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Chair of Sustainable Strategies for Business Leaders

Funding as an activator for greater sustainability: a Research on the sectors that benefited the most from it

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Introduction

In these days, more than ever the topic of climate change and environmental preservation has pervaded all the disparate kinds of industries and the great urge to deal with the negative consequences of the business activities has become a command for both enterprises and institutions. These are required to adopt processes and strategies for a better impact on the areas of climate, biodiversity, and quality of life. Sustainable Funding, also referred to as all the financial instruments and initiatives to encourage the adoption of sustainable practices, is a powerful mean to realize the conversion to sustainability and therefore will be the object of this study.

To better understand the urgency for such concrete interventions, we will take a quick look at what the current situation is, through some precious data provided by the *State of the Climate in Europe Report 2022*[1]. In 2022 Europe reached temperatures the double higher than the average level from 1980 to nowadays, and levels 2,3 °C higher than the pre-industrial age average from 1850 to 1900[2]. Furthermore, for the most of European countries 2022 has been the hottest year on record so far. This phenomenon is undermining safety of species, forcing some of them to migrate and causing the extinction of the others. Global warming is leading to other important consequences in Europe such as meteorological, hydrological, and climatic hazards, which already generated a higher number of correlated deaths together with the temperature-factor.

Not surprisingly, there has been a huge impact on the energy sector, in which renewable sources generated, for the first time in 2022, more electricity than the non-renewables: 22,3% of total European energy was produced by wind and solar energy. That's it: if on one side there are higher levels of recorded solar radiation, frequent floods and inundations, and more powerful air currents (generated by strong temperature changes between different regions of the earth), on the other side there is more room for a greater potential to be exploited[3]. In fact, one of the main European sustainable objectives to be

[1] *State of the Climate in Europe* has been jointly produced by the World Meteorological Organization and the European Union's Copernicus Climate Change Service.
https://library.wmo.int/viewer/66206/?offset=#page=1&viewer=picture&o=bookmark&n=0&q=

[2] Period considered as the main benchmark in the Paris Agreement for climate changes of 2015.

[3] https://www.arpat.toscana.it/notizie/2023/rapporto-wmo/il-clima-in-europa-nel-2022-record-di-caldo-ma-buone-notizie-per-le-energie-alternative

achieved by 2030 is to increase renewable energy to at least 42,5% of the total consumption. Coming to the situation of global CO2 emissions, China is the country that has the highest level of emissions, followed by United States, Europe, India, Russia, and Japan according to "CO2 emissions of all world countries, 2022 Report"[4] (by the European Commission). To achieve the goal of the increase of 1,5 °C with respect to the pre-industrial temperature levels (as defined in the Paris Agreement in 2015), net emissions should decrease by 43% by 2030, considering the 2010 levels[5]. According to the report, European emissions in 2022 were 5% lower than in 2019. Furthermore, all these "record" countries are in a downward trend on emissions, except for China which has been increasing levels for years since its economic boom.

Regarding emissions based on sectors instead, the graph below shows the different CO2 emission levels per sector worldwide during the period 1970-2021 (data from the same report has been used).

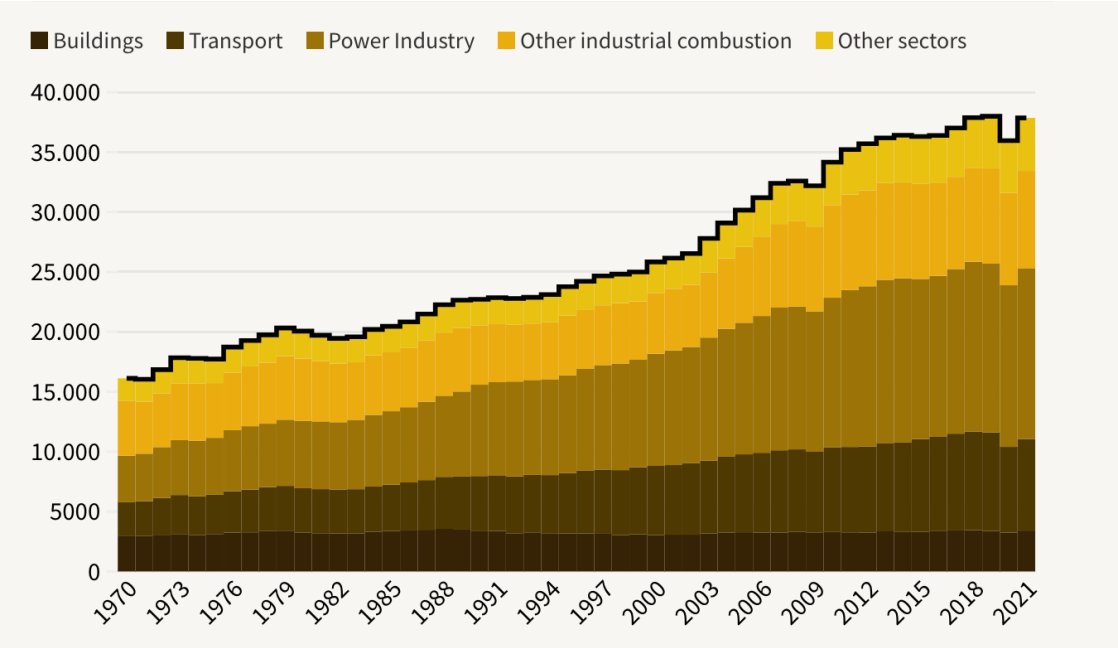

Figure 0.1: "Emissioni CO2 per settore nel mondo", from Il Sole 24 Ore, 2022.

The one with the highest level and the percentage growth in emissions is the energy sector with 14.258,81 megatons of CO2 emitted globally in 2021. Regarding Europe, as we

[4] https://edgar.jrc.ec.europa.eu/report_2022#emissions_table

[5] Il Sole 24 Ore: https://lab24.ilsole24ore.com/cop27-dati-CO2-mondo/?refresh_ce=1

might expect after the Covid-19 pandemic, all the sectors increased their emissions in 2021 with respect to 2020.

In 2015 the Paris Agreement, stipulated between the 196 member States of the United Nations Framework Convention on Climate Change (UNFCCC) regarding the period starting from 2020, dealt with the definition of some fundamental long-term objectives, such as the decrease of CO2 emissions and the Sustainable Finance. Three are the main pillars of the agreement:

1) To keep the average-temperature increase under 2 °C with respect to the pre-industrial levels, at the same time trying to stop this increase at maximum 1,5 °C.
2) Climate resilience: to increase the adaptation skills to the negative effects of the climate change, (e.g. promoting lower emissions without damaging the food production industry).
3) To make financial flows coherent to a sustainable and low-emissions path.

Noticeably from point 3, the topic of Sustainable Finance is of remarkable importance.
It is true especially when it comes to understand how to actively encourage sustainability at both levels of the sectors and individual firms, through concrete actions and initiatives, coming top-down from institutions to achieve these objectives. One of those actions is Sustainable Funding, which will be the object of an in-depth analysis in the following chapters.
The main aim of this study is to understand whether Sustainable Funding can be a real promoter for firms to adopt a "sustainable mindset" over time. To do so, the research will indagate on what has been the response to funding in Europe based on the sector. Sectors would respond positively to sustainable funding if for example they'd undertake new sustainable projects or partnerships. Moreover, the analysis indagates on what is the funding typology (i.e. the type of incentive) that works best for a conversion towards sustainability and more specifically, in a certain sector. The assumption is that there could be forms of financing that would be better for certain sectors more than others and, consequently, institutions could implement differentiation of types of financing based on the industry, to reduce their efforts and increase the efficiency and success of their initiatives.

The study starts by exposing the context of sustainable funding in Europe, including the main pillars of the changing regulatory environment on sustainable finance and typologies of funds. Then, the second chapter will present the research methodologies that have been adopted. Specifically, it will be shown what kind of data have been extrapolated from statistics, more details on target firms and sectors, and the parameters that helped define whether a positive response to sustainable funding over time occurred or not. The third chapter will show detailed results from the main sectors, confirming or denying the initial research questions.

In conclusion, final suggestions will be provided, together with a review of the limits of the research.

Chapter 1: The European context of sustainable funding

1.1 The main decarbonization strategies for a climate neutral vision

In this paragraph we will first indagate on the possible types of sector-based decarbonization strategies. Moreover, we will observe what is the relationship of decarbonization strategies with macroeconomic variables and on which industries there is the most important strategic focus.
This kind of analysis is particularly relevant to the study because it provides an understanding of the sectors in which the strategic focus is currently concentrated the most, with the aim of determining whether there's the need to redirect it and to eventually redesign the financing methods, considered here as a strategic lever for the decarbonization path.

1.1.1 Types of sector-based decarbonization strategies

The contribution of Rajvikram et al (2022) is useful to highlight interesting sector-based decarbonization strategies with a significant impact on reducing emissions. In practice, these translate into the exploitation of specific techniques, emerging technologies or materials. The sectors that will be discussed are buildings, energy, industrial, and transportation.
In the building sector, it has been demonstrated that 3D printing helps significantly reducing the requested energy supply and operative costs, other than CO2 emissions. Moreover, Palazzo Italia in Milan was the first one to experiment a disruptive innovation concerning the use of a particular material in the building construction. It consists of a *biodynamic skin* put on the external surface of the buildings that converts smog and emissions giving back a better quality of the air, thanks to the TX active technology[6].
Coming to the energy sector, it can be interestingly observed that about 50% of the EU's annual energy consumption is from heating and cooling demands. Apart from countries

[6] The TX active technology (a registered mark) exploits a photocatalytic process: a specific ingredient is stimulated by the light to trigger a chemical reaction that transforms the smog into something harmless. https://www.heidelbergmaterials.it/it/txactive-principio-attivo

in Northern Europe, the non-renewables satisfy in most cases more than 80% of the energy needs. This is caused by many factors, such as the great dependency on non-renewables, the inefficiency in the thermal energy conversion and a poor thermal management approach. Techniques like bioenergy-based heating systems, solar-thermal systems, municipal waste incineration, geothermal-based heating, and ameliorating energy efficiency by using heat energy from energy conversion processes would help reducing emissions and increasing the management approaches.

In the overall energy sector, not only the discover and use of brand-new techniques, but also an integrated energy business model is required. The Power-to-X chains are processes with whom the energy generated in excess from renewables can be exploited to produce fuels (power-to-fuel), hydrogen and methane (power-to-gas, using techniques such as the electrolysis to produce green hydrogen), ammonia and methanol (power-to-liquid), and so on. In fact, when the energy is not entirely consumed (that is when its supply exceeds the demand), it can be stored or shared on request towards other applications. Moreover, fuels, gas, and liquids can be converted back into electricity (for example, through a long-term storage, hydrogen can be brought back to electricity to be sold when the market is profitable).

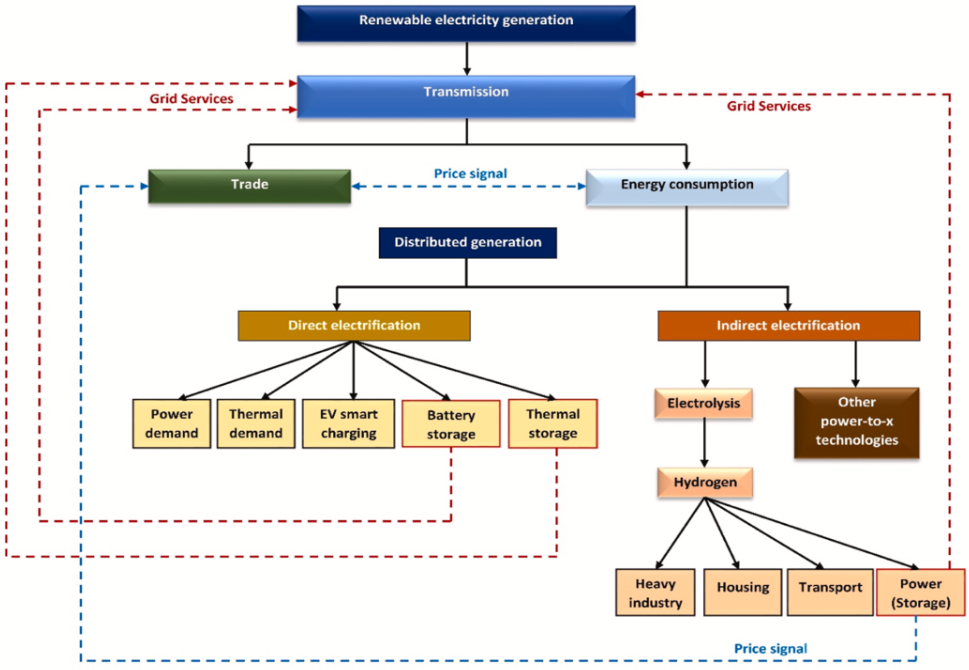

Figure 1.1: "Integrated energy sector model with high renewable energy penetration", Rajvikram et al, 2022.

Scientists are discussing the possibility of Power-to-X chains enabling a European zero-impact business model for the energy sector. A so-called *All Electric Society*[7] would be an energy system that guarantees a continue flow and sustainable generation of energy, then shared between different sectors. This is an example of an integrated model representing the most promising decarbonization strategy for this specific industry, since it would lead to the highest levels in efficiency and savings, and to a significant reduction in emissions. Moreover, it would be a remarkable driving force for a possible "sector coupling" process, where the energy generation and consumption are conceived in a holistic way, and where all the sectors are connected in a global network of energy sources and distribution channels.

As for the industrial sector, digital technologies seem to be the most reasonable way to tackle carbon emissions. In fact, resource efficiency can be achieved with automation, process control, and response to the demand side. In addition, recycling alone can significantly reduce emissions, until it doesn't damage some materials' features.

Coming to the transportation sector, it is the second must polluting sector in Europe.

The two main decarbonization strategies here are: powering vehicles with clean energy sources and optimizing and reducing vehicle usage. For sure, in this sector regulations have had great relevance, helping to establish norms and limits to polluting emissions from vehicles. Moreover, Broghan Helgeson and Jakob Peter (2020) analyzed the way electricity could help decarbonizing the road transport sector. In their study the role of Power-to-X fuels was considered. Even in this case, not all the various transportation sectors could already adopt electrical initiatives due to not enough matured technologies. For example, in the aviation sector, electric flights still can't sustain long-distance travels due to limitations in the battery density. That's why investments in R&D are always required for decarbonization. However, there are still initiatives that can work at the current state of art. In short-distance travels (like in the case of two/three wheelers or city cars) electric solutions are suitable. Nevertheless, there could be the risk of some rebound effects on energy levels of consumption, so a complete switch to renewable sources is the better long-term solution. Still in the transportation sector, aimed to optimization and reduction of vehicle usage, tracking systems and sharing services are key.

[7] https://www.phoenixcontact.com/it-it/industrie/power-to-x

1.1.2 The relationship with the macroeconomic variables

How do macroeconomic variables influence the choice of decarbonization strategies?
Let's first see what the influence of the main macroeconomic variables on carbon emissions is (Rajvikram et al, 2022), on the basis of which to talk about the decarbonization guidelines. A positive change in the *population size, economy growth* (as a function of both GDP and population size), and *emission intensity* (considering emissions from a single activity) would increase overall carbon emissions for sure. On the other side, a decrease in the *energy intensity* (translating into more efficient and less-consuming processes) is not always leading to a reduction in final carbon emissions due to the so called "rebound effect". The rebound effect is measured as the difference between the "ceteris paribus" potential environmental benefits and the actual environmental benefits, (Vivanco et al, 2022). Where the supply of some energy services grows up, their effective price decreases, leading to an increase in demand, which will erode the overall technological efficiency gains (Greening et al, 2000). In other words: the less a process is energy-intensive, the more it will be exploited on large scales, or it will cause a save in money that will be invested in other polluting activities; in both cases there will be an overall increase in carbon emissions over time, compared to the period before the introduction of the process (Rajvikram M.E., Rishi P., et al, 2022).
On the other side, two relevant macroeconomic variables with a good influence on the level of carbon emissions are *innovation and affordability*. An increase in innovating technologies and their level of affordability on the market leads to a decrease in carbon emissions over time. In fact, a study reveals that increasing the penetration of innovating technologies, (in this way guaranteeing a greater affordability on the market), does not necessarily lower their price (Monyei C.G. et al, 2019), which would otherwise lead to the same consequence as for the rebound effect. While macroeconomic variables such as population, economy growth, emission intensity, and energy intensity increase carbon emission levels, the fastest and simplest way to decarbonization seems to be higher investments in innovation and affordability. Investing in research for sustainable technologies, especially clean energy technologies (considering also that the energy sector is the most polluting industry in terms of carbon emissions levels), is key to tackle the climate crisis because: even if they'd encourage the economy growth (including also population) in the long term, they could reduce emission intensity through process or

material innovation and could consist of some renewable sources that, even while increasing levels of energy intensity, wouldn't harm the environment.

1.1.3 Where is the focus and where it should be

In Europe, over 75% of GHG emissions comes from the energy use and production[8]. To effectively pursue the carbon emission neutrality goal by 2050[9], a great part of the financial efforts should be directed towards the clean energy sector. Moreover, considering the current geopolitical situation in Europe, everyone seems to look for a strategic independence from the Russian energy sources: that's why nuclear energy is at the center of the current European debate. So, while the greatest attention in EU is on the energy sector (electricity and heat energy), aggregate emissions from other sectors such as transport, industry, residential, and agriculture, are overall higher, so strategic attention should be redirected to concretely pursue effectiveness in the decarbonization path (Rajvikram M.E. et al, 2022).

Alternatively, since the energy sector has pervading features for definition, attention could be shared by looking at the energy sector's influences on the other sectors.

We could wonder for example what are the energy-intensive industries in Europe. First, the steel industry has the great limitation to struggle in achieving a low-carbon steel production due to its undeveloped technologies. In general, also for cement, chemical and petrochemicals, and aluminum industries green innovation is required to decarbonize the relative products. For this reason, sustainable financings should be always directed towards the R&D functions of firms to increase the processes' efficiency and reduce the emissions linked to the energy consumption in the industrial sector.

Furthermore, we can observe that the heating sector (a significant segment of the energy sector) is particularly dependent from the building sector. In fact, to successfully pursue a strategic decarbonization path in both sectors, interventions are necessary to refurbish

[8] A clean energy transition, European Commission site link: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/energy-and-green-deal_en#:~:text=The%20production%20and%20use%20of,achieving%20carbon%20neutrality%20by%202050.

[9] That is the main long-term objective of the European Green Deal.

the old buildings so as to improve their energetic performance together with an increase in the energy-efficient appliances usage (Rajvikram M.E. et al, 2022).
Some recent decrees including the Relaunch Decree (34/2020), were aimed at energy efficiency in buildings (as well as at static consolidation or reduction of seismic risk of buildings). In detail, it provided an Eco bonus received in the form of a tax credit that, starting from 2022, could be deducted in four years. It was a 110% deduction of the overall expenses deriving from specific interventions aimed at energy efficiency and building refurbishing for seismic risk reduction. Unfortunately, we could object to the ease of bureaucratic procedures and to the method chosen to provide the financing. In fact, a tax credit isn't always the fastest method to finance. In addition, the annual deduction (corresponding to the 25% of the overall deduction) had to be at least equal to the annual amount of the taxes the beneficiary had to pay, or they would have had to sell the tax credit to another subject like a bank or another private institution to have back the money. Speaking of which, no guarantee was given to the beneficiaries that they would have had their expenses paid otherwise. This is just an example of how the success of a funding depends on the chosen accounting way to provide the money and on the guarantee provided.

1.2 The European Regulation on Sustainable Finance

The latest regulations on sustainability are always included in greater strategic frameworks conceived to coherently orient legislative decisions towards the 2030 and 2050 sustainable objectives. First, the current sustainable strategy for finance will be described. Then, the global topic of the European Green Deal will be exposed to give a better comprehension of the context in which the sustainable finance strategy is inserted.

1.2.1 The renewed Sustainable Finance Strategy

Currently, the most used rating system for the sustainable analysis and evaluation of investments is the ESG rating, which unfortunately presents some critical pitfalls. For this reason, the European regulation is being renovated on three different pillars. It was 2018

when the European Commission came up to a sustainable finance strategy and a related action plan on financing a sustainable growth[10]. The recommendations for the action plan came from the high-level expert group on sustainable finance. The action plan was articulated into ten key actions, that could be divided into three main areas: "Reorienting capital flows towards a more sustainable economy", "Mainstreaming sustainability into risk management", and "Fostering transparency and long-termism".

Regarding the first area, the most important actions were:

1) Creating a EU's taxonomy for sustainable activities. For an activity to be classified as sustainable, it has to contribute to at least one of these six objectives: climate change mitigation, climate change adaption, sustainable use of water and marine resources, circular economy, pollution prevention, healthy ecosystems.
2) Creating an EU Green Bond Standard.
3) Fostering investments in sustainable projects, then done through the Sustainable Europe Investment Plan, InvestEU, and many other EU funds (the topic will be explored in depth in the next paragraph).
4) Incorporating sustainability in financial advice. In 2019 the Commission published the rules that investment advisors and insurance distributors must follow that regards sustainability factors (such as sustainability risks and opportunities) when providing advice to clients. This point emphasizes the importance that was given to transparency and direct information, together with point 7).
5) Developing sustainability benchmarks. In fact, a lot of attention was directed to providing better comparability and reliability of information.

About the second point, the introduction of a standard for green bonds ("the European Green Bond Standard[11]") is aimed at promoting an easier comparability between sustainable financial products and a better comprehensibility from the side of investors. The related Regulation introduces a voluntary EU label for green bonds made to reinforce their credibility and reliability towards investors (Regulation 2023/2631 was published in

[10] Renewed sustainable finance strategy and implementation of the action plan on financing sustainable growth. European Commission, 2018 (updated in 2022). Site link: https://finance.ec.europa.eu/publications/renewed-sustainable-finance-strategy-and-implementation-action-plan-financing-sustainable-growth_en

[11] European Commission website for finance, link: https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/european-green-bond-standard-supporting-transition_en

2023 and will enter into force on December 21st, 2024). The Standard relies on the criteria of the EU Taxonomy, which defines the green economic activities, and companies' issuances will be controlled by external supervisors and indirectly reviewed by the European Securities and Markets Authority (ESMA). Moreover, issuers of EuGBs must disclose information on their use of proceeds and, if they communicated some transition plans, how they are actively contributing to implementing and funding the plans.

About the fifth point, two different indexes have been introduced that will work as climate benchmarks. In detail, considering the European action plan (2018), the regulation on benchmarks (EU 2016/2011) has been modified on two fronts. First, every existing benchmark must indicate how ESG principles are included in the investments they are referred to. Second, standards about low-emissions financial products have been introduced through two new benchmarks: the EU Climate Transition Benchmark (EU CTB), built on stocks and bonds emitted by companies that undertook a decarbonization path; and the EU Paris-aligned Benchmarks (EU PAB), which are more ambitious and rigorous about minimal criterions that must be satisfied, since they are aligned to the Paris Agreement's objectives. The new regulation on benchmarks entered into force in 2020. Furthermore, it is expected that some funds classified as Article 9 from the SDFR will use one of these two benchmarks. Funds from Article 9 are those with the objective of sustainable investments or of carbon emissions reduction, but it is still controversial whether the ones for CO2 reduction must be confronted with an EU CTB or PAB index (Morningstar guide, 2022) [12].

A comprehensive EU taxonomy for sustainable activities, the reliability and comparability of information, and the standardization of some sustainable financial products, are all aimed at reinforcing trust between investors through a better transparency and comprehension in the financial products selling process[13].

[12] Morningstar guide (2022). It explains also the technical minimal standards for climate benchmarks. https://static.gedidigital.it/repubblica/pdf/2022/economia/guidamorningstar.pdf
[13] L'economia per tutti, Banca d'Italia per la cultura finanziaria, 2019. Site link: https://economiapertutti.bancaditalia.it/informazioni-di-base/finanza-sostenibile/faq/index.html

Coming now to "Mainstreaming sustainability into risk management"[14], three are the points to be discussed:

6) Better integrating sustainability ratings and market research. In 2019, ESMA (European Securities and Markets Authority) updated the guidelines on disclosure requirements applicable to credit ratings starting April 2020.
7) Clarifying duties of asset managers and institutional investors regarding sustainability. The *Regulation on sustainability-related disclosures in the financial services sector* was published in 2019 in the Official Journal of the European Union. The so-called *Sustainable Finance Disclosure Regulation*[15] (SFDR) regards mandatory information about financial services that must be provided to clients in general and through the pre-contractual documents and periodic reports[16].
8) Introducing a 'green supporting factor' in the EU prudential rules for banks and insurance companies. The European Banking Authority (EBA) is the one mandated to evaluate whether to introduce a greater risk sensitive treatment for green assets (the so-called green supporting factor). It basically operates by reducing weighted risk of green financial products. This allows banks and other financial institutions to commit less capital for loans that contribute to accelerating a decarbonization path[17]. EBA mandated also to identify the methods and principles to introduce ESG risks in the review done by supervisors. The Action Plan on Sustainable Finance specifically regarding reports, advices, guidelines and technical standards mandated to EBA, was published by the same authority in 2019.

[14] Renewed sustainable finance strategy and implementation of the action plan on financing sustainable growth. European Commission, 2018 (updated in 2022). Site link: https://finance.ec.europa.eu/publications/renewed-sustainable-finance-strategy-and-implementation-action-plan-financing-sustainable-growth_en

[15] With SFDR financial institutions and their asset managers are required to provide more information on the sustainability risks and impact of their investment products sold in Europe. Link to SFDR: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019R2088

[16] Commission Delegated Regulation (EU) 2023/363 of 31 October 2022 amending and correcting the regulatory technical standards laid down in Delegated Regulation (EU) 2022/1288, Link: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023R0363

[17] "Green finance: Considering a Green Supporting factor", by the European Banking Federation, 2022. Link: https://www.ebf.eu/regulation-supervision/green-finance-green-supporting-factor-is-a-sensible-idea/

The third and last area of the Action Plan was that about "Fostering transparency and long-termism"[18]. Two the actions:

9) Strengthening sustainability disclosure and accounting rulemaking, on the objective of fostering transparency. The European Commission has published guidelines on reporting climate-related information, as support to the already existing normative of the *Non-Financial Reporting Directive*[19] (NFRD) which was first published in 2014 and has started to be reviewed by the commission in 2020.
10) Fostering sustainable corporate governance and encouraging long termism in capital markets. EBA, EIOPA, and ESMA demonstrated through their reports that the disclosure of ESG factors facilitates the institutional investor engagement, leading to the awareness that a developed sustainability corporate governance is for sure beneficial, together with the undoing of short-term pressure from the financial sector on corporations.

In 2018 the Commission proposed a series of measures (which, as we have just seen, have been adopted in practice) to implement several of these key actions. The package included proposals for an EU taxonomy regulation, for a regulation on sustainability disclosures, and for developing climate (low carbon) benchmarks.
Given the current debate on the European Green Deal, the Commission renewed the strategy for sustainable finance, to support the green transition appropriately after the pandemic. What has been discussed up to this point is already the renewed version of the sustainable finance strategy.

1.2.2 The European Green Deal

The overall European strategic framework on sustainability is comprehensive of many other topics than finance and is best explained by the Green Deal. The European Commission's role is to make legislative proposals, that will be then examined by both

[18] Renewed sustainable finance strategy and implementation of the action plan on financing sustainable growth. European Commission, 2018 (updated in 2022). Site link: https://finance.ec.europa.eu/publications/renewed-sustainable-finance-strategy-and-implementation-action-plan-financing-sustainable-growth_en
[19] Non-financial reporting directive (2014). Link: https://eur-lex.europa.eu/eli/dir/2014/95/oj

the Council and the Parliament. In case of proposals aimed at a reform in the legislation, the latter are co-legislators, who make decisions following the ordinary legislative procedure. The European Commission published the proposal for a regulation on the Green Deal in December 2020, then the Council formally adopted it in July 2023. It regards highly related topics such as climate, environment, energy, transports, industry, agriculture, and sustainable finance. The Regulation (EU) 2021/1119 of the European Parliament and of the Council enshrined in legislation the objective of climate neutrality by 2050 (which was proposed and approved in 2019) and established a reduction target for GHG emissions of at least 55% compared to 1990 levels by 2030. From 2019 on[20], a set of initiatives comprised in the Green Deal[21] have been proposed and some of them already carried out. Here the main initiatives:

- Ready for 55%[22]: a package of legislative proposals to update the European climate, energy and transport legislation made by the European Council. This initiative will contribute to make the neutrality goal effective and legally binding by setting different target levels for emissions based on sectors in each member state.

In detail, one of the initiatives included in the package was the revision of the effort sharing regulation (ESR)[23], made to align to the new targets for the climate goals[24] in the transport, buildings, agriculture, small industries, and waste sectors. The rules regard a 40% cut (against a 29% existing target) of gas emissions produced by ESR sectors to be done by 2030. So, the ESR sets binding targets for each member state regarding GHG emissions levels on the already named sectors. Moreover, the targets are set in a cost-effective manner and considering national circumstances. To help member states reach their targets, some flexibilities have

[20] The timeline of the European Green Deal's initiatives. Link: https://www.consilium.europa.eu/it/policies/green-deal/timeline-european-green-deal-and-fit-for-55/
[21] The European Council on the Green Deal, website link: https://www.consilium.europa.eu/it/policies/green-deal/#:~:text=La%20Commissione%20europea%20ha%20presentato,generale%20il%2017%20marzo%202022.
[22] https://www.consilium.europa.eu/it/policies/green-deal/fit-for-55/#0
[23] Despite the 'ESR sectors' make up the 60% of total EU emissions, they are not covered by the EU emissions trading system (EU ETS) yet, which only covers the large industries and sectors with high emission intensity.
[24] Fit for 55: reducing emissions from transport, buildings, agriculture, and waste. Link: https://www.consilium.europa.eu/en/infographics/fit-for-55-effort-sharing-regulation/

been introduced. If a country emits more than its annual target limit, it can borrow from the following year's allocation. Reversely, if a country emits less than its annual limit, it can use the surplus for the following year. Furthermore, countries can trade their excess allocations among themselves.

Another important point inside the Ready for 55% package is the reform of the EU emissions trading system (EU ETS)[25]. The EU ETS is one of the world's largest carbons markets and covers around 40% of total EU emissions. The system includes the European sectors of electricity and heat generation, energy-intensive industries, and the commercial aviation. The ETS latest reform was formally adopted by the Council in April 2023. The system consists in putting a price on carbon: each year entities covered by the ETS buys allowances corresponding to their GHG emissions. An annual cap (or a limit) is set on the total GHG emissions permitted to each operator covered by the system. The limit results in a maximum number of emission allowances permitted (one allowance gives the right to emit one tone of CO2 equivalent). These 'permissions' decrease year by year to ensure a slow-down of carbon emissions over time. In fact, the latest reform on the ETS was aimed at reducing further the cap on emissions to align it with the new target of a 55% reduction of EU GHG emissions by 2030. It will result in a financial incentive for the companies covered by the system to cut their emissions. Furthermore, under the Fit for 55, a separate new ETS for the buildings and road transport sectors will be created, so that they will be covered by both the new ETS and the ESR system. At last but not least, the reform includes also the extension of the ETS to the maritime transport sector.

Other important initiatives in the package are the revision of the energy efficiency directive and of the renewable energy directive, the institution of a fund to support the most affected citizens and businesses (the social climate fund), and the regulation on methane emissions reduction.

- A European legislation on climate: in this way the neutrality goal becomes a legal obligation. The law entered into force in July 2021,

[25] Fit for 55: reform of the EU emissions trading system. Link: https://www.consilium.europa.eu/en/infographics/fit-for-55-eu-emissions-trading-system/

just one month after the adoption by the Council. So, the European countries have now the obligation to reach the 2030 and 2050 climate objectives.

- A new EU strategy for adaptation to climate changes. It was proposed by the Commission and approved by the Council in June 2021[26]. The strategy is based on a better sharing and collecting of data to enhance the knowledge on climate impacts and adaptation. This is going to happen also thanks to support of the Climate-ADAPT online platform.
- The EU biodiversity strategy for 2030. It includes the extension of land and sea protected surfaces, the reduction of usage of pesticides to restore the degraded ecosystems, and the increasing of financings and of the monitoring of the progress. The strategy was approved by the "Environment" Council in October 2020. A normative for the nature restoration has been proposed and in June 2023 the Council has agreed on some points. It was formulated to formally integrate some of the objectives for biodiversity in the legislation. The norms would constitute a bond for member states to perform initiatives for the restoration of at least 20% of lands and seas in Europe.
- "From farms to forks" strategy. It is aimed at orienting the current EU food system towards a sustainable model. The final goals of this strategy are the security of food supply and of aliments, as well as guaranteeing nutritious food (at accessible prices within the earth's limits), promoting sustainability among food productions, and encouraging healthy diets. The "From farm to fork" strategy was presented by the Commission in May 2020[27], and is placed in the greater context of the CAP reform. The CAP 2023-2027 (Common

[26] European Council, Press release, June 10th, 2021. Link: https://www.consilium.europa.eu/it/press/press-releases/2021/06/10/council-endorses-new-eu-strategy-on-adaptation-to-climate-change/
[27] European Council, press release of October 19th, 2020. Link: https://www.consilium.europa.eu/it/press/press-releases/2020/10/19/council-prioritises-actions-for-sustainable-food-systems-conclusions-on-the-farm-to-fork-strategy/

Agricultural Policy)[28] entered into force on January 1st, 2023. It is aimed at supporting farmers in providing high-quality and affordable food in the EU area. The related approved plans were conceived to integrate the Green Deal, and to specifically sustain the "From farm to fork" strategy and the biodiversity strategy. The CAP is financed through the European Agricultural Guarantee Fund (EAGF) and the European Agricultural Fund for Rural Development (EAFRD)[29]. The funds and the relative programs are managed nationally, but everything must conform to the European legislation that protects transparency.

- The strategy for sustainable chemical substances. This is designed not only to sustain a better environment, free of toxic substances, but also to protect the human health and reinforce the industry's competitivity.
- The strategy for forests and deforestation. It was presented by the Commission in July 2021. Based on the EU biodiversity strategy, it is also coherent with the "Ready for 55%" package of initiatives, since it is crucial to support the emissions reduction of at least 55% by 2030. This strategy, the strategies for biodiversity, for sustainable chemical substances, and the "from farm to fork" strategy are all based on the "One Health" approach, a holistic model aimed at optimizing the health of people, animal, and ecosystems at the same time.
- The Industrial strategy for Europe. The principles or sustainability and circularity applied to the industries would help them also in the recovery after the Covid-19 pandemic. The latest upgrade to the strategy was made in 2021 by the Commission. The final aim is to encourage the European industry sector to guide the green and

[28] European Council, Common Agricultural Policy, website link: https://www.consilium.europa.eu/en/policies/cap-introduction/#how
[29] Agriculture and rural development website. The Common Agricultural Policy in brief: https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-glance_it

digital transition and become that needed driving force at a global level.

- The action plan for circular economy. Presented in March 2020 by the Commission, the plan proposes 30 points regarding the design of sustainable products, the circularity along production processes, and the opportunity of giving consumers and buyers information to operate accordingly. Furthermore, still on the topic of circularity, a new formal regulation for batteries' management and disposal was adopted in 2023. It is relevant because the batteries' demand is expected to grow by ten times by 2030 and a urge for correctly managing them has risen.
- Clean and secure Energy. As already discussed, considering that 75% of GHG emissions in the EU are from the energy use and production, the decarbonization in this sector is key to achieve the medium- and long-term sustainable objectives. For the relative strategy, we refer to some of the initiatives included in the "Ready for 55%" package, from the revision of the energy efficiency directive[30], to the shifting to renewable low-carbon gases[31], to the revision of the energy taxation directive[32], to the REPowerEU plan[33] that was presented to respond to the energy market disruption caused by the Russian invasion of Ukraine. About this last initiative, the plan aims to reach a EU's independence on Russian fossil fuels by boosting renewables (by speeding up the permitting processes of renewables projects). The REPowerEu plan's proposals are present in the revision of the EU renewable energy directive.

[30]European Council, "Fit for 55: how the EU will become more energy-efficient". Website link: https://www.consilium.europa.eu/en/infographics/fit-for-55-how-the-eu-will-become-more-energy-efficient/
[31]European Council, "Fit for 55: shifting from fossil gas to renewable and low-carbon gases". Website link: https://www.consilium.europa.eu/en/infographics/fit-for-55-hydrogen-and-decarbonised-gas-market-package-explained/
[32]European Council, "Fit for 55: how the EU plans to revise energy taxation". Website link: https://www.consilium.europa.eu/en/infographics/fit-for-55-energy-taxation/
[33]European Council, "Fit for 55: how the EU plans to boost renewable energy". Website link: https://www.consilium.europa.eu/en/infographics/fit-for-55-how-the-eu-plans-to-boost-renewable-energy/

- The Just Transition Mechanism. This was introduced to guarantee financial aid and technical assistance to the regions that were struggling the most in the transition towards neutrality. It will be better explained in the next paragraph.

1.3 The main European funds for climate neutrality

This paragraph deals with the main sustainability funds the European institutions created to provide financings for the climate neutrality objectives for 2050. The ways in which these funds provide the financings will be exposed as well. The financial contribution to climate neutrality was an important part of the Paris Agreement of 2015, which set a goal budget of 100 billion dollars per year as a contribution from the developed countries to international financings for climate actions until 2025. The EU and its Member States are the main providers of public financings at a global level for climate actions. Just in 2022, they have mobilized 28,5 billion euros from public sources and destined other 11,9 billion to financings in the private sector in the developing countries to help them adapt to the climate changes[34].

Coming to the financings in the EU area, almost 580 billion euros were dedicated to the multiannual budget for climate change, and they were distributed between the different funds that will be exposed in the following pages[35]. They constitute the 30% of the pluriannual European budget (2021-2028) and of NextGenerationEU (which is the main tool for the recovery after the COVID-19 pandemic) that have been dedicated to green investments[36]. More in detail, from these 580 billion euros, 200 billion come from the Next Generation EU tool for recovery and resilience, and 92 billion from the Cohesion Fund and the European Regional Development Fund (ERDF). There are then some of the

[34] European Council, Press release of November 23rd, 2023. "Climate finance: Council approves international climate finance amounts for 2022". Webpage link: https://www.consilium.europa.eu/it/press/press-releases/2023/11/23/climate-finance-council-approves-2022-international-climate-finance-figures/

[35] European Council, infographics on how EU is financing the climate transition. Webpage link: https://www.consilium.europa.eu/it/infographics/financing-climate-transition/

[36] To learn more about all the funding opportunities financed by the 2021-2027 multiannual financial framework and NextGenerationEU, see the link: https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes_it#rubrica-3-risorse-naturali-e-ambiente

proceeds coming from the auctioning of the ETS allowances (the Emissions Trading System discussed in the previous paragraph) that contribute to the overall budget.

The types of financings[37] are distinguished into:

- *Grants:* these are direct non-refundable financial contributions. They are usually awarded to third-party beneficiaries after participating to a call-for-proposals. This is a funding opportunity issued by EU institutions to finance and encourage sustainable projects. The funds are paid by the EU to the regional or national authorities that, in a second moment, will send the payment to the project owners. There are two types of grants[38]: the action grants fund a specific action that help achieve some policy objectives, the operation grants fund the operating costs of an organization realizing a project that sustains the objectives of certain European policies.[39] Signing the "Grant agreement", the winning beneficiaries of the grant must respect some reporting, deliverables and visibility requirements. The payment of the grant is usually done through different installments. However, a pre-financing payment is made, which may be followed by one or more interim payments. At the completion of the project a final payment is provided. Each of the installment and the final payment are provided only if the project's deliverables previously defined in the grant agreement are respected[40].
- *Subsidies*: managed by national or regional bodies. Generally, it is carried out through co-financings, where the EU shares the financing of the project with other bodies.
- *Loans, guarantees* and *equity:* designed as forms of assistance to support EU policies and programmes.
- *Loans:* to EU Member States and other countries.
- *Prizes:* awarded to winners of the Horizon Europe competitions.

The management of funds can be direct, shared, or indirect. In the first case the EU funding is managed directly by the European Commission and the payments are made

[37] European Union website, "Funding, grants and subsidies". Website link: https://european-union.europa.eu/live-work-study/funding-grants-subsidies_it

[38] European Union website, "Grants". Webpage link: https://international-partnerships.ec.europa.eu/funding-and-technical-assistance/looking-funding/grants_en

[39] For more information about Grants consult the Financial Regulation: Title VIII of the Regulation (EU, Euratom) 2018/1046 of the European Parliament and of the Council of 18 July 2018. Link: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R1046

[40] European Union, "Managing your project under a grant agreement". Webpage link: https://commission.europa.eu/funding-tenders/managing-your-project/managing-your-project-under-grant-agreement_en#:~:text=Grants%20are%20usually%20paid%20out,on%20completion%20of%20the%20project.

only if the objectives set out in the plan have been achieved. Moreover, applications can be done by responding to a call-for-proposals. Through the shared mode, which is adopted in 70% of cases, the fund is managed jointly by the Commission and national authorities of the EU countries: national, regional and local governments choose the eligible projects of which they will be responsible for a daily-basis implementation, then the European Commission examines the related plans and accept the ones that respect certain target measures. Finally, with the indirect mode the fund is managed by partner organizations that operate within or outside the EU. This mode covers 10% of cases.

The following are the main European funds and programmes for climate neutrality.

- The social climate fund: up to 65 billion euros. It covers the period 2026-2032 and is dedicated to people and enterprises in the sectors of building, road transport, and fuels for additional sectors, that are suffering the most the introduction of the new system on the emission-shares exchange. The fund is financed with 25% of the proceeds coming from the ETS allowances (or emission allowances) auctioning under the new system. It'll help reduce energy poverty and encourage sustainable mobility and transport. As seen in the previous paragraph, the social climate fund is a key point in the "Ready for 55%" package of legislative initiatives. The fund was instituted with the Regulation (EU) 2023/955 of May 10th, 2023[41]. In brief, according to the regulation, the member states that want to benefit from the fund shall submit by June 2025 to the Commission their Plans, "consisting of a coherent set of existing or new national measures and investments to address the impact of carbon pricing on vulnerable households, vulnerable micro-enterprises and vulnerable transport users in order to ensure affordable heating, cooling and mobility, while accompanying and accelerating necessary measures to meet the climate targets of the Union" (Chapter II, Article 4, point 1). The submission of the plan

[41] Link to the Regulation (EU) 2023/955: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R0955

must happen after a first moment of consultation with local and regional representative authorities. In order for the Member States to get the financing from the fund, their measures and investments must achieve the targets defined by the same regulation. This fund provides non-repayable financial support (*grants*) to Member States, generated through the auctioning of allowances under the ETS. It will start in 2026. The available budget from the fund itself will reach a maximum amount of 65 billion euros for the 2026-2032 period, but with the mandatory co-financing from Member States a final amount of 86,7 billion euros will be mobilized.

- The Just Transition Mechanism: around 55 billion euros in total. The mechanism is a key point of the European Green Deal Investment Plan. The Just Transition Mechanism will mobilize such amount between 2021 and 2027, and it is dedicated to three main subjects. The support is provided to *people and communities* by encouraging job opportunities and building refurbishing (to enhance their energy efficiency), to *companies* by financing the R&D function to develop new green technologies, and to *member states and regions* by creating new job positions in the green field. It is based on three pillars. The first one is the Just Transition Fund[42] (JTF) whose current endorsement is of 17,5 billion euros. It is currently sustaining SMEs and new enterprises, research and innovation, clean energy technologies and emissions reduction, and job assistance and workers retraining. It will finance projects in communities that strongly depend on fossil and highly-emission-intensity industries and that need to diversify their local economy. Each euro from the Just Transition Fund will have to match with money from the European Regional Development Fund and the European Social Fund Plus. The JTF is a jointly managed fund that

[42] European Council, Press release of June 7th, 2021. "Climate Neutrality: Council adopts Just Transition Fund", Link: https://www.consilium.europa.eu/it/press/press-releases/2021/06/07/climate-neutrality-council-adopts-the-just-transition-fund/

will only be available to Member States and regional authorities based on their territorial just transition plans. The total budget of 17,5 billion euros is divided into 7,5 billion euros available for budgetary commitments in the period 2021-2027 and into the remaining 10 billion euros included in the Next Generation EU recovery instrument that have been already available in 2021, 2022, and 2023. As just said, the JTF is only the first pillar of the Just Transition Mechanism. The second pillar is the budgetary guarantee under the InvestEU[43] program that in turn consists of three components: the InvestEU fund, the InvestEU advisory hub, and the InvestEU portal. The InvestEU fund, that mobilizes around, is supported by financial (or "implementing") partners that invest in sustainable and innovative projects while benefitting from the protection of a European budget guarantee of 26,2 billion euros that backs their investments. The decision to provide the financing is made by local financial institutions such as banks, venture capitalists or angel investors. So, while the JTF is financed through grants, the InvestEU funding is available through *loans, microfinance* and *equity* (e.g. venture capital)[44].

In conclusion, the third pillar of the Just Transition Mechanism is the Public Sector Loan Facility (PSLF) that provides 1,5 billion euros in *grants* from the EU budget combined with 10 billion euros in *loans* provided by the European Investment Bank[45]. Successful projects receive a grant from the EU Commission and a loan from the EIB.[46]

[43] European Union website, InvestEU. Link: https://investeu.europa.eu/investeu-programme_en

[44] Your Europe (an official website of the European Union), "Access to EU finance" website page. Here are explained the typologies of EU programmes that provide financings through loans, microfinance or equity. Link: https://youreurope.europa.eu/business/finance-funding/getting-funding/access-finance/search/en#inline-nav-1

[45] European Council, Press release of April 26th, 2021. "Public sector loan facility to support just climate transition – provisional agreement reached". Link: https://www.consilium.europa.eu/en/press/press-releases/2021/04/26/public-sector-loan-facility-to-support-just-climate-transition-provisional-agreement-reached/

[46] European Union website, "Just Transition Mechanism Public Sector Facility call for proposals". Webpage link: https://cinea.ec.europa.eu/funding-opportunities/calls-proposals/just-transition-mechanism-public-sector-loan-facility-call-proposals_en

- Modernization Fund[47]: around 48 billion euros (but the exact amount depends on carbon price). They are assigned, between 2021 and 2030, to the 10 Member States with the lowest incomes. The funding is destined to renewable energy, energy efficiency, energy storage, energetic networks, just transition in the carbon-dependent regions. The fund is financed through the auctioning of the emissions allowances in the EU. More specifically, through the 2% of the total allowances for the period 2021-2030. It has already provided 7,5 billion euros since 2021 and has been utilized in 10 countries to finance more than 100 projects. It is a fund that is jointly managed by Member States, the Commission, and the European Investment Bank (EIB). Beneficiary Member States can submit investment proposals to the EIB and the investment committee at any time of the year, then if the proposals fall into the priority area and meet certain requirements (previously defined in the ETS Directive) the EIB approves the investment. Otherwise, if it is classified as non-priority and then however recommended for financing by the Investment Committee, the disbursement decision is made. Next, the EIB transfers the financings to the designated Member States that made the winner proposals. The EIB acts as the auctioneer for the EU emissions allowances sale and receives the proceeds from the auctions, on behalf of the beneficiary Member States. Since it is a process based on call-to-proposals, the financing here is provided through *grants.*

- Horizon Europe[48]: 95,5 billion euros (in the period 2021-2027) of which 5,4 billion are for Next Generation Europe (the recovery plan after the pandemic). Aimed at climate change, at achieving UN's Sustainable Development Goals, and at boosting EU's competitiveness and growth, it is the key funding program for

[47] Modernization fund EU. Website link: https://modernisationfund.eu/how-it-works/
[48] European Commission, Horizon Europe. Webpage link: https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes/horizon-europe_en?prefLang=it

research and innovation in Europe and the largest program of its type worldwide. It is possible for third countries (not included in the EU) to participate under certain conditions[49]. Most importantly, 35% of its funds are destined to climate projects. With respect to the previous Horizon 2020, this new version (2022) is enriched by some elements, such as the introduction of a European Innovation Council that guarantees a more solid financial aid for the most disruptive innovations that otherwise might represent a too high risk for private investors. Horizon Europe is a program that strengthen the impact of research and innovation that supports and helps implementing European policies in line with the climate challenges. It is a program directly managed by the European Commission. The participation and selection processes are based on a call-to-proposals. For this reason, the funding is done through direct financial contributions (i.e. *grants*).

- Innovation fund[50]: around 40 billion euros between 2020 and 2030. The fund is dedicated to the development of innovative low-carbon technologies such as high energy-intensive processes, carbon capture, use and storage, renewables, energy storage, net-zero mobility and buildings. The focus is on energy and industry, and the aim is to bring solutions to decarbonize the EU industry. It is fundamental in order to achieve the goals of both the REPowerEU plan and the Green Deal industrial Plan. The innovation fund is financed through the auctioning of emissions allowances in the context of the EU ETS. More precisely, with the revision of the EU Emissions Trading System Directive done in 2023, the Innovation Fund was strengthened on some points. First, it is now filled with

[49] APRE (Agenzia per la Promozione della Ricerca Europea), Horizon Europe in brief. Webpage link: https://horizoneurope.apre.it/he-in-breve/#1611590828478-84e708fd-26c8

[50] European Union website for climate action, "What is the Innovation Fund?". Webpage link: https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/what-innovation-fund_en#:~:text=The%20Innovation%20Fund%20focuses%20on,%2Dkind%2C%20highly%20innovative%20projects.

the revenues of the sale of around 530 million allowances instead of 450 million. Moreover, new sectors such as maritime and aviation were introduced, together with the application of the Do Not Significant Harm (DNSH) applied starting 2025. Its funding is done through grants provided to the awarded beneficiaries of the calls-for-proposals. In detail, the fund supports up to 60% of the costs previously calculated according to the methodologies explained in each call for proposals. Then, the grants are disbursed based on the project milestones and their related financial needs. In the case of regular grants, up to 40% of the grant can be given before the project's completion based on the milestones previously defined in the grant agreement [51]. The evaluation of the proposed projects is made by the Innovation Fund implementing body, the European Climate, Infrastructure and Environment Executive Agency (CINEA).

- LIFE programme: 5,432 billion euros (between 2021 and 2027), to fund the approved projects through grants that cover up to 60% of the eligible costs and up to 75% in case of projects funded under the area "Nature and Biodiversity" (Regulation (EU) 2021/783 of the European Parliament and of the Council of 29 April 2021[52], Article 9, point 4). According to its Regulation, the LIFE Programme can be conducted in direct or in indirect management and may provide funding in *grants, prizes* and *procurement*. Organized on a call-for-proposals base, the projects' submission is available on the Funding & Tenders portal and initiatives are categorized depending on the area of intervention. Four are the sub-programmes under LIFE[53], divided into two fields and established by the Regulation:

[51] European Union website, Calls – regular grants from the Innovation Fund. Describing financing rates. Webpage link: https://cinea.ec.europa.eu/programmes/innovation-fund/calls-regular-grants_en
[52] Link to the Regulation: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R0783&qid=1642409673439
[53] European Union website, "LIFE Programme". Webpage link: https://cinea.ec.europa.eu/programmes/life_en

1) The field “Environment” (budget of 3,488 billion euros), which includes:

i) Nature and Biodiversity. This area is aimed at the protection and restoration of Europe’s nature and at reversing the biodiversity erosion. It supports the achievement of the objectives of the EU’s biodiversity strategy for 2030. It supports also the projects that contribute to the development of the Natura 2000 Network (i.e. the largest network of protected areas in the world).

ii) Circular Economy and Quality of Life. This sub-programme is aimed at transitioning towards a sustainable, toxic-free, energy-efficient and climate-resilient economy, while restoring the environment. It supports the projects that implement innovative solutions for this area, by providing mostly *action grants*. It also covers the evaluation, implementation and monitoring of the EU environmental policies and laws.

2) The field “Climate Action” (budget of 1,944 billion euros), which includes:

iii) Climate Change Mitigation and Adaptation. For what concerns the mitigation action, the sub-programme supports projects in the areas of farming, land use, renewables, and energy efficiency. With regard to the adaptation instead, the programme operates through co-financings, by providing *action grants* for projects that enhance the resilience to climate change.

iv) Clean Energy Transition. This sub-programme has a budget of about 1 billion euros over the period between 2021 and 2027. Projects are co-financed and paid in *action grants*. Five are the areas of intervention: building a policy framework to support the clean energy transition, encourage private finance towards sustainable energy, accelerating digitalization and new business models, supporting investment projects at a local level, including citizens in the clean energy transition.

- National funds. In the context of the Next Generation EU (the main programme for the recovery after the COVID-19 pandemic), the tool of Recovery and Resilience Facility (disciplined by the Regulation (EU) 2021/241) has translated at a country level into the single national Recovery and Resilience Plans. The RRPs of each country must reflect the objectives of a climate neutrality by 2050 remarked by the European Green Deal. In fact, two are the main constraints that national RRPs must respect:

1) A minimum 37% of resources provided by the European fundings must be dedicated to the green transition.
2) The principle 'Do Not Significant Harm' must be respected in the implementation of the interventions of the RRPs.

Starting from the RRPs, each country created its national funds to finance the green transition.

Italy was the country who received the greatest allocation, equal to 191.5 billion euros (distinguished between 122,6 billion in loans and 68,9 billion in grants)[54].

An example of a national sustainable fund is The Green Transition Fund[55]. Created with a budget of 250 million euros in *grants* taken from the European allocation for Italy, it is managed by CDP Venture Capital (an asset management company). Its aim is to encourage the green transition through direct and indirect *venture capital* (equity) investments in start-ups (classifiable as SMEs or venture capital) operating in the field of the ecological transition (e.g. in the sectors of circular economy, sustainable mobility, energy efficiency, waste management, and energy storage) at all stages of their life cycle. The investments are between 1 and 15 million euros for direct and between 5 and 20 million for indirect investments.

[54] Camera dei deputati, documentazione parlamentare. "The national Recovery and Resilience Plan". Webpage link: https://temi.camera.it/leg19/pnrr.html#:~:text=Pertanto%20la%20dotazione%20totale%20del,68%2C9%20miliardi%20di%20sovvenzioni.

[55] Ministry of Business and Made in Italy, "PNRR – Support for start-ups and venture capital active in the ecological transition". Website link: https://www.mimit.gov.it/it/pnrr/progetti-pnrr/pnrr-supporto-a-start-up-e-venture-capital-attivi-nella-transizione-ecologica

1.4 Does funding really encourage sustainability across firms?

The EU and its Member States are the main public sustainability financiers worldwide. As demonstrated in the previous paragraph, many are the current funds in Europe aimed at encouraging sustainability across firms in all disparate sectors. The aim of this study is to understand whether these great financial contributions towards the green transition are effectively promoting sustainability across firms in the long-term and eventually *where* (meaning in which sector) they have reached the best results.
The following are the first two research questions:

- Are these fundings and consistent efforts really activating a 'sustainable mindset' across firms, that can be found in the adoption of sustainable practices, in the commitment to sustainable projects and partnerships, or in a whatever business interest in the green field? In other words, is funding a true promoter of sustainability?
- If yes, what is the sector that responded best to funding and why?

Noticeably from the second research question, the analysis will be done based on sectors, specifically: buildings, energy, industrial, and transportation. Moreover, it would be interesting to understand why a sector would eventually respond better than others. The hypothesis of an existence of a correlation between the type of financing (Grants or Loans) and the conversion to sustainability in different sectors could try to explain that.
This brings us to the third research question:

- Which type of funding is most effective in driving the level of conversion to sustainability, depending on the specific sector?

In that case, redesigning the structure of the financial contributions would be key to increase the effectiveness of the funds and, therefore, the success of the green transition.

Chapter 2: Research Methodologies

In the following pages it will be explained how the research was structured and what have been the main drivers guiding the process.

First, let's remember the final purpose of the study: to assess whether beneficiaries of the green funding demonstrated increased interest in the sustainability sector. This can be evaluated for both beneficiaries who are still implementing the financed projects and those who have already completed them. However, one important remark must be made: if not all the beneficiaries, most of them were already interested in sustainability. An exception could be represented by start-ups and other firms' first attempt in the sustainability field, but they constituted the smallest part of cases. For this reason, the analysis indagated whether they either had a conversion towards or an enhancement in sustainability.

The following points constitute premises and criterions followed in the study to gather data and prepare the dataset for the analysis.

a) The target countries for the study were those in the European geographical area, including all EU Member States and non-members such us the UK, Norway, Switzerland, Ukraine, Serbia, and Albania. This means that the companies included in this study were solely those based in the European geographical area, even though the funds selected for financing were also directed towards non-European countries.
b) The projects considered in the data-collecting process were both *closed* and *ongoing*. A closed project is one where all financial contributions have been made for each milestone, including the final one, and all operational steps have been completed. In contrast, an ongoing project is one where financing and milestones are still in progress and have not yet been fully achieved. Considering both closed and ongoing projects is relevant for the analysis, as it allows for examining the potential of a company to demonstrate renewed or new interest in sustainability, both during the project execution and after its completion.
c) Moreover, the referring periods for the data collecting process were 2014-2020 and 2021-2027. Both were relevant to the analysis. The 2014-2020 period would comprehend the greatest number of projects, including also *ongoing* projects

other than just *closed*, providing with more substance in the results of the analysis. On the other hand, the 2021-2027 period encompasses more recent projects, many of which are likely still *ongoing*, allowing the analysis to include results from these active projects. This is particularly relevant, as conversions to (or enhancements in) sustainability can also be calculated for new projects, different from the financed one, initiated during this period[56].

d) Most importantly, to understand whether a correlation exists between the financing method and the effectiveness of the fund, the EU programmes or funds from which data were gathered were categorized between two main typologies: grants or loans. The equity method (i.e. venture capital) was excluded because it was found to be more used at the national levels (such as in the case of the Italian Green Transition Fund briefly described in paragraph 1.3), and the focus of this study remains at an international level only.

The sources from which it was possible to pick up data were the CINEA[57] projects webpage for grants-funded projects, from which it is possible to visit the link to a Qlik webpage, featuring all the statistics and graphs built on projects data[58], and the InvestEU operations website for loans-funded projects[59].

The reason why CINEA was chosen as one of the two sources for the data is that among its managed programmes there are the Innovation Fund, the LIFE programme, and Horizon 2020, which are the main sustainable funds financed through grants. The Innovation Fund is the most comprehensive between all funds and programmes, including the most variety of sectors, and the LIFE programme, being the oldest between all funds, provides thousands of cases useful for the analysis. On the other hand, Horizon 2020 is the largest programme dedicated to the R&D area but, due to this fact, it is addressed to research centers and universities and not exactly to common companies; therefore, it presents also

[56] With regard to the projects funded under the Innovation Fund programme, they will be referring exclusively to the period 2021-2027, as the programme was established in 2020.
[57] CINEA states for "European Climate, Infrastructure and Environment Executive Agency".
[58] Link to the Qlik webpage: https://dashboard.tech.ec.europa.eu/qs_digit_dashboard_mt/public/sense/app/3744499f-670f-42f8-9ef3-0d98f6cd586f/sheet/d2820200-d4d9-4a26-b23b-58e323c803c2/state/analysis
[59] Link to the InvestEU operations webpage: https://investeu.europa.eu/investeu-operations/investeu-operations-list_en?prefLang=it

different financing procedures. These were the two reasons why Horizon 2020 was excluded from the selected programmes for the analysis.

On the other hand, regarding loan-funded projects, as previously mentioned, the chosen program for data collection is InvestEU. As outlined in paragraph 1.3, InvestEU is the primary fund that provides financing for sustainable projects through loans, supported by banks and other investors. The main implementing partner for this program is, in fact, the European Investment Bank.

Right away, a dataset on Excel was formed, containing two different sheets: one for grants-funded projects and another for those funded through loans.

Regarding the projects, the following are the most important specifications to be made.

- The two sheets were formed with the specifications for the participants and the related projects. Regarding the grants-funded sheet, the following have been the columns providing such specifications: the participant's legal name, participant's role (to be distinguished among *participant* and *coordinator*), participant's legal status (whether *public* or *private),* SME flag, the participant's country, the referring programme for the project, the financial framework (2014-2020 or 2021-2027), the sub-programme, the project's number, the project's acronym, the project's title, the project's status (*closed* or *ongoing*), the project's start date, the project's end date, the EU contribution (€), and the project's closure date.

  Instead, for the loans-funded sheet the following have been the columns: the participant's legal name, the type of participant, the SME flag, the participant's country, the participant's country group (Member States or Non-Member States), the name of the programme, the implementing partner (direct financier), the financial framework (2014-2020 or 2021-2027), the project's number, the public/private flag, the project's title, the project's link, the project's description (i.e. a brief description), the project's status (i.e. *closed* or *ongoing*), the project's approval date (i.e. the date when the commission approved the project), the project's start date, the project's end date, the EU contribution (€), the project's investment cost.

- The projects were distinguished by an ID number (the original one assigned by the authorities). These numbers are useful to collocate companies to the respective projects in the dataset. That's it: more companies are allowed to participate to one single grands-funded project, so they are either classified as *participants* or *coordinators*. For this reason, the list of the projects is shorter than the one regarding companies (i.e. the participants' specifications sheet). However, the analysis was still made singularly on each company regardless of their typology (i.e. whether they are *participants* or *coordinators* in the case of grants and *direct participants* or *financial intermediaries* in the case of loans), rather than on the single project, evaluating their sustainability conversion or enhancement favored by the funding.
- Another important consideration to be made is that one company might operate in various sectors. This was the case of R&I organizations participating in the LIFE and Innovation Fund programmes (not necessarily in Horizon 2020) for instance. They are characterized by the fact that their goods or services aren't sector-specific, and thus they're exploitable in different commercial applications. Since it was quite difficult to categorize them, the referring sector for them was that of the related project (i.e. the industry in which the project was developed and/or exploited).
- The data extrapolated from the sources were of the scale of thousands. For this reason, the analysis started by applying an *inferential statistical methodology* to generate two separated samples, one from each sheet (so one for each funding methodology). Afterwards, only the companies belonging to the samples were surveyed by looking for what sector they belonged to and whether they had undertaken new sustainable initiatives or not. Thus, one new sheet was created for each sample, containing the variables on the (sustainability) *Conversion* and (sustainability) *Enhancement*, and the categorical variable of the *Sector* (i.e. buildings, energy, industrial, and transportation). To determine whether a company has undergone a *Conversion*, an *Enhancement*, or neither, its sustainable

initiatives have been evaluated in relation to a specific reference date: the “project start date”. A company was classified as having undergone a *Conversion* to sustainability if, prior to the start of the funded project, it had never engaged in any sustainability initiatives (whether through sustainable projects or partnerships) and only began undertaking new and distinct sustainability efforts after that date, beyond the funded project itself. On the other hand, a company was classified as having undergone an *Enhancement* in sustainability if it had already engaged in sustainability initiatives before the start of the funded project and continued to undertake additional sustainability efforts afterward. If neither a Conversion nor an Enhancement was observed, the case was recorded as "None”, meaning the company did not perceive the funding as a lever to further embrace sustainability. Based on that, for each company in the sample, an assessment was conducted to determine whether it exhibited a 'Conversion,' 'Enhancement,' or 'None.' This evaluation was carried out by searching online for press releases, corporate websites, newspapers, and magazines to identify past and new initiatives in relation to the project start date.

e) A possible limitation to the study is the fact that the sector to which companies belong was not approached as an independent variable, so that it can be called as a hidden variable. In fact, the analysis is made bottom-up, from the generation of the sample to the discovering of their belonging sector, instead of top-down, starting by dividing the companies by sector and going forward to the generation of the sample. However, this limitation will be better discussed in the fourth chapter.

f) Next, the various levels of the statistical analysis are explained. Five were the levels of the analysis, once the samples had been generated, the related sector for each of the companies had been found, and the conversion or enhancement had been verified by looking for new projects or partnerships of theirs on the internet. From now on, the sum of the two samples obtained from the two sheets, will be referred to as the group “S”. Repetitions of companies across the two sheets were not found. The variables selected from the two sheets for the Group S sample

were the following: Participant legal name, Participant legal status, SME flag, Participant country name, Programme, Subprogram, Implementing partner, Type of financing, Financial framework, Project number, Project title, Project start date, EU contribution, Sector, Subsector, Conversion, and Enhancement.

Moreover, it must be considered that generally, the programs financed through Grants (such as LIFE, Innovation Fund, Horizon Europe, Interreg, ERASMUS+, and others) provide direct funding to beneficiaries (companies, public entities, NGOs, universities, etc.). Grants are managed directly by the European Commission or by executive agencies such as: CINEA (European Climate, Infrastructure and Environment Executive Agency) for LIFE and Innovation Fund; REA (Research Executive Agency) for Horizon Europe; and EISMEA (European Innovation Council and SMEs Executive Agency) for innovation and SME programs. Instead, for Loans-funded projects the implementing partners were found between EIB, EIF, CEB, CDC, EBRD, NIB, CDP, ICO, BPI, BGK, CDPE, Garantiqa, and Invest-NL.

The following are the steps of the statistical analysis applied to the study.

1) First, the *Conversion* or *Enhancement* variables for the group S were calculated, regardless of the sectors and types of financing. By making this numbers a percentage on the overall cases in the group, an answer to the first research question "Is funding an activator for greater sustainability across firms?" was given.

2) Second, these variables calculated on the group S were fragmented across sectors, to look for the sector(s) which would present the highest value of conversions or enhancements. This basically consisted in answering the second research question: "Which sector responded best to funding?".

3) Then, still on point 2), possible *qualitative* explanations were identified by looking at the sectors' characteristics.

4) The fourth step of the analysis was evaluating whether there was a difference in the *Conversion* or *Enhancement* scores of the two samples, <u>regardless of the sectors</u>. This was made to determine to which type of financing corresponded the highest conversion towards or enhancement in sustainability.

5) In conclusion, to respond to the third research question, “Which type of funding is most effective in driving the level of conversion to or enhancement in sustainability, depending on the specific sector?”, also a crosstab analysis was made to examine the relation between the sector and the *type of financing*: the *Conversion* or *Enhancement* scores were calculated for each sector in one sheet and confronted with the main variable scores of the related sectors in the other sheet. This was made with the aim to understand what type of financing suited better a certain sector in terms of improvement in the effort towards sustainability.

Chapter 3: Most relevant findings

This chapter presents an in-depth analysis of the effectiveness of sustainable funding in fostering corporate sustainability. By evaluating firms that received funding through *grants* and *loans*, the aim was to determine whether financial support has led to an increase in sustainable practices. The analysis is based on key metrics such as conversion to sustainability (adopting sustainability for the first time) and enhancement (improving pre-existing sustainable initiatives). Additionally, sectoral differences were assessed as well as the relative effectiveness of different types of funding.

The role of sustainable finance in driving corporate environmental responsibility is widely debated. While financial assistance is often viewed as a necessary tool to facilitate sustainability transitions, its real impact remains uncertain. This chapter explores the degree to which funding mechanisms influence corporate behavior, with a focus on industry-specific variations and funding effectiveness. By analyzing patterns across firms and sectors, it was provided empirical evidence to assess whether financial incentives truly enable a shift toward greener business models or merely reinforce existing commitments to sustainability.

First and foremost, two samples made up each of 20 firms were extracted from the datasets obtained from CINEA's website (through the external Qlik link) and the Invest EU portal for Grants and Loans data, respectively.

To assess the impact of sustainable funding, a structured statistical approach (as already explained in the second chapter) was applied to these samples:

1. A descriptive analysis of conversion and enhancement rates across grants and loans datasets.
2. A qualitative explanation to determine the causes behind the differences in the responses across the sectors and across the types of financing.
3. A crosstab analysis to explore sector-specific trends in funding effectiveness.

These methods provide a comprehensive understanding of how funding influences sustainability adoption across different industries. Descriptive statistics offer an initial

insight into patterns and trends, while hypothesis tests would ensure the validity of observed differences. The cross-tabulation technique further examines whether certain industries are more responsive to specific types of financial support. Additionally, specific criteria were applied to set up the statistical analysis on the two datasets in a proper way:

- Sustainability *Conversion* and *Enhancement* scores were assessed based on relevant initiatives, such as new sustainable partnerships or projects, rather than merely the existence of a sustainability report or similar documentation.
- If the exact project start date was unavailable, the project's approval year was used as a reference.
- Joint ventures were excluded since they are project-specific entities, making it impossible to assess broader sustainability improvements.
- Newly formed companies, established just before receiving funding, were included only if they were not solely created for that specific project.
- Special Purpose Vehicles (SPVs) and investment funds were excluded, as they represent indirect financing mechanisms where EU funding was directed into financial pools rather than directly supporting corporate sustainability projects.
- Despite many firms being recognized as sustainable by reputation, this analysis focuses strictly on improvements or conversion linked to the received funding.
- The public/private classification refers to stock market participation, not to State ownership.

In the next pages an explanation of the key findings of the analysis will be explained, following the five steps listed in the second chapter.

3.1 Conversion and Enhancement rates

First, as explained in the second chapter (point f.1), the Conversion and Enhancement scores for the group S were calculated. This assessment was conducted independently of sectors and types of financing to ensure a broad understanding of the overall impact of sustainable funding. By computing these numbers as percentages of the total cases in the

group, an answer to the first research question—"Is funding an activator for greater sustainability across firms?"—was obtained.

The results of this analysis are summarized in Figure 3.1, providing a clear overview of how companies responded to financial support in terms of sustainability adoption and improvement.

Category	Percentage
Conversion - YES	2.5%
Conversion - NO	97.5%
Enhancement - YES	72.5%
Enhancement - NO	27.5%

Figure 3.1 – Conversion and Enhancement rates

Notably, as shown in Figure 3.1, only one firm fully transitioned to sustainability after receiving the funding. This is reflected in the 2.5% conversion rate, indicating that only a small fraction of companies used financial incentives to enter the sustainability space for the first time. Meanwhile, the vast majority—97.5% of firms—did not explicitly convert, which could suggest that many recipients were either already engaged in sustainable practices or did not find the funding to be a decisive factor for an initial transition.

However, an important observation arises from the enhancement rate: 72.5% of the funded companies demonstrated improvements in their sustainability efforts. This strongly suggests that while funding may not always be the primary catalyst for initiating sustainability, it plays a crucial role in strengthening existing practices, expanding sustainable projects, and fostering long-term commitment to environmental goals.

These findings align with the hypothesis that sustainable finance acts as an accelerator rather than a trigger—helping firms scale up their green initiatives, invest in cleaner technologies, and refine operational strategies to align with environmental objectives. Moreover, this trend could indicate that companies are increasingly viewing sustainability not just as a compliance requirement but as a strategic advantage that funding enables them to pursue more effectively.

Understanding these dynamics is essential for policymakers and funding institutions, as it highlights the need for targeted incentives that not only support new entrants into the sustainability space but also drive deeper transformations within firms already engaged in the green transition.

3.2 Conversions and Enhancements across sectors

First and foremost, an explanation about how firms have been addressed to a specific sector must be made. As already specified in the Second Chapter, since a single firm can generally operate in various sectors through different lines of product or through different projects, the referring sector for a firm was that of the relative funded project, which could be its *commercial exploitation* or the *final aim of its execution*. The referring sector for the projects was evaluated case by case by looking at these two criteria. To provide an explicative example, projects whose aim was that of producing alternative fuels (like biofuels and hydrogen), were addressed to the energy sector because their aim was that of discover a new renewable source, independently from its direct commercial exploitation (that in this case could be in the transport sector). The projects were assigned to a specific sector based on these two criteria, rather than considering the value chains of the four sectors. Consequently, listing the types of enterprises operating in each sector as a reference for determining which projects should be assigned to which sector would be of little use.

Second, as explained in the second chapter (point f.2) the Conversion and Enhancement rates as discussed in the previous paragraph, were calculated on the group S (so as to be regardless of the type of financing) were fragmented across sectors, to look for the sector(s) which would present the highest value of conversions or enhancements. This basically consisted in answering the second research question: “Which sector responded best to funding?”.

SECTOR	CONVERSIONS (ABSOLUTE)	ENHANCEMENTS (ABSOLUTE)	NONE (ABSOLUTE)	CONVERSIONS (%)	ENHANCEMENTS (%)	NONE (%)
ENERGY	1	11	2	7.14%	78.57%	14.29%
TRANSPORT	0	4	2	0%	66.67%	33.33%
INDUSTRIAL	0	10	4	0%	71.43%	28.57%
BUILDINGS	0	4	2	0%	66.67%	33.33%
TOTAL	1	29	10	2.50%	72.50%	25.00%

Figure 3.2 – Sector-based sustainability response

As outlined in Chapter 2 (point f.2), the conversion and enhancement rates were calculated and segmented by sector to analyze whether specific industries showed higher levels of sustainability adoption (conversion) or improvements in existing sustainable practices (enhancement). This assessment was made on the Group S dataset, in order to be conducted independently of the types of financing. The following sections will present the key findings for each sector, providing a short analysis of their response to sustainable funding.

1) The energy sector was the best performing industry:

- It recorded the highest number of enhancements, with 11 out of 14 firms (78.57%) improving their sustainability efforts after receiving funding.
- The Conversion Rate stood at 7.14%, indicating that one company transitioned into sustainability for the first time due to financial support.
- The None Rate was the lowest among all sectors, at only 14.29%, suggesting that almost all firms in this category leveraged funding to enhance or adopt sustainable practices.

The energy sector emerged as the strongest responder to funding, leading in both absolute enhancement numbers and percentage improvements.

2) The transport sector had a moderate improvement, with no conversions:

- The Conversion Rate in the transport sector was 0%, meaning that no firms adopted sustainability for the first time.

- However, 66.67% of firms enhanced their sustainability efforts after receiving funding, showing that financial support helped strengthen pre-existing initiatives.
- The None Rate was relatively high at 33.33%, indicating that one-third of companies did not demonstrate any notable sustainability improvements despite the funding received.

While the transport sector benefitted from funding in terms of enhancement, the lack of conversions suggests that financial support alone was not a decisive factor in encouraging new firms to enter the sustainability space.

3) The industrial sector had a strong performance in enhancement:

- Similar to the transport sector, the industrial sector recorded a 0% conversion rate, meaning that no new firms transitioned into sustainability due to funding.
- However, the Enhancement Rate was 71.43%, slightly higher than transport, showing that a significant portion of firms used funding to advance their existing sustainable initiatives.
- The None Rate stood at 28.57%, meaning that just over a quarter of the firms did not exhibit any improvements despite financial support.

The industrial sector showed one of the strongest enhancement responses, ranking second only to the energy sector.

4) The buildings sector showed modest results, with no new sustainability adopters:

- Like the Transport and Industrial sectors, the Buildings sector recorded 0% conversions, indicating that no firms entered sustainability for the first time due to funding.
- The Enhancement Rate was 66.67%, the same as the Transport sector, showing that while funding helped strengthen existing sustainability commitments, it did not necessarily drive new sustainable initiatives.

- The None Rate was 33.33%, meaning that one in three companies showed no impact from funding.

  The buildings sector demonstrated similar funding responses to the transport sector, showing moderate levels of enhancement but no new sustainability adopters.

In conclusion, the aggregated results across all sectors reveal the following trends:

- The overall Conversion Rate was of 2.50% (only one company out of 40 adopted sustainability for the first time).
- The overall Enhancement Rate was of 72.50%, meaning that nearly three out of four firms improved their sustainability efforts due to funding.
- The overall None Rate was of 25.00%, indicating that funding had no impact on one in four companies.

To answer the second research question: "Which sector responded best to funding?", the energy sector demonstrated the strongest response to sustainable funding, ranking first in both absolute and percentage-based enhancement rates. With 78.57% of firms improving their sustainability initiatives and the only sector to record new conversions (7.14%), Energy clearly benefitted the most from financial support. The industrial sector also showed a strong response, with 71.43% of firms enhancing sustainability, though without any conversions. The transport and buildings sectors exhibited moderate results, with enhancement rates of 66.67%, but no firms adopted sustainability for the first time.

These results indicate that sustainable funding appears to be more effective at enhancing existing sustainability efforts rather than converting firms that were previously unsustainable. This is evident from the low conversion rate (2.5%) but high enhancement rate (72.5%) across sectors.

Some suggestions could be given starting from these results:

- Future funding strategies should include targeted incentives for sectors with lower enhancement rates (e.g., Transport and Buildings) while stimulating also first-time sustainability adoption (i.e. conversion).
- The Energy sector benefits the most from sustainable funding, suggesting that policymakers and financial institutions should continue prioritizing investments in this industry, as it demonstrates the highest responsiveness to financial incentives.
- Additional qualitative research should be conducted to understand why firms that received funding but did not enhance sustainability (25% of the sample) failed to leverage financial support effectively. Possible explanations could include structural barriers, financial misallocation, or regulatory constraints.

This analysis confirms that sustainable funding has a measurable impact on firms' ability to improve their sustainability practices, particularly in sectors like Energy and Industry. However, financial incentives alone aren't really driving sustainability adoption in firms that were previously non-sustainable, and this is evident from the fact that the greatest majority of firms participating to the call for proposals or generally to these funding programmes were already operating in sustainability, as it is evident from data. However, this point will be better discussed in the fourth chapter on the limitations of the study.

3.3 Analysis of sectoral disparities in response to funding

The objective of this section is to find out possible explanations for the responses across sectors being different. One way to do so could be assessing whether there are statistically significant differences in the amount of funding received across different sectors. If significant differences exist, they could potentially explain why some sectors responded more effectively to funding than others, as this variation might be influenced by disparities in funding amounts. One of the primary statistical methods used to verify the presence of significant differences among groups is the ANOVA (Analysis of Variance) test**.**

An ANOVA test (which stands for ANalisys Of VAriances) is a statistical method to compare variances across the means of different groups, with the aim to determine whether there is a statistical significancy in the difference of these means. In order for the formula to be applied correctly, the compared groups must be uncorrelated, which was our case. In this study, the ANOVA test would have been conducted separately on the two sheets. For each of them, the groups whose means had to be compared were the sectors. The mean value for each group would have been the *average amount of financing*. With respect to this variable, another limitation of the study would have been that a kind of data pre-process, the normalization process, couldn't be done. The normalization would be intended to relate the *amount of financing* to the company turnover (e.g. dimension), because it is apparent that the same amount of money has different impacts on companies with different turnovers. In absence of such data on the turnovers (or on the companies' dimensions), the normalization wouldn't be possible.
Initially, the test would be aimed at defining whether the difference between these average amounts across the sectors was statistically significant. If so, it would have meant that the amount of financing was strictly related to the sector, and that it could be also a determinant of the main variable score outcome. Consequently, this would have represented a possible motivation to the second research question; that is: one sector might present a higher Conversion or Enhancement score than another (meaning that it responded better to the funding) basically because it received a bigger amount of financing. The reason for separating the analysis on the two sheets was that otherwise the result would have presented a hidden variable, such as the type of financing, this being a possible cause for the amount of financing to be bigger or smaller.

To conduct this analysis, the funding amounts were divided between grants and loans and then categorized into four groups (i.e. the sectors) for each of the two sheets. However, a fundamental assumption of the ANOVA test is that the data follows a normal distribution. A normal distribution, also known as a Gaussian distribution, is a symmetrical, bell-shaped probability distribution where most data points cluster around the mean, with fewer occurrences appearing towards the extremes. In the case of a normal distribution, the mean is the same as the median and the mode. To evaluate the normality of the distributions, the mean and median were calculated for the values in the "EU contribution" column (representing the financing amounts) across the four sectors. The

comparison revealed that, in all four sectors, the mean for these values was consistently higher than the median. This indicates that the distribution of EU contribution was right-skewed across all sectors, thus not normal. Consequently, the ANOVA test could not be conducted, as its validity depends on the assumption of normality. Had the test yielded a significant result, it could have provided a plausible explanation for why certain industries exhibited higher enhancement rates than others—potentially linking these improvements to higher funding amounts.

It is important to note that the inability to conduct the ANOVA test does not automatically rule out the possibility that funding amounts played a role in influencing sectoral responses. In fact, when calculating the average funding amount per sector, it emerges that the energy sector received the highest average contribution. This observation further supports the plausibility of the hypothesis that higher funding amounts may have played a role in driving greater enhancement rates in this sector. However, due to the inability to conduct the ANOVA test, this remains an unverified assumption rather than a statistically confirmed conclusion (the test's limitation merely prevents the statistical verification of this hypothesis, but it does not invalidate it as a potential explanation). In other words, while the assumption of normality was not met—thus making it impossible to formally test for significant differences in funding across sectors—this does not mean that funding amounts did not contribute to the observed differences in enhancement rates. The absence of statistical validation simply means that this hypothesis remains unverified rather than disproven.

Therefore, it is more appropriate to analyze sector-specific qualitative characteristics to better understand the differences in how the four sectors responded to funding. The following pages present a qualitative assessment of sectoral traits, offering potential explanations for why these sectors leveraged the received funding in different ways, these being already exposed in paragraph 3.2.

3.3.1 The Energy Sector

The energy sector recorded the highest enhancement rate (78.57%) and was the only sector to show a conversion (7.14%). This can be explained by several key characteristics:

- The high regulatory and policy support. The energy sector is a central focus of EU sustainability policies, such as the Green Deal and Renewable Energy Directives. Companies in this sector are highly incentivized to enhance sustainability due to strict carbon reduction targets (European Commission, 2021).
- The capital-intensive nature. Energy projects, particularly those involving renewables, require large-scale infrastructure investments. Firms that receive funding are more likely to expand or upgrade existing projects, contributing to the high enhancement rate (IEA, 2022).
- The presence of a mature market for green investments. The renewable energy market is already well-established, with clear pathways for sustainable innovation. This allows firms to leverage funding effectively, leading to improvements in energy efficiency, storage, and distribution (IRENA, 2021).
- The strong business case for sustainability. Unlike other industries, where sustainability might be a secondary priority, in the energy sector, transitioning to renewables and clean technologies is a fundamental aspect of long-term profitability and competitiveness (Oxford Academic, 2023).

These factors could explain why the energy sector demonstrated the highest responsiveness to funding.

3.3.2 The Transport Sector

While 66.67% of transport firms improved their sustainability efforts, none transitioned into sustainability for the first time. This can be attributed to:

- The presence of technological barriers. Many sustainable transport solutions, such as electric mobility or hydrogen-powered vehicles, require extensive R&D and infrastructure development. This can limit immediate adoption despite financial support (McKinsey & Company, 2021).
- The high dependency on fossil fuels. The transport sector is still largely reliant on traditional fuels, making the transition to sustainability slower. Companies receiving funding may focus on incremental improvements rather than complete overhauls (IEA, 2022).

- High market fragmentation. The sector includes a mix of public transportation, logistics, and private vehicle manufacturers. Differences in business models and regulatory requirements make uniform sustainability adoption more challenging (World Economic Forum, 2022).
- The long investment cycles. Fleet electrification and sustainable fuel alternatives require long-term investments, which may delay the immediate impact of funding (European Environment Agency, 2023).

Overall, while funding helped existing sustainable projects grow, it was not enough to trigger new entrants into sustainability.

3.3.3 The Industrial Sector

With a 71.43% enhancement rate, the industrial sector showed strong improvement, but like transport, it had no new sustainability adopters. This can be explained by:

- The heavy dependence on existing processes. Many industrial firms operate within established manufacturing frameworks where immediate sustainability conversion is difficult. Funding is often used for efficiency improvements rather than structural transformation (OECD, 2022).
- Cost vs. Benefit considerations. While sustainability improvements can lead to long-term savings, the high upfront costs associated with green technology adoption can deter firms from making drastic changes (World Bank, 2021).
- The supply chain complexity. Industrial sustainability often requires changes across entire supply chains, making transitions more complex than in sectors where individual firms have greater control over their processes (McKinsey & Company, 2022).
- The incremental nature of industrial sustainability. Unlike energy firms, where clean technology adoption is more straightforward, industrial firms often adopt sustainability through gradual upgrades in materials, waste management, and emissions reduction (European Commission, 2021).

This sector's response to funding reflects its nature: improvements are made where feasible, but large-scale sustainability conversions remain challenging.

3.3.4 The Buildings Sector

The buildings sector showed similar trends to the transport sector, with a 66.67% enhancement rate and no conversions. Possible explanations include:

- The regulatory and bureaucratic barriers. Many sustainable building projects require permits, compliance with zoning laws, and coordination with multiple stakeholders, which can delay or complicate sustainability adoption (European Environment Agency, 2023).
- The long asset lifespan. Buildings are long-term assets, meaning that sustainability enhancements typically occur during renovations or new constructions, limiting immediate adoption even when funding is available (OECD, 2022).
- The slow return on investment. Energy-efficient buildings and sustainable materials can lead to cost savings over time, but the initial investment required can deter some firms from adopting new practices (World Economic Forum, 2022).
- The focus on incremental efficiency gains. Much like the industrial sector, sustainability efforts in buildings often focus on improving insulation, adopting renewable energy sources, or enhancing HVAC systems rather than complete overhauls (IEA, 2022).

These sectoral characteristics suggest that funding was more effective in improving existing sustainability efforts rather than driving fundamental changes.

3.4 Analysis of disparities based on types of financing

As mentioned in the Second Chapter, the fourth step of the analysis was evaluating whether there was a difference in the *Conversion* or *Enhancement* rates across the two types of financings. For this reason, the analysis for this step started again from the two separated samples (i.e. Grants and Loans). This was made to determine to which type of financing corresponded the best response towards sustainability, this time regardless of

the sectors. Thus, the first thing to do was calculating the Conversions and Enhancements across the two sheets.

TYPE OF FINANCING	CONVERSIONS (ABSOLUTE)	ENHANCEMENTS (ABSOLUTE)	NONE (ABSOLUTE)	CONVERSIONS (%)	ENHANCEMENTS (%)	NONE (%)
GRANTS	0	16	4	0.00%	80.00%	20.00%
LOANS	1	13	6	5.00%	65.00%	30.00%

Figure 3.3 – Sustainability response based on type of financing

As evident from Figure 3.3, the analysis revealed that among the grants-funded projects, no company recorded a conversion towards sustainability. However, 16 firms initiated new sustainable initiatives, indicating an enhancement in sustainability. Conversely, within the loans-funded projects, there was one recorded conversion and 13 cases of enhancement, resulting in a total of 14 positive responses. Apparently, there weren't great differences across the two samples in terms of enhancements. The loans-method of financing encouraged one conversion across firms; however, this is not a significative result to investigate further on.

The following points briefly present some of the potential reasons why the type of funding may not influence the levels of conversion or enhancement in companies:

- Strategic motivation in a company could be independent of funding. Companies may pursue sustainability initiatives based on pre-existing corporate strategies rather than the type of funding received. If sustainability is already a strategic priority, financial support merely accelerates an already planned process, regardless of whether it comes in the form of a grant or a loan (Berns et al., 2009).
- Regulatory and Compliance Requirements. In certain industries, the transition toward sustainability is driven by environmental regulations and legal requirements that compel companies to adopt sustainable practices. In such cases, the type of financial support received may be irrelevant, as firms must comply with these regulations regardless of the funding source (Fiandrino & Raschillà, 2023).
- Access to Alternative Resources. Companies may have access to other financial resources, such as private investments, equity capital, or government incentives, which support their sustainability efforts. If a firm benefits from diversified sources

of capital, the type of EU funding (grant vs. loan) may not be a decisive factor in its decision to transition to or enhance sustainability (Baglioni, 2020).

- Corporate Culture and Internal Commitment. Some companies have a strong sustainability-oriented corporate culture, which leads them to invest in sustainable projects regardless of the financial support they receive. In such cases, funding serves as an additional lever to accelerate progress but does not directly influence the company's behavior (Fiandrino & Raschillà, 2023).
- The nature of the project and economic returns. Some sustainable projects generate significant long-term economic benefits, such as cost savings from improved energy efficiency or enhanced production efficiency. In these cases, companies may choose to undertake sustainability projects because they are financially advantageous, regardless of whether they are supported by grants or loans (Berns et al., 2009).
- Flexibility in Financial Management. Companies can strategically allocate the funds received, redistributing internal resources or combining them with other financial instruments. This means that the way a company invests in sustainability is likely to depend more on its overall financial strategy rather than the specific nature of the EU funding it receives (Baglioni, 2020).

In parallel with the analysis conducted in the previous paragraph, it would have been interesting to investigate the possible causes behind the differences in the responses between the firms in these two datasets. A suitable statistical approach for this type of investigation is the t-test analysis. The t-test is a statistical method used to assess the significance of the difference between the means of two distinct samples that approximately follow a normal distribution. In this case, the variable considered for the distributions would have remained the amount of financing. If a significant difference is found between the means of the two distributions, this would indicate that the type of financing is a determining factor in the level of transition towards or improvements in sustainability, as it could directly affect the amount of funding received. For a t-test analysis, as well as for an ANOVA test, a fundamental prerequisite is that the data follow a normal distribution. While this condition was met for loans data—where the mean and

median of the financing amounts' distribution were identical— unfortunately, it was not satisfied for grants, as in this case, a right-skewed distribution was observed.

In the present chapter, the methodologies of the ANOVA test and the t-test were briefly discussed or at least introduced, despite not being applicable to the datasets obtained in this study. This was done to provide a point of reflection for potential future studies addressing similar research questions. The failure to meet the normality assumption of the distributions compromised the effectiveness of these tests, preventing their application in the present study. On the other hand, the non-normality of the distributions for the variable *EU contribution* (which represents the amount of financing allocated to each project) could be attributed to the way the examined samples were extracted. It is possible that incorporating additional data sources could yield different results, enabling a more in-depth quantitative analysis through the statistical methods mentioned in this section.

3.5 A crossed analysis through sectors and types of financing

The last step of the analysis is aimed at responding to the following research question: "Which type of funding is most effective in driving the level of conversion to or enhancement in sustainability, depending on the specific sector?". To answer that, a crosstab analysis was made to examine the relation between the *sector* and the *type of financing*. The Conversion and Enhancement scores were calculated for each sector in one dataset and compared with the main variable scores of the corresponding sectors in the other dataset. This approach was designed to determine which type of financing is best suited for a given sector in terms of fostering improvements in sustainability efforts.

The Conversions or Enhancements were calculated for each sector in one sheet and confronted with the main variable scores of the related sectors in the other sheet. This was made with the aim to understand what type of financing suited better a certain sector in terms of improvement in the effort towards sustainability.
Results from the cross-tab analysis are exposed in Figure 3.4 and Figure 3.5.

SECTOR	LOANS-CONVERSIONS	LOANS-ENHANCEMENTS	LOANS-NONE	GRANTS-CONVERSIONS	GRANTS-ENHANCEMENTS	GRANTS-NONE
Energy	1	5	2	0	6	0
Transport	0	1	1	0	3	1
Industrial	0	5	1	0	5	3
Buildings	0	2	2	0	2	0

Figure 3.4 – Cross-tab analysis with absolute values

SECTOR	LOANS-CONVERSIONS (%)	LOANS-ENHANCEMENTS (%)	LOANS-NONE (%)	GRANTS-CONVERSIONS (%)	GRANTS-ENHANCEMENTS (%)	GRANTS-NONE (%)
Energy	12.50%	62.50%	25.00%	0.00%	100.00%	0.00%
Transport	0.00%	50.00%	50.00%	0.00%	75.00%	25.00%
Industrial	0.00%	83.33%	16.67%	0.00%	62.50%	37.50%
Buildings	0.00%	50.00%	50.00%	0.00%	100.00%	0.00%

Figure 3.5 – Cross-tab analysis with percentages

Since firms from the two samples differ in number for each of the sectors, the percentage values are the most appropriate for comparison in the cross-tab analysis. Next a sector-by-sector comparison is made.

The energy sector presented a mixed response to funding types:

- Grants-funded firms showed a 100% enhancement rate**,** meaning all firms receiving grants used them to improve their sustainability efforts.
- Loans-funded firms showed a 62.50% enhancement rate and a 12.50% conversion rate.

This suggests that while grants are exclusively used for improvements, loans enabled some firms to transition towards sustainability (conversion). However, 25.00% of loan-funded firms did not display any sustainability progress, indicating that loans might not be a universal driver for sustainability in the sector.

The transport sector had more firms showing no progress:

- Grants led to a 75.00% enhancement rate, showing that most firms used them to improve existing sustainability efforts.
- Loans resulted in a 50.00% enhancement rate and 50.00% of firms showing no progress.

Unlike in the energy sector, loans were less effective in driving enhancements in Transport. A high percentage of firms (50%) under loans did not exhibit sustainability progress, indicating that this funding type might not be suitable for sustainability investments in the transport industry.

The industrial sector showed higher efficiency for grants:

- Grants led to a 62.50% enhancement rate, whereas loans resulted in 83.33%. Interestingly, loans outperformed grants in fostering enhancements within the industrial sector. This might be because industries that already recognize sustainability as an opportunity are willing to take loans to finance improvements, rather than relying on non-repayable grants.
- Loans also showed a lower percentage of firms with no sustainability progress (16.67%) compared to grants (37.50%). This indicates that grants were less efficient in pushing all industrial firms toward sustainability improvements.

The buildings sector is where grants dominate in enhancements:

- Both grants and loans resulted in enhancements, but grants performed better (100% vs. 50%).
- Loans saw 50.00% of firms showing no sustainability progress, whereas all grant-funded firms used them to improve sustainability.

This suggests that in the buildings sector, grants are significantly more effective than loans in promoting sustainability initiatives.

Based on these findings, several conclusions can be drawn:

- Loans and grants serve different purposes across sectors. Loans are more effective in driving conversions in Energy and Industrial sectors where sustainability projects

require high capital investments with long-term payback. Grants are more effective in driving enhancements across all sectors, especially in Transport and Buildings, where firms prefer non-repayable financial support to expand sustainability initiatives.

- Loans do not guarantee sustainability progress. In Transport and Buildings, loans had 50% of firms showing no sustainability improvements. This indicates that while some firms may use loans for sustainability, others might prioritize different investments or fail to implement impactful projects.
- Sector-specific funding strategies are necessary.

    - Energy: A mix of loans and grants might work best, since both led to enhancements, and loans drove the only conversion case.
    - Transport: Grants should be prioritized as they led to better enhancement rates. Loans did not drive conversions and had high "None" percentages.
    - Industrial: Loans worked well in enhancements and resulted in fewer firms with no sustainability progress, making them a strong option.
    - Buildings: Grants should be the preferred financing method, as they ensured a 100% enhancement rate, while loans left 50% of firms with no improvements.

In conclusion, the cross-tabulation analysis confirms that grants are the most effective in supporting ongoing sustainability efforts, whereas loans work best in sectors where sustainability requires high capital investments. However, loans are not always effective, as seen in Transport and Buildings, where many firms failed to achieve sustainability progress. This insight could be useful in designing sector-specific financing mechanisms to maximize the effectiveness of sustainability funding.

Chapter 4: Limitations of the study and final suggestions

This chapter's aim is to expose the limitations of the study and to propose final suggestions for future further in-depth analysis.

- Sector Classification as a Hidden Variable. One key limitation of this study is that the sector to which companies belong was not treated as an independent variable but rather emerged as a hidden variable. The analysis was conducted bottom-up, meaning that companies were first sampled and then classified into their respective sectors. A top-down approach—starting by dividing companies by sector and then generating the sample—could have provided a clearer framework for understanding sector-specific patterns in the allocation and impact of sustainability funding. This methodological choice might have introduced an uncontrolled source of variation, making it harder to determine whether differences in conversions and enhancements are due to funding type or sector-specific factors.
- The prevalence of already sustainable companies. This trend may account for the relatively low occurrence of Conversions—defined as cases where a previously unsustainable firm begins undertaking sustainable initiatives after the project start date. As a result, several enhancements were made instead of conversions, suggesting that sustainability funding programs are primarily supporting the advancement of firms that are already engaged in sustainable practices. This finding implies that either markets are predominantly composed of firms that have already integrated sustainability into their strategies, or that public funding is currently more effective in fostering improvements within already sustainable firms rather than incentivizing new entrants into the sustainability domain. Future policy frameworks should therefore consider introducing targeted incentives for firms that have not yet embraced sustainability, aiming to drive broader industry-wide transitions. Additionally, future research should explore methodologies best suited to addressing this critical challenge.

- The timeframe of the study and long-term effects. The study primarily analyzes relatively recent projects, meaning that many companies may still be in the early stages of implementing their sustainability strategies. It is possible that some firms that did not show conversions or enhancements during the study period might do so in the coming years. This presents a challenge: the real effectiveness of sustainability funding programs can only be accurately assessed over a longer time horizon. The absence of immediate conversions in some sectors does not necessarily mean that firms will not engage in sustainability later. This insight leads to two important recommendations:

    - Short-term incentives should be introduced to encourage firms to undertake new sustainability projects within a defined timeframe after receiving initial funding.
    - Follow-up assessments should be conducted after a few years to track long-term impacts, ensuring that firms are not just receiving funding but also implementing effective sustainability transformations.

- Methodological limitations: ANOVA and T-test Constraints. One of the study's methodological limitations was the inability to conduct ANOVA and t-tests due to non-normal distributions of the variable *EU contribution* (amount of financing per project). These statistical tests rely on the assumption of normality, which was not met by the dataset used in this study. Furthermore, an important data preprocessing step—normalization—could have not been performed. Normalization, which adjusts the amount of financing relative to company turnover or size, would have allowed for more meaningful comparisons. This is particularly relevant because the same amount of funding may have drastically different impacts on companies depending on their financial capacity and operational scale**.** This specific limitation suggests a crucial direction for future research:

- Future studies should ensure the availability of firm-level financial data (e.g., turnover, size, pre-existing sustainability investments) to enable a more rigorous statistical evaluation of funding effectiveness.
- Alternative non-parametric statistical techniques should be considered if normality cannot be assumed, to allow for more robust comparisons across funding types and sectors.

- Sample size and statistical inference constraints. A fundamental principle of statistical inference is that its validity increases with larger sample sizes. In this study, some sectors—such as Transport—had fewer cases, which might have skewed the observed results. The low number of conversions or enhancements in specific sectors may simply be a reflection of data scarcity rather than an actual lack of impact. For instance, the Transport sector displayed fewer enhancements and no conversions, but this could be due to a limited number of cases, preventing meaningful statistical conclusions. This limitation points to another key recommendation:

    - Future research should use larger and more balanced datasets, ensuring that each sector has a sufficient number of observations to allow for statistically significant comparisons.
    - Policymakers should consider sector-specific data availability when designing funding impact assessments, ensuring that underrepresented industries are adequately analyzed**.**

Regarding the findings, this study provides valuable insights into the role of grants vs. loans in driving sustainability enhancements and conversions across different sectors. More specifically, these findings are now exposed in strict relation to the initial research questions, as formulated at the end of the First Chapter (paragraph 1.4):

1) "Are these fundings and consistent efforts really activating a 'sustainable mindset' across firms, that can be found in the adoption of sustainable practices, in the commitment to sustainable projects and partnerships, or in a whatever

business interest in the green field? In other words, is funding a true promoter of sustainability?". The findings suggest that while sustainable funding plays a role in reinforcing corporate sustainability, it is not necessarily a strong driver for initial conversion. Instead, it serves as a catalyst for improvement.

2) "If yes, what is the sector that responded best to funding and why?". The best response to funding came from the Energy sector, the only one showing conversions and a very high enhancement rate.
3) "Which type of funding is most effective in driving the level of conversion to sustainability, depending on the specific sector?". The analysis suggests that for the energy sector, a combination of loans and grants might be the most effective solution, as both led to improvements, with loans driving the only conversion case. In the transport sector, grants should be prioritized, having demonstrated higher enhancement rates, while loans did not drive conversions and showed a high percentage of ineffectiveness. For the industrial sector, loans proved to be a strong option, as they facilitated enhancements and reduced the number of firms with no sustainability progress. Finally, in the buildings sector, grants appear to be the preferred financing method, ensuring a 100% enhancement rate, whereas loans left 50% of firms without any improvements.

In conclusion, the limitations discussed above in the present chapter outlined highlight areas for further research and policy refinement.

1. First and foremost, funding institutions should consider sector-specific financing structures to maximize impact.
2. More incentives should be given to companies with no prior sustainability history to encourage full conversions. Future research should explore methodologies best suited to addressing this critical challenge.
3. Given that many of the data were coming from recent projects, many of which were still ongoing, introducing long-term monitoring mechanisms to assess sustainability progress beyond the short-term scope could be very useful.
4. Expanding datasets and incorporating firm-level financial indicators to enable more rigorous statistical analysis.

5. Exploring alternative statistical methods to overcome the constraints posed by non-normal distributions in funding allocation data.

By addressing these limitations, future studies and policy frameworks can ensure that public funding for sustainability achieves maximum impact, fostering both improvements among existing sustainable firms and encouraging new firms to transition towards sustainability.

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