bond proceeds in 2018. *Source: Enel S.p.A.*

- Green Bond 2019 (see **Figure 33**): projects in new innovative infrastructures.

Country	Project name	Technology	Status	Capacity (MW)	Commercial operation date	Investment (value in currency)			GB proceeds allocated in 2017 (mil euros)	GB proceeds allocated in 2018 (mil euros)	GB proceeds allocated in 2019 (mil euros) [2]
						Currency	Value in currency (mil)	Equivalent in euro (mil) [1]			
USA	Whitney Hill	Wind	In Operation	66	dec-19	USD	281	340	-	-	10
USA	Aurora Wind	Wind	Under Construction	299	oct-20	USD	111	135	-	-	10
USA	Cimarron Bend 3 phase I	Wind	Hand Over to Do	199	nov-20	USD	114	137	-	-	4
AUSTRALIA	Cohuna	Solar	Under Construction	34	feb-20	USD	54	65	-	-	31
AUSTRALIA	Girgarre	Solar	Ready to Build	96	feb-21	USD	144	174	-	-	7
ITALY	Various projects [3]	Hydroelectric		40		EUR	55	55	-	-	10
CANADA	Riverview	Wind	Under Construction	115	apr-20	USD	170	143	8	-	81
CANADA	Castle Rock Ridge 2	Wind	Under Construction	31	feb-20	USD			2	-	23
MEXICO	Magdalena 2	Solar	In Operation	220	sep-19	USD	165	136	9	-	112
MEXICO	Amistad II	Wind	In Operation	100	dec-19	USD	115	97	22	-	55
MEXICO	Amistad III	Wind	Under Construction	100	feb-20	USD	104	86	11	-	59
MEXICO	Amistad IV	Wind	Under Construction	149	apr-20	USD	149	123	13	-	50
MEXICO	Dolores	Wind	Under Construction	244	mar-20	USD	280	235	36	-	192
USA	High Lonesome	Wind	In Operation	501	dec-19	USD	720	595	-	81	75
USA	Roadrunner	Solar	Under Construction	497	jun-20	USD	436	366	-	30	141
GREECE	Kafireas	Wind	In Operation	154	oct-19	USD	300	300	-	64	126
Total									**101**	**175**	**986**

n.a. not applicable
(1) Indicative value in euros (EUR), although the investment in US dollars (USD) applies where present. The exchange rate used for projects allocated in the 2017 green bond is 1.11 USD/EUR, for projects allocated in the 2018 green bond is 1.19 USD/EUR whereas for projects whose investment value has been updated – including those with the new Capex identified in GB 2019 – the exchange rate is 1.21.
(2) Additional proceeds were allocated for some renewable projects that were already.
(3) Aggregate data related to 8 small sized Italian projects. The concerned technology is hydroelectric.

Figure 33: Investment in euros and the share of Green Bond proceeds in 2019. *Source: Enel S.p.A*

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4. CHAPTER: GREEN BONDS: AN ALTERNATIVE SOURCE OF FINANCING? AN EMPIRICAL EVIDENCE

The aim of this dissertation, and in particular of this chapter, is to analyze whether the issue of a green bond can be a valid alternative to the conventional sources of financing in the renewable energy market in Italy. In order to do so, the chapter is structured as follow. The first part is dedicated to the description of the most conventional source of financing in the renewable energy industry in Italy, the project finance, studying as this instrument is composed, the actors, the stages and documents required, the most common financial covenants requested by banks and finally the different methods used as valuation project. The second part describes the renewable energy sector in Italy, the development of the last years and the description of the incentive mechanisms, which represent a significant component for the sector.
In the last part of the chapter, an empirical analysis is proposed. In light of what discussed in the previous chapters, the analysis is conducted in order to evaluate if it is economically convenient issuing a green bond rather than using the project finance instrument. The analysis is conducted on the refinancing process of a hypothetical wind farm company, comparing the two scenarios in a time value of 10 years through the forecast of Profit&Loss, Balance Sheets and Cash Flow statements. Finally, the analysis concludes with the NPV of the project for both scenarios, highlighting the different Weighted Average Cost of Capital used as discount rate.

4.1 Project Finance

The literature on structured finance and on project finance is very extensive. Connected to the term “project finance” there is a wide range of financial instruments and techniques with the aim of financing specific investment projects. For this reason, it is not easy to define this tool in a simple way. The current literature places the financing of a given project as fundamental characteristic of project finance. This type of financing is guaranteed, not by the sponsor of the initiative, but from the specific project of the financing and, therefore, in its ability and credibility to generate cash flow.

The project finance, being a source of financing, has the purpose to finance both public and private projects. There are two key models of project financing applied to the public sector:

- **B.O.T.** (Build, Operate and Transfer): "the public sector grantor grants to a private company the right to develop and operate a facility or system for a certain period (the "Project Period"), in what would otherwise be a public sector project."[140]

- **B.O.O.** (Build, Operate and Own): in which a project company builds and manages a given work remaining the owner of the property. This scheme can also be applied to wholly private initiatives, where there is no public concession act.

In cases where the government is the sponsor, the longest established method used is B.O.T..[141] The period between operating and transfer of ownership to the sponsor enables the project company to recoup the initial investment.[142] As stated by Mawutor (2014), B.O.T. might take two forms, B.L.T. (Build, Lease and Transfer) and B.O.O. (Build, Own and Operate). With B.L.T. "The arrangement entitles the sponsor to lease the project from the contractor for a given period of time after which the sponsor takes full and final possession of the project after the expiration of the lease agreement".[143]
Given the nature of the process, project finance has become the main tool in public-private partnership (P.P.P.).
The economic revolution marked by project finance is characterized by the transition from a subjective to an objective vision of the financial intervention[144]: from corporate finance to project finance. The main difference between the two approaches lies in the operations autonomy of project finance: if, from a corporate-oriented point of view, the lender can rely on the overall assets of the promoter of the initiative to repay the amounts

[140] World Bank (2020) - Link: https://ppp.worldbank.org/public-private-partnership/agreements/concessions-bots-dbos#BOT_projects
[141] Mawutor K.M. J. & Kwadwo O. (2014) - *The Role of Project Finance in Contemporary Financing: "Theoretical Perspective"*
[142] Sabramanian et al (2007) – *The paradox of Capital*, Finance and Development, a quarterly magazine of the IMF
[143] Hoffman, S. L., (2001) - *The Law and Business of International Project Finance*, 2nd Ed., New York, Transnational Publishers,Inc.&TheHague,TheNetherlands,Kluwer LawInternational.
[144] Sambri, S. M. (2013) - *Project financing: la finanza di progetto per la realizzazione di opere pubbliche*. Padova: CEDAM.

lent, in a project-oriented perspective, it has as a guarantee only the progress of the project financed.

In the project finance, the project assumes legal autonomy with respect to the companies promoting the initiative and the aim is to create a separate market whose profits are intended to repay the debt for the implementation of the initiative and the remuneration of capital.

The use of project financing has some specific organizational and contractual implications. In fact, the financing is not directed to a pre-existing company but is directed to a newly established company ("SPV" - Special Purpose Vehicle), whose exclusive purpose is the implementation and management of the project itself. The SPV is a legally distinct entity from the project promoter, with the resulting separation of the flows generated by the project from those related to the other activities of the sponsor. The twofold result is that, in the event of default of the project, the lender will not be able to rely on assets of the promoter other than those owned by the project company (SPV) and, symmetrically, in the event of bankruptcy of the sponsor, the SPV will continue to exist. In addition, the establishment of a SPV allows the financing institutions to apply very strict control formulas and the imposition of contractual and corporate constraints necessary for the structuring of a project financing operation.

Finally, it is fundamental to highlights how the interests have to be paid to lenders. On project finance loans, the interest rate (called also "margin") is often adjusted "at the current wholesale market rate at which the lenders raise their funding"[145] (in this thesis, I have used the Euribor 6 months). In this way, the interest rate is a 'floating' rate rather than a fixed.

In this framework, in order to mitigate the floating interest rate risks, companies usually use interest rate hedging arrangements. As stated by Yescombe (2014), "the commonest type of hedging used in project finance is interest-rate swaps and in this agreement one party exchanges an obligation for payment of interest on a floating-rate basis to one for payment at a fixed rate, and the other party does the opposite." In fact, it is typical in a project finance operation that the SPV pays to the bank (the "swap provider") "the difference between the floating rate and the agreed-upon fixed rate if the floating rate is

[145] Yescombe, E. R., (2014) - *Principles of Project Finance*, 2 ed., Elsevier.

below this fixed rate". If the floating rate is greater than the fixed rate, the swap provider has the obligation to pay the SPV.

If the SPV wants to pay the debt before the expiry date (it is usual in case of refinancing of the old debt, as it will be analyzed in the last paragraph of this chapter) the swap arrangement has to be "broken" and the swap provider has to enter into another swap in order to balance.

The difference between the original fixed rate and the new fixed rate, called the "breakage" cost, represents a loss to the original swap provider.[146]

4.1.1. Project Finance Actors

A project financing operation is characterized as a complex organization in which different actors are involved and aim to meet the economic expectations of each of them.[147]

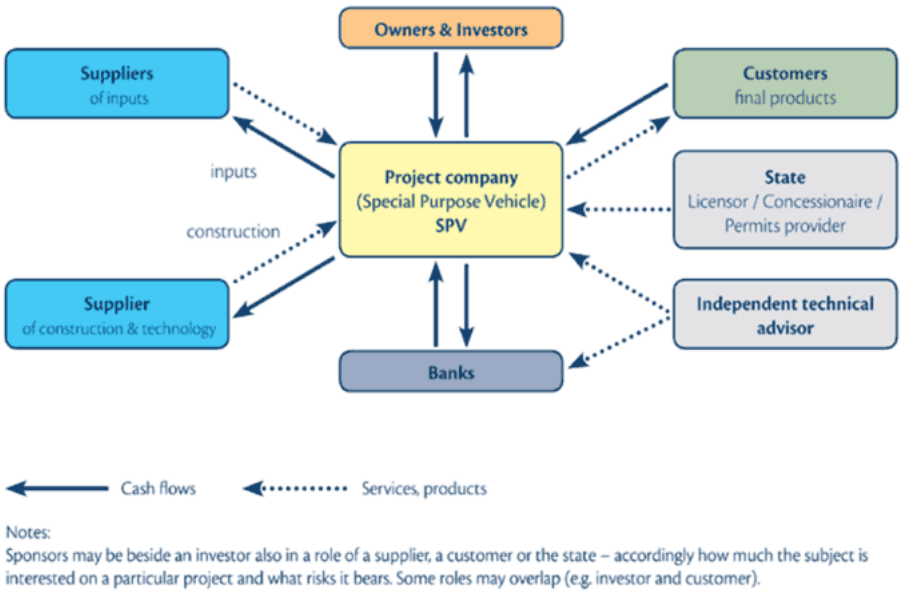

Figure 34: Project Finance actors.

Typically, the actors, or subjects, of the process (see **Figure 34**) are:

[146] Yescombe, E. R., (2014) - *Principles of Project Finance*, 2 ed., Elsevier.
[147] Mariani, Menaldi & Associati. (2012) - *Il project financing: analisi giuridica, economico-finanziaria, tecnica, tributaria, bancaria, assicurativa*. Torino: Giappichelli.

- SPV (Special Purpose Vehicle)
- Sponsors
- Banks
- Public Actors
- International Financial Institutions
- Suppliers
- Independent Technical Advisors

Below an analysis for each actor:

SPV

As described in the previous paragraph, project finance requires the creation of an ad hoc company whose sole purpose is the implementation and management of the initiative: the project company. This vehicle not only has all the rights related to the operation but also it is legally distinct from the sponsor. In this way an economic-patrimonial separation can be realized (the so-called ring fence) between the flows generated by the project and those from other activities of the sponsor. The SPV instrument qualifies the financing as an off-balance operation.

Sponsors

The sponsors are private companies or public institutions that, once identified an investment opportunity, decide to start a project financing operation by establishing the project company. The sponsors are the project planners, the operators "responsible to initiate, develop, complete and actively participate in the management of the project"[148]. The motivations that drive both private and public institutions towards project finance are;

- for public administrations, to ensure the community a service that would not be eligible for funding
- for private companies, to seize an excellent investment opportunity.

In both cases, due to the complexity of the structure and the significantly high cost of the operation, the sponsors adopt project finance solutions when other financing methods

[148] Esty, B. & A. Sesia Jr., (2005) - *An Overview of Project Finance*, Harvard Business School Case

are not practicable. The equity contribution plays a very important role as it allows to support and finance the activities of study, design, and analysis of feasibility of the initiative till the preparation of the business plan to be submitted to the investors.

Banks

Banking institutions are the protagonists of a project financing operation because they are often the owners of the majority of the third-party capital that finances the project. Usually, the projects financed requires strong investments and for this reason it is usual to require the intervention of a pool of banks led by one of them, characterized by international standing and high specialization in the field of project finance. This subject is called the *arranger*.

The arranger guides the negotiation activity of the overall size and contractual terms of the financing between the project company and the sponsors. It also has the role as coordinator of the pool of banks. Moreover, an *"agent bank"* should be selected within the banking pool. The agent bank has the power of administration and control of the flows generated by the operation. In addition, this bank often assumes the role of controlling the deviations between the financial results recorded and the flows provided by the business plan.

Finally, the sponsors and SPV rely on *the advisor* in order to assess and confirm the reliability of the project: the advisor provides a consultancy service in the formation of the project, in order to evaluate the financial elements that make it reliable for banks. Advisors usually propose to the banks a series of analyses based on indices that will be studied in the next paragraph.

Public Actors

Public actors play a key role in the success of a project financing operation. In fact, when the public actor is not involved as a sponsor, it monitors some characteristics of the project that influence the final initiative: in particular, characteristics as administrative authorizations, tariff policies and the stability of the legal and institutional framework. In most cases, the government institutions serve as the clients and sponsors concurrently[149].

[149] Fight, A. (2006) - *Introduction to Project Finance*. Essential Capital Markets. Elsvier 1st Edition.

International Financial Institutions

This includes supranational organizations whose mission is to promote economic development, particularly in developing countries. Within an operation of project financing, they can assume both the role of sponsor, giving the risk capital to the SPV, and the role of bank, financing the initiative at favorable conditions compared to the market. Commercial banks, and multilateral institutes such as the CAF, IFC, IMF, play such eminent roles in project finance thereby making them the real participating financiers in developed and emerging markets.[150]

Suppliers

Suppliers are the entities that, on the basis of certain contracts, provide the inputs to carry out the project. The contractor, on the other hand, is the subject of the project that operates with a strictly defined budget of available resources and bears the primary responsibility in case of delays in the implementation of the project.

Independent Technical Advisors

Technical consultants may be requested by the SPV, the sponsor or other subjects involved in the process, in order to evaluate the feasibility of the project from a technical point of view. The quality of the project is fundamental for the operation, being the project at the center of the financing.

4.1.2 Typical Project Finance Transaction

A project financing operation is divided into several phases. Each phase is characterized by the development of specific relationships between the subjects described in the previous paragraph. Despite the different scenarios that project finance can assume, it is possible to describe a standard process divided in different steps of the operation (see **Figure 35**).

[150] Taylor (2003)

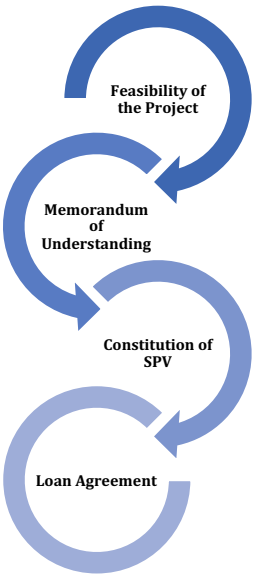

Figure 35: Typical Project Finance Process. Source: personal elaboration

In the first phase, the sponsors prepare the initiative drawing up a series of documents. The first is the *feasibility study of the project*, which focuses on estimating both the pay-back period and the ability of cash flows to repay debt and capital. Moreover, it provides information on how to acquire the necessary public concessions. Another key document is the *Memorandum of Understanding*, which defines the contractual part of the initiative highlighting the relationships and the distribution of risks between the parties involved. According to Graham (2005), "the memorandum of understanding is a document that contains management's estimation of the projects expenditure revenue term sheet, and other relevant information in relation to the project". This is a phase of negotiation between the parties (investors, sponsors, project contract counterparts) involved in the implementation of the project, with variable duration and aimed to reach an optimal distribution of risk among them. This stage includes the negotiation and preparation of a series of legal documents.

The second phase is characterized by the constitution of the SPV: first of all, the analysis of advisors is studied from a legal and technical perspective, in order to structure in a definitive way the operation in all its aspects. At this stage, the SPV, with the assistance of legal and financial advisors, draws up the project's *information memorandum*. The information memorandum is a fundamental information document that allows the SPV, with the direct support of the sponsor(s), to promote the initiative with potential

investors. This document usually contains information such as the project's financial and operational plan, costs and revenues structure, description of the technology used, etc..

The next step is the *loan agreement*, through which the banks undertake to pay the funding to support the implementation of the project. After the signing of these documents, the next stage corresponds to the construction of the project and it is the most risky.
Finally, built the work and standardized its management, it is usually stipulated a new debt to pay the previous, linked to the construction of the project, financing the current management.

4.1.3 Project Valuation

In a typical project financing transaction, the analysis for financial evaluation is an essential tool to promote the initiative and, at the same time, to convince banks and investors to take part in the project and consequently to establish the necessary guarantees.
The valuation of a project is based on the determination of cash flows generated by the project, before financial charges but after tax. In fact, as we will see in the analysis model proposed in the following paragraphs, the analysis focuses on the estimation of the operating components of the project cash flow, in which the difference between income and expenses before the financial components are included in the cash flow statement.
The cash flow analysis shows that a project is sustainable only according to the size and the variability over time of the cash flows generated by the project in order to repay investors and shareholders. In addition, the investors cannot rely, in the case of limited recourse, on the sponsors for the satisfaction of their credit. For this reason, the cash flows analysis of an operation is crucial, as it has a particular trend related to the life cycle of the project itself.
In the construction phase, in the absence of revenues, the project cannot generate revenues or cash inflows (see **Figure 36**) due to the strong investments that characterize the realization of the project[151].

[151] V. Khmel, S. Zhao (2016) - *IATSS Research 39*, 138–145

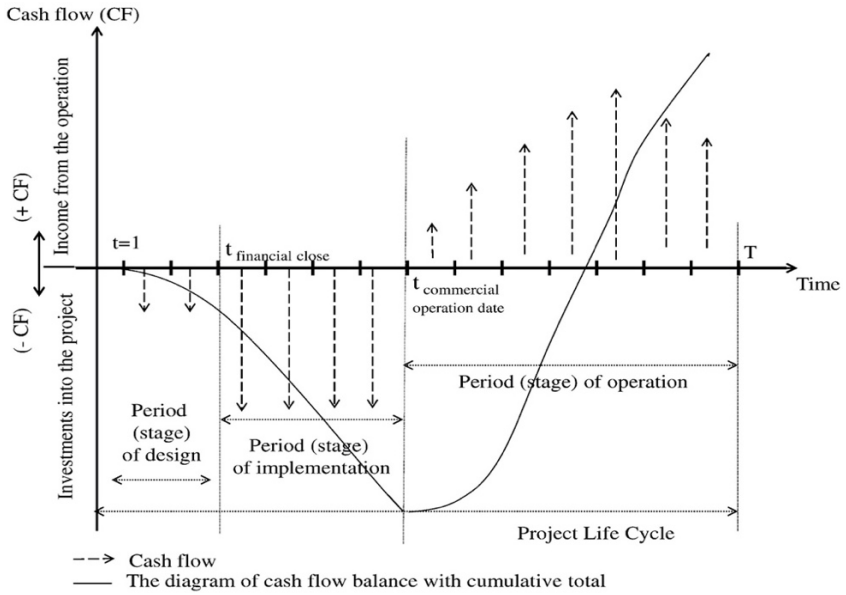

Figure 36: Operational Cash Flow trend in Project Finance. *Source: Khmel & Zhao (2016)*

Regarding the indexes used to assess the feasibility of the project, they are calculated in order to make the initiative "bankable". The term "bankability" refers to the ability of a project to present structural features that demonstrate an acceptable risk/return ratio for the lenders.

The indicators taken into account for these purposes are:

- *Debt Service Cover Ratio (DSCR)*
- *Loan Life Cover Ratio (LLCR)*
- *Debt-to-Equity Ratio (D/E)*

The **DSCR** is calculated as the ratio between Cash Available for Debt Service and the Debt Service (principal and interest plus commissions). This value is calculated for each year (or semester) of the operational life of a project. It is not calculated in the construction period if the project financial structure is set correctly.

The purpose of this indicator is to report the capacity of the project to generate operating cash flows to cover debt service. If the index is equal to one, it means that the investment generates sufficient resources to cover the debt. A value greater than one indicates the possibility not only to repay the financing but also to pay dividends to shareholders.

$$DSCR = \frac{CFADS}{DS}$$

Where:

- *CFADS*: Cash Flow Available for Debt Service
- *DS*: Total Debt Service (Principal, Interests and Commissions)

The **LLCR** has a similar meaning to the DSCR, but it has a more complex calculation and it is less immediate in interpretation.

The LLCR is calculated by the ratio of the sum of available discounted cash flows between the time of the valuation and the last year of repayment of the debt and the total amount of outstanding debt. It represents the amount of cash flows that lenders can count on to meet the debt repayment. An index value equal to one represents stability. The higher the value, more financially profitable the investment will be.

$$LLCR = \frac{\sum_{t=s}^{n} \frac{CFADS_t}{(1+i)^t} + DR}{O^t}$$

Where:

- *CFADS:* Cash Flow Available for Debt Service
- *t :* The time period
- *s :* The number of years expected to pay the debt back
- *i :* The WACC (Weighted Average Cost of Capital) expressed as interest.
- *DR :* Cash reserve available to repay the debt (the debt reserve)
- *O :* The debt outstanding at the time of valuation

As stated by Yescombe (2014), a higher **D/E Ratio** is the essence of project finance. The debt-to-equity ratio identifies in a company the relationship between total corporate liabilities and equity and it is a typical ratio applicated by banks in order to study, for example, the financial sustainability of a company. From a mathematical point of view, the formula can be derived just as the relation between debt and equity capital, but it is usually calculated also as follow.

$$Debt\ to\ Equty\ ratio = \frac{Debt}{Debt + Equity}$$

The most common instruments used to evaluate the economic value of an investment are the NPV (Net Present Value) and the IRR (Internal Rate of Return).

The net present value (**NPV**) of a project is the sum of the present values of each of the cash flows, positive as well as negative that occur over the life of the project.[152]

$$NPV = \sum_{t=1}^{N} \frac{CF_t}{(1+r)^t}$$

Where:

- CF = Cash Flow in period t
- r = Discount rate
- N = Life of the project

The NPV represents incremental profitability, whether a positive value (NPV > 0) and, if it is negative (NPV < 0), it represents the destruction of value, generated by an investment, expressed as if it were available at the time of the valuation.
The discount rate used represents the cost of capital to finance the investment. Indeed, it is used the **WACC** (Weighted Average Cost of Capital), which represents the weighted average cost of third-party capital and equity. Associated to the WACC are the tax benefits of the debt, more concretely in the use of the after-tax cost of debt and the expected additional risk that derive from this issuance of debt, in the form of higher costs of equity and debt at higher debt ratios.[153]

$$WACC = K_e * \frac{E}{E+D} + K_d * \frac{D}{E+D} * (1-t)$$

where:

- K_e = Cost of Equity

[152] Damodaran A. (2016) - *Applied Corporate Finance*, Fourth Edition, Wiley, Hoboken, NJ
[153] Damodaran A. (2002) - *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset,* New York: Wiley

- E = Equity
- K_d = Cost of Debt
- D = Debt
- $(1 - t)$ = Tax shields

The cost of debt is the current cost that the company has to undertake to finance a project through third-party capital. It is calculated as follow:

$$K_d = r_f + DS$$

Where

- r_f = Risk Free rate
- DS = Default Spread

The cost of equity represents the average return expected by shareholders compared to an investment project with similar characteristics and risks. For the calculation of this component different methods are used, but usually the most used one is the CAPM (Capital Asset Pricing Model). In the CAPM, all of the market risk is captured in one beta, measured relative to a market portfolio, which at least in theory should include all traded assets in the marketplace held in proportion to their market value[154].

$$K_e = r_f + \beta * (r_m - r_f)$$

where:

- r_f = Risk Free rate
- β = as stated by Koller et al. (2005), "an estimate to the exposure of a company to the market risk".
- $(r_m - r_f)$ = the equity risk premium, which measures what investors demand over and above the risk-free rate for investing in equities as a class.[155]

The **IRR** is defined as the rate that makes the NPV equal to zero, which makes the initial investment perfectly equal to the present value of all cash flows.

[154] Damodaran A. (2016) - *Applied Corporate Finance*, Fourth Edition, Wiley, Hoboken, NJ
[155] Damodaran A. (2016) - *Applied Corporate Finance*, Fourth Edition, Wiley, Hoboken, NJ

$$\sum_{t=1}^{N} \frac{CF_t}{(1+IRR)^t} = 0$$

As argued by Damodaran A. (2016), the IRR has to be compared to the discount rate. "If the IRR is greater than the discount rate the project has to be accepted and vice versa".[156]

4.2 Renewable Energy sector in Italy

The renewable energy sector in Italy grows year after year with 17 GW of installed power and 42.000 Gwh produced between wind, biomass, hydroelectric and geothermal (see **Figure 37**). In particular, the generation of electricity from photovoltaic records 20.7 GW installed and a total of 874.520 plants.

Photovoltaics, and more generally the production of energy from renewable sources, is a strategic and profitable investment for companies in the energy sector, as demonstrated by the data provided by Enel S.p.A. on its installed production capacity: 50.2% renewable plants.

Italy is one of Europe's leading countries in the production of electricity from RES: it ranks second, behind Germany, by national impact on the European Union total, contributing 10.7%.[157]

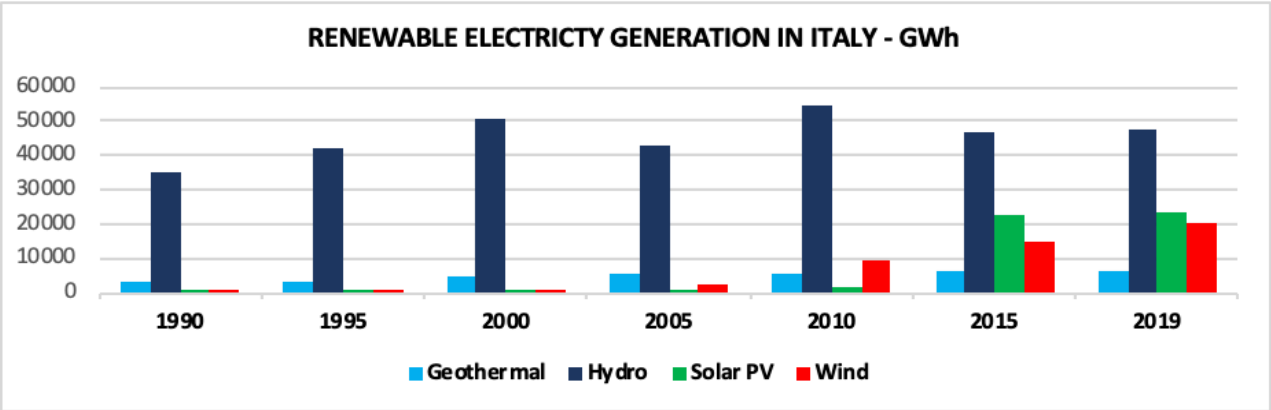

Figure 37: Renewable Electricity Energy in Italy. Source: personal elaboration

[156] Damodaran A. (2016) - *Applied Corporate Finance*, Fourth Edition, Wiley, Hoboken, NJ
[157] GSE REPORT - Renewable energy in Italy and Europe 2018

In Italy, the energy sector is the one where the project financing technique is most applied. For example, in 2012 the value of financial close was 61.081 million of Euros, an increase of 10.2% compared to the previous year. Despite being mostly refinancing operations, the new investment sector is driven by the renewable energy market with a value of operations of 1.2 billion of Euros for photovoltaic and 0.5 for wind power.
Investments in the energy sector, and more particularly in the renewable energy sector, share characteristics that vary from case to case. Indeed, energy projects tend to be capital intensive and require significant investments at the start of the initiative. These projects are characterized by a long life of the assets. For example, hydropower plants can be operative for fifty years, exposing the project to greater risks regarding the future costs and benefits of the business. Moreover, the times of realization of the works can be very long, making riskier the evaluation of the feasibility of the project with long maturity.
The energy sector in Italy attracts the resources of venture capitalists despite these investments have different characteristics compared to the high-tech, in which VC are traditionally used to operate. Indeed, projects in renewable energy require more capital and more time to generate profits.
The overall financing can be raised through the intervention of large companies, venture capital funds or the capital market or bank loans. Among the most widely used sources of financing, it is common to use project finance but also financing by large companies, the use of the capital market and bond issues.

The European policies in support of renewable energies are focused on supporting the development of electricity production from renewable sources. The most widespread incentive mechanism at the global level is the feed-in-tariff, which consists in the payment of an additional price or a bonus for each KW of electricity produced from renewable sources. In recent years, there has been a reshaping of these policies in order to adapt to new market scenarios and, in particular, to face the effects of the global economic crisis: the majority of the incentive tariffs in use have been reduced and the eligibility criteria for the system have become more stringent.
In Italy, the national system provides three different systems to support the production of electricity from renewable sources that are described in what follows.

Green Certificates (CV)

Green certificates (CV) are a form of incentives for the production of electricity from renewable sources and is based on the obligation to introduce annually a share of electricity produced from plants powered by renewable sources in the national electricity system.[158] They can be traded on the market through bilateral on dedicated platforms. They are recognized to energy producers according to the electricity produced and technology.

Feed-In Tariff (FIT)

"It is an energy policy instrument to support the development of new renewable energy projects, based on long-term purchase contracts for electricity produced".[159]

Utilities, which own the electricity grid, are obliged to purchase electricity generated from renewable sources at a rate set by the public authorities and guaranteed for a specific period of time. These purchase contracts are commonly signed for 10-25 years and they cover every KWh of electricity produced. The calculation methods are basically two: if the installed power is less than 1 MW, the all-inclusive tariff will be based on the technology and size, added to other specific incentives. If the installed capacity is greater than 1 MW, the all-inclusive tariff will be reduced by the zonal hourly price and added to other specific incentives.

Conto Energia (CE)

The Conto Energia (CE) is the incentive mechanism provided for solar energy (photovoltaic), which consists in the supply by the GSE (described in chapter 1) of a tariff established on the basis of the energy produced by the plants and of the installed power size, additional to the selling price, through the exchange or consumption of the electricity produced.

[158] Link: http://www.mercatoelettrico.org/it/mercati/cv/cosasonocv.aspx

[159] Cory K., Couture T., Kreycik C., Williams E. (2010) - *A Policymaker's Guide to Feed in Tariff Policy Design*, National Renewable Energy Laboratory (NREL), U.S. Department of State, p. 6.

4.3 Green Bonds vs Project Finance: an empirical evidence

4.3.1 Literature Review

As described in the previous paragraphs, "the energy sector is a key factor against climate change since it is responsible for 80% of the CO2 emissions that are causing global warming". Regarding the financial structure of the energy sector's companies, we have seen that the conventional source of financing is project finance. On the other hand, the emissions of green bonds are increasing exponentially, proposing themselves as alternative to traditional sources of financing.

In this framework, the literature does not propose a solution between the choice of the two alternatives.

In general, bonds "are especially suitable if a project is being refinanced after it has been built and has operated successfully for a period and, conversely, the greater flexibility of bank loans tends to make them more suitable for the construction and early operation phases of a project, projects that require long-term financial flexibility, more complex projects, or projects in more difficult markets."[160]

The green bonds have rarely been studied for the perspective of green financial products. In fact researches prefer to study the link between green bond prices and financial markets.[161]

The purpose of this thesis is to study whether, in renewable energy sector, there is a financial incentive to issue green bonds rather than using project financing, from the issuers' point of view. The most effective research in this context has been conducted by Conde et al. (2020), in which they take the perspective of a project finance sponsor in order to analyze whether there is a direct financial incentive for issuing green bonds in contrast to other types of financing. They conclude that the analysis proposed demonstrates a higher IRR (internal rate of return) for shareholders issuing green bonds rather than bank loans. Moreover, they confirm the lack of researches on this topic.

[160] Yescombe, E. R. (2014) - *Principles of Project Finance*, 2 ed., Elsevier.

[161] Alonso-Conde, Ana & Rojo-Suárez, Javier. (2020) - *On the Effect of Green Bonds on the Profitability and Credit Quality of Project Financing.* Sustainability. 12. 6695. 10.3390/su12166695.

Indeed, as stated by Conde et al. (2020), their article is "one of the first research papers to explicitly study the impact of the cost of green financing on the profitability of a company in the energy sector, from a purely financial perspective".
On the other hand, the literature on project finance is effective.
Gatti (2013), defined project finance as "*a structured financing of a specific economic entity (the SPV), created by the sponsor using either equity or mezzanine debt and for which the lender considers cash flows to be the primary source of loan repayment, while the assets represent only collateral*".[162]

Moreover, project financing presents advantages and disadvantages, as described by Finnestry (2007). For example, Kleimeier, S. and Megginson W.L. (2000) showed that project financing is more effectively priced than other types of loan. Furthermore, Miglo (2010) presents an analysis in which "*the quality of firms that issue at least one claim without recourse is higher than that of firms that only issue corporate claims and when the asymmetric information is large and uniformly distributed across projects, companies generally issue corporate claims, meaning that non-recourse debt is generally issued when the asymmetric information is not uniformly distributed*".[163] Indeed, Müllner (2017) claimed that "*a clear separation between the SPV and the sponsor balance sheet reduces the asymmetric information between the lender and the sponsor and a more efficient evaluation of credit quality*".[164] Also in this context, Conde et al. (2020) sustain that one of the main advantages of project finance is its ability to expand the project's borrowing capacity. In fact, this structure implies that project debt is not a direct obligation for the sponsors and, therefore, does not appear on their balance sheets: for this reason, the deal can support a debt-to-equity ratio that could not otherwise be attained.[165] Finally, Esty (2005) stated that "project finance resolve market imperfections. In particular, the author explained

[162] Gatti, S. (2013) - *Project Finance in Theory and Practice*, 2nd ed.; Elsevier: Atlanta, GA, USA, 2013; pp. 1–21.
[163] Miglo, A. (2010) - *Project Financing Versus Corporate Financing under Asymmetric Information*. J. Bus. Econ. Res. 2010
[164] Müllner, J (2017) - *International project finance: Review and implications for international finance and international business*. Manag. Rev. Q. 2017, 67, 97–133.
[165] Alonso-Conde, Ana & Rojo-Suárez, Javier. (2020) - *On the Effect of Green Bonds on the Profitability and Credit Quality of Project Financing.* Sustainability. 12.6695.10.3390/su12166695.

that when projects are carried out on a stand-alone basis, they are better analyzed, mitigating information costs".[166]

On the other hand, project financing presents several disadvantages, due in particular to separation of the SPV and the sponsor. In general, Conde et al. (2020) state that diverse risks can arise both during the construction phase, when the project is not yet generating cash, and during the operations phase. In fact, "lenders delegate responsibility to shareholders, so covenants are made to reduce moral hazard that can result in opportunistic practices that destroy value for lenders and conflicts of interest between lenders and sponsors often arise when setting dividend policy and restructuring distressed companies".[167]

Regarding green bonds, as said above the literature does not provide a clear vision as for project financing. This lack is due in particular to the little experience of this innovative instrument. However, as Esty (2005) stated, project finance contributes significantly to transparency in the construction phase, leading to a reduction in the cost of capital. In this regard, Conde et al. (2020) explained that "*effect can benefit from the requirements for public information established for the issuance of green bonds, which largely explain the relatively low interest rate*" assumed in their analysis.

Moreover, Maltais and Nykvist (2020) proposed one of the first empirical studies designed to address the broader questions of what attracts investors and issuers to the green bond market, the role of green bonds in shifting capital to more sustainable economic activity, and how green bonds impact the way organizations work with sustainability. They concluded that "the three most important incentives to issue green bond are broadening the investor base, lowering the cost of capital, meeting investor demand for sustainable investment products".[168] Furthermore, "green bond issuers focus

[166] Esty, B.C. Petrozuata (2005): *A case study of effective use of project finance*. J. Appl. Corp. Financ. 2005,

[167] Alonso-Conde, Ana & Rojo-Suárez, Javier. (2020) - *On the Effect of Green Bonds on the Profitability and Credit Quality of Project Financing.* Sustainability. 12.6695.10.3390/su12166695.

[168] Maltais, A.; Nykvist, B. (2020) - *Understanding the role of green bonds in advancing sustainability*. J. Sustain. Financ. Invest. 2020.

on a variety of benefits, such as attracting customers and staff interest or incorporating sustainability into internal operations".[169]

Finally, Tang et al. (2020) construct a comprehensive dataset covering all corporate green bond issuance worldwide to provide the first empirical analysis of the market's reaction to firms' environmental, social, and governance (ESG) activities. They find little evidence that green bonds are issued at lower yields than regular corporate bonds from the same issuers, suggesting that the main advantage of green bonds is not cheaper debt financing.[170] Moreover, issuing green bonds can stimulate the exposure to new investors, attracting more media exposure and satisfying investors' requirements.

To conclude, Conde et al. (2020) state that green bond financing delivers higher returns for shareholders than conventional financing but it is important to highlight that they focused on the supply side, assuming demand as given. This is an important point considering that the consolidation and strengthening of green bond market will likely come from the alignment of incentives between issuers and investors.[171]

4.3.2 Empirical Analysis

In light of the discussions of the literature regarding the effects of green bonds in the companies' financial structure, an empirical analysis is proposed in the following paragraphs. The analysis is conducted on a hypothetical wind farm company located in Italy and the main purpose is to investigate whether the issuing of a green bond could be an alternative source of financing in the renewable energy sector. In particular, the analysis is focused on the comparison between the issuing of a green bond and the most conventional source of financing in the renewable energy sector in Italy, the project finance, from a shareholder/investor perspective.

The analysis is computed through the construction of a financial model, in order to forecast the financial statement of the company in a time value of 10 years.

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[169] Alonso-Conde, Ana & Rojo-Suárez, Javier. (2020) - *On the Effect of Green Bonds on the Profitability and Credit Quality of Project Financing.* Sustainability. 12.6695.10.3390/su12166695.

[170] Tang, D.Y.; Zhang, Y (2020) - *Do shareholders benefit from green bonds?* J. Corp. Financ. 2020, 61, 101427.

[171] Alonso-Conde, Ana & Rojo-Suárez, Javier. (2020) - *On the Effect of Green Bonds on the Profitability and Credit Quality of Project Financing.* Sustainability. 12.6695.10.3390/su12166695.

4.3.2.1 Methodology

In the next paragraphs I will analyze a hypothetical onshore wind farm company called θ Wind S.r.l., located in Italy. The wind farm is composed by 11 turbines, with a power of 2 MW each. The total power installed is 22 MW.
θ Wind S.r.l. is part of Electric Utilities Industry and it generates and sells electric energy in the market. Moreover, the company holds Green Certificates that expire at 30/06/2026.
The analysis has the purpose to study the impact of two different sources of financing in the θ Wind S.r.l. financial structure, in case of refinancing of the old debt. In fact, starting from the Financial Statement at 31/12/2019, it will be analyzed the NPV of the project in two different cases: in the first case a traditional source of financing in the energy renewable sector, which is project finance, and in the second case the emission of a green bond, a new financial instrument which is growing exponentially. It has been used the same perspective of Conde et al. (2020) who analyzed whether there is a direct financial incentive for issuing green bonds in contrast to other types of financing, taken the perspective of a project finance sponsor,.[172]

The main difference with Conde et al. (2020)'s work is that the forecasts of the two sources of financing have been studied starting from an actual situation in 2019. The Financial Statement at 31/12/2019 shows that θ Wind S.r.l. has an outstanding bank debt of 18.916k € and an Interest-Rate-Swap which hedges the company to the floating interest rate. Assuming that θ Wind S.r.l wants to refinance the existing debt, the purpose of this thesis is to analyze, thought the use of a financial model, the refinancing process with project financing or with the emission of a green bond, comparing the NPV of the project in the two different cases.
As a premise, it has to be said that θ Wind S.r.l. meets all the prerequisites necessary to be refinanced on both project finance and green bond basis. In this context, it is fundamental to highlight that green projects can be refinanced using green bonds (see **Figure 38**).

[172] Alonso-Conde, Ana & Rojo-Suárez, Javier. (2020) - *On the Effect of Green Bonds on the Profitability and Credit Quality of Project Financing.* Sustainability. 12.6695.10.3390/su12166695.

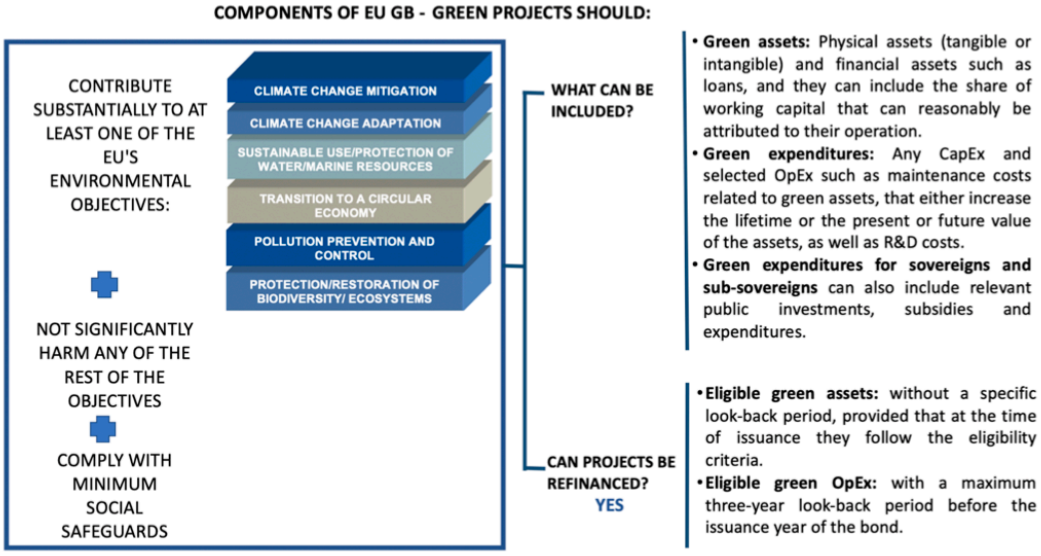

Figure 38: Components of European Union Green Bond (EU GB). *Source: Conde et al. (2020)*

In fact, as stated by Conde et al. (2020) "*when refinancing is for eligible green assets, no specific look-back period is required before the issuance, provided that at the time of the issuance the assets follow the eligibility criteria*".

The project finance scenario has been built with characteristics aligned to the market and with covenants typically used in similar projects. In particular, as described in the previous paragraphs, the most used covenants in project finance are a minimum DSCR and LLCR and in addition a maximum Debt-to-Equity ratio.

On the other hand, for the green bond case, it has been used most of the contractual terms of the green bond issued by Asja Ambiente Italia S.p.A., whose purpose is comparable to that of θ Wind S.r.l. In particular, the green bond taken as reference was issued by Asja Ambiente Italia S.p.A. in December 2019 with ISIN IT0005394868. It is completely suitable for the case under analysis and it has been selected in order to make the analysis as realistic as possible.

4.3.2.2 Financial Data

P&L Statements and Balance Sheets

In order to forecast the Profit & Loss Statement and the Balance Sheet of θ Wind until 2030, different assumptions have been made starting from the Financial Statement at 31/12/2019. As discussed previously, in the first semester of 2020 the company redeems the old debt (18.916k €), and therefore pays the IRS Breakage costs (2.500k €), issuing a green bond or using project finance for an amount of 20.000k €. In order to analyze the impact of the two sources of financing on the financial structure as realistically as possible, the analysis proposes two forecasts of the statements: the former in the refinancing case with project finance (see **Figure 39**) and the latter in the refinancing case issuing a green bond (see **Figure 40**).

P&L - Project Finance	2019	2020	2021	2022	2023	2024	2025	2026	2027	2030
Revenues										
Sale EE	2631	2.576	2.821	2.746	2.756	2.784	2.900	3.020	3.248	1.743
Tariff	4542	5.013	4.864	4.985	5.047	5.108	5.115	2.138	-	-
Total Revenues	**7.790**	**7.589**	**7.685**	**7.731**	**7.803**	**7.892**	**8.015**	**5.158**	**3.248**	**1.743**
OPEX										
Total Operating Expenses	**(1.242)**	**(1.141)**	**(1.145)**	**(1.155)**	**(1.166)**	**(1.182)**	**(1.194)**	**(1.216)**	**(1.239)**	**(647)**
EBITDA	**6.548**	**6.448**	**6.540**	**6.576**	**6.637**	**6.710**	**6.821**	**3.942**	**2.010**	**1.096**
Depreciation	(3.057)	(2.763)	(2.763)	(2.763)	(2.763)	(2.763)	(1.502)	(705)	(239)	(117)
EBIT	**3.491**	**3.685**	**3.777**	**3.813**	**3.874**	**3.947**	**5.319**	**3.237**	**1.771**	**978**
Interests & Other Financial	(1.137)	(454)	(436)	(348)	(271)	(194)	(106)	-	-	-
Agency Fees	(25)	(40)	(40)	(41)	(41)	(42)	(42)	(43)	-	-
IRS Breakage	(0)	(3.050)	-	-	-	-	-	-	-	-
EBT	**2.328**	**141**	**3.301**	**3.424**	**3.562**	**3.712**	**5.171**	**3.194**	**1.771**	**978**
IRES	(650)	(382)	(802)	(830)	(863)	(899)	(1.249)	(776)	(426)	(235)
IRAP	-	(145)	(149)	(150)	(152)	(155)	(209)	(128)	(70)	(39)
Net Income	**1.686**	**(386)**	**2.351**	**2.444**	**2.546**	**2.657**	**3.714**	**2.290**	**1.275**	**704**
% Margin	*22%*	*-5%*	*31%*	*32%*	*33%*	*34%*	*46%*	*44%*	*39%*	*40%*

Balance Sheet - Project Finance	2019	2020	2021	2022	2023	2024	2025	2026	2027	2030
Total Fixed Assets	**20.064**	**17.365**	**14.602**	**11.839**	**9.076**	**6.313**	**4.811**	**4.106**	**3.867**	**3.154**
Commercial Receivables	1.463	1.050	1.046	1.060	1.071	1.083	1.094	252	271	291
VAT Credit	232	46	46	47	47	48	48	49	149	53
Deferred Taxes	646	646	646	646	646	646	646	646	646	646
Other receivables	177	177	177	177	177	177	177	177	177	177
Tax Credit	-	39	-	321	377	391	78	1.374	878	196
Cash	4.553	5.369	4.248	2.374	1.695	1.091	854	400	400	400
Total Current Assets	**7.071**	**7.327**	**6.163**	**4.624**	**4.012**	**3.436**	**2.897**	**2.898**	**2.520**	**1.762**
Assets	**27.135**	**24.692**	**20.765**	**16.463**	**13.088**	**9.748**	**7.708**	**7.004**	**6.387**	**4.916**
Share Capital	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Legal Reserve	200	200	200	200	200	200	200	200	200	200
Other Reserves	4.053	4.053	2.151	1.087	178	-	-	-	-	-
Accrued Profit/Dividend Debts	-	163	1.151	1.198	1.250	1.301	1.666	4.001	3.261	1.715
Profit/(Loss)	1.686	1.137	1.200	1.246	1.295	1.356	2.048	514	634	697
Total Equity	**6.939**	**6.553**	**5.702**	**4.731**	**3.924**	**3.857**	**4.914**	**5.715**	**5.095**	**3.612**
Bank Debts	18.916	16.865	13.505	10.455	7.885	4.610	1.510	0	0	0
Total long term debt	**18.916**	**16.865**	**13.505**	**10.455**	**7.885**	**4.610**	**1.510**	**0**	**0**	**0**
Commercial Payables	128	207	208	210	212	214	217	221	225	237
Other debts	364	364	364	364	364	364	364	364	364	364
Tax liability	84	-	283	-	-	-	-	-	-	-
Total Short Term Liabilities	**577**	**571**	**855**	**574**	**576**	**578**	**581**	**585**	**589**	**601**
Liabilities	**27.135**	**24.692**	**20.765**	**16.463**	**13.088**	**9.748**	**7.708**	**7.004**	**6.387**	**4.916**

Figure 39: Profit & Loss / Balance Sheet – Project finance case. Source: personal elaboration

P&L - Green Bond	2019	2020	2021	2022	2023	2024	2025	2026	2027	2030
Revenues										
Sale EE	2631	2.576	2.821	2.746	2.756	2.784	2.900	3.020	3.248	1.743
Tariff	4542	5.013	4.864	4.985	5.047	5.108	5.115	2.138	-	-
Total Revenues	**7.790**	**7.589**	**7.685**	**7.731**	**7.803**	**7.892**	**8.015**	**5.158**	**3.248**	**1.743**
OPEX										
Total Operating Expenses	**(1.242)**	**(1.141)**	**(1.145)**	**(1.155)**	**(1.166)**	**(1.182)**	**(1.194)**	**(1.216)**	**(1.239)**	**(647)**
EBITDA	**6.548**	**6.448**	**6.540**	**6.576**	**6.637**	**6.710**	**6.821**	**3.942**	**2.010**	**1.096**
Depreciation	(3.057)	(2.763)	(2.763)	(2.763)	(2.763)	(2.763)	(1.502)	(705)	(239)	(117)
EBIT	**3.491**	**3.685**	**3.777**	**3.813**	**3.874**	**3.947**	**5.319**	**3.237**	**1.771**	**978**
Interests & Other Financial	(1.137)	(386)	(369)	(365)	(342)	(278)	(203)	(129)	-	-
Agency Fees	(25)	(60)	(60)	(61)	(62)	(62)	(63)	(64)	(66)	-
IRS Breakage	(0)	(2.700)	-	-	-	-	-	-	-	-
EBT	**2.328**	**539**	**3.347**	**3.387**	**3.471**	**3.607**	**5.053**	**3.043**	**1.705**	**978**
IRES	(650)	(792)	(818)	(826)	(846)	(879)	(1.225)	(745)	(426)	(235)
IRAP	-	(145)	(149)	(150)	(152)	(155)	(209)	(128)	(70)	(39)
Net Income	**1.686**	**(398)**	**2.381**	**2.411**	**2.472**	**2.572**	**3.619**	**2.171**	**1.209**	**704**
% Margin	*22%*	*-5%*	*31%*	*31%*	*32%*	*33%*	*45%*	*42%*	*37%*	*40%*

Balance Sheet - Green Bond	2019	2020	2021	2022	2023	2024	2025	2026	2027	2030
Total Fixed Assets	**20.064**	**17.365**	**14.602**	**11.839**	**9.076**	**6.313**	**4.811**	**4.106**	**3.867**	**3.154**
Commercial Receivables	1.463	1.050	1.046	1.060	1.071	1.083	1.094	252	271	291
VAT Credit	232	46	46	47	47	48	48	49	149	53
Deferred Taxes	646	646	646	646	646	646	646	646	646	646
Other receivables	177	177	177	177	177	177	177	177	177	177
Tax Credit	-	-	150	394	376	379	71	1.370	874	196
Cash	4.553	8.545	10.825	12.098	11.152	8.957	7.256	4.000	300	300
Total Current Assets	**7.071**	**10.464**	**12.890**	**14.422**	**13.469**	**11.290**	**9.292**	**6.494**	**2.416**	**1.662**
Assets	**27.135**	**27.829**	**27.491**	**26.260**	**22.545**	**17.603**	**14.103**	**10.600**	**6.283**	**4.816**
Share Capital	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Legal Reserve	200	200	200	200	200	200	200	200	200	200
Other Reserves	4.053	4.053	2.635	2.372	1.594	549	-	-	-	-
Accrued Profit/Dividend Debts	-	(253)	1.165	1.178	1.206	1.251	1.610	3.640	3.157	1.615
Profit/(Loss)	1.686	1.184	1.216	1.233	1.266	1.322	2.008	472	634	697
Total Equity	**6.939**	**6.184**	**6.216**	**5.983**	**5.266**	**4.322**	**4.819**	**5.312**	**4.991**	**3.512**
Bank Debts	18.916	20.000	20.000	19.000	16.000	12.000	8.000	4.000	-	-
Total long term debt	**18.916**	**20.000**	**20.000**	**19.000**	**16.000**	**12.000**	**8.000**	**4.000**	**-**	**-**
Commercial Payables	128	207	208	210	212	214	217	221	225	237
Other debts	364	364	364	364	364	364	364	364	364	364
Tax liability	84	371	-	-	-	-	-	-	-	-
Total Short Term Liabilities	**577**	**941**	**572**	**574**	**576**	**578**	**581**	**585**	**589**	**601**
Liabilities	**27.135**	**27.829**	**27.491**	**26.260**	**22.545**	**17.603**	**14.103**	**10.600**	**6.283**	**4.816**

Figure 40: Profit & Loss / Balance Sheet – Green bond case. Source: personal elaboration

Assuming that the refinancing process starts in the first semester of 2020 for both cases, macro-economic assumptions have been necessary to forecast the statements:

- **Inflation rate**: the source is the International Monetary Fund [173]. It was needed for the calculation of the projections until 2030.
- **Electric Energy Prices**: the energy prices are fundamental for the revenues calculation in the long term. The electricity sale in the market is the main source of revenue in a wind farm company (with, in this specific case, the Green Certificate). The price value derives from EEX Prices Futures website.[174]

[173] Link: https://www.imf.org/external/datamapper/PCPIPCH@WEO/WEOWORLD/VEN/ITA
[174] Link: https://www.eex.com/en/market-data/power/futures

- **Green Certificates**: As described in the GSE website[175], the calculation of the tariff is based on the energy prices. The price of the tariff is then multiplied to the MWh of the plant in order to calculate what is actually received from the incentive tariff.

Additionally, for the construction of the P&L Statements and the Balance Sheets, other assumptions have been necessary:

- The **Operating Expenses** (Operation & Maintenance, Insurances and other general expenses) are assumed constant during the analysis, adjusted every year with the inflation.

- The percentage of **Depreciation**, as in the analysis conducted by Conde et al. (2020), is assumed to be constant in the future periods.

- Regarding **Taxes**, projections consider the current tax credits that result from tax losses and the constraints for the deduction of interest expenses.[176] In particular, the percentage of taxes used in the analysis are 24% of IRES and 3,9% of IRAP [177].

Debt Assumptions

In the project finance case (see **Figure 39**), the new debt issued in 2020 is completely used to repay the old debt and to pay the breakage costs of the Interest-Rate-Swap. The new bank loan has a maturity of 6 years, with a six-monthly principal repayment. In fact, the debt expires at 30/06/2026 and, as showed in the **Figure 41,** the repayment structure is composed by the senior repayment and the interests' payment.

[175] Link: https://www.gse.it/servizi-per-te/fonti-rinnovabili/impianti-a-fonti-rinnovabili-grin/modalità-di-calcolo
[176] Alonso-Conde, Ana & Rojo-Suárez, Javier. (2020) - *On the Effect of Green Bonds on the Profitability and Credit Quality of Project Financing.* Sustainability. 12.6695.10.3390/su12166695.
[177] Assumed IRAP of Regione del Veneto, link: https://www1.finanze.gov.it/finanze2/dipartimentopolitichefiscali/fiscalitalocale/aliquoteirap/dettaglio_irap.php?id=265&reg=21&anno=2019&privacy=ok

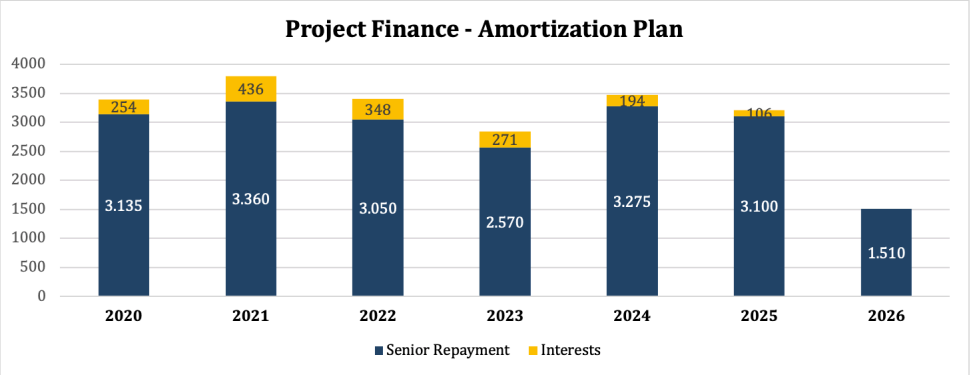

Figure 41: Repayment structure in project finance case. Source: personal elaboration

The interests are paid as percentage of the outstanding balance of the period and they are calculated as the sum of a Margin plus the Euribor. The Margin applicated in the analysis is 2,8% and the Euribor used is the *Euribor 6 months*. The margin is aligned on the average of the sector.[178] In addition, as in the old debt, an Interest-Rate-Swap (IRS) is needed in order to mitigate the interest-rate risk, being a floating-rate loan. This hedging policy is assumed to cover the 70% of the debt, paying an IRS of 0%[179].

Moreover, as discussed previously, the financial covenants, which are essentials in the calculation of the dividend flows for shareholders, are assumed comparable to similar projects. It is assumed that for the financing period the lenders request a minimum Annual DSCR of 1,40x, a minimum LLCR of 1,35x and a maximum Debt-to-Equity ratio of 80%.

Due Diligence costs have to be taken into consideration. "The lenders need to evaluate the terms of the project's contracts insofar as these provide a basis for its construction costs and operating cash flow, and quantify the risks inherent in the project with particular care".[180] The costs of this process are called Due Diligence costs and for the project financing case are assumed to be 150 k€. Finally, the Annual Agency Fee, the fee payable to the agent bank, is assumed 40 k€.

On the other hand, the green bond case has been built taking as reference the contractual terms of the green bond issued by Asja Ambiente Italia S.p.A. in December 2019. The

[178] The interest margins in project finance loans are typically in the range of 2-3,5% as stated by E.R. Yescombe (2014) in "Principles of Project Finance" (Second Edition).
[179] The IRS 7 years at 30/06/2020. Link: https://mutuionline.24oreborsaonline.ilsole24ore.com/guide-mutui/irs.asp#storico
[180] Yescombe, E. R., (2014) - *Principles of Project Finance*, 2 ed., Elsevier.

repayment structure applicated (see **Figure 42**) is the same of the green bond taken as reference.[181]

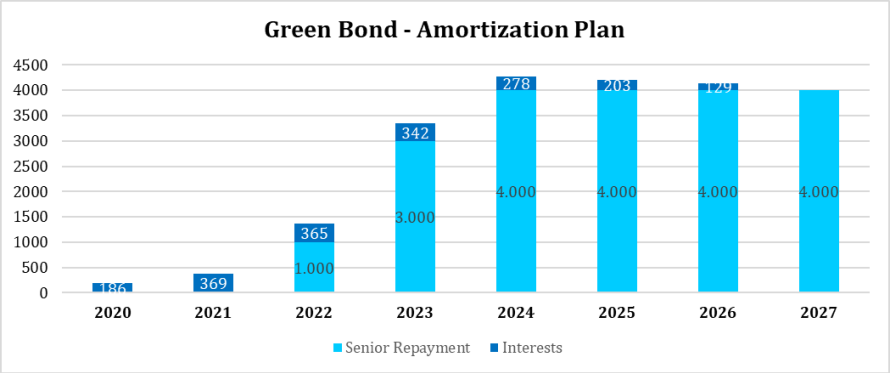

Figure 42: Repayment structure in green bond case. Source: personal elaboration

The green bond is a plain vanilla corporate bond, issued for an amount of 20.000k € and listed on ExtraMOT PRO3, the dedicated segment to green bonds of Borsa Italiana.
Considered the bond structure, a fixed coupon payment at pre-determined fixed intervals is applicated, as showed in **Figure 42**. Therefore, the maturity of the bond is also pre-determined. In order to be consistent with the analysis, the date of issuance is assumed on 30/06/2020 with a maturity of 7 years. In fact, the expiry date is assumed on 30/06/2027. The coupon amount, paid on a six-month basis, is assumed to be 1,82% of the outstanding balance of the bond. The interest rate applicated represents the average of the latest 10 green bonds issued in the same dedicated segment of the market, considering similar purposes.[182] This calculation was needed in order to be as realistically as possible. In contrast to project finance case, a hedging policy is not necessary being the bond a fixed-rate bond.
The green bond issued has the same purpose of the project finance case, i.e. to repay the old debt and to pay the breakage costs of the Interest-Rate-Swap.
The financial covenants proposed are consistent with the contractual terms of the green bond issued by Asja Ambiente Italia S.p.A.. In particular, for the financing period a maximum NFP/Equity ratio of 5x and a maximum NFP/EBITDA ratio of 8x are required.

[181] Contractual terms: https://www.asja.energy/wp-content/uploads/2019/12/Documento-Ammissione-completo.pdf
[182] Calculated at 30/06/2020

Due Diligence costs and Annual Agency fees are assumed higher than project finance case, amounting respectively to 200 k€ for the former and 60 k€ for the latter.

In **Figure 43** a summary of the Debt Assumptions applicated for both cases is presented. The main differences will be explained in the next paragraph.

Debt Assumptions	Project Finance	Green Bond
Amount	20.000.000	20.000.000
Date of issuance	30/06/20	30/06/20
Expiry Date	30/06/26	30/06/27
Currency	EURO	EURO
Interest rate	2,8% + EURIBOR	1,82%
Hedging Coverage	70%	-
IRS	0,0%	-
Annual Agency Fee	40.000	60.000
Due Diligence	150.000	200.000
Covenats		
DSCR	1,40	-
LLCR	1,35	-
D/E	75%	-
NFP/Equity	-	5
NFP/EBITDA	-	8

Figure 43: Debt Assumptions applicated in the financial model. Source: personal elaboration

Cash Flow Statements

Finally, starting from the P&L Statements and Balance Sheets projections proposed above, the Cash Flow Statements have been calculated for both cases: **Figure 44** for project finance case and **Figure 45** for green bond case. As it is possible to see, the Operating Cash Flows is similar for both cases, focusing on the cash flows generated by the regular operating activities of the project.

Cash Flow Statement - Project Finance	2020	2021	2022	2023	2024	2025	2026	2027	2030
EBITDA	**6.448**	**6.540**	**6.576**	**6.637**	**6.710**	**6.821**	**3.942**	**2.010**	**1.096**
(Taxes)	(650)	(628)	(1.585)	(1.071)	(1.068)	(1.144)	(2.200)	-	(250)
(Capex)	(64)	(0)	(0)	(0)	0	0	0	0	0
Δ VAT Credit	186	(0)	(0)	(0)	(1)	(1)	(1)	(99)	52
Δ Net Working Capital	491	6	(12)	(9)	(10)	(8)	846	(15)	(6)
Operating Cash Flows	**6.411**	**5.917**	**4.979**	**5.556**	**5.631**	**5.668**	**2.587**	**1.895**	**892**
Drawdown - Senior Financing	20.000	-	-	-	-	-	-	-	-
IRS Breakage / Other Financial	(3.250)	-	-	-	-	-	-	-	-
Reimbursement Old Financing	(18.916)	-	-	-	-	-	-	-	-
Cash Flow Before Debt service	**4.245**	**5.917**	**4.979**	**5.556**	**5.631**	**5.668**	**2.587**	**1.895**	**892**
Interests	(294)	(476)	(389)	(312)	(235)	(148)	(43)	-	-
Principal Repayment	(3.135)	(3.360)	(3.050)	(2.570)	(3.275)	(3.100)	(1.510)	-	-
Cash Flow After Financing	**816**	**2.081**	**1.540**	**2.674**	**2.121**	**2.420**	**1.034**	**1.895**	**892**
Dividends	-	(1.300)	(2.351)	(2.444)	(2.546)	(2.657)	(1.489)	(1.895)	(892)
Reserves distribution	-	(1.901)	(1.064)	(909)	(178)	-	-	-	-
Cumulated FCF	**816**	**(1.120)**	**(1.875)**	**(679)**	**(603)**	**(237)**	**(454)**	**(0)**	**-**
Cash EOP	**5.369**	**4.248**	**2.374**	**1.695**	**1.091**	**854**	**400**	**400**	**400**

Figure 44: Cash Flow Statement – Project finance case. Source: personal elaboration

Cash Flow Statement - Green Bond	2020	2021	2022	2023	2024	2025	2026	2027	2030
EBITDA	**6.448**	**6.540**	**6.576**	**6.637**	**6.710**	**6.821**	**3.942**	**2.010**	**1.096**
(Taxes)	(650)	(1.487)	(1.221)	(981)	(1.038)	(1.126)	(2.172)	-	(246)
(Capex)	(64)	(0)	(0)	(0)	0	0	0	0	0
Δ VAT Credit	186	(0)	(0)	(0)	(1)	(1)	(1)	(99)	48
Δ Net Working Capital	491	6	(12)	(9)	(10)	(8)	846	(15)	(6)
Operating Cash Flows	**6.411**	**5.059**	**5.343**	**5.646**	**5.662**	**5.686**	**2.615**	**1.895**	**892**
Drawdown - Senior Financing	20.000	-	-	-	-	-	-	-	-
IRS Breakage / Other Financial	(2.900)	-	-	-	-	-	-	-	-
Reimbursement Old Financing	(18.916)	-	-	-	-	-	-	-	-
Cash Flow Before Debt service	**4.595**	**5.059**	**5.343**	**5.646**	**5.662**	**5.686**	**2.615**	**1.895**	**892**
Interests	(246)	(430)	(426)	(403)	(340)	(266)	(193)	(66)	-
Principal Repayment	-	-	(1.000)	(3.000)	(4.000)	(4.000)	(4.000)	(4.000)	-
Cash Flow After Financing	**4.349**	**4.629**	**3.917**	**2.243**	**1.322**	**1.420**	**(1.578)**	**(2.170)**	**892**
Dividends	(357)	(932)	(2.381)	(2.411)	(2.472)	(2.572)	(1.678)	(1.530)	(892)
Reserves distribution	-	(1.417)	(263)	(778)	(1.045)	(549)	-	-	-
Cumulated FCF	**3.992**	**2.280**	**1.273**	**(946)**	**(2.195)**	**(1.701)**	**(3.256)**	**(3.700)**	**0**
Cash EOP	**8.545**	**10.825**	**12.098**	**11.152**	**8.957**	**7.256**	**4.000**	**300**	**300**

Figure 45: Cash Flow Statement – Green bond case. Source: personal elaboration

In order to estimate these statements, different assumptions have been requested. In particular:

- **Δ Net Working Capital:** the income from the sale of electricity is assumed after 1 month, while the income from the incentive tariff is assumed after 2 months.

- **Dividends and Reserves Distribution:** The dividend policy is assumed different depending on the source of financing. In project finance scenario, the company has to take into account, in every dividends distribution date, the financial covenants discussed previously (ADSCR; LLCR; D/E) and in addition the company has to keep enough amount of cash in order to be able to pay the next calculation date's debt service (Principal Repayment + Interests). In green bond case the mechanism is the same but the financial covenants to take into consideration are different (NFP/Equity; NFP/EBITDA)

Regarding the Operating Cash Flows, it is possible to see a substantial reduction between 2025 and 2027. This reduction is totally explained by the contraction of the EBITDA, a decrease of 73% between 2025 and 2026, and a decrease of 96% between 2026 and 2027 (in total, a reduction of 239% between 2025 and 2027). This important contraction is due to the expiration of the Green Certificates on 30/06/2026, as it is possible to note in the P&L Statements in **Figure 39** and **Figure 40**.

4.3.2.3 Results and Conclusions

In order to analyze if issuing a green bond could be an alternative source of financing in the Italian renewable energy sector, in this section the results achieved in the analysis developed for θ Wind S.r.l. are presented.

Starting from the Cash Flow Statements, **Figure 46** shows the comparison between the cash flows after debt service for both cases, project finance and green bond.

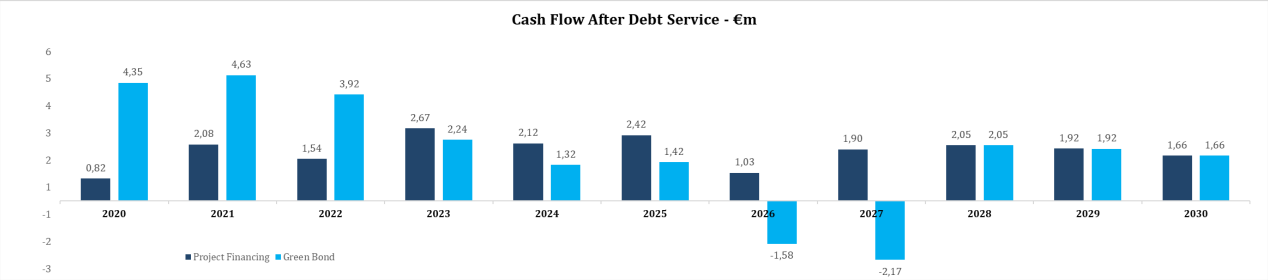

Figure 46: Cash Flow After Debt Service for both cases. Source: personal elaboration

In the green bond scenario, the cash flow after debt service is more irregular during the valuation period, resulting decidedly higher in the first years of the financing and then becoming negative in the last two years of debt service (2026 and 2027). On the other hand, in the project finance case, the cash flow after debt service presents a regular trend. This valuable difference is due to the different amortizing plans (see **Figure 41** and **Figure 42**) of the two sources of financing. However, it has to be said that the debt sculpting scheme is more frequent in bank loans than in bond emissions, depending always by the contractual terms.

Moreover, the contractual terms are crucial for the dividends to shareholders. **Figure 47** shows the trend of the dividends from 2020 to 2030, highlighting that the green bond case presents a slight, but still better, ability to repay the shareholders.

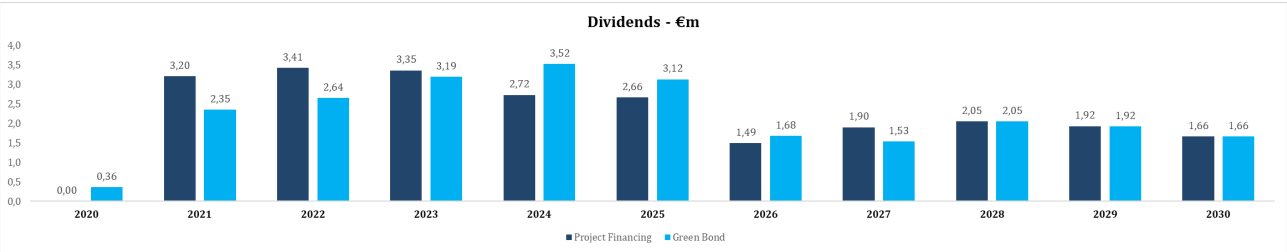

Figure 47: Dividends to shareholders for both cases. Source: personal elaboration

This result is obviously influenced by the debt assumptions (see **Figure 43**). In particular, as described above, the dividend policies include different covenants, which affected the two dividend trends. In addition, the maturity and the interest rate influence the ability to repay the shareholders.

Regarding the interest rate of the two sources of financing, it is interesting to note that even if project finance case pays a higher interest rate than green bond case, the former pays less interests in percentage terms on the overall financing (see **Figure 48**). In fact, in the bank loan case the company pays 93% in senior repayment and 7% in interests, meanwhile in the green bond case the company pays 91% in senior repayment and 9% in interests.

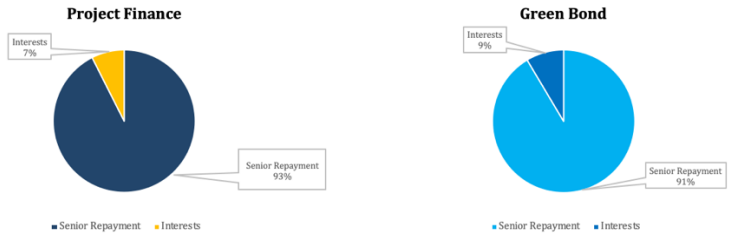

Figure 48: Percentage of Senior Repayment and Interest paid in both cases. Source: personal elaboration

The higher costs in Due Diligence and Agency Fees and a longer Maturity explain the higher percentage of interests paid in the green bond case.

Regarding the quality ratios, **Figure 49** shows the Annual DSCR from 31/12/2020 to 30/06/2027 for both cases. The DSCR calculation in the green bond case starts with the first senior repayment date (30/06/2022) and ends in the expiry date (30/06/2027).

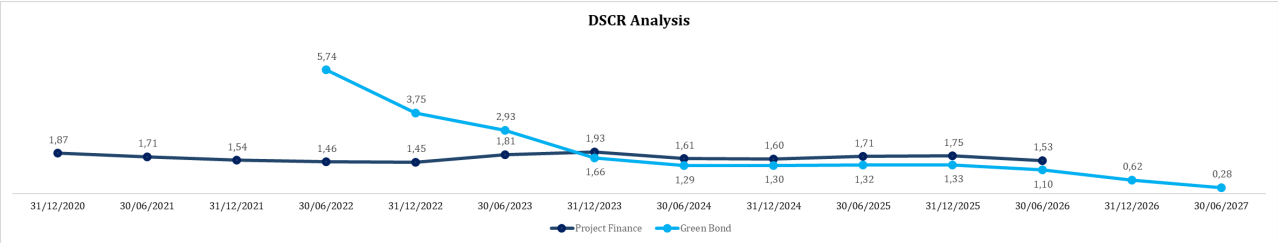

Figure 49: Annual DSCR for both cases. Source: personal elaboration

The DSCR reflects the project's debt capacity and it is a ratio that the lenders, especially in bank loans, rely on to determine the financial viability of the project.[183] For this reason, a minimum DSCR is a covenant in the project finance case and the amortizing plan is built taking in consideration the DSCR trend over the years. On the other hand, in the green bond case, the DSCR is not a covenant and this kind of analysis is affected by the amortizing plan taking as reference. However, the Average DSCR during the financing period is higher in green bond case (1,94x) than in the project finance case (1,66x).

Finally, the NPV Analysis is conducted by discounting the Cash Flows From Operations (FCFO) taking into consideration the WACC as discount rate. As discussed above, this assumption is crucial for the profitability calculation and for the overall result. The Cost of Equity is calculated on different assumptions. The Risk Free rate applicated is the Italian BOT 10Y updated at 01/10/2020[184] and for the Market Risk Premium calculation it has been used the data provided by Aswath Damodaran[185]. The MRP then is calculated as the spread between the Equity Risk Premium and the Italian Rating-based Default Spread. The Beta Unlevered has been calculated as average of the Beta Unlevered of three competitive companies in the Italian renewable energy sector[186]. Finally, the choice to apply an Additional Risk Premium is conservative, given the company's small size.
Moreover, **Figure 50** shows the WACC calculation for both cases and the relative NPV. Although the green bond case presents a higher NPV of the project, the final result is similar.

[183] Alonso-Conde, Ana & Rojo-Suárez, Javier. (2020) - *On the Effect of Green Bonds on the Profitability and Credit Quality of Project Financing.* Sustainability. 12.6695.10.3390/su12166695.
[184] Link: https://mercati.ilsole24ore.com/obbligazioni/spread/GBITL10J.MTS
[185] http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/ctryprem.html
[186] As average between: 0,66 Enel Green Power; 0,81 Falck Renewables; 0,71 ERG

NPV Analysis	Project Finance	Green Bond
Risk Free Rate - Rf	0,86%	0,86%
Market Risk Premium	3,23%	3,23%
Beta Unlevered	0,73	0,73
Beta Levered - βl	2,08	2,42
Additional Risk Premium	2,50%	2,50%
Cost of Equity - Ke	**10,07%**	**11,18%**
Cost of Debt - Kd	**2,80%**	**1,82%**
Tax Shield - Ts	0,78%	0,51%
Cost of Debt Net of Ts	**2,02%**	**1,31%**
E/(D+E)	28%	24%
D/(D+E)	72%	76%
WACC	**3,86%**	**3,36%**
NPV	**34.811**	**35.148**

Figure 50: NPV analysis for both scenarios. Source: personal elaboration

The slight but better performance of the project in the green bond scenario is explained by the lower interest rate of the green bond. This assumption is consistent with the results provided by part of the literature in this context, which emphasizes the lower cost of capital resulting from green financing compared to other types of debt[187].

In conclusion, if the research question of this analysis is whether the issue of a green bond can be a valid alternative to the conventional sources of financing in the renewable energy market in Italy, the answer is positive. However, it has to be said that this analysis takes into consideration only some of the overall assumptions for both cases, focusing on the investor perspective. For this reason, the main purpose of this thesis is not to state a general result but to demonstrate that in this hypothetical specific case the issuing of a green bond could be effective. In addition, in light of the green bond literature, this thesis aims to foster future further researches on this topic, in order to outline the profitability of this innovative instrument.

In terms of implications, this analysis suggests that the green bond instrument can play an important role in the low-carbon transition, aligning private companies' objectives to the national and supranational purposes involved against climate change.

[187] Alonso-Conde, Ana & Rojo-Suárez, Javier. (2020) - *On the Effect of Green Bonds on the Profitability and Credit Quality of Project Financing.* Sustainability. 12.6695.10.3390/su12166695.

CONCLUSIONS

The main purpose of this thesis is to study and analyze green bonds in depth. More specifically, the underlying question of this research is whether green bonds can be considered an alternative source of financing in the renewable energy market in Italy. The examination conducted in this thesis suggests a positive answer.
In order to reach this goal, the thesis starts from a general description of the phenomena related to climate change. From the earliest studies in the 1800s to the most recent European and international agreements, such as the Green New Deal and the Paris Agreement, it is increasingly evident that climate change will be one of the most difficult challenges that humankind will have to face in the next decades.

The ongoing Covid-19 pandemic is stressing the importance of a global change in order to limit global warming below 1.5 C°, compared to pre-industrial levels.
In this context, climate finance, defined by the United Nations Framework Convention on Climate Change (UNFCCC) as "*local, national, or transnational financing— drawn from public, private, and alternative sources of financing—that seeks to support mitigation and adaptation actions that will address climate change*" plays a key role.
In fact, in order to accelerate the transition to low carbon energy, several studies and analyses estimate that an important effort combined with a rapid disinvestments of fossil fuels will be necessary to achieve the ambitious targets of the Paris Agreement, especially in terms of investment in renewables and energy efficiency. According to IEA, in order to achieve the 1.5 °C target, renewable energy investments need to be increased up to 550 billions of dollars every year and, in contrast, fossil energy disinvestments need to be much more substantial. Climate finance offers several instruments to achieve this goal, divided between financial instruments to raise funds and financial instruments to deploy funds. The former are composed by instruments such as green bonds, climate bonds, climate policy performance bonds, catastrophe bonds, insurances and debt for climate swaps. The latter comprise capital instruments and risk management instruments.
In this context, given their exponential growth in the last decade, green bonds are recognized as the most effective and innovative tools of climate finance.

A green bond can be defined as a special kind of bond in which the revenues may be used exclusively to finance or re-finance, in part or in whole, new and existing green projects. The main purpose of these financial instruments is to increase liquidity in financial markets and to facilitate the low-carbon transition financing specific projects. In fact, as stated by Zerbib O. (2017), "*they are highly attractive financial instruments that foster the environmental transition while enabling low-carbon project holders to expand their funding capacity*".[188]

Raising awareness of investors about the "green" component is the most innovative part of this instrument, as it goes beyond the purely traditional mindset focused on profit maximization. From the point of view of a green bond issuer, this can translate into lower interest rates than traditional bonds. Regarding this last point, the international literature is divided and it seems challenging to agree on a definitive solution.

As mentioned above, the empirical contribution of this thesis aims to observe whether, in a specific case examined, the issuance of a green bond in the renewable energy market can be a valid alternative to conventional sources of financing used in Italy such as project finance, from a shareholder perspective. In order to answer this question, first of all the project finance mechanism is described, studying how this instrument is composed, the actors, the stages and documents required, the most common financial covenants requested by banks and finally the different methods used as valuation project. Moreover, a paragraph is dedicated to the current situation of the renewable energy sector in Italy. In particular, the development of the market in the last decade is taken into examination, as well as the functioning of incentive mechanisms managed by GSE (Gestore dei Servizi Energetici), which represents a significant component for the sector.

The final empirical analysis is conducted in order to evaluate if there is a profitability convenience in issuing a green bond rather than using the project finance instrument. The examination is conducted on the refinancing process of a hypothetical onshore wind farm company located in Italy, with a total power of 22MW. The analysis has the purpose to study the impact of two different sources of financing within the company financial structure, in case of refinancing of the existing debt. In order to do that, the company's financial statements (profit & loss, balance sheet, cash flow statement) over a time value of 10 years (from 2020 to 2030) have been calculated through the construction of a

[188] Zerbib O. (2017) - *The green bond premium*. Department of Finance, Tilburg School of Economics and Management

financial forecasting model based on various assumptions. The results have been obtained by the analysis of these statements. Regarding the results obtained, the Cash Flows From Operations (FCFO) have not been compared, as they are similar for both scenarios. On the other hand, in the green bond scenario the Cash Flow After Debt Service presents a more irregular flow during the valuation period, resulting decidedly higher in the first years of financing and then becoming negative in the last two years of debt service. This difference is given by the different repayment plan defined by the agreement terms. These terms also influence the company's ability to repay the shareholders, highlighting a slight but better performance in the green bond scenario. This result is impacted by the debt assumptions of the analysis, in particular by the dividend policies, the covenants, the maturity and the interest rate. In conclusion, the most comprehensive result is given by the NPV analysis, calculated by discounting the FCFO and using two different WACC as discount rate depending on the scenario. The analysis shows a slight better result in the green bond scenario and it is explained by the lower interest rate of the green bond. This assumption is consistent with the results provided by part of the literature in this context, which emphasizes the lower cost of capital resulting from green financing compared to other types of debt [189].

In conclusion, the issuing of a green bond can be a valid alternative to the conventional sources of financing in the renewable energy market in Italy. As already stated, the main purpose of this thesis is not to state a general result but to demonstrate that companies should seriously consider green bonds as potential alternatives to more traditional financial instruments.

Regarding the limitations found on the drafting of this thesis, they are to be found in the assumptions necessary for the construction of the evaluation model and in the scarce literature on this subject. More precisely, the assumptions at the base of this analysis are strictly influenced by the real cases taken as reference. Furthermore, the literature is strongly focused on the study of the green bond from an investor's point of view, trying to analyze if they can be more profitable than traditional bonds, or on the study of green bond prices in the markets. One of the few researches that has been used as a reference has been conducted by Conde et al. (2020) who took "the perspective of a project finance

[189] Alonso-Conde, Ana & Rojo-Suárez, Javier. (2020) - *On the Effect of Green Bonds on the Profitability and Credit Quality of Project Financing*. Sustainability. 12. 6695. 10.3390/su12166695.

sponsor", analyzing whether there is a direct financial incentive for issuing green bonds in contrast to other types of financing. For this reason, this thesis does not intend to achieve a definitive result, but rather aims to stimulate future research on the same topic. To conclude, it is possible to state that green bonds represent instruments that differ from the usual conventional financial instruments, shifting the main objective from profit maximization to the environmental and green dimension.

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